

PART 15: STRAND 15

Early Years Science Education

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CHARACTERISTICS OF SCIENCE TEACHING IN PRESCHOOL

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This paper focuses on characteristics of science teaching in preschool. Science in general is in focus, but a special interest is put on what may characterize chemistry teaching in preschool. The study is part of a much broader R&D programme where in total almost three hundred preschool teachers/managers collaborate with a researcher group to which we belong. The participants (N=177) were in the autumn 2018 asked to answer a question in an e-mail-questionnaire about their views on science/chemistry teaching in preschool. On average a participant answered with 30 words, but obviously there was a big span, from 1 to 444 words in a single answer. In the word material (consisting of about 5400 words in total) we looked for common and prominent words, words used only low-frequently or not at all, and other patterns. We identified eighteen words that were used about 30 times or more. Among these words are: experiment, water, animal, plant, nature, forest, explore, examine, phenomenon, and baking. Low frequently used words were categorized in seven categories, among them chemistry. The words atom, molecule and particle could not at all be found in the word material. More qualitatively we also looked for patterns/traces based on the three main Didaktik questions: Why? What? and How?. Statements from the preschool teachers/managers were categorized in seven categories. In the discussion and forthcoming studies we will relate science/chemistry teaching in preschool both to the recently revised curriculum for the Swedish preschool and to other content areas and more general theories and ideas on what may characterize teaching in preschool.

Keywords: Pre-school Education; Continuing Professional Development; Didaktik

A R&D PROGRAMME ABOUT TEACHING IN PRESCHOOL

During the last years there has, at least in Sweden, been a growing interest in exploring what characterizes teaching in preschool (e.g. Hedefalk, Almqvist & Lundqvist, 2015; Melker, Mellgren & Pramling Samuelsson, 2018; Pramling et al., 2019, Thulin & Jonsson, 2018; Vallberg Roth, 2018) and not at least science teaching (e.g. Broström, 2015; Andersson & Gullberg, 2014; Fridberg, Jonsson, Redfors & Thulin, 2019; Gomes & Fleer, 2018; Sjöström, 2018; Sundberg, Areljung & Ottander, 2019). In the latest version of the Swedish curriculum for preschool (SKOLFS 2018:50), the mission of teaching was enhanced. The curriculum also includes science as a content area and the present study focuses on what may characterize teaching in and about the natural sciences, including chemistry. One of the goals in the curriculum for preschool is to provide each child with the conditions to develop “an understanding of natural sciences, knowledge of plants and animals, and simple chemical processes and physical phenomena”.

The study described here is part of a much broader R&D programme, which is a collaborative initiative involving eight Swedish municipalities and the independent Institute for Innovation, Research and Development in School and Preschool (Ifous), as well as Malmö University. In total almost three hundred (300) preschool teachers/managers collaborate with a researcher group of six, to which we belong and one of us (Prof. Vallberg Roth) is leading. The programme started in the summer 2018 and will continue for three years in total. The aim of the present study is to get a better understanding of what may characterise science teaching, including chemistry, in preschool.

RESEARCH METHOD AND DESIGN

In the beginning of the R&D programme, the participants were asked to answer an e-mail-questionnaire about their views mainly on teaching in preschool, generally and in some specific content areas, among them natural science. Here we report results from the question (in the e-mail-questionnaire) about what may characterize teaching in and about the natural sciences, including chemistry. The specific question was (our translation): “What may characterize teaching in natural sciences, including chemistry, in preschool?”. The collected and analysed empirical material consists of about 5400 words from in total 177 respondents, of which 131 were preschool teachers and 46 preschool managers. Of the words about 4400 words were from the preschool teachers and about 1000 from the preschool managers. The number of words per participant were as follows: On average a participant answered with 30 words, but obviously there was a big span, from 1 to 444 words in a single answer. For more details, see: Sjöström, 2019a.

