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Gender Knowledge as an Important but Neglected Aspect of Pedagogy of Science

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Introduction

Sweden is one of the most equal countries in the world according to Global gender gap index 2012 and gender equality issues has been a constant element in national policy documents since the 1970s (Edström 2009). Swedish law promotes gender equality 'from above', in what has been described as state feminism (Weiner & Berge 2001), for example, it requires that the school curriculum and practices explicitly address gender stereotypes. Gender equality regarding education is for example manifested in the Swedish national Curriculum for the Preschool (Ministry of Education, 1998 revised 2010) which states that "The preschool should counteract traditional gender patterns and gender roles. Girls and boys in the preschool should have the same opportunities to develop and explore their abilities and interests without having limitations imposed by stereotyped gender roles". Despite this only one of the 17 programs in upper-secondary school has a nonsignificant gender bias in its student enrollment. Technical programs are almost exclusively chosen by boys, while girls chose nursing and child caring (Statistics Sweden, 2012). Thus, students' academic interests are highly gendered.

Considering the gender bias an important issue for teacher education is to address gender perspectives. One explanation to the gender bias is that children are raised with different expectations depending upon their gender, and that subjects are viewed with gendered characteristics. These characteristics are strongly internalized that we think that our subject interests solely are our own choices and not an effect of our sensitivity to what is expected from us. Johansson (2011) argues that our basic assumptions about a person, often unconsciously, will affect our attitude towards the person. Our treatment of a child is, thus, affected by our assumptions about the child's personality, based on our previous experiences and perceptions, but also societal norms regarding e.g. class, ethnicity, age and gender. Because these assumptions often are unconscious teachers reconstruct them at the same time as they may claim lip-service to the wording in pre-school curriculum (about counteracting stereotypical gender patterns). Teachers' beliefs about a subject and a child's 'ability' to develop skills in the subject area have been shown to affect whether the child's learning is stimulated or inhibited (Andersson 2010). Research has also found that teachers' beliefs and expectations on students, influence their performance at a topic specific level for example in science (Andersson & Gullberg, 2012; Huang & Fraser, 2009). Although teachers claim that they have the same expectations on girls' and boys' achievement in science, their teaching practice indicates different expectations (Kahle, Anderson & Damjanovic, 1991). Moreover, teachers also hold assumptions about the subjects they teach. The symbolic value attributed to different science subjects give rise to different status thus contributing to a hierarchical order and gender is an integral part of this power hierarchy. The more a subject is associated with rationality, logic, objectivity, 'pure thinking' and mathematics, the higher its status and the more it is perceived as masculine. Previous studies have shown that teachers with negative experiences of science and technology avoid teaching these topics in preschool (Appleton, 2005). Girls' performance in mathematics decline when they are taught by female teachers with low mathematics self-confidence, while the boys' performances were not affected (Beilock et al. 2010). Teacher's conscious or unconscious beliefs influence their pedagogical content knowledge. Although the teachers' views on science

subjects and pupils' ability to develop such knowledge are clearly gender related, the gender aspect is very rarely taken into account in teaching content (Hussenius et al. 2013). Teacher education usually addresses gender as a general pedagogical knowledge competence and not in relation to subject matter teaching and learning. In a research and intervention project we investigated how an increased awareness of gender issues in science and in science teaching among pre-school student teachers influenced their identities as teachers, and their views of teaching science. This paper will present different interpretations represented among the pre-service teachers, concerning situations where they considered gender to be important. In order to make science available for all students, we use these examples to highlight the necessity of integrating gender perspectives in science teaching.

Design and procedure

We followed a cohort of 120 students from two universities in Sweden through their first year of science courses. As an integral part of these science courses our intervention introduced critical perspectives on gender and science as related to the culture of science and a feminist critique of the sciences using Hirdman's (1990) and Harding's (1986) theories of gender order in society as theoretical frameworks. The empirical material collected consists of preservice teachers' written tasks, audio recorded group discussions and interviews. One of the assignments were an essay assignment in which preservice teachers described and reflected upon episodes in their pre-school placements where they judged gender to be important and impacted the children's science and technology learning. The situations involved interactions between children-children, children-adult, adult-adult and/or children-material. The analysis of 45 students' written assignments forms the basis for this paper. The analysis was carried through in several steps using NVivo to organize the developing different themes and identification of critical incidents (Braun & Clark, 2006).

Findings and analysis

From the analysis of the essays two main themes regarding the view of children were identified: (1) children have a stable core identity and should be supported to 'be who they are', or (2) children are a "jack-of-all-trades" with potential interests in a variety of subject matter topics and that these interests could be supported by teachers. Within the first theme it is concluded that teachers should support children's "gendered" identities without interference. Several of the preservice teachers that participate in our study were strongly influenced by this child perspective and it is shown in the observation task. One preservice teacher writes:

The preschool teachers speak in the same way to girls and boys. They think the children's personalities and how they act guide their play, not their sexes. Once one preschool teacher said *Gender is to let the children be the ones they are without interference from us, the grown-ups*. We should not force boys to play with dolls and girls to play with cars. However, what we can do is to help and support the children to *dare to be who they are* (the student italicizing) regardless what they like to do.

