SEEKING ECOLOGICAL CONNECTIONS IN THE FOUNDATION PHASE: PLANTS ARE THINGS BUT ANIMALS ARE ANIMALS

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ABSTRACT– This paper aims at describing the intuitive ideas that foundation phase learners express about the differences between biotic and abiotic components of ecosystems. Clinical interviews were conducted with foundation phase children at a primary school in Soweto, Johannesburg, to stimulate their thinking about the various components of ecosystems and how these components are related. The participants consisted of 10 grade R and 10 grade three learners who were expected to group pictures of ecological components in two categories of their own choosing. From this they were probed on their choice of groupings as to determine the learners' reasoning when deciding to group certain components. Data was collected through conducting individual clinical interviews and video analysis of these interviews. Open coding was used to analyse the data generated from the interviews. The findings indicate that most of the foundation phase learners group plants together with abiotic environmental factors and seldom include plants in the same category as animals. In their explanation it becomes evident that the distinction between their groupings is not based on superficial qualities like the colour of the pictures but involves deeper causal reasoning to explain the connections between these groupings. The paper recommends that foundation phase teachers consider and use children's spontaneous reasoning as well as the intuitive ideas they hold about ecological interactions in their teaching. This paper shows that young children see greater correlation between plants and abiotic environmental components than to animals. This impacts on the teaching of ecological concepts later in the learners' schooling as the understanding of concepts relating to categorisation and classification depends greatly on the learners' ability to reason causally. The question that this research asks is "What are the considerations of foundation phase learners when categorising ecological components?" The author argues that these considerations should be explored in order to identify the intuitive theories that children hold. This in turn can be used to inform the design of activities to lead the child towards understanding the normative concepts.

Keywords: Foundation Phase Science Education, Conceptual change, Causal reasoning, Ecology.

1. INTRODUCTION

Children become familiar with concepts related to ecology long before they enter the formal science classroom in the intermediate phase. They experience and interact with their environment in such a way that they formulate what authors describe as 'intuitive theories' (Carey, 2009) or 'naïve concepts' (diSessa, 2006). It is this interaction with the environment and other social encounters that facilitate the formation of framework theories (Chi, 2005) that children use as explanatory fodder to make sense of ecological phenomena. Authors like Ioannides and Vosniadou (2002); Carey (1999); and Wellman and Gelman (1992) explain that the formation of these framework theories occur in a similar way that scientists formulate theories and in a sense becomes 'little scientists'. This premise is referred to as the *theory* theory of conceptual development (Gopnik & Meltzoff, 1999) and explains that children formulate these theories through their own rudimental empirical techniques of observation, hypothesis formulation, hypothesis testing and causal reasoning (Vosniadou & Ioannides, 1998). It is therefore senseless for science teachers to design lessons with the presumption that learners are oblivious to the content that they wish to teach. It would be more sensible for the teacher to first determine the nature of the intuitive theories that the individual child holds before contemplating the teaching strategies that will be used to teach concepts. diSessa (2006) explains that the aim of teaching is assisting a child in augmenting these naïve concepts in such a way as to reach

what he refers to as a normative concept. A normative concept is the most recent common understanding of that concept as expressed by the scientific community (Ozdemir & Clark, 2007). One of the concepts from the field of ecology that children formulate early on is linked to biotic and abiotic factors in the environment (Carey, et al., 2015). The difference between living and non-living elements of an ecosystem can be difficult to restructure in such a way that it resembles the normative view. Causal reasoning becomes an essential skill for children in order to change their intuitive theories regarding biotic and abiotic factors of the environment.

This paper sets out to describe the intuitive ideas that foundation phase learners express about the differences between biotic and abiotic components of ecosystems and asks the question *"What are the considerations of foundation phase learners when categorising ecological components?"* Understanding these considerations allows us a window into the conceptual framework of the child and elucidates the nature of the child's intuitive theories. The identification of these intuitive theories can then inform the design of activities to lead the child towards understanding the normative concepts.

