Anthropomorphism and Animism in Early Years Science: Why Teachers Use Them, how They Conceptualise Them and What Are Their Views on Their Use

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Abstract

There is considerable evidence that use of anthropomorphism and animism in science teaching is a common practice in all grades of education. However, not much is known about teachers' own views on the real reasons why they have been using animistic and anthropomorphic formulations or on the issue of whether animism and anthropomorphism should or should not be used in science. The present work, which was carried out in Greece, investigates early years teachers' views on the use of animism and anthropomorphism and on the reasons behind their use of these formulations. The study was designed as a small-scale exploration study. Research data were obtained from recorded group interviews and from written tasks. Results indicate that early years teachers seem to adopt the view that animism and anthropomorphism in early years science can cause cognitive problems in young children, and also that these teachers believe that in special cases use of animism and anthropomorphism can cause emotional problems as well. Results also reveal that, despite their reservations, teachers use animism and anthropomorphism both consciously and unconsciously and that they attribute their conscious use of these formulations to their low levels of content and pedagogical content knowledge in science.

Key Words: animism in science, anthropomorphism in science, early years science, metaphors in science, personification in science, teachers' knowledge in science, teachers' personification, teachers' views on anthropomorphism

There has been a tradition of explorations of anthropomorphism and animism, which was brought into considerable prominence by Piaget in his 1929 study of child animism. For Piaget, animism refers to the tendency children have to regard objects as living and conscious, while anthropomorphism is the tendency to ascribe to non-human beings and inanimate objects not only life but also reasoning, feelings, desires and human capabilities: that is, human characteristics. Teleology is the tendency to attribute purpose to objects and beings that are not human, which enables them to arrive at rational decisions. Tamir and Zohar (1991) consider teleology as a special instance of anthropomorphism since, they note, "as suggested by Hampel (1965), the teleological explanation makes us feel that we really understand the phenomenon at hand because the explanation is given in terms of purposes and intentions which fit the way we are accustomed to view our own purposeful behaviour" (p. 58). Gallant (1981) considers anthropomorphism, teleology and, in the broad sense, animism, to be three major types of personification.

Taber and Watts (1996) distinguish two classes of anthropomorphism: a metaphorical, or "weak," anthropomorphism that uses desires, feelings and human capabilities to communicate ideas in analogy with a social being, and a "strong" anthropomorphism, which is teleological and which allows phenomena to be explained in terms of non-existent desires and feelings in the entities involved to achieve the end state.

In 1969 Looft and Bartz reviewed both Piaget's initial work and other literature on animistic thought and empirical work. They reported that researchers have found anthropomorphic and animistic notions in populations of all age ranges and great cultural differences. In addition, a number of studies in the past two decades that have examined the use of anthropomorphism and animism in biological, physical and chemical phenomena by elementary and secondary school students of different ages have shown that anthropomorphic language is common among both students and teachers.

One issue that has occupied researchers and has created quite a number of arguments is the issue of whether anthropomorphism and animism should or should not be used in science instruction. Several researchers (e.g., Taber & Watts, 1996; Watts & Bentley, 1994; Zohar & Ginossar, 1998) argue that, although there is a mismatch between animistic thought and the mechanistic world view of orthodox science, use of anthropomorphism and animism can be a useful aid to students' understanding and learning in science. They note that use of anthropomorphism and animism does not necessarily imply prevalence of anthropomorphic reasoning in high school students, since most of them can distinguish between anthropomorphic and factual explanations. In a study of anthropomorphism and teleology in biology education, Friedler, Zohar, and Tamir (1993, p. 439) report finding that "maturation contributes to the development of causal, non-teleological reasoning between tenth and twelfth grade." However, several studies (e.g., Bell, 1954; Crannell, 1954; Crowell & Dole, 1957; Dennis, 1953, 1957; Lowrie, 1954; Papalia-Finlay, 1978; Simmons & Goss, 1957) that conducted investigations with even older students in more than one country found that considerable percentages of these populations attributed life to one or more inanimate things or gave at least a few animistic responses.

Treagust and Harrison (2000, p. 1165) suggest that anthropomorphisms and teleologies are acceptable elements of effective pedagogical content explanations because "teachers' pedagogical content knowledge is neither pure science nor it is intended to be." Lemke (1990) argues that use of personification is acceptable when both teacher and students know what is happening, when both teacher and students understand that it is contrary to the scientific orthodoxy and that they are breaking the rules. As Taber (1995, p. 92) notes, metaphors, "unless the user is aware of their metaphorical nature, may direct thinking in ways the user does not realise." There are also some reports on students' reactions to the use of anthropomorphic and animistic formulations. Lemke (1990) describes an example of such a reaction where a "teacher is being chided for personification although the students know perfectly well" what happens (as cited in Taber & Watts, 1996, p. 559). Tamir and Zohar (1991) also report that many of the younger students (age 15) in their sample were concerned that anthropomorphic and animistic formulations may be confusing and

misleading and hence should be avoided. Therefore, as they note, the answer to the question of whether we should use anthropomorphic formulations is not simple.