Below, the results will be presented, analysed and discussed in a similar way as presented in some recent articles on teaching in Swedish preschools (e.g. Vallberg Roth, 2018; Vallberg Roth, Holmberg, Löf & Stensson, 2019). The analysis of the material can methodologically be described in terms of abductive analysis (Peirce, 1903/1990; Tavory & Timmermans, 2014), alternating between theory-loaded empiricism and empirically loaded theory. The purpose of the analysis is to identify traces and patterns in the “word data” (see further: Silverman, 2011), relating to the aim of and questions posed by the research. In the word data for the question about science/chemistry (i.e., about 5400 words from in total 177 respondents), we looked for common (and prominent) words, words used only low-frequently or not at all. The frequency of prominent words was counted using the “Find”-function in Word.

We also looked for qualitative patterns. How words interact with and reinforce each other in their contexts was analysed. The analysis was built on both high- and low-frequency traces in a second and qualitatively oriented interpretive path. The word-frequency analysis can be viewed as offering stabilising support in the analysis of the distinctive traces. Quotations were selected for their clear exemplification of the traces in the material. More concretely, the analysis involves identifying traces in the material in relation to the research aim. The analysis can be described in terms of the following interpretive paths (see e.g. Rapley, 2011; Tavory & Timmermans, 2014): close reading; distinctive traces were identified; and distinctive traces in the third interpretive path were problematized in relation to earlier research and concepts.

The so called *Didaktik* questions serve as both a practical tool and as a basis for analytical questions. In the context of research, such questions focus on what (content), how (teaching actions), who/whom (actor/actors), where (space/place), when (time) and why (goal and motivation). The three main *Didaktik* questions, What?, How?, and Why? are in focus in this paper.

Abductive moments in the analysis can involve suddenly seeing an alternative, discovering a previously undiscovered possibility: “Reality is not simply ‘what is here-and-now’ [...] but also includes what potentially can be achieved – and which in the moment merely reflects a vague possibility” (Peirce, 1903/1990, p. 31). In this study, concepts were tested in relation to traces in the material that were revealed as possibilities by the analysis. Furthermore, cohesive analysis was performed in light of *Didaktik* models, resulting in a conceptualising focus. In practice, empirically based and theory-based interpretive paths are typically intertwined.

RESULTS AND DISCUSSION

We identified eighteen words that were used about 30 times or more. These high-frequency words (translated from Swedish) are below presented in a “word cloud” (Figure 1). Together these words give us an idea of the most common understanding and views on what may characterize science teaching in preschool in Sweden in 2018. The most common and prominent word was “child”. It was used about 140 times, meaning about 2,5% of the total amount of words. On second place was “experiment”, which was used about 100 times. This word was the typical answer for what may characterize science/chemistry teaching in preschool. More than half of the respondents used that word explicitly. Actually it was also the only single word used in an answer by one preschool teacher and in some other cases it was the only content: “We have experiments” and “experiments, for example”.