1.1 Foundation phase curriculum content relating to ecology

South African children are only formally introduced to a science curriculum in the intermediate phase which is divided into four strands: life and living; matter and material; energy and change; and earth and beyond (South Africa. Department of Basic Education, 2011). Ecological content is mostly dealt with in the life and living strand that is taught in the first term of each grade. Content pertaining to the differences between living and non-living elements of an ecosystem is the first content that children in grade 4 are exposed to and is only taught for a total of 7 hours over 2 weeks. Categorising elements found in an ecosystem as biotic or abiotic is seen as one of the 'big ideas' of science as it has cross cutting implications on various other scientific concepts. Yet we dedicate so little time to formally teaching this concept. The inclusion of ecological content in the life skills strand of the foundation phase curriculum is scant to say the least. The total time spent on teaching content related to ecology equals to 82 hours throughout the entire foundation phase's 4 years. It is important to mention that the national curriculum does not explicitly state that this content has to be taught with a focus on ecology. The curriculum merely lists concepts that has to be taught. In analysing the life skills subject of the curriculum I grouped all the content that in my opinion has strong connections to ecology. Taking this into consideration makes it evident that the 82 hours becomes the maximum exposure a child would get to engage with content related to ecology as outlined in the curriculum document. From this I could only find 4 hours of content that explicitly resembles the teaching of concepts related to the differences between living and non-living elements of an ecosystem. It is therefore evident that the foundation phase does not require the same depth and detail as the intermediate phase and children in the foundation phase are left to discover these topics on their own with little instruction.

The problem is compounded by the inexperience of foundation phase teachers in teaching science as their pedagogical content knowledge of science is poor (Appleton, 2008). Another factor that contributes greatly to the problem of teaching science in the foundation phase is the focus on teaching the 'more important' subjects of mathematics and language (Greenfield, et al., 2009). This contributes greatly to the lack of foundational knowledge that is necessary to build the many new facts and concepts that these children are expected to learn from grade 4 onwards. With these factors as background I set out to determine what the intuitive ideas are that foundation phase children hold regarding living and non-living elements of the ecosystem and attempted to identify the differences of these intuitive ideas between children in grade R and those in grade 3.

It is imperative that children develop a steadfast scientific foundation in the foundation phase in order to ensure that these facts and concepts can be built upon in the intermediate phase. This conceptual development and reasoning of which causal reasoning forms part, build upon each other in what Carey (2009) refers to as 'mental representations' in an abstract manner as neurological connections make connections physiologically to form representations of the natural world and creates symbols that serve as shortcuts or placeholders. By letting children categorise images of the natural world in to groups allows researchers to see the externalisation of the child's mental representations. In the child's explanation of their categorising we get to witness their reasoning ability which in turn makes the connections between their representations evident. Their categorisation as well as their reasoning becomes important developmental indicators.

The argument, or hypothesis, of this paper is that many of the misrepresentations of children in grade 3 are similar to those found in grade R. These incorrect representations are deeply rooted in the conceptual framework of individuals and are difficult to change. I would argue that these deeply rooted misconceptions could be eliminated if we spend more time teaching science in the foundation phase. Infusing the teaching of the characteristics of living organisms in the foundation phase curriculum would not be difficult to achieve as there are many topics that can be easily aligned with these concepts.

I thus argue in this paper for an integrated approach to teaching ecology in the early grades as a way to advance learners' conceptual development regarding living and non-living elements of the ecosystem. In this way we attempt to create awareness of important societal issues that are impacted by the misconceptions created by having a skewed understanding of the differences between biotic and abiotic components of an ecosystem. This I believe to be part of a teachers brief. Teachers can assist in ordering intuitive theories that children hold into an accurate coherent set of conceptual nets whilst also drawing on their reasoning skills with factual knowledge to organise the facts and concepts. Infusing the facts regarding the characteristics of living organisms in their teaching, teachers give children the opportunity to not only make connections with other concepts but also furthers the child's reasoning skills that will assist the child to move conceptually from a naïve or intuitive theory towards a normative theory. I have previously (Naude, 2015) argued for an integrated curriculum that could consist of the systemic use of science content knowledge to inform the teaching of other subject content. The inclusion of the teaching of the characteristics of living organisms in language comprehension lessons is more beneficial than using arbitrary stories with little relevance to the real experiences of the learners.

In order for learners to make these connections conceptual change has to occur and learners need to come to grips with the scientific meaning of concepts by gradually changing their intuitive ideas. But before teachers can attempt to include science concepts in their lessons they first need to determine what these intuitive ideas are that the child holds. The following sections describe the methodology I used as well as the analysis of the data generated.

