

REPRESENTATIONS AS MEDIATIONAL MEANS IN STUDENTS' MEANING-MAKING ABOUT THE HUMAN BODY

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The aim of this proposal is to investigate students' meaning-making processes of multiple representations during a teaching sequence about the human body in lower secondary school. Two main influences are brought together to accomplish the analysis, on the one hand, theories on signs and representations as scaffoldings for learning and, on the other hand, pragmatist theories on how continuity between the purposes of different inquiry activities can be sustained. Data consist of 10 videotaped and transcribed lessons with 14-year-old students (N=26) in Sweden. The analysis focuses instances where meaning of representations were negotiated. Findings indicate that continuity was established as a progression in use of language, towards a more scientific register in a mode continuum between every day and scientific registers. In this process, the use of interlanguage expression enables the students and the teacher to maintain the conversation and explain key issues to support immediate action. Furthermore, understanding of the human body is dependent on explanations at multiple organisation levels, and students' learning progressions were afforded by representations that specifically pointed towards a shift in organisation levels.

Keywords: Representations, Reasoning, The role of Language in Science Education

INTRODUCTION

The construction of representations and models in education may be understood as an inquiry process (Kress, Jewitt, Ogborn & Tsatsarelis, 2001; Prain & Tytler, 2012) resembling that of science practices (Osborne, 2014) and in this paper two main influences are brought together to accomplish an analysis of students' learning progressions about the human body. These are, on the one hand, theories on signs and representations as scaffoldings for learning (Ainsworth, 2008; Tytler & Prain, 2013) and, on the other hand, pragmatist theories on how continuity between the purposes of different inquiry activities can be sustained (Dewey, 1938/1997; Wickman 2014).

A crucial aspect in students' learning is the ability to establish continuity between different organising purposes, an aspect which has been operationalised by Johansson and Wickman (2011) as the progression from proximate purposes (close to students' prior experiences) to ultimate purposes (new, more scientific ones). The focus in this paper is on students' meaning-making processes of multiple representations where each modality and the way it is communicated in the classroom offers different constraints and possibilities for meaning making (Kress et al, 2001) depending on the organising purposes given and how they together give students affordances that allow them to reach more ultimate purposes (Johansson & Wickman, 2011).

The analysis focuses on how continuity emerges in action over time and the specific questions are: a) in what ways do representations afford the students' ways of making sense of the content? b) in what ways is continuity established between purposes?

METHODOLOGY

Data was generated within a teaching sequence about the human body in Swedish school year 8 with 26 students (12 girls and 14 boys) approximately 14 years old. Among the applied representations one, known from children books, was recurrently used: *Barbapapa*, which is more or less ‘an empty sac’. The teachers’ intention with selecting this type of representation was that it would scaffold the learning progression towards ‘the cell’. The driving question, communicated in every day language, was: “what enters the body and where does it go?”

All lessons were videotaped: 4 whole classes (50 minutes each) and three half classes (40 minutes each) which meant that each student attended 7 lessons. The video camera focused on the teacher who was equipped with a wireless microphone. Two groups with three students each were also audiotaped during two group discussions. The talk recorded by the teacher microphone was transcribed verbatim as well as the talk during the two group work sessions.

The analytic procedure started with making a collection of instances where representations were negotiated. In the next step, we made use of Peirce’s triadic model of meaning making of representations (interpreted by Waldrip & Prain, 2013, p. 17) where “*meaning* (sense made of sign, concept, idea or explanation)” is connected to “*representation* (verbal, visual, metaphoric, mathematical etc)”. This procedure enabled us to discern ways that students established continuity in action over time. Three main themes in relation to content give structure to the result section below.

RESULTS

First, metaphors were frequently used and one example concerns the question about how substances were transported and exchanged between organs and over membranes. This was an issue on the agenda throughout the sequence but a temporary agreement was expressed already in lesson one in a rather everyday manner. In response to a problem raised by the spatial model as to whether organs could be directly connected (they could not) and what the nature of material exchange was across the interface between systems of organs, the group decided that substances ‘jump’ between systems thus avoiding articulation of the specific mechanisms of material exchanges that the next school level eventually will establish. This sense making metaphor is kept through the sequence although the words associated with the materials that ‘jump’ change, for example ‘oxygen is picked up’ or ‘unloads carbon dioxide’. Thus, the language becomes more refined and discriminating in terms of specifying particular chemicals that are exchanged, but no scientific mechanisms for the ‘jumping’ are mentioned.

Naming of substances is a second theme that undergoes a progression over time in a mode continuum between every day and scientific registers. The sense and wording in the beginning is *food* and air which gradually transforms during the sequence, and the words are added to arrows: food-nutrition, nutrients-sugar-glucose and air, oxygen, oxygen molecule.

A third theme is that the students face a gradual need to establish continuity between processes and part/whole relations and here the students seem aware of the more overarching idea (that everything that enters the body should reach and react in the cells). This is shown by repeated student questions about next step and circularity, for example they recurrently ask each other “where does this substance go now?” or “how does it [*substances*] reach the cell?”

DISCUSSION

The use of a metaphor (jump) articulated as an interlanguage expression (Olander & Ingerman, 2011) enables the students (and the teacher) to maintain the conversation and explain the more urgent issues to support continuity of the immediate action. Continuity between proximate and ultimate purposes is established, which also the second theme illustrates. The affordance of the visual diagram lies in the way it productively constrains attention (Prain & Tytler, 2012) to the spatial elements of the material exchange in relation to the organs. There is only a limited space to draw in which creates a need (Wickman, 2014) for inclusion of other semiotic resources like arrows and words. Since the organs in the representation (Barbapapa) are fixed and the students agree with the idea that substances (food and air) have to be transported another need is created (Wickman, 2014), a need to phrase the substances as particles (nutrients and oxygen).

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