DEVELOPMENT OF THE CONCEPT OF LIVING THING THROUGH AGE: AN EXPLORATORY STUDY ADDRESSING PUPILS FROM TWO DIFFERENT YEARS OF SCHOOLING

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SUMMARY: This study sought to check the understanding of living thing in pupils from two different years of schooling. To this end, a questionnaire was applied to 20 pupils who were in the 3rd year of schooling (mean age 8.5) and 15 students in the 5th (mean age 11). In both groups, the topic had been addressed in a formal context through a traditional approach with interactive lectures and use of the textbook. In the questionnaire the pupils had to mark the living things presented in a series of images and to indicate the characteristics of this type of beings. The results showed a better performance of pupils from the 5th, who revealed fewer misconceptions related to the topic. However, some pupils in both groups have revealed more difficulty in the identification of the features common to all living beings. Some implications of the results for teaching practice are discussed at the end of the text.

KEYWORDS: Primary School, Living thing concept, Misconceptions, Traditional teaching process, Constructivism.

OBJECTIVES: Several scientific concepts suffer a differentiated understanding through students' age, as a result of their cognitive development. This development stems from biological transformations, but is also stimulated in the course of the learning process promoted by the school and other educational contexts. Thus, many of the non-scientific ideas, the so-called misconceptions, may disappear, especially if teachers promote practices that allow students to deconstruct their wrong ideas frequently acquired through common sense.

Based on these ideas, the main objectives of this study were:

1. To identify the concept of living thing in pupils who were in the 3rd and in the 5th year of schooling;
2. To check differences and similarities between the two groups in the identification of different beings and in the features they recognize in all living things;
3. To analyze the implications of the results for teaching practice.

In both years of schooling the concept of living thing had been addressed one month before the implementation of the present research. The teachers of both groups had traditional practices with interactive lectures and the use of the school textbook.

THEORETICAL FRAMEWORK

When pupils arrive at school they already have a conceptual network which can explain many phenomena that occur in nature and defines various scientific concepts. Many of these ideas are pre-scientific ideas which interfere with the formal learning of science, the so-called misconceptions (Anderson, Fisher & Norman, 2002; Kose, 2008). Misconceptions related to the notion of living thing are very frequent, since pupils do not always correctly distinguish between living and non-living beings and have difficulties to identify the features that all living things have in common.

Allen (2014) argues that we should start to clarify the concept of living thing before trying to identify pupils ideas related to it. For this purpose, he defines living thing as entities capable of seven processes of life: (m)ovement, (r)espiration, (s)ensitivity, (g)rowth, (r)eproduction, (e)xcretion and (n)utrition, and uses the acronym MRS GREN to better remember these features. The principal problem is that learners use only some of these features to classify entities as living things or sometimes think that some of them are not present. Allen (2014) claims that pupils can consider other natural entities, and even artifacts, as living things as, for instance, the sun, air, clouds, cars and robots, because they seem to be alive. But plants are one of the most discussed cases, since they are frequently regarded as non living things by pupils who think they can´t breathe or move (Stavy & Wax, 1989; Anggoro et. al., 2005). Of course, as Hobbs (2010) points out, plants, with their roots stuck in the soil, don´t have the opportunity to walk. But plants can manifest Phototropism (growing towards light), Gravitropism (growing towards or away from gravity, depending on which end of the plant you are), and carnivorous plants can also show very quick movements to trap insects. Nevertheless, a study by Sá & Varela (2004), with pupils who were in the 1st year of schooling, found that the majority of children considered animals and plants as living things, contradicting the idea that smaller children always exclude plants from the group of beings in discussion. This result, contrary to the other studies quoted, suggests that more research is needed.

Teachers with a constructivist perspective of the teaching process are in a better position to identify pupils' ideas and to find the best strategies to change their conceptual structures. To encourage this change, we should take into account that children´s development influences learning, the Piagetian tradition, and that learning, promoted in a social context, helps development, the Vygotskian tradition (Sylva, 1997). But, as Duveen (1997) highlights, the separation of these two traditions makes no sense, and they should be more strongly connected since they both contribute to the improvement of the quality of the learning process. But, as it was mentioned before, the teachers involved in the present study didn´t follow this approach more centered on students.

