

Science process skills in small children's science education

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This article discusses the central science process skills in the education of sustainable chemistry in inquiry-based learning of children under school age. Science process skills are skills that are essential in learning chemistry and other natural sciences. They can be learned best through inquiry-based working. An inquiry-based approach makes it possible to practice small children's science process skills in a suitable way for the child's level of development, supported by parents. This article introduces a science education model for the practicing of small children's science process skills, which has been developed in a doctoral dissertation.

According to previous research, it is recommended that children are introduced to chemistry and science before school age, so that a child's early understanding of how the world functions would be in right direction (Eshack & Fried, 2005). For 3-6 year old children, the learning of science process skills and thinking skills are proposed as targets of learning in science (Kuhn, Black, Keselman, & Kaplan, 2000) in a playful (Bulunuz, 2013) environment that enables inquiry-based learning (Samarapungavan, Patric & Mantzicopoulos, 2011). Especially, mastering basic level science process skills, has been proven to benefit the child from the point of view of learning results and motivation, later after starting school (Greenfield et al., 2009; Sackes, 2013).

Science process skills

Science process skills are skills that are essential in different parts of research such as observation, reasoning, asking questions, controlling variables and drawing conclusions. In science education of children under school age, practicing the basic level science process skills is emphasized (Kuhn et al., 2000). Observation is a skill, which all the other science process skills are based on (Howes, 2008). The observations made by children and the children's descriptions of these observations are important to the designers of teaching, so that the child's first experience about the researched subject could be linked both to the child's earlier world of experience and to the future educational experience (Howes, 2008). When we have an idea of how small children describe their observations, it is possible to develop the assignments used in science education, the extensions of exercises, pedagogical solutions of the learning environment and the functions of teachers and instructors. In literature, slightly different meanings for basic skills in research have been presented. In all of these, the basic principle is, however, the ability to pay attention systematically, to interpret own observations, to communicate these observations to others, to make observations more accurate with the help of gauges and to make predictions of future events based on previously acquired information. This can be presented also in the form of questions. Rezba, Sprague, McDonnaugh, & Matkins, (2007) divide science process skills into basic skills (observation, reasoning, measuring, communication, classification and prediction) and into integrated skills (controlling variables, coming up with a hypothesis, forming models, interpreting data and conducting experiments). Integrated science process skills require the mastering of basic level skills.

Inquiry-based learning of chemistry and science

The approaches of learning support the children's learning of science, where the learner has to actively pose questions, plan research, collect data, draw conclusions and communicate received results to others (Minner, 2010), and support the learning of science process skills (Bunterm *et al.*, 2014). Inquiry-based learning is a recommended approach in teaching science for all ages and especially in small children's science education (Samarapungavan, Patrick, & Mantzicopoulos, 2011; Peterson, 2008).

In early science education, generally guided inquiry is being used (Samarapungavan *et al.*, 2011; Magnusson & Palincsar, 1995; Brown & Campione, 1994;). Here the teacher or an instructor gives continuous support to the child in different parts of researching. Researching is divided into three phases: the phase prior research, researching and the phase taking place after researching (Samarapungavan *et al.*, 2011). The phase taking part before researching is usually such that concerns the entire group, where research is introduced by connecting it to the child's life, by motivating a child towards researching and by offering the setting for doing the research. The researching phase occurs normally in smaller groups, where children, with the help of an adult, determine questions and discuss what kinds of observations can be made from the subject of research. In the researching phase, children make observations and interpretations, they document different stages and results and they draw conclusions. In the phase, which takes place after the research, children present their results to each other and together they reflect on these results (Samarapungavan *et al.*, 2011).

A playful approach

Several prior researches recommend small children's science education to be carried out through play (Inan & Inan, 2015; Bulunuz, 2013). Through play it is possible to bring along easily inquiry-based learning into science as well as children's active participation and taking children's positive feelings into consideration (Inan & Inan, 2015). Bulunuz (2013) shows in his research on children's playful learning science that children do not necessarily reach an understanding of the concepts of natural sciences, but children, who studied through play, fared distinctly better than the control group. In addition that children got some kind of an idea of scientific concepts through action, before anything they learned science process skills (Bulunuz, 2013).

Supporting the practicing of children's science process skills

In the doctoral dissertation (Vartiainen, 2016), a science education model has been developed for small children's inquiry-based learning of science as well as for practicing science process skills. In the model, the things that have an effect on the children's practicing of science process skills, such as the areas of a child's observation and connecting the subject of the research into the child's previous and future worlds of experience, have been taken into consideration. In this model, playfulness can be seen especially through the action of a teacher or an instructor. The research proved that we should also pay attention to supporting the instructor both on the cognitive and affective levels so that the child's early science education can be carried out perseveringly.

This science education model, developed for the practicing of science process skills, is used currently in for example the "Pikku-Jipot" (Little Jipot) science clubs in the University of Helsinki. In the LUMA

Centre Finland's YouTube channel, you can get acquainted with activities, which are used for practicing small children's science process skills:

<https://www.youtube.com/playlist?list=PL6PZxHwJcfbNycKUKd3Nnr8CDDmD3yoeX>

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