Is Action Research a Feasible Way to Study Natural Science, Gender and Power in the Scientific Classroom?

Kristina Andersson and Anita Hussénius
Department of Mathematics, Natural and Computer Sciences
University of Gävle
kns@hig.se, ahh@hig.se

Abstract
Science is considered as objective and true and gender structures are seldom questioned. In society natural sciences and technology, historically as well as nowadays, hold a position of power and status. Feminist researchers claim that these subjects are strongly associated with the concept of masculinity. In an ongoing investigation we want to enlighten the questions how/if gender awareness may change the view of teaching natural sciences and if such a change, in a long term perspective, eventually will result in these disciplines becoming more important and interesting for both girls and boys. The intention of the research project is to initiate and follow a work of progress among teachers in the comprehensive school and therefore action research is a possible method of choice. In this paper we want to discuss the usefulness of the action research method in connection with the purpose/aim of the study. We also want to raise some questions concerning difficulties that are associated with this method.

Introduction
It is a fact that few women choose science careers and a lot of research has tried to understand and explain why women are not entering sciences. Feminist researchers claim that one reason for this is that mathematics, technology and science are intimately linked with the concept of masculinity. It is difficult for girls/women to identify with these subjects and to internalise them in the process of becoming a woman. Some domains are more or less possible for women (Staberg 2002). In Sweden there are quite a number of female biologists and chemists especially at the lower levels, but fewer physicists, mathematicians, mechanical engineers which still are occupations associated with masculinity. Within the medical profession there are more and more women except in high status specialities as surgery.

In the curriculum of Sweden's comprehensive school an aim of equality is clearly expressed (Lpo-94). It says that the school shall offer the opportunity for children to develop all their abilities and interests independently of sex. The school shall actively and deliberately support equal rights and possibilities for both women and men. However, a lot of studies show that the school reproduce the prevailing gender system instead of counteract it (Hultman 1990). Girls and boys are treated differently in the classroom situations where for example boys get more time for speech and the girls get the message that their opinions are not as important as the boys.

What is specific for science education, and what happens in the scientific classrooms that generates observed gender differences in interest for these disciplines? Else-Marie Staberg (1992) follows 32 pupils from seventh to ninth grade in her thesis work. She shows that girls and boys interest in chemistry are the same in seventh grade, but in eighth and ninth grade the girls’ enthusiasm for the subject has essentially declined. The laboratory experiments engage all pupils in seventh grade but in ninth grade more girls seem to be bored. According to Staberg the reason for this is that the teaching focuses on the boys’ fields of interest. The functions of engines and technical details have a prominent position according to the tradition of natural sciences. Staberg also shows in her thesis that girls have a stronger need to
understand than boys and when they not get a trustworthy explanation on phenomena they loose their interest.

In her thesis "Lust att lära naturvetenskap och teknik? En longitudinell studie om vägen till gymnasiet", Britt Lindahl (2003) finds almost the same results as Staberg. Lindahl has, among other things, interviewed pupils about their views about teaching and different subjects in school and also about their thoughts of upper secondary school. She finds that high achieving girls talented in science, drop sciences programmes in favour of social sciences programmes. The girls’ argumentation for this is that teaching in science is boring and uninspired, with too much "learn by heart" and the science lessons give few opportunities for discussions where the pupils points of views are taken seriously. Here the pupils experience a difference compared to the lessons in social sciences. They also express that the teachers in social sciences are more enthusiastic about their subjects than the teachers in natural sciences. Furthermore girls don't have confidence in their ability in natural sciences, they think they don't understand these subjects. Despite their high marks, these girls don't think they will be able to manage to study at the science programme in upper secondary school. Lindahl means that especially in physics and chemistry teaching there is a grave and hidden message that these subjects are complicated and hard to understand and they are addressed to a few selected members. The pupil's confidence in their own ability is essential for keeping the pleasure and interest for these subjects alive.

Jay L. Lemke (1990) has studied and analysed the language of science and how talking science takes place in the classroom. The language of science has its own unique semantic patterns and its own specific ways of making meaning and as a student you have to learn these patterns and this language to be able to understand and talk science. In most cases this happens in the dialogue in the classroom. Lemke states that it is important to study power relations in the science classroom and he means that it is an imbalance in power on different levels. The teacher has more often the power of the dialogue; what will be talked about, who has the right to talk, does the teacher makes the same effort in listening and trying to understand argumentations from students that are not male, white, middle-class or of a higher-status ethnic group, etcetera? There is also an unequal power between what is talked about in a commonsense way or in a scientific way. Science education convinces the students that people that talk science are the experts and they are smarter than common people. Lemke is critical about that science education also sends the message that science is value-free or value-neutral and stands outside the system of social values. Within feminist pedagogy an attempt to look differently at the concept of power has been made. Gaell M. Hildebrand (2001) chooses Carolyn Shrewsbury's definition of power as "energy, capacity and potential" (1987) rather than as domination. With that view it will be an important task to increase the power of all actors, not to limit the power of some.