Things become even more complicated when it comes to very young children (4–6 years). Piaget (1951 considers that in the young child animism and anthropomorphism result from egocentricity. He argues that it is "not to be wondered that the child takes personifications of language literally" and that "adult language provides the very conditions necessary to foster children's animism and anthropomorphism and this the more so since, generally speaking, the child takes all metaphors literally" (p. 238). According to Piaget use of anthropomorphic language can foster subjectivity in young children and notes that in order "to arrive at an objective view of things the mind must free itself from subjectivity and abandon its innate egocentricity . . . Only qualitative development of the child's mind can lead it to abandon animism" (p. 248).

In the same context, Gallant (1981) argues that use of personification may lead to misconceptions by young students who may not be able to distinguish fact from fiction, notes that young students must try to see the natural world from a non-human point of view and warns that, until they are made aware of the pitfalls of personification, they stand little chance of understanding why inanimate objects and non-human beings behave the way they do. Hughes (1973) also argues against the use of anthropomorphism, animism and teleology and supports the view that the behaviour of non-human beings should be described in terms of function rather than purpose. He notes that "anthropomorphism can be deceiving and even dangerous" and that "an anthropomorphic characterization is never needed for a complete understanding of the behaviour of a non-human species" (p. 10). Sharefkin and Ruchlis (1974), however, suggest that the use of anthropomorphic statements is appropriate when dealing with children operating at the pre-operational and concrete levels. For these children, they note, anthropomorphic formulations are not only natural but aid comprehension of the world they observe. Views, therefore, seem to be controversial; and although many educators caution against the use of anthropomorphic formulations, since the danger of confusion with regard to the nature of cause and effect appears to be real and valid, there seem to be good reasons why many teachers have been continuously using anthropomorphic formulations (Tamir & Zohar, 1991).

However, not much is known about teachers' own views on the use of animism and anthropomorphism and on the reasons why they use these formulations in science activities. Several questions can be raised. Do teachers use anthropomorphism and animism because they believe it is a better way for students to understand, or are there other reasons as well, such as, for example, the lack of other suitable alternative frameworks to call upon? As Gallant (1981) notes, animism and anthropomorphism may represent an easy way out of difficult explanations of physical concepts. Is the use of anthropomorphism and animism related to teachers' knowledge and understanding in science? A recent study (see Kallery & Psillos, 2001) that explored Greek early years teachers' content knowledge in science and its use in real classroom settings showed that these teachers' knowledge in science is quite limited. The same study showed that these teachers used anthropomorphic formulations on

the one hand in their answers to the questionnaire that was used to investigate their knowledge and understanding in science, and on the other, in the classroom, during science activities. Anthropomorphic formulations were expressed by teachers a lot more frequently during science activities, that is, when teachers were dealing with children, than they were in the questionnaire. Teachers used these formulations in their explanations, questions, descriptions, presentations, predictions and answers to children's questions.

The present study was undertaken in view of the above. The study, which concerns early years teachers and was carried out in Greece, specifically addresses three questions:

1. How do early years teachers perceive animism, anthropomorphism and teleology?
2. What are these teachers' views on issues concerning the use of animism and anthropomorphism in early years science?
3. Do early years teachers use animism and anthropomorphism in science activities with young children and why?

This investigation can provide information that may be useful for improving early years teachers' teaching and knowledge in science and is part of a larger project investigating early years educators' attitudes, knowledge and practices in this field (see other results in Kallery, 2001; Kallery & Psillos, 2001, 2002).

Contextual Information

The National Curriculum for Greek pre-primary education introduces children of 4–6 years of age to basic science concepts and phenomena of the natural world. The curriculum distinguishes activities into two kinds: "free" activities for the children, being activities chosen and carried out by the children themselves without direct teacher involvement, and "teacher-organised" activities, being activities planned and organised by the teachers according to the objectives that have to be met. The content of the science activities comes from the following units, which the curriculum calls "cycles of knowledge and experiences":

(a) Acquaintance with the physical properties and characteristics of the objects
(b) Acquaintance with the natural environment.

The latter includes living things, natural phenomena and scientific concepts, earth and outer space.

Activities derived from unit (a) touch upon subjects such as: the colour, weight, temperature of bodies, properties of their matter such as the property to float or sink, to melt, to dissolve in water and so forth. Activities derived from unit (b) touch upon subjects such as: plants and animals, atmospheric phenomena such as water evaporation, rain, snowfall, rainbow, the phenomenon of gravity and concepts of sound, light, motion, magnetism, as well as topics of Earth, Moon, Sun and the phenomenon of day and night. Scientific concepts are also touched upon through activities deriving from other curriculum units, such as physical education, rhythmic and motor skills.

Some of the guidelines as stated in the curriculum are the following:

- In science activities children should be assisted to become acquainted with "actual scientific facts and the objective view of things."
- Language is considered to be a decisive factor for the development of children's scientific concepts.
- In science activities teachers are required to introduce the appropriate vocabulary.

The National Curriculum for Greek pre-primary education was based on the curricula of other countries with a greater tradition at this level of education, such as Belgium, France, Canada and Cyprus.