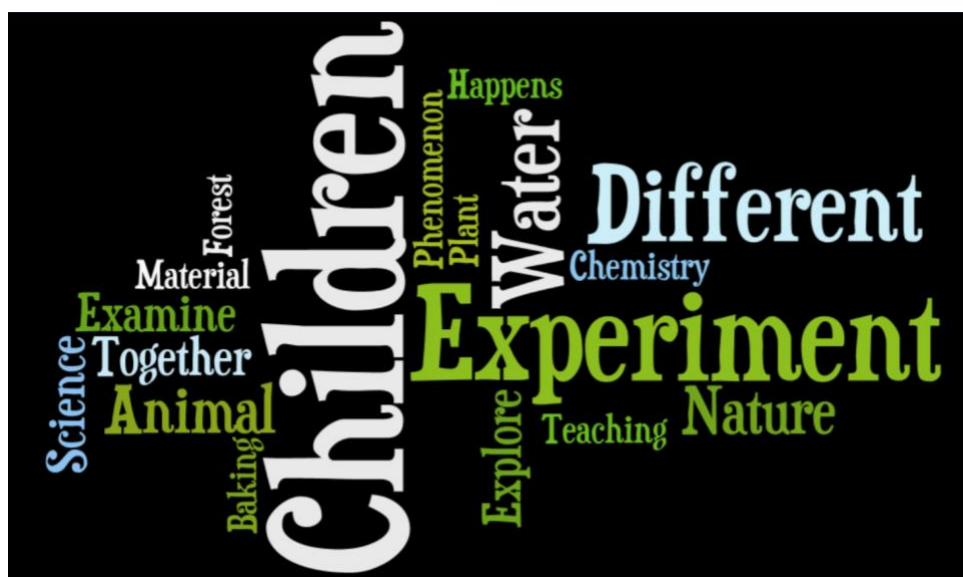


Figure 1. High-frequency words (translated from Swedish) in the answers on the question of what may characterize teaching of science, including chemistry, in preschool year 2018. The word cloud was made in Wordle.

As seen in the word cloud, other common words were for example: water, animal, plant, nature, forest, explore, examine, phenomenon, and baking. Another word was “happens”, which is about that something is happening during for example an experiment. Except experiment and water, it is mainly “baking” that can easily be related to chemistry. One preschool teacher answered: “In chemistry it is usually experiments and baking that are included.”

Ever since the start of the Swedish preschool at the end of the 19th century, “nature meetings” have been central (Ärlemalm-Hagsér & Sundberg, 2016). Since the national curriculum for the preschool was introduced in 1998, the focus has also been on environmental work. Chemical processes and physical phenomena were introduced in 2010, when revising the curriculum (Thulin & Gustavsson, 2017). Sundberg, Areljung, Due, Ottander and Tellgren (2016) have claimed that science in preschool is dominated by the following content: water, human body, compost, nature and forest. These words, except for human body and compost, were – as seen in Figure 1 – common in the answer on what may characterize science/chemistry in preschool. On the other hand human body was a common word in the answers on what may characterize health teaching in preschool (another question in the questionnaire) and compost on what may characterize teaching about sustainable development in preschool (also another question). Except on the question on what may characterize science in preschool, nature, water and material were also high-frequent in the answers on what may characterize teaching about sustainable development in preschool (Sjöström, 2019b).

Except the high-frequently used words, we also identified many words used with lower or low frequency or not at all. For example the words atom, molecule and particle could not be found in the word material. The low frequently used words were categorized in the following seven categories: scientific work; physics (with or without connections to mathematics, technology, metrology and/or astronomy); chemistry; biology (including both green biology and human biology); general science linked to everyday-life; environmental science (including sustainability issues); and science pedagogy/teaching methods in preschool.

More qualitatively, we also looked for patterns/traces based on the three main *Didaktik* questions: Why? What? and How?. Statements from the preschool teachers/managers were categorized in the following seven groups: Why science in preschool?; What characterizes science in preschool?; Prerequisites: subject knowledge of the preschool teachers and educational teaching material; What content?; What activities and how?; Other pedagogical ideas; and, finally: The nature of chemistry teaching in preschool. We have a lot of quotations connected to the seven groups (Sjöström, 2019a), but here we focus on chemistry in preschool. Previous research on chemistry in preschool is very limited (e.g. Adbo & Vidal Carulla, 2019; Fridberg, Jonsson, Redfors & Thulin, 2019; Hansson, Löfgren & Pendrill, 2014; Åkerblom, Součková & Pramling, 2019).

Chemistry in preschool

One interesting quotation about what may characterize chemistry in preschool is (our translation): “Chemistry is more difficult, usually it becomes experiments that becomes

‘happenings’ without any follow-up or anchoring”. One example of a “happening experiment” is the “how to make a volcano”-experiment, which is common on the Internet and also – at least previously – in Swedish methods books about experiments to be done in preschool and primary school. “Volcano” is mentioned six times in the word material. However, the purpose of that experiment is unclear and its value can be questioned (see further discussion in: Sjöström, 2019a).

