International Conference
NEW PERSPECTIVES in SCIENCE EDUCATION

Students' Concepts of Plants

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Abstract

Students' conceptions of plants is still a understudied area in biology education. Mostly, students' understanding of plants is investigated in conjunction with students' understanding of living things using a very small number of different plants (four to six). On average, students achieve a more mature understanding of life, incorporating humans, animals and plants into a general concept around eleven years of age [1]. For the (ongoing) study presented here, I interviewed a total of 33 students from 2nd to 4th grade, and additionally six middle school students focusing on their concepts of plants independently from their understanding of living things using 20 images of different plants as prompts (and 13 images of non-plants). First results indicate, that the middle school students have still a fragmentated understanding of what plants are, with problems to categorize wood or un-typical non-native plants, even though there are huge differences between students. Their reasoning is more complex than that of fourth graders, but the understanding of most of the interviewed student is no more sophisticated than that of fourth graders. In this talk I will discuss these differences and implications for teaching.

Keywords: *Conceptual change; biology education; plants; middle school students;*

1. Introduction

Research on conceptual development with respect to naïve biology has been strongly influenced by the work of Giyoo Hatano. Together with Kayoko Inagaki, he explored children's early understanding of plants, an area which is even today often not touched upon when discussing the early children's thinking (e.g. plants do not appear in Carey [2], which extensively discusses early understanding of physical objects and animate beings; even Inagaki's and Hatano's –reprinted - chapter in Vosniadou, [3], which is the only chapter on childhood naïve biology in the volume, addresses plants only in a very general way (vitalistic explanations for living things in early childhood).

Hatano studies (e.g. [1], [4]) present a wealth of information on how plants fit in in the early domain structure of inanimate physical things (naïve physics) and living beings, how reasoning on living beings can then break down in animate beings with a naïve theory of mind, biological facts with a naïve biology, which further divides into animals and plants.

While artificial objects are a specific subgroup of inanimate physical objects, early reasoning of children in naïve biology is also frequently teleological.

In this study, I build on a study on children's understanding of plants and living things, undertaken in 2013, adding further interviews from other classes and looking at middle school students' understanding of plants.

2. Methods and analysis

Study context and subjects: For this study, I interviewed 33 students from 2nd to 4th grade (from two different elementary schools), as well as six middle school students (7th grade). All students were interviewed with the same instrument (all in November 2017), using among other a sorting task of pictures involving 21 plants and 15 other objects. The schools are situated in a small town (less than 10.000), one elementary school is located in a small village; thus nature, plants and the life cycle is something children experience as part of their daily life.

Interviews were audiotaped and transcribed using easytranscript, further analysis will make use of MAXQDA. In a first round, interview answers for the individual interview questions are paraphrased and compared between the interviewees. Further analysis makes use of discourse analytic methods, to describe the semantic network built by individual students (see [5]).

3. First Results

Usually children's understanding of plants is studied in conjunction with their developing understanding of `living things`. That development is generally seen to be concluded at around 11 years. Thus, studies on children's understanding on plants focus on elementary students

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understanding in the context of living things [1]. Few studies investigate the understanding of plants with respect to their variety of forms and adaptations, and these studies also usually focus on elementary school students [6] as it is assumed that children acquire the plant concept in elementary school.

I found, that the middle school students' (of a lower track secondary school) understanding of plants was no more advanced than the average fourth grade student, and sometimes even less so. The middle school students had more 'facts' about plants, they were more advanced in their argumentation, but lacking a comprehensive understanding of plants, they attributed these facts partly to subgroups of plants, and developed individual theories to bridge gaps in their understanding.

Elementary school students understanding on the other hand varied a lot. One main issue seems to be the extension of the plant concept – something which is well known for trees, which are often not included by younger students in the plant concept.

However, this also extents to other less familiar plants, or familiar plants which are associated with other words – drawing on simple lexicon acquisitions heuristics, which Markman [7] describes, i.e. the preference to use words exclusively. Thus "vegetables" are not considered plants by some children, as are "weeds" etc. Unfamiliar plants, i.e. plants that exist in conditions which defy living conditions for plants evolved to exist in the children's environment, are also not considered to be plants, or create doubt about their placing. This eludes to the complexity of the concept involved: It incorporates not only visual features, but also knowledge elements, which need to fit to apply the concept.

The plant theory young children develop may even lead them to reason that there are no plants in Asia and Africa, "since it is far too hot" (2STE1).

The extension of the plant concept determines how they respond to questions which make use of their understanding of plants (like: What happens to us, if there are no more plants; what happens to plants, if we are gone). If they see plants as something we grow, plants become dependent on us for watering etc.

4. Discussion

The analysis presented here, shows how heterogeneous the concepts of plants are. It highlights, that children may have very different understanding of plants, which nevertheless share a common subgroup – flowers. These are the prototypical plants, which are easily transported, disassembled etc., and thus used for presentation and manipulation in many classrooms. However, without explicitly extending the scope of the meaning of 'plants' to incorporate other plants, students' extension will remain idiosyncratic, even up to higher middle school. Concepts like photosynthesis etc. are then learnt and reproduced by students, who apply them to their concept of plants. This highlights the necessity to revisit the plant concept in middle school, and again discuss 'what a plant is', and the many forms as different functions and ecological nieces a plant can inhabit.

At least in Austria, this is not called for in the national curriculum, instead it is assumed that children already enter middle school with a satisfactory understanding of (the extension of) plants. The elementary school curriculum explicitly asks teachers to "to develop an understanding of the elements of a plant and their function in their environment using examples from the local context, in particular flowers". This is problematic, as it hinders an appropriate taxonomic understanding of the plant concept, leading to the fragmentation of new information learnt about plants (which plant?). In conclusion, the concept of plant encompassing a wide variety of forms has should be explicitly addressed and elaborated on in middle school.

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