Research Design

The present research was designed as a small-scale exploration study. Ten teachers, typical of Greek early years teachers, participated in this study. They were all female (the majority of early years teachers in Greece are female) and had an average of 15 years of teaching experience. The teachers were recruited from a randomly chosen number of schools, and our sample was those who agreed to participate in the study. Teachers were informed about the purpose of this exploratory study in an introductory meeting.

A combination of three tools – written questionnaire, written task and group interview – were used for data collection. This approach creates opportunities for data triangulation. Group interview was chosen because it presents opportunities for interaction between participants, development of discussions of points that may come up spontaneously and production of a broad spectrum of answers as well as for stimulation of unanticipated but useful trains of thought in the participants (Cohen & Manion, 1997). A total of four tasks and two group interviews were used in the study. Written tasks were piloted with a small population of four teachers similar to those who participated in the study. The completion of the tasks and the group interviews were done in sequential group meetings in order on the one hand to avoid respondent fatigue and their consequent difficulty in answering carefully and elaborating on their views, and on the other to allow researchers to make adjustments at each of the subsequent stages. Group interviews were recorded and transcribed. The coordination of the group meetings and the moderation of the group interviews were done by the first author.

Task 1 (T1)

At the beginning, teachers' conceptions of animism, anthropomorphism and teleology were explored. Teachers were asked to complete the first written task, which consisted of the following questionnaire: what, according to your view, are:

- Animism.
- Anthropomorphism.
- Teleology.

Task 2 (T2)

In the same context teachers were given the second written task to complete. This consisted of 15 statements, one of which presented a causal explanation while the other fourteen presented animistic, metaphorical anthropomorphic and teleological anthropomorphic formulations. Teachers were asked to identify these formulations in all statements and determine their type.

The construction of a number of the statements was based on examples or ideas given by Piaget (1951) and on answers and explanations teachers had given to science questions used in previous research to explore the level of their content knowledge in science. Some of the statements, especially those concerning biological phenomena, were adapted from other studies (e.g., Tamir & Zohar, 1991). Representative examples of the statements presenting all types of formulations are given in Figure 1.

After teachers had completed the above tasks, they were given written definitions of animism, anthropomorphism and teleology, as these are found in the literature (e.g., Gallant, 1981; Piaget, 1951), and examples of each of the above. Definitions and examples were discussed extensively in a group meeting and teachers took them home for further study. This was aimed at helping teachers gain better insights into the scientifically accepted ideas about the above concepts before proceeding to the next stages of the research.

Task 3 (T3)

Next, teachers' views on issues concerning the use of animism and anthropomorphism in early years science were explored. Teachers were given the third task, which consisted of the following written questionnaire: "Would you use animism and anthropomorphism to explain or describe concepts or phenomena to young children? Explain why."

- An athlete who is preparing for a contest runs several kilometres daily in order to improve his cardiovascular functioning (causal).
- Fog, which comes down heavy some mornings, scatters when the sun goes up (animism).
- In the pressure cooker the steam is trying to escape from the exhaust valve (anthropomorphism).
- The chameleon, wishing to hide from its enemies, changes its colour so that it might not be detected (anthropomorphism-teleology).

Figure 1: Representative examples of statements presenting all types of formulations used in Task 2.

First Group Interview (I1)

In order to collect more detailed and supplementary data to those collected by the above task, a group interview session was held. In this, the question "What are your opinions on the use of animism and anthropomorphism in early years science?" was put forward for discussion. The reason for choosing such a broad question was to enable teachers to touch upon and express their views on several different issues concerning the use of animism and anthropomorphism in early years science. Probing and clarifying questions were asked by the interviewer as seen fit.

Second Group Interview (I2)

In the next group meeting a second group interview session was held. The following question was put forward for discussion: "Do you use animism and anthropomorphism in science activities with young children, and why?" The aim of this interview was to explore if and why teachers use animism and anthropomorphism in the real classroom.

Task 4 (T4)

Lastly, teachers were given the fourth written task to take home. In this task teachers were asked to choose a science phenomenon or concept that they were planning to present to the children and to describe how they would present it using animistic and anthropomorphic formulations. Teachers were also asked to underline all the formulations they had used. The aim of this task was to explore what types of such formulations teachers may be primarily using in science activities.

Results

Analysis of teachers' interviews and written tasks gave the following results.

Task 1 (T1)

Animism

Five teachers gave definitions of animism that were very close to the definition found in literature (e.g., Gallant, 1981; Looft & Bartz, 1969; Piaget, 1951): "Animism is to ascribe life to inanimate objects;" "Animism is when somebody gives soul to inanimate objects." Four of the teachers gave definitions that matched the definition of anthropomorphism found in literature (e.g., Gallant, 1981; Watts & Bentley,

1994): "Animism is the attributing of human characteristics to inanimate objects;" "Animism is when somebody ascribes human feelings, reasoning and purpose to inanimate objects." One teacher did not answer the question of what animism is.

Anthropomorphism

Eight of the teachers regarded anthropomorphism as the tendency to portray inanimate objects, plants and animals with human faces: "Anthropomorphism is when you give a human face to plants, animals and things;" "Anthropomorphism is when you give a human face to objects and beings that are not human."