According to Else-Marie Staberg (2002) the most fruitful way of looking at gender and science is to make existing structures and hierarchies of power visible and to examine how meanings of gender are produced and reproduced. She also points out that there are few studies within science education that have tried to develop and change the teaching and the content of teaching regarding to new gender or feminist research. Feminist researchers as Nancy Brickhouse (2001) and Jane Gilbert (2001) mean that it is important to deconstruct and unmask the masculinity within the sciences and also critical examine the context in which scientific knowledge is constructed and argued. The feminist researchers also want to work against the dichotomy characterizing the Western thinking (female-male, object-subject, emotion-reason, and so on). Gilbert (2001) suggests a new approach to science education where the aim of teaching should be to educate pupils about science, instead of training them
to be scientists. One of her proposals is to treat science as a series of texts/stories where the pupils develop a relationship to science which is similar to the one that a literacy critic have to literature, one which is rather different from being a writer (a lot of people can appreciate reading literature but there are only a few how can become writers). Gilbert has also developed teaching materials in genetics and ethology based on this approach and used them in conventional teaching situations (Gilbert 1996, 1997).

Brickhouse (2001) is surprised by the fact that feminists in science education, to such a little extent, have written about learning processes. Some researchers rely upon a constructivist view of learning, but Brickhouse points out that constructivism alone do not raise the gender issues. She asserts that it isn't enough to study the pupil's understanding of concepts to understand how pupils are learning science. We also need to know how pupils engage in science and how this is related to whom they are and who they want to be. Thus a girl who sees herself as someone who needs credible explanations for how the world functions and aspires to understand this scientifically, may engage in science differently than a girl who wants to be a high achieving student but does not aspire to know more about science than is required of her. Just as important to understand what creates engagement is to understand underlying factors why pupils are unengaged and rejecting towards science. Brickhouse sees new possibilities for the feminist science education by incorporation of perspectives from situated cognition. Hildebrand (2001) however stresses problems with both constructivism and situated cognition. For example the conceptual change model that grown out from constructivist perspective is unfavourable for women. Women have already emotions of self-doubt and this conceptual change model merely increase themselves as inadequate knowers. One problem with situated cognition is its "situatedness", which leads to passivity and an acceptance that "science-as-is". The student is simply incorporated into the current knowledge regime of the scientific community. Hildebrand brings about a new approach for learning which she calls "critical activism". She wants the students to actively think critically about for example "the social world of scientists as it construct their practice; of the impact that science has on society; and of the power dimensions involved in the scientific community and the ways these are used politically, economically and socially to support particular authoritative positions and to oppress other perspectives in society" (Hildebrand 2001, p.11).

In our study we will focus on questions like
- how power relations find expression in the scientific classroom
- how gender awareness can be defined, described and measured
- how or if an increased gender awareness among the teachers may change their view of teaching science and even change their choice of subject content.
In this paper we want to discuss whether action research can be a useful method for studying these aims.

Two examples from a classroom observation
Before getting into the discussion whether action research is a feasible way to study natural science, gender and power in the scientific classroom, we want to bring to the fore how power between pupils can be expressed in an ordinary lesson. In a pilot study we are working together with two female teachers teaching pupils aged 10-12 in grades 4-6. Following event happened when we visited the sixth grade during a laboratory lesson about electricity. In this class there were eleven girls and seven boys. They could choose between making a torch, a burglar alarm or an electronic game. The pupils could also choose whether they wanted to try on their own or whether they wanted to have an instruction to read. In this particular scene, three girls have managed to make a burglar alarm. When the current circuit is closed, a buzzer starts to peep. The girls are overwhelmed that they have succeeded and they make the alarm
peep over and over again. Now they want to try it in a "real situation". They want to put the alarm under a rug in front of the classroom door and one of them who are playing the burglar is supposed to come through the door and tread on the rug. The girls find a rug and when they are placing the alarm under the rug, which takes some effort, a boy is coming and he says "I want to be the burglar". He steps outside the door and after a few seconds he comes in, treads on the rug and the alarm goes on. The circuit gets disconnected and the girls have to fix it again. The boy leaves the group and now one of the girls wants to be the burglar. They repeat this procedure several times but every time they tread on the rug they have some work to put the wires in place.