METHODOLOGY

This study used a predominantly quantitative methodology and involved 20 students in the 3rd year of schooling (mean age 8.5) and 15 students in the 5th (mean age 11). The groups had an approximate number of boys and girls and the pupils were mostly from a medium to low socioeconomic background. The groups were from two state schools in Lisbon region and were chosen since their teachers usually receive students from an institution of higher education during the curricular units related to teaching practice.

To achieve the two first objectives before mentioned, a questionnaire with open and closed questions was applied. Considering pupils' ages, its structure was simple, with short questions (Table 1).

The beings included in question 1 were chosen based on the synthesis presented by Allen (2014) of results obtained in other similar studies. Thus, animals and plants with different complexity were chosen, some of them more common of the children's daily life and others less. A mushroom was also included, a being from the Fungi Kingdom, in order to include a living thing that did not obey to the animal / plant dichotomy. The other images were artefacts or natural inanimate beings. The questionnaire was previously piloted in a group of 15 children with similar characteristics to those from the sample, and some questions were changed in their form but not in their content. The final version was then validated by two experts in the field of Didactics of Science.

Table 1.
The structure and questions of the questionnaire applied to both groups

Part I
1- Under the images, mark with an X those that represent living things: Clock, seahorse, human being, rock, bush, teddy bear, fly, sun, mushroom, water, water lily, louse, airplane, flower, stars, starfish, cactus, clouds, algae, jellyfish, moon.
Part II
Which of the following features does a living thing have? Mark with a X. A) It has to feed itself; B) It can move in space; C) It must have eyes and mouth; D) It dies; E) It can not be too small; F) It has cells.
Part III
Mention other features, not included in the previous question, which all living things have.

The data analysis in the closed questions was based on counting the correct answers in each item for both groups; the results of question number 3, open question, were subject to content analysis. In this analysis we respected the principles defined by Cohen, Manion and Morrison (2007) which are: i) to identify the different ideas of the inquired; ii) to organize the same ideas in a wider field; iii) to create a category that could be representative of those ideas. Therefore, we have used an inductive process with categories emerging from the data.

In order to compare the results of both groups in the closed questions, inferential statistics, a chi-square test, was used to check the existence of statistically significant differences, for a significance level of 0.05.

RESULTS

With regard to the first question, in which pupils were asked to mark the images representing living things, the results are shown in Table 2.

From the results, it should be noted that pupils of the 3rd year tend to associate animals more easily with living things than plants, showing some difficulties in the correct classification of the shrub, cactus, water lily, flower and algae. The same difficulty happened with the mushroom, which only half of the children include in the living beings. Also, some pupils insert the sun and stars into living things.

The pupils of the 5th year had a better performance in the identification of the beings presented. However, there are still some difficulties in identifying the water lily, the mushroom, the shrub and the human being as living beings. Even so, for most of the beings above mentioned, the differences between groups were statistically significant.

Overall, the average success rate in the pupils of the 3rd year was 78% and 95% in the pupils of the 5th, values that can be considered good, despite the concepts revealed.

In the second part, regarding the identification of some features that are common to all living things, the results are presented in Table 3.

Table 2.
Frequency and percentage of correct answers obtained by the pupils of both groups in relation to the beings presented in the questionnaire. The *p* values obtained by using a chi-square test are also presented

	3rd year of schooling		*5th year of schooling*		
Beings	Freq.		Freq.	%	*p.*
Clock	20	100%	15	100%	-
Teddy bear	20	100%	15	100%	-
Airplane	19	95%	15	100%	0.380
Rock	16	80%	14	93.5%	0.265
Water	17	85%	12	80%	0.698
Clouds	16	80%	14	93.3%	0.265
Stars	9	45%	14	93.3%	0.003
Sun	12	60%	15	100%	0.005
Moon	14	70%	14	93.3%	0.088
Bush	13	65%	13	86.7%	0.147
Water lily	10	50%	9	60%	0.557
Flower	13	65%	15	100%	0.010
Cactus	11	55%	14	93.3%	0.013
Algae	13	65%	14	93.3%	0.048
Mushroom	10	50%	13	86.7%	0.024
Fly	20	100%	15	100%	-
Louse	19	95%	15	100%	0.380
Starfish	18	90%	14	93.3%	0.727
Jellyfish	19	95%	15	100%	0.380
Seahorse	20	100%	15	100%	-
Human being	18	90%	13	86.7%	0.759