This type of anthropomorphism, which does not exactly match the types of anthropomorphism described in the introduction, is literal, in that in Greek, from which the term comes, it means anything that has a human face or shape.

Only one teacher gave a definition for anthropomorphism that was very close to the definition given in literature (e.g., Gallant, 1981; Watts & Bentley, 1994). One teacher did not answer the question of what anthropomorphism is.

Teleology

Only two of the teachers answered the question of what teleology is. However, neither of their definitions matched the generally accepted definition of teleology (e.g., Gallant, 1981; Hughes, 1973): "Teleology is the belief that a specific cause has always the same effect."

Task 2 (T2)

The five teachers whose definitions of animism were very close to those found in literature were able to identify correctly only a number of animistic statements in Task 2. As shown in Table 1, the majority (9) of the teachers were not able to identify and correctly determine the types of formulations in more than three (20%) of the statements. Less than half the teachers were able to identify and determine the types of formulations in anywhere from 6 (40%) to 15 (100%) of the statements: these were considered as no answer. Finally, in statements containing more than one type of formulation, seven of the teachers were able to identify one of these types of formulation in some of them. These answers, since they contained some correct elements, were considered as incomplete.

Task 3 (T3)

Teachers were grouped in three categories according to their answers.

The first category comprised those teachers, all "potential users," who would make use of animism and anthropomorphism in early years science. Only one teacher

Table 1

Types of Teachers' Answers in Numbers (N) and Percentages of Statements in the Second Task.

Teacher	Type of answer			
	Correct N (%)	Incorrect N (%)	No answer N (%)	Incomplete N (%)
1	3 (20.0)	9 (60.0)	3 (20.0)	0 (0.0)
2	1 (6.6)	1 (6.6)	13 (86.6)	0 (0.0)
3	4 (26.6)	4 (26.6)	4 (26.6)	3 (20.0)
4	0 (0.0)	0 (0.0)	13 (86.6)	2 (13.3)
5	2 (13.3)	5 (33.3)	6 (40.0)	2 (13.3)
6	0 (0.0)	3 (20.0)	10 (66.6)	2 (13.3)
7	2 (13.3)	1 (6.6)	11 (73.3)	1 (6.6)
8	0 (0.0)	11 (73.3)	1 (6.6)	3 (20.0)
9	3 (20.0)	8 (53.3)	0 (0.0)	4 (26.6)
10	0 (0.0)	0 (0.0)	15 (100.0)	0 (0.0)

Note: Percentages not summing to 100 due to rounding errors.

belonged in this category. This teacher expressed the view that using "animism and anthropomorphism is an easy way of simplifying concepts and phenomena for young children."

The second category comprised teachers, all "potential non-users," who would not make use of animism and anthropomorphism in early years science. Two teachers belong in this category. One of the teachers expressed the view that because "children of these ages live in a fantasy world, teachers should talk to them in a rational way." This teacher also raised an interesting question: [with the use of animism and anthropomorphism] "How far do we succeed in bringing children into contact with what really happens in the world around them?" The second teacher in this category expressed the belief that "animistic and anthropomorphic explanations can confuse children, especially if these are not based on scientifically valid explanations."

The third category comprised those teachers, all "potential users with reservations and under conditions," who would make limited use of animism and anthropomorphism in early years science, with great caution and under certain conditions. The other seven teachers of our sample fell into this category. These teachers would use animism and anthropomorphism only because, in their view, (a) it is a "pleasant" way to present concepts and phenomena to the children, "Animism and anthropomorphism make the activity, the lesson, like a story," and (b) because it can make teachers' work easier, "It is an easy solution."

However, these teachers expressed several reservations about the use of animism and anthropomorphism. Their belief is that use of animism and anthropomorphism may cause cognitive and emotional problems in very young children.

Use of animism and anthropomorphism allows teachers to be carried away by very simplistic and naive explanations that can lead children to wrong impressions and misconceptions.

Children of such young ages do not completely understand metaphoric language, and the use of animism and anthropomorphism to explain phenomena like earthquake, volcanic eruption, flooding or tornado can cause misunderstanding and fear in children and instead of helping them understand the phenomena can cause cognitive and emotional trouble.

Teachers also expressed the view that if animism and anthropomorphism could not be avoided, it would probably create fewer problems if they were used under certain conditions. Some of the conditions specified by the teachers are:

1. That children have developed a good understanding of concepts and phenomena, for example, "Children will not become as confused with the use of animism and anthropomorphism if they have developed a good understanding of concepts and phenomena."

2. That teacher and children are aware that animism and anthropomorphism are being used, for example, "If animism and anthropomorphism are used, children and teachers should be aware of what is happening."

3. That use of animism and anthropomorphism is supported by good scientific knowledge on the part of the teacher.

If animism and anthropomorphism are used, they would be more successful and reliable if supported by good scientific knowledge.

Use of animism and anthropomorphism is risky and may confuse children if the teacher who uses them her/himself does not have a clear knowledge of the concepts and phenomena that are being introduced to the children in this way.