Another girl has chosen to make a torch by herself. She has been working tenaciously and concentrated, but yet she hasn't completed her task. A boy, who has finished his work, comes and sits down in front of her, starts talking and fiddles with her not yet finished torch. Suddenly he has taken it into pieces, but the girl and the boy go on talking without even comment on it. (Observation, February 2006)

These two events which appear within the same lesson express how gender power relations are constructed or re-constructed in the classroom. Berge (2000) means that power is not a state, instead it emerges in interaction between individuals. Interesting questions from Berge’s and Hildebrand’s points of views are what position the pupils are taken and what positions are accepted by the actors and the teacher in these events? Is it possible or even desirable to change these positions? In the first event the girls are happy about having succeeded with their task and they are very excited about trying the alarm in a real situation. And then suddenly a boy takes the leading part and without asking he wants to be the first person to tread on the alarm. The girls allow him to do that without any objection. The same scenario is happening in event two when that boy can damage the girl's torch without her objection. She doesn't even tell him that he can't. The boys take for granted that they have the girls’ permission to take command over their activities and even to disrupt or damage what they are doing. Are the girls on the other hand used to be treated like this and therefore don't even make a complaint or an objection when the boys are taken over the situations? If teachers pay attention to events of this kind, this imbalance concerning power relation in the classroom could perhaps be changed. One way of action is that the teacher makes this relation explicit and expresses it in words for the children. The girls can be requested to put their foot down in similar situations and to say "NO" to the boys. The boys need to experience similar situations from the girls’ position and acquaint themselves with the emotions that may arise if they are treated in the way the girls are treated in the examples given above. In this study one of our aims is to follow, describe and analyse these kinds of processes and actions in school environment.

**Action Research**

Action research differs from traditional science in some fundamental ways. The first point is that action research wants to bring about changes in school practices. The second point is that the research is carried out together with, not on the practitioners. The researcher is participating in the working process. A third point is that the aim of the research is to study the processes of change (Berge 2000). There is a variety of traditions within action research. One of them, "participatory research" which is associated with the work of Paulo Freire, has a more emancipatory emphasis in the sense that it is concerned with questions about equity, self-reliance and oppression (Herr and Anderson 2005).

John Baird (1998) asserts that teachers have to get the opportunity for focused reflection and dialog with colleagues and one way of offering that is action research. Louis Cohen and
Lawrence Manion (1997) describe action research like a collaboration project tied to a specific situation, where researchers together with the teachers ‘on the floor’ define a specific problem in the context they are working in and try to find solutions for that problem. However, in action research there is concern about the researchers’ position in relation to the practitioners and the perspective of being an insider or outsider agent (Herr and Anderson 2005). Within the action research field there is an ongoing debate whether the initiative of the research should be taken by the practitioners or the researcher. Rosalind Driver and Philip Scott (1998) have used action research for modelling successful teaching within three different concept areas: plant nutrition, particle theory of matter and energy. The teachers volunteered to the project, where the researchers and the teachers worked side by side so that the theoretical perspectives should influence the design and the development of new teaching strategies. In this case, it was the researchers who initiated the project, defined the aims and limits for the project, while the teachers were involved in developing the teaching material and tested it in their own classrooms. Driver and Scott mean that the action research method gave the teachers an opportunity to examine their practice by a reflective theoretical attempt.

Action research leads to changes in the school practice, but Cohen and Manion also point out (by a reference to Stenhouse 1979) that action research also can generate theories about education and teaching.

**Action research design in a pilot study**

In a pilot study started in spring term 2005, we have been working with different groups of teachers in comprehensive school. The participating teachers analyse their teaching, discuss their experiences and develop new teaching concepts in order to improve the learning environment in a more gender reflective way. To provoke such a process the teachers, together with the researchers, meet at seminars. To these occasions the participants prepare themselves by reading literature concerning gender theory and research in science education. The literature is chosen by the researchers. To be able to see and understand their own action and progress the teachers make notes in their personal diary, record their observations on a Dictaphone and video tape teaching situations. This material composes a basis for discussions and reflections during the seminars. It may also generate new thoughts and ideas about teaching science with a gender perspective and new ways of looking at and select the subject content. Such ideas are tested in real teaching situations and the experiences evolved are again discussed in the seminar group. An arising working process of this kind could be described as an ongoing action research spiral (Vals A Koshy, 2005 by a reference to Kemmis and McTaggart, 2000). Some observations of class room situations and interviews with the teachers in one of the seminar groups have also been done so far.

**Questions we want to address during the discussions at the conference in Kristianstad**

- A main difficulty that needs to be addressed is the relation between the researchers and the practitioners. As researchers we have an idea of what we want to accomplish, we initiate the work and we invite teachers to participate optionally. But the teachers’ motive for participating might be different from ours. We think that this can create an imbalance between us and the practitioners in the sense of actions, expectations and motives for participation. In our pilot project we have already noticed that the teachers are expecting that the work will be guided by us. They also want us to have suggestions on planning the lessons and more or less want to shift the responsibility for the science content to us - we are the experts. Moreover, it is hard to articulate and explain for the teachers what this project is about and what we want to achieve, probably because we ourselves have problems with describing the process and its direction. It is important to make the
different roles visible and clear since it will have impact on the progress of the project. Perhaps an agreement or contract between the participants has to be formulated?

- Is it possible to get the participants involved in designing the project? If so, how can it be achieved? And is it desirable?
- Who owns the data collected?
- Is the size of the group, e.g. the number of the participants, of importance to get a creative dynamic milieu? How many teachers are needed for the discussions to be fruitful and generate new ideas?
- If one wants to describe and analyse a process, what indicators are to be looked for/at?

References