2. METHOD

Clinical interviews were conducted with foundation phase children at a primary school in Soweto, Johannesburg, to stimulate their thinking about the various components of ecosystems and how these components are related. Convenience sampling was used as the researcher has a good relationship with the management and teachers of the school. The participants consisted of 10 grade R and 10 grade three learners, selected at random, who were expected to group pictures of ecological components in two categories of their own choosing. There were 20 pictures in total depicting various ecological factors. Ten pictures of abiotic factors including, amongst others, soil, water, clouds and the

sun. The remaining 10 pictures depicted, trees, flowers, insects, fish, birds, reptiles and mammals. From their choices they were probed on their decision making behind their choice of groupings as to determine the learners' reasoning when deciding to group certain components together. The interviewer then rearranged the pictures in two groups where all the biotic factors and abiotic factors were separated and asked the learners why he had chosen to group his pictures like this. Following their explanation the interviewer allowed the learner to once again group the pictures and explain their decisions. Data was collected through conducting individual clinical interviews and video analysis of these interviews. The interviews were conducted in isiZulu and translated to English. Open coding was used to analyse the data generated from the interviews. The data were scrutinised for specific discourse markers about children's knowledge and specifically the utterances about possible causality, using the coding and categorizing scheme suggested by Henning, Van Rensburg and Smit (2004; chapter 6).

3. ETHICAL CONSIDERATIONS

Permission to conduct research was obtained from the principal of the school. Ethical regulations from the institution hosting the study were strictly adhered to (Clearance Number: 2016-009) and informed consent was attained from the participants' parents or gaurdians. I was guided by the core ethical principles of autonomy, non-maleficence, beneficence and justice (Alderson 2014; O'Reilly, Ronzoni & Dogra 2013). Throughout, all participants and their parents were protected from harm and had the right to withdraw their contributions if they wished to do so.

4. RESULTS AND DISCUSSION

The findings indicate that most of the foundation phase learners group plants together with other abiotic environmental factors and seldom include plants in the same category as animals. In their explanation it becomes evident that the distinction between their groupings is not based on superficial qualities like the colour of the pictures but involves deeper causal reasoning to explain the connections between these groupings. What became evident during the initial grouping is that learners do not separate their groups according to biotic and abiotic factors at all. Their consideration is rather to see the connections between animals and their habitats. When asked to explain their decision learners regularly said: "This one belongs with this one." Further probing illuminated their reasoning in that the learners would group the pictures of the fish and the whale with pictures of water because these animals live in water. Another example of the connections between the pictures is in their grouping of trees with soil. The learners would explain that "These go together because the tree grows in the sand."

After the interviewer regrouped the pictures separating the biotic and abiotic factors most learners could identify that the one group "is for animals" and the other group "is for the things where the animals live". None used the discourse of living or non-living factors of an ecosystem. What was evident is that plants were seldom acknowledge as part of the 'animal group'. Few learners referred to the plants when explaining the groupings.

When the learners were allowed to group the pictures for a second time we found that they tried to repeat how the interviewer grouped the pictures. The initial number of pictures placed in the groups were seldom equal i.e. 10 pictures in one group and 10 in the other. Yet during the second attempt most groups had equal numbers of pictures in each group. The learners even copied the spacing that the interviewer used when arranging the pictures. Given the intent of copying the groups made by the interviewer, learners still arranged the pictures based on the connections between the elements shown in the pictures. The biggest consideration still remained the habit or location of the objects.

342

The ability of the learners to reason based on the environmental connectedness of objects despite the limited learning opportunities as described in the curriculum shows that the intuitive theories that develop based on naïve concepts which are formulated due to exposure to phenomena in the natural world supplies the learner with enough explanatory fodder to solve novel problems.

5. CONCLUSION AND RECOMMENDATIONS

This paper shows that young children see greater correlation between plants and other abiotic environmental components than to animals. This impacts on the teaching of ecological concepts later in the learners' schooling as the understanding of concepts relating to categorisation and classification depends greatly on the learners' ability to reason causally. The paper recommends that foundation phase teachers consider and use children's spontaneous reasoning as well as the intuitive ideas they hold about ecological interactions in their teaching.

6. ACKNOWLEDGEMENTS

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