First Group Interview (I1)

In the first group interview, as in the questionnaire, teachers expressed their concerns about the use of animism and anthropomorphism in early years science and referred to several other issues, the most important of which are:

1. From fiction to fact: Teachers reported cases from their own experience where children could not make the transition from fiction to fact, for example, "We had children who could not make the jump, the transition, from fiction to fact and stayed with fiction. It is then that children draw the wrong conclusions."

2. Children's reactions: Some of the teachers referred to reactions that are sometimes encountered when they use anthropomorphism for explaining or presenting phenomena. These are reactions of surprise and wonder at what their teachers do.

For example, 'Many children ask us: "Why do you say it to us in this way when it is not like that"?'

3. Ways of presenting content to young children: the majority of the teachers expressed the view that it is necessary for children of these ages to have contact with scientific explanations appropriately formulated for their ages and using scientific terminology, and that for science matters it would be much better for them if teachers used scientific language.

I personally consider it necessary that children should have contact with scientific explanations appropriately formulated for their age and with scientific terminology.

I believe that for natural phenomena it would be much better to use scientific language.

In this context teachers presented experience-based views on ways that could be effective for presenting or explaining science concepts or phenomena to children and could help teachers avoid using animism or anthropomorphism. Teachers find simulation a good method, for example, "Simulation is a great way of showing or explaining to the children a science phenomenon without using metaphors."

They also pointed out that they prefer using analogies rather than animistic or anthropomorphic explanations.

My experience says that analogy works better in topics that are unknown to children and difficult for them to understand. An analogue that is familiar to children is much closer to real situations and real scientific explanations, in a simplified way.

If we had a good knowledge of the topic, what we should look for is an appropriate analogy to use in order to make things comprehensible to children and not use either animism or anthropomorphism.

Teachers gave few examples of analogies they use in science activities.

When I explain to the children how plants take the water from the ground I often tell them that the roots are like straws and plants absorb the water just like people drink their juice with straws. I think that this helps children visualize how it works. I believe that this can make children understand easily, since it describes facts that also happen to them.

When we talk about what a motor needs to make it run I tell children that like people who need to consume food to keep them going, the motor needs to consume fuel. So we have to provide the motor with fuel just like we give food to people.

4. Interactions with teachers' own knowledge: finally, teachers discussed how the use of animism or anthropomorphism affects their own knowledge. They believe that when they have to face difficult science issues they rely on the use of animism or anthropomorphism and do not try to improve their knowledge of the subject.

[Use of animism or anthropomorphism] allows us to relax our vigilance. It allows us to leave our knowledge as it is; we can go into the classroom and give children what we know either from our children's knowledge or from our poor, fragmentarily acquired knowledge. The other way [scientific] requires good preparation on our part.

Second Group Interview (I2)

In the second group interview all teachers declared spontaneous or preplanned use of animism and anthropomorphism in the classroom. Teachers also stated that they use "two different types of anthropomorphism." As their explanations disclose, these are metaphorical and "literal" anthropomorphism.

When we say the sun travels, this is a metaphor. But when we give a face to the cloud, we make the cloud a child and this is not exactly the same.

Teachers gave examples of the second, "different," as they explained, type of anthropomorphism, that is the "literal" form:

In order to explain to the children why we have earthquakes, we portray the earth as a woman with an angry face who shakes us.

To explain rain we portray clouds with children's faces who travel in the sky trying to find their mother and when they are tired and sad they cry and their tears come down their faces and make the rain.

Teachers also reported that, in early years science, they make use of this type of anthropomorphism quite often. However, they pointed out that this deprives children of the opportunity to see things as they are in reality.

We have the tendency to do it [use it] very often. Yes, but this tendency, when we discuss scientific phenomena, doesn't allow us to present or explain to the children things as they really are.

Next, teachers referred to the reasons why they use animism and anthropomorphism in science activities with young children and also to ways that would allow them to avoid their use.

1. Conscious use: the majority of the teachers stated that in most cases they choose to use animism and anthropomorphism because they do not have sufficient knowledge of the topic or the issue they are dealing with. Teachers confess that for them animism and anthropomorphism are an easy way out of difficult and unfamiliar scientific explanations.

The basic problem lies in our poor knowledge. That is why we readily turn to animism and anthropomorphism.

For us it is a good way to escape scientific explanations.

I turn to animism and anthropomorphism when I don't have good knowledge of what I teach, in order to cover up my ignorance.

Teachers also pointed out that they often have to use animism and anthropomorphism in science activities because they don't know or have other appropriate ways of presenting or explaining science concepts and phenomena to children of these ages. For example, "We do not know other ways to work with – that is why we

use this way," "I turn to animism and anthropomorphism when I want to simplify a phenomenon," "If I had a simulation in school then I would not need to tell children that 'the earth becomes angry and shakes us.'"

There are further reasons why teachers use animism and anthropomorphism in the classroom. One of them, as some of the teachers noted, is to attract the attention of children who sometimes do not seem to understand, and therefore are not interested, when something is presented in a "scientific way." Another reason mentioned by teachers is that, since they lack a good scientific background, they are frequently sidetracked by children who at these ages use animism and anthropomorphism quite often.

