Play with Science in Inquiry Based Science Education

Background and framework

> Lisa: Now I'll do.
> Gustav: Here doctor, thirty seconds.
> (Transcript from laboratory work in 6th grade science class)

The above excerpt is an example of sixth grade students engaging in play activity along with their completion of a laboratory task of testing for glucose in different nutrients. Gustav and Lisa engage in role-play of a doctor and an assistant. Lisa puts the testing stick in the investigated food and Gustav counts to thirty. This play involves making use of what they know about testing, possible social roles and science culture. Through play, children interpret their experiences, dramatize, give life to and transform what they know into a lived narrative. Children's play is not just simple remembering but a creative transformation of the experienced – creating a world that meets the needs and interests of children (Vygotsky 1930/2004).

There is an extensive literature on play in general but research is rather scattered in relation to science education. Following Vygotsky, however, play needs to be understood in relation to the needs and motives of specific human action. In science education students sometimes create and engage in imaginary science-oriented play where ideas about science and scientists are put to use. Students create imaginary situations by combining experiences available to them; be it personal experiences or someone else's historical or social experiences made available through narratives, literature, media etc (Vygotsky 1930/2004). These play activities open opportunities for students to explore ways of positioning themselves in relation to science. A scrutiny of informal play activities is therefore also a scrutiny of science classrooms as places where identities are developed through students' engagement in activity (cf. Kelly & Sezen 2010; Wenger).

In relation to compulsory school science education there has been an interest in play as part of instruction in terms of role-play and computer-games. McSherry & Jones (2000) argue that role-play in science lessons is underrated and underused and attempt to provide a theoretical basis for the use of role-play as part of developing the experiential side of teaching science. Simulation-role-play is held by Aubusson, Fogwill, Barr and Perkovic (1997) to allow students to demonstrate their understanding, explore their views and develop deeper understanding of phenomena although they raise concerns about students' capacity to distinguish role play from the subject matter being studied. Burton (1997) provides detailed steps to guide teachers through the process of role play in order to enhance learning in science. With the growth of educational computer games and program emphasis has been placed on play with computor programs (as game-play) as instructional method (Roussou 2004; Steinkuehler & Chmiel 2006; Barab, Sadler, Heiselt, Hickey & Zuiker 2007).

In pre-school, play – in particular 'free play' – has been recognized as an important part of learning in general ever since Friedrich Fröbel's work in the early 1800's (Lindqvist 1996). The role of the pre-school teacher is described as a facilitator of children's play (op cit). In relation to science learning there are few studies of play. Henniger (1987) analyzes learning opportunities in science and mathematics available through children's play. In particular he studies what attitudes to learning science are developed through play. However, Goldhaber (1994) reports on pre-school teachers expressing insecurity in relation to whether children may be allowed to play if the activity is to be called science.

In relation to learning science at university, Hasse (2002) has shown that play as science preparation is very much part of learning physics. She showed that games, like creating new experiments rather than adhering to given tasks, prepare students, boys in particular, for lives as scientists, and allow students to play out their imagination.

The research initiatives on play and science education differ in relation to different forms of education. Hasse's (2002) study on play in university physics focus on informal play as an integral part of learning science whereas studies of school science focus on formal instruction. Research on play in pre-school science take a semi-formal approach recognizing informal play as mediating formal learning. However, there is little reason to expect that informal play would be of less importance as an integral part of learning science in school as compared to learning science at university. Even though there may be important differences relating to the goals and motives of educational activity in different forms of schooling.

Aim and research questions

The aim of this paper is to explore students' spontaneous make-believe play as part of activity in lower secondary school science. This paper reports from a larger study on learning, narrative knowing and remembering in inquiry based science education (IBSE). Hence, we focus specifically on play in IBSE. The following research questions are addressed: (1) What different kinds of spontaneous make-believe play do students engage in, in lower secondary IBSE? (2) What opportunities are opened up for students to explore different ways of positioning themselves in relation to science and scientists in spontaneous make-believe play?

Methodology

The study was conducted in two Swedish compulsory schools (school A and B). School A is situated in a relatively prosperous residential community and school B in a less advantaged suburban community. In each school we followed one teacher and their 6th grade class working with the unit 'Chemistry of food' in the curriculum material *Naturvetenskap och teknik för alla* (for an overview see Author 2007). The unit covered a period of about 10 weeks. Data were collected throughout the 10-week-period using video- and audiotape recordings of classroom work (app. 55 h). The audiotape recordings were transcribed verbatim with the video recordings used as support.

Data were analyzed using the constant comparative method (Glaser & Strauss 1967). This involves a constant comparison of incidents in empirical data that eventually generates the theoretical properties of a category. This method was developed by Glaser and Strauss as part of their development of grounded theory. The aim is to generate social theory that is integrated, consistent, plausible and close to data. Our procedure begun with comparing incidents, in the transcribed data as a whole, which could be understood as play. By this constant comparison, properties of categories are developed, categories are integrated and reorganized. Eventually, the categories presented in this article emerged. An underlying idea of grounded theory is that research should be inductive and grounded in qualitative studies of social life (ibid). However, our research questions as well as coding and interpretation of incidents in data are informed by our understanding of students' work in school as collective, artifact-mediated and object-oriented activity.

Results

When working with inquiry students are given a variety of resources for inquiry work (measurement tools and food for investigation). These resources are also used by students as resources for imaginary science-oriented play. In our preliminary analyses we have discerned two different categories of play: *role-playing* and *game-playing*. Both kinds of play involve transformations of the tasks given and open up for different social positioning in relation to science. *Role-playing* involves play with social roles as in the introductory transcript with the doctor-assistant play. There are several examples of students engaging in role-playing. In this paper we analyze e.g. one example of role-playing where a group of boys creating an imaginary situation where they act as potential Nobel Prize Laureates and play with cultural values of science; that one has to be open to what the test shows (regardless of prior experiences) and that big counter-intuitive discoveries are highly rewarded. *Game-playing* involves a transformation of the given tasks in relation to play activity. There are examples of several groups of students transforming the given tasks of testing different food for different nutrients into a game-play of lottery. In this game-play students distance themselves to the science content of the given tasks and create an imaginary situation where coherence between predictions and outcomes are celebrated.

Conclusions and Implications

The practice of the studied IBSE classroom offer students a variety of resources that may be used to engage in spontaneous make-believe play with science. When students engage in play they transform the given tasks in relation to needs and motives that are personally meaningful to them. Hasse (2002) showed that play activity is part of university physics students' preparation for a scientific career and that play enable students to learn hidden rules of science. Our examples of play in the lower secondary IBSE classroom are not only examples of ways of making meaning in relation to becoming a scientist but also examples of students distancing themselves in relation to the science content as in game-play. A teacher may promote students learning about science as a cultural endeavor by facilitating and encouraging students' exploration of different ways of positioning themselves in relation to science and a community of scientists in spontaneous play.

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