Science Centres and Museums as Rooms of Revelation (RoR) in Science Education

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A theory of practice

The focus of this research project is the dynamic between the arena of learning, *the learning room*[1], and the learning processes in out-of-school science education. The project stems from my experience as a science teacher and educational entrepreneur. I wrote a thesis for my MSc on contextualised physics education (Nordal, 2006), and worked to integrate this perspective at Nannestad Upper Secondary School. With partners from business and industry I lead the development of Newton Science Centre Nannestad at the school. In our elegantly designed "Newton Room" we presented teaching modules related to the real life professional contexts of our partners, and we offered the modules to both our own pupils and pupils from neighbouring schools. However, I came to realise that the fancy room did not fit the content of many of the modules, and rather than being a credible arena for real world encounters it became more of an artificial showcase. Even though the pupils enjoyed the modules as variation in the daily routine I strongly felt that the science centre did not meet its potential as an arena for learning.

Schön (1974; 1995) emphasises the value of "reflecting practitioners" in educational research, and how formulated "theory in practice" may give important contributions to educational theory. It is my theory of practice that motivates this study, but I also regard it as part of my empirical data.

The learning room

I have selected two different out-of-school learning rooms as cases for my study. Case A is the *Mind Gap* neuroscience exhibition at the Norwegian Museum of Science, Technology and Medicine (NSTM) and the teaching modules developed for this exhibition[2]. Case B is *The Wind Turbine Week*, in which 24 grade nine students worked for a full week building wind turbines in a mechanical workshop connected to the renewable energy laboratory at our university. Case A was selected because it represents a carefully aestheticized ("iscenesatt") learning room, with focus on staging a room that matches the theme of the learning sequence. Case B was selected because it represents a learning room that conveys a strong sense of authenticity to the students.

I believe, as Zubrowski (1982), that scenography, dramaturgy and design are generally underrated as pedagogical instruments to create aesthetic experiences that stir the students both cognitively and emotionally. Dewey (2005) describes as an aesthetic *experience* as "when the material experienced runs its course to fulfillment" (p. 36) "to arouse vivid consciousness" (p. 55). I will insist that science learning driven by "aesthetic curiosity" (Zubrowski, 1982, p. 411) involves the student more profoundly than traditional textbook-

[1] In Norwegian the term is "læringsrom" – literarily *learning room*. This gives more emphasis on attributes of the physical room where the learning takes place, than the general term *arena of learning*.
[2] The Mind Gap exhibition was designed by the famous American theatre director Robert Wilson for the 200th anniversary of the University of Oslo in 2011, and was recently awarded the International Design and Communication Award in the category Best Exhibition Layout.

driven learning.

Lave & Wenger (1991) state that all learning is situated in a concrete context. The practical context of most science teaching in Norway is the natural science classroom, which is (of course) inherently decontextualized from nature and the real world outside. Braund & Reiss call for a more authentic science education, maintaining that "school science is too restrictive: for all the advantages of school laboratories, they constrain the activities that take place" (2006, p. 1385). Frøyland (2002, 2010) emphasizes that a call for more out-of-school science activities is in accordance with Gardner's (2006) theory of Multiple Intelligences. Frøyland's model of Multiple Experiences in Multiple Settings (MEMUS) informs my project.

I will argue that the science teacher should choose a variety of appropriate learning rooms based on an understanding of what learning processes the students need to involve themselves in.

The learning process

Learning can be regarded as a function of attention and participation on part of the learner (Hugo, 1995). So, what different kinds of participation can be seen among pupils in an out-of-school arena of science learning? And how do the characteristics of the learning room influence the learning processes?

Hugo (ibid) describes three distinct forms of mental participation, or *Eigenbewegungen*[3]. These are 1) movement of attention (meeting the phenomena), 2) movement of perspective (meeting others), and 3) self-observation (meeting oneself).

The notion of interactivity (Caulton, 1998; Davidsson & Jakobsson, 2012) is essentially a matter of participation. However, as Heath and vom Lehn (2008) remark, the common kind of computer-based 'interactive' science centre exhibitions do not necessarily produce real engagement and participation. Indeed, Dewey (1998) warned against "overemphasis upon activity as an end, instead of upon intelligent activity" (p. 69). What Axelson (1998) calls "The Liseberg Effect"[4] is well known to science teachers: That pupils on school trips to science centres run around pushing buttons without focus or intention to explore and learn (Shortland, 1987); there is in other words no real participation.

So, the traditional hands-on imperative is not sufficient. The activities must be designed so that the pupils remain *minds*-on (Duckworth, Easley, Hawkins, & Henriques, 1990) and, since modern cognitive research has shown that all learning involves emotion (Damasio, 2006) and affect (Alsop, 2005), also *hearts*-on.

I believe that museums and science centres have a unique potential to design learning rooms that can evoke this kind of participation and create strong, revelatory learning experiences from what Hein labels "complete sensory immersion" (1996). However, to take out this potential the museum or science centre visit needs structures of scaffolding (Wood, Bruner, & Ross, 1976). Comprehensive preparatory and post-visit activities enhance the pupils' learning experiences and address what Allen et al. (2007) refer to "the constructivist dilemma" in exhibit design, providing the pupils with some common ground and directedness in their walk between the different rooms of experience.

In my study I will identify learning processes in the two cases, and relate these processes to Hugo's (1995) different kinds of participation.

Methodology

This is an explorative multiple-case study (Yin, 2009) framed in a phenomenological

[3] This is a German translation of Hugo's Norwegian term "egenbevegelser". It is difficult to translate into English, but signifies something like *self-generated conscious action* or *autovolition*.
[4] Named after the amusement park in Gothenburg.

investigation (Moustakas, 1994) of learning processes in out-of-school arenas. The two selected cases represent two very different kinds of learning rooms: Case A (Mind Gap) representing the quality of design (“iscenesettelse”) and Case B (the Wind Turbine Week) representing the quality of authenticity. In both cases there is an element of intervention on my part:

- In case A I have revised the teaching material (including the tutor’s guide and the pre and post visit activities). I did this after first having studied three classes with the original teaching plan, following a design-based research strategy (Collins, Joseph, & Bielaczyc, 2004; Sandoval & Bell, 2004). This fall I shall study three more classes with the revised material.
- In case B I planned and lead the entire program, in accordance with principles of action research (McNiff & Whitehead, 2002).

From both cases the data collected include, in addition to field notes, video and voice recordings, individual and focus group interviews, and student work. These are to be analyzed with ATLAS.ti (v 7), focusing on identifying events and arguments (Derry et al., 2010) that relate to learning processes and physical situation.

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