2. Unconscious use: teachers also believe that they may often use animism and anthropomorphism without realising it. For example, "I believe that often we do it unwittingly," "It has happened to me many times that I have used these metaphors, and when I realized what I was doing I explained their meaning."

Teachers attributed their spontaneous or unconscious use of anthropomorphic and animistic formulations to three factors. One is the fact that these formulations are one of the ways in which they have acquired their own knowledge. Therefore teachers believe that these formulations are to a degree interwoven with their knowledge, "That's the way we have learned things. These formulations are embedded in our knowledge." The second is that animism and anthropomorphism are how teachers have learned to present science to the young children, "This is the way we have learned to talk about some things in science." The third reason is that metaphors are part of everyday language, "We should not personify nature and phenomena but language does not exclude metaphors. When we talk we use metaphors. It is part of . . . isn't it? It is the way we talk."

3. Avoiding use: request for better knowledge. Teachers believe that they could avoid using animistic and anthropomorphic formulations by improving their scientific knowledge, "I believe that large percentages of these formulations could be avoided. This presupposes serious improvement of our knowledge." They also believe that improvement of their knowledge would allow them better control of the language they use in science activities, "I believe that I could have better control of the language I use if I had a better grasp of the subject."

However, teachers pointed out that for certain things in science they don't want a deep scientific knowledge because they believe they are not going to need it, but they want knowledge at a level that would make them understand how some things work and would be useful to them to use with children.

Yes, we don't need to learn the deep scientific knowledge. Nobody is going to ask us to explain such things. Therefore we don't need to know details or what exactly happens.

I just need somebody to explain some things to me in a simple way. A "light" knowledge, that would make me understand how some mechanisms work and which I can use, would be enough. For some things we don't need to have "pure" scientific knowledge.

Finally teachers noted that, in addition to improving their content knowledge in science, they also "need to develop a good knowledge of appropriate scientific ways in which concepts and phenomena should be introduced to children of these ages."

Task 4 (T4)

Analysis of teachers' lesson descriptions showed that they have used a combination of animism, "literal," teleological and metaphorical anthropomorphism.

Animism was detected in the writings of three teachers, for example, "The day comes and the night goes," "Trees wake up in spring."

Metaphorical anthropomorphism was detected in the writings of nine teachers, "Plants love the sun because he helps them to grow," "The sun takes care of all beings on earth satisfying all they want."

"Literal" anthropomorphism was detected in the writings of four teachers.

The teacher, in order to explain thunder to the children, portrays the clouds with human faces. The clouds fight, push and beat each other and this is how thunder is created.

The teacher drew the sun with a human face and described it as God and father of all who gives life to everything.

Teleological (strong) anthropomorphism was also detected in four teachers' writings.

During winter the seeds sleep under their blanket, the ground, in order to protect themselves from the cold.

Trees rest during winter in order to gain strength and produce new leaves in the spring.

An interesting finding is that seven of the teachers were able to locate (underline) only a small proportion of the animistic and anthropomorphic formulations that they had used in their writings.

Analysis of Findings

In this section findings from tasks and interviews are presented and discussed in relation to the research questions that guided the study. In order to answer the research questions, findings from the following data sources were considered together. Task 1 and Task 2, to provide answers to research question 1; Task 3 and the First Group Interview, to provide answers to research question 2; Task 4 and the Second Group Interview, to provide answers to research question 3.

Research Question 1 (RQ1)

Research Question 1 deals with identifying early years teachers' conceptions of animism, anthropomorphism and teleology. The findings of Task 1 and Task 2 indi-

cated the following: initially none of the early years teachers were able to explain teleology. Half of the teachers could explain animism but the rest did not seem to be aware of the fine distinctions between animism and anthropomorphism, since they identified animism with anthropomorphism. Also, teachers were not able to classify correctly a substantial number of statements that included animistic, anthropomorphic and teleological formulations or a combination of these. It is interesting to note that although half of the teachers could explain animism they were able to identify only a number of the animistic formulations included in these statements.

Regarding anthropomorphism, the majority of the teachers gave a definition that was the literal description of the term. Metaphorical anthropomorphism can be considered as an extension of the literal in the sense that anything that has a human face or shape would have other human characteristics as well.

Research Question 2 (RQ2)

Research Question 2 deals with identifying early years teachers' views on issues relating to the use of animism and anthropomorphism in early years science. The principle findings of Task 3 and First Group Interview show that the views of the majority of the teachers on the use of animism and anthropomorphism in early years science reveal serious concerns. The most significant of these concerns regard cognitive and emotional aspects of children's development. Cognitive issues concern mainly children's confusion and formation of wrong impressions and misconceptions due to several factors, such as – for example – their frequent difficulty in making the transition from fiction to fact and in interpreting metaphoric language. Emotional issues, according to teachers' views, are related to the fears that can be created in children by the use of personification in the explanation of devastating natural phenomena. It should be noted here that while the teachers reported children's reactions to the use of anthropomorphism, they did not say whether these were reactions to metaphorical or to literal anthropomorphism.