Table 3.
Frequency and percentage of correct answers indicated by the pupils of the two groups, regarding some features possessed (or not) by all living beings

	3rd year of schooling		*5th year of schooling*		
Features	Freq.	%	Freq.	%	*p.*
It has to feed itself	19	95%	15	100%	0.380
It can move in space	6	30%	3	20%	0.503
It must have eyes and mouth	9	45%	8	53.3%	0.625
It dies	20	73.3%	11	100%	0.014
It can not be too small	19	95%	15	100%	0.380
It has cells	15	75%	13	86.7%	0.393

It should be noted that most students in both groups have the idea that living things must have the ability to move in space. This is a relevant fact since, although the majority of the 5th year pupils tend to include plants in the group of living beings, they also mark this feature as a distinctive feature of living things. In fact, it was decided not to put the item "to have movement" because it could be interpreted as synonymous with displacement in space, and thus, not allowing to accurately identify the ideas of the pupils. More surprising was the selection by several students of both groups of the feature "it must have eyes and mouth". It seems that pupils, when confronted with this feature, suffered a kind of conceptual regression, again associating the notion of being alive with that of animal. Thus, since some of the misconceptions persist in both groups, there were only statistically significant differences for the feature "it dies", with all the pupils that were in the 5th year recognizing this feature to be common to all living beings.

Finally, regarding the pupils' answers to the open question, Table 4 shows the incidence of the answers given by both groups after their categorization. It should be noted that ideas already expressed in the previous question have been excluded and that some pupils have repeated them again (for instance, it has cells).

It should be noted that in this open question, the differences between groups were very small. Even so, only the group from the 5th year pointed out that living beings must reproduce and mentioned, with a greater incidence, the presence of certain functions such as breathing and excretion. In the 3rd year group, there was a higher incidence of answers related to the possession of certain organs, which seems to reflect once again the association of living things with animals.

Table 4.

Categorization of the other features common to all living things mentioned by the pupils from both groups presented in frequency and percentage. Some pupils indicated more than one feature.

	3rd year of schooling		*5th year of schooling*	
	Freq.	%	Freq.	%
It is born	7	35	2	14
It grows	4	20	1	7
It reproduces	-	-	4	27
It has certain organs (bones, lungs, heart, skin, etc.)	7	35	3	20
It does certain functions (breathing, excretion)	7	35	8	53
It has certain behaviors or needs (Habitat, protect itself, it should be free)	4	20	3	20

CONCLUSIONS

In this study the older pupils manifest fewer misconceptions about the concept of living thing. Still, pupils from both groups reveal greater ease in identifying living things from images than in mentioning the features that they all possess.

The results may be useful for teachers who have to teach the topic under discussion in different years of schooling. Particular attention seems to be given to plants, since their exclusion from living beings is found even in some older pupils. But the inclusion of some natural inanimate entities in the group of living things, such as water, the stars in general or the sun, deserve also attention. Even the fact that four pupils did not include the human being in the living things should be a focus of attention. It should be regarded as a lapse? Or could it be regarded as a revelation of a special status for human beings?

Teaching practice that explicitly includes the seven processes of life referred by Allen (2014) with the acronym of MRS GREN, discussed at the beginning of this text, can be an aid. Especially if that practice is based on the principles of constructivism that starts from the previous ideas of pupils and explicitly promotes the deconstruction of misconceptions.

The present study is regarded as a pioneer in the context of the Portuguese reality, but it is intended to be deepened in the near future with a broaden sample and, in particular, to better understanding the reasons that lead some pupils to include living things in the category of non-living things and vice versa. This was not done immediately because we want to start with an exploratory study that could give us clues to the next steps. Therefore, we intend to include interviews to some pupils, a better methodological approach to help avoiding justifications of the type "because that is the way it is", very frequent in children. Finally, it will be important to compare pupils' conception of living thing when subject to different teaching practices, to a more effective understanding of the potentialities of each one and to evaluate the effectiveness of those which are supported by the principles of constructivism.

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