When preservice teachers refer to the importance of *letting children be as they are*, it becomes a rhetoric to justify avoid shaping and guiding children's activities. The reasoning presupposes that e.g. girls play with specific toys depending on an intrinsic own wish, free from external influences, demands and expectations. Some students use the curriculum for preschool to confirm the importance to scaffold the children's individual traits:

"The preschool should strive to ensure that each child develop their identity and feel secure in themselves" (Lpfö 1998 revised 2010, p 9). The statement in the curriculum that children shall

develop their *own identity* could be said to assume an essentialistic view of children; that there exists a genuine quintessence/core in each child and which it is up to the preschool teacher to catch sight of. This stance may lead to typification of boys/girls and marginalization of children that not fit in to the norms. There is a risk that this very individualized view will reestablish and confirm gender stereotypes and not provide children the opportunity to explore new areas of interest.

When children are conceptualized as “jack-of-all-trades” it is considered that teachers have an important role in facilitating and presenting new topics for the children. In other words, it becomes the teacher’s responsibility to encourage children to broaden their interests. Some preservice teachers claim that it is particularly important to challenge children to engage in activities they not are used to because of traditional gender stereotypes:

This made me think about how important it is to stimulate and support children to engage in a variety of activities, especially those they aren’t used to. I was struck by this and had a lot of thoughts about how we often in preschool predispose material and place to the stereotypical view of girls and boys.

Preservice teachers in the “jack-of-all-trades”-theme showed different types of gender awareness: detected gender stereotyping perceptions within their preschool placement, challenged stereotyping behavior and/or reflected on their own stereotyping behavior and thoughts. For example one preservice teacher wrote about a situation where the pre-school teachers guide the children’s activity into a gender-stereotype pattern concerning science:

The teachers planned to start a ‘friend group’ in order to find a way towards better cooperation between three boys. The boys often played together, but all of them wanted to be in charge and had a difficult time agreeing upon things. The teachers’ idea was that the boys should work with dinosaurs together, since they had that interest in common. The teachers started to discuss different possible ways of putting the ‘friends group’ together, and all different suggestions consisted of purely boys. I raised the question why girls couldn’t be included. The teachers were completely taken aback and confessed that they hadn’t even considered that. At the same time they argued that all the suggested boys were very interested in dinosaurs and they wanted to bring these boys together with the other boys. The ‘friends group’ ended up consisting of five boys.

Moreover, the preservice teacher reflected on this situation:

It’s frightening that the teachers didn’t even consider that girls could be part of the group. Surely, we should have the children’s own interests as our point of departure in what we are doing, but there were several girls in the group who also were interested in construction and played with dinosaurs. My experience was that the teachers saw it as important that the boys found a way to collaborate and formed a group of friends. To encourage the children to play in other constellations wasn’t anything that the teachers seemed to reflect upon. That the project was about science possibly also contributed to the choice of children, where they assume that boys are more interested.

This preservice teacher reflected upon the teachers’ actions and made the interpretation that since the project was about science there’s an underlying assumption that boys have a greater interest

than girls. S/he observed the pre-school teachers and asked critical questions that made them aware of different ways of thinking. Pedagogical content knowledge includes, among other things that the teacher has a pedagogical repertoire that allows one to act in a wide variety of ways depending on context and situation (Shulman, 1986). This particular situation demonstrates that by identifying separation of the sexes and act in a critical way the opportunity to access science activities are opened up for girls.

Preservice teachers, who connected the situations only to the individual level, did not problematize the situations and offered no critique of the larger structural cultural issues impacting science, gender and education.

Discussion

Sweden is considered as one of the most equal countries in the world and both Swedish law and curriculum stipulate equity and that stereotypic gender patterns should be counteracted. In spite of that, girls 'and boys' subject interests do not develop regardless of gender, which can be clearly seen in their educational and career choices. One reason may be teachers' lack of knowledge of gender linked to pedagogy of science and as a consequence differential treatment of girls and boys is neither observed nor addressed.

In this study, two different views have been distinguished according to preservice teachers' reasoning about the relevance of gender in scientific activities. The first view characterized by an underlying idea that children "should be as they are" is particularly problematic when it comes to science and technology. These subjects are perceived as masculine highly and therefore girls may find it difficult to harmonize science interest with their gender identity formation. On the other hand if preschool teachers holds the second view, 'jack-of-all-trade', they provide children with a variety of opportunities to develop different interests independent of sex. In the examples given above preservice teachers show how they detect gender stereotypes, how they combat these in practice and reflect upon their own prejudices. By visualizing gender stereotypes in science teaching contexts strategies can be developed for including all children. Gender knowledge also implies an ability to detect structural patterns and limits the risk of dismissing gender stereotypes as 'individual choices'. Thereby, it becomes an important teacher competence to be able to move the attention in and out from structural, symbolic and individual levels, to see and make use of general patterns for understanding course of events in practice. We argue that for gender/feminist knowledge to be incorporated, preservice teachers need being provided such training.

An implication of this study is the importance of including gender knowledge in science education at a topic specific level, in order to make the natural sciences and technology available for both girls and boys.

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