Task 3 and First Group Interview also elicited a few more themes. One concerns teachers' views on the conditions that might make use of animism and anthropomorphism more acceptable. Their belief is that use of animism and anthropomorphism would probably create fewer problems in young children if the use of these formulations were supported by good scientific knowledge on the part of the teacher, if teacher and children were aware of their use and if the children had developed a good understanding of both concepts and natural phenomena.

A second theme regards teachers' views on the approaches that should be used in introducing science issues to children of these ages. Their view is that children should have contact with scientific explanations and information appropriately formulated for their age. Based on their experience, teachers also expressed views on alternative ways for communicating content to children, such as simulations and analogies. Examination of the examples of analogies teachers use in science instruction shows

that these analogies have target objects in the domains of both physics and biology, while their base object comes only from biology and is specifically the human being.

A third theme regards teachers' views on the interaction of the use of animism and anthropomorphism with their own knowledge. Teachers see use of these constructs as an easy solution to difficult scientific issues, which makes their work in science easier. They feel that they rely on this safe and easy solution and do not try to improve their own scientific knowledge.

Research Question 3 (RQ3)

Research Question 3 deals with early years teachers' use of animism and anthropomorphism in teaching. Findings from the Second Group Interview and Task 4 indicate the following: early years teachers use animistic and metaphorical and teleological anthropomorphic formulations in the real classroom both consciously and unconsciously and are aware of their frequent unconscious use of these formulations. Findings indicate that the use of 'literal' anthropomorphism is a conscious choice on the teacher's part and is quite extensive.

Teachers attribute unconscious use of metaphoric formulations to several factors, including the influence of everyday language and the influence of their personal experiences of, on the one hand, science courses taught at school and, on the other, courses on early years teaching methodology taught during their training years.

Regarding conscious use of animism and anthropomorphism, there seem to be several reasons that, in their own view, impel teachers to it. These concern chiefly the children's lack of interest in issues presented to them in a scientific way, the lack of appropriate didactic materials, and their own low levels of content knowledge and of knowledge of ways of presenting and explaining science topics to young pupils. Teachers expressed the need for improvement of these aspects of their knowledge and expressed the belief that improvement of their knowledge will allow them better control of the language they use in science activities.

An interesting finding is that although early years teachers consider their knowledge improvement to be the key factor in avoiding use of animism and anthropomorphism in early years science, they believe that knowledge should be given to them only at a level that is sufficient to enable them to cope with their day-to-day needs in science.

The examination of the results of the Second Group Interview and Task 4 yields three more interesting findings. First, while in their lesson descriptions teachers used far more metaphorical anthropomorphic formulations than literal, in their interview they mentioned only extensive use of the literal form, although they reported use of both types. Second, while they used teleological anthropomorphism in their lesson descriptions, they did not mention its use in their interview. Third, although after studying and discussing animism and anthropomorphism the teachers were able on the one hand to give examples of some of these constructs in the tasks and interviews that followed Tasks 1 and 2 and on the other to construct such formulations in their

lesson descriptions, more than half of them were able to identify only some of the animistic and anthropomorphic formulations they had used in their descriptions of their lessons.

Discussion and Conclusions

The present research provides an insight into the way early years teachers in Greece conceive animism and anthropomorphism and into their point of view on issues concerning the use of animism and anthropomorphism in early years science. It also discloses a number of reasons why these early years teachers use these formulations in science instruction. We shall discuss the most striking of the results, starting with teachers' views on issues concerning the use of animism and anthropomorphism.

The principle findings of this study reveal that these teachers do not seem to adopt the view that the use of animism and anthropomorphism can aid pupils' comprehension in science. On the contrary, they believe that these can cause cognitive and, in special cases, emotional problems in young children.

Regarding cognitive issues, teachers' views that use of animism and anthropomorphism can cause confusion in children and the formation of wrong impressions and misconceptions are consistent with those of a number of researchers (e.g., Gallant, 1981; Hughes, 1973; Piaget, 1951) whose work concerned children in their early years.

Regarding emotional issues related to the fears that can be created in children by the use of personification in the explanation of devastating natural phenomena, Piaget notes in his work, "The Child's Conception of the World," that children may feel threatened by the fury of nature and when swayed by fear show a spontaneous tendency "to regard the whole world as aware of their fault" (p. 246). He suggests that "the part played by educators in the genesis of the child's beliefs certainly needs questioning" (p. 247).

Teachers' views that if the use of animism and anthropomorphism is supported by good scientific knowledge on the part of the teacher, if teacher and children are aware of their use and if children have developed a good understanding of concepts and natural phenomena that might make the use of animism and anthropomorphism more acceptable are also in line with the views of some of the researchers (e.g., Lemke, 1990; Taber, 1995) cited in the introduction. However, previous research (see Kallery & Psillos, 2001) has shown that early years teachers often face the problem of insufficient content knowledge in science. Also, very young children have not yet developed a good understanding of scientific concepts and phenomena, and it is quite likely that in many cases they may not be able to realize the use of metaphoric formulations and personifications of language (Piaget, 1951). Therefore it is reasonable to assume that such conditions may not be feasible in early years science.