The empirical material (the word material) can also be discussed and problematized in relation to the chemistry triplet (macro; submicro; symbolic/representations) (see e.g. Johnstone, 1993; Talanquer, 2011). Furthermore, the statements by the preschool teachers/managers can be compared to the ongoing international discussion on when (what age) and how to introduce the concepts of particles and molecules to children (e.g. Sjöström, 2012; Åkerblom, Součková & Pramling, 2019). In forthcoming analysis and studies we will also relate our results to previous studies on science teaching in preschool and to more general theories and discussion on teaching/*Didaktik* in preschool.

Science content in preschool

According to Klaar (2016; see also: Klaar & Öhman, 2014), there are the following three main content areas related to nature/science, in the Swedish preschool:

1. to promote children’s personal development and health by being outdoors,
2. to care for the natural environment, and
3. to learn about nature, both in terms of scientific phenomena and processes and through inquiry.

The first content area links to a healthy lifestyle and the second to sustainable development. Scientific phenomena, products and processes are mainly to be found in the third content area. At the same time, “nature teaching” in preschool can also be about nature experiences and wonder in a broad sense (Hadzigeorgiou, 2001; Hadzigeorgiou & Schulz, 2014), as well as about how scientific knowledge relates to technology, health and environmental work.

“Nature” is mentioned five times in the revised curriculum for preschool in Sweden. It is about stimulating the children’s “interest in and knowledge of nature, society and technology”. Furthermore, the preschool shall provide each child with the conditions to develop “an understanding of relationships in nature and different cycles in nature, and how people, nature and society affect each other”. Except in the curriculum goal about “natural sciences”, which was quoted above, “science” is mentioned three more times in the curriculum. It is about providing each child with the conditions to develop an ability to explore and discuss science and technology, and about language and communication in relationship to mathematics, science and technology (SKOLFS 2018:50).

In Figure 2, we suggest a *Didaktik* model on “nature / science content” in preschool. The corner “Experience of nature in a broad sense” includes for instance the human body and natural phenomena. Read more about different types of *Didaktik* models in e.g.: Sjöström 2019c; Sjöström, 2019d; and Vallberg Roth, Holmberg, Löf & Stensson, 2019.

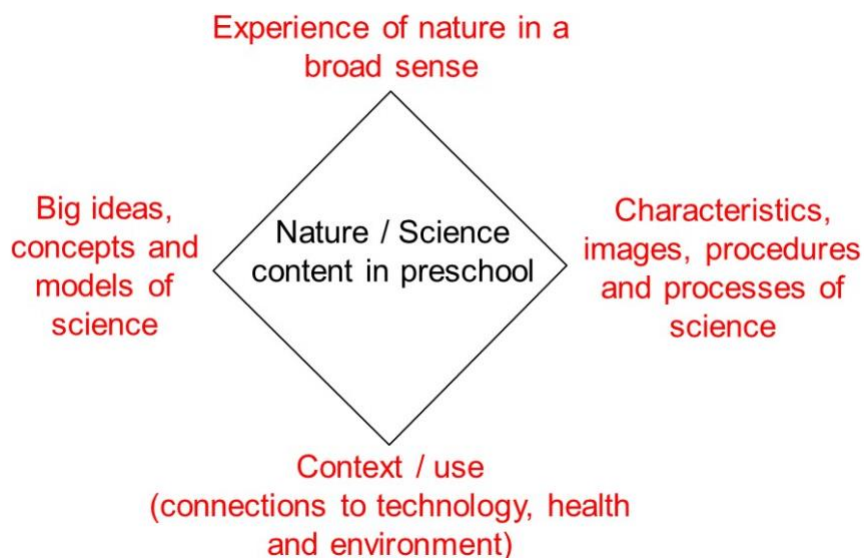


Figure 2. Didaktik model on nature / science content in preschool. The model is an English translation of a model in: Sjöström, 2019a.

In forthcoming scholarly work, based on the work presented here and related work, we will more in general discuss the concepts of *Didaktik* models and modelling in relation to preschool teaching praxis. Furthermore, we are interested in what happens when more general ideas about science teaching and *Bildung* (Sjöström, Frerichs, Zuin, & Eilks, 2017) are applied to a preschool context.

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