Taking into consideration on the one hand the fact that early years teachers' views on the use of animism and anthropomorphism have been moulded by classroom experience and on the other that the conditions that could make use of these constructs more acceptable may not be feasible in early years science, it is our view that extensive use of animism and anthropomorphism, especially of the literal form, may cause problems in children of these ages.

The early years teachers of our study seem, in their majority, to be convinced of young children's need of contact with facts and explanations presented to them in appropriately adapted scientific language, and suggested alternative ways for communicating content to children, such as simulations and analogies. Some researchers (e.g., Inagaki & Hatano, 1987), however, consider personification as a person analogy. That is, knowledge about humans is used as the base domain for making analogical explanations of unknown attributes of less familiar objects. Young children, being quite familiar with the human being, tend to apply their knowledge about it to "other animate or even inanimate objects if they perceive some similarity between human being and target object" (Inagaki & Hatano, 1987). Carey (1985) and Inagaki and Hatano (1987) note that the closer the target is biologically to the human being the more often children will recognise similarities.

In the case of the early years teachers of our study, their examples reveal use of person analogies with target objects in the domains of both physics and biology. We suggest that these person analogies should be used with caution because, as Inagaki and Hatano (1987) report finding, while personification as analogy can lead children of 5–6 years of age to generate educated guesses about less familiar non-human objects, it can, if rich precise knowledge of the target is lacking, lead to unreasonable personifying responses. The analogy may be carried beyond its limits or with inaccurate mapping . . . and thus produce false inferences. Therefore, use of personification as a person analogy can be valuable in introducing or explaining scientific issues to the young children, provided that it is carefully orchestrated in order to avoid potential dangers and disadvantages (e.g., Duit, 1991; Glynn, Britton, Semrud-Clikeman, & Muth, 1989).

Another important finding of the present study is that, despite their various concerns, early years teachers use animism and anthropomorphism in science instruction both consciously and unconsciously. One reason for teachers' unconscious use of these formulations could be that teachers do not always recognise them even when they can define them or construct their own examples of them (T1, I2 and T4). There are several indications for this. One comes from the fact that initially, in Task 2, the teachers were not able to locate and correctly identify all animistic formulations in a substantial number of statements, although half of them were able to define animism correctly. Other indications come from the last three findings of Research Question 3: first, from the fact that while in their lesson descriptions teachers used far more metaphorical anthropomorphic formulations than 'literal,' in their interview they mentioned only extensive use of the literal form, although they reported use of both types; second, from the fact that while they used teleological anthropomorphism in their lesson descriptions, they never mentioned its use in their interview; and third,

from the fact that the majority of the teachers were able to identify only some of the animistic and anthropomorphic formulations that they had used in their lesson descriptions. As teachers themselves noted, these formulations are interwoven into their knowledge and it is therefore difficult for them to be aware of using them. Also, everyday language facilitates unconscious use of animism and anthropomorphism since our language is full of metaphors (Howard, 1989) and, as teachers noted "it is the way we talk" (I2). Also Taber and Watts (1996) argue that "language is fluid, and when we use metaphors on a regular basis they cease to be metaphorical and become literal, as word meanings themselves change" (p. 561). Therefore, in present conditions it is not easy for early years teachers to avoid unconscious use of metaphors in science instruction.

Regarding conscious use of animism and anthropomorphism, two of the factors to which teachers attributed their use are their low levels of content knowledge in science (which seems to be a persistent issue in our study), and their lack of knowledge of appropriate ways of presenting and explaining science topics to young pupils. The latter constitute aspects of teachers' pedagogical content knowledge (Shulman, 1986).

Teachers also seem to be in a vicious cycle. Low levels of content knowledge drive them to use animism and anthropomorphism in science instruction. In turn animism and anthropomorphism, as an easy way out of difficult explanations of science issues (Gallant, 1981), allow teachers to rely on their use and neglect improving their knowledge. Thus use of these constructs can be considered an impediment to improvement of teachers' own knowledge in science.

In summary, the study reveals that early years teachers are confused by their insufficient knowledge in science, and feel entrapped by the use of animism and anthropomorphism in covering their instructional needs in early years science. They believe that improvement of their knowledge in science will make a difference to their conscious and unconscious use of animism and anthropomorphism. However, apart from specific discipline knowledge, early years teachers also need to develop a better understanding of the nature of science, since extensive use of animism and anthropomorphism – especially of the literal form – may indicate possession of alternative world views incorporating myths that are not consistent with standard science.

Exposition of teachers' views on issues concerning the use of animism and anthropomorphism in early years science is, as noted earlier, somewhat rare in science education literature. Although the results of the present study should be interpreted within the limitations of, on the one hand, a small-scale exploration study and, on the other, a study of teachers coming from a single country, we feel that some issues that were brought to the forefront are of wider interest. The present research also highlights significant issues that require investigation. We suggest that further work should be undertaken, on the one hand to examine in a more systematic manner where personification helps children of these young ages and where it misleads them, so that we can better understand how conceptual and emotional problems may be generated, and on the other to explore what didactical tools could replace use of specific types of personification in science instruction in the early years.

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