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Gender as a foreground and a background in mathematics education research

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Abstract. *Complexity is a characteristic of the problem field in mathematics education. Thus, in any educational study, the researcher has to choose between different factors and dimensions. Gender is one of the perspectives to decide upon: either gender is a dimension in the foreground or a variable in the background. A framework is presented for analyzing gender in mathematics education from four points of view: structural, symbolic, personal and interactional gender, and Danish and Norwegian researchers'/ teachers' work within the field of gender and mathematics is presented with reference to these viewpoints. The main thread through the lecture is the researchers' willingness and intentions of investigating the gender perspectives in mathematics education. However, in 2007, these intentions of research have not been realized in Denmark and Norway. The lecture concludes with a brief discussion of the following question: Under what circumstances is it possible to design a scientific study in mathematics education with gender as a foreground dimension based on data from a study where gender is in the background?*

Complexity is a characteristic of the problem field in mathematics education. None of the problems in or related to teaching and learning mathematics can properly be isolated from the others. In any educational study, the researcher has to focus one of the problems without disregarding the others. Diversity in mathematics education (gender, ethnicity, social class etc.) leads to one kind of complexity which calls for multi- and inter-disciplinary studies and for different research methodologies. However, the focus and the methodology of any study are determined by its purpose, theory and research questions. For example Evans and Tsatsaroni (2008) have argued that research into gender within a social justice agenda requires both quantitative and qualitative methods. In the next step, when the research problem is formulated and the method and the sampling strategy are to be decided, the researcher has to choose among a series of factors and dimensions to reduce complexity. Gender is one of the perspectives to decide upon. In this paper, I present the notions of gender as research dimension in the foreground and in the background and an analytical framework for studying gender, with examples from mathematics education. Based on an overview and analysis

of recent research in Denmark and Norway (Wedege, 2007), my purpose is to start a discussion about the possibilities for designing a scientific study with gender in the foreground based on data from as study where gender was in the background.

Gender in the foreground or in the background

In some studies, gender is a dimension in the *foreground*: the study is designed to investigate gender and mathematics – meaning that gender is focussed in the research question. In other studies, gender is a variable in the *background*: gender is just an independent variable among others. *No gender* in the study means that information about gender is not available in the data. In a quantitative study, gender is not a variable in the survey. In a qualitative study, the data are anonymized in a way that does not allow you to see whether this is a male or a female (Teacher A, Teacher B, or student 1, student 2).

In the majority of the studies in mathematics education, we find gender in the background or no gender. Hence, internationally, we have a large amount of data which has not been investigated from at gender perspective. In a recent overview of mathematics education research in Denmark and Norway, it showed up that very few studies were designed with gender in the foreground (Wedege, 2007). In none of the 14 volumes of the journal "Nordic Studies in Mathematics Education" (1993-2008), may you find a Danish or Norwegian article with focus on gender. However, among the researchers in the field, I have detected intentions to have gender as a main focus. This happened for example at a series of conferences and seminars held in the two countries with focus on gender. Moreover, Danish and Norwegian teachers/researchers have also participated in the Swedish "Women and Mathematics" conferences since 1990 (Kvinnor och Matematik).

Four analytical viewpoints on gender

In my analysis of gender in mathematics education in Denmark and Norway and later on in a pilot study on adults' motivation for studying mathematics (Wedege, 2007 & 2008), I have used four analytical points of view developed by Bjerrum Nielsen (2003): structural, symbolic, personal, and interactional gender. For a first illustration of these viewpoints, I have translated an episode with a pink eraser in the mathematics classroom from a similar episode with a pink soapbox observed in the European project on "gender in Scouting" (Bjerrum Nielsen, 2003 p. 10):

> The mathematics teacher asks Niels to rub out a diagram in his exercise book. Niels inquires if any one has an eraser. Anne fetches her eraser, gives it to him, and he teases her because it is pink.

Anne was teased in the mathematics classroom because of her pink eraser. Would this have happened if the eraser was blue or yellow? Gender exists in the world and in people's head as mental models, and what we perceive as gender is always a product of an ongoing interaction between "gender in the head" and "gender in the world". The episode with the pink eraser illustrates how girls are doing services to boys in the mathematics classroom (structural gender); that femininity is not highly valued in this context (symbolic gender); that Anne seams eager to serve the boys, while Niels seams eager to push femininity away (personal gender); and finally how Niels positions Anne, and she gets feedback on limits of "doing femininity" in the mathematics class room (interactional gender).

In the following presentation of the four points of view, I use examples from Kirsten Grønbæk Hansen's research in the Danish technical schools in the late 1980s (Hansen, 1991, 2000; see also Wedege, 2007), which also might illustrate the situation in mathematics classrooms in a period where many of the students in the NRDC project went to school and had their first experiences with learning – or not learning –mathematics.

First point of view: *structural gender*
Gender constitutes a social structure where for example men and women are unevenly distributed in terms of education and occupations; men earn more than women, who furthermore hold fewer leading positions in society; women do more housework in most families. In the early 1990s, there was a clear division of gender in the Danish technical schools. The higher secondary level with technical mathematics and physics (called "TX") and the vocations in metal and building industries were mainly chosen by boys while vocations like hairdresser and "sandwich maker" were primarily chosen by girls.

Second point of view: *symbolic gender*
The gendered structures gradually form the gender symbols and discourses (symbolic meaning) in people's heads. It becomes, for example, normal and natural that men take the leading positions in society while women have part-time jobs to take care of home and family. Gender also becomes a framework of interpretation. In the Danish technical schools, the world and its qualities were divided into masculine and feminine, and everybody

had integrated this dualism whether they wanted to or not. Mathematics was seen as a masculine area of competence with its logic and precision and this symbolism became generally accepted by the students. The boys at optional mathematics classrooms did not speak about mathematics being difficult; they spoke about the bad teachers and said that they did not feel like working with it, that they would rather use their body. One of the consequences of this dualism was that teachers – despite their good intentions – might have used different standards for boys and girls. Structural and symbolic gender are connected almost by definition:

> … symbolic gender will have consequences for the further development of structural gender, and vice versa (Bjerrum Nielsen, 2003, p. 18).

Structural and symbolic gender tells us what is normal and what is deviant for men and women, girls and boys whether we personally consent to these norms or not.

Third point of view: *personal gender*
Gender is seen as a personal matter and a reality for everybody. People are not passive bricks in social and cultural structures. They shape their lives within these structures, discourses and norms, and gender in the world is more diverse than the often dichotomous and stereotyping gender in our heads.

> Personal gender concerns the way we fit into (or do not fit well into), identify with or protest against available cultural models of gender (Bjerrum Nielsen, 2003, p. 22).

Most of the students in Danish technical schools came from homes unfamiliar with education. The girls in the TX-classes were in a process of upward social mobility and they used the masculine field to help achieve this goal. By doing mathematics they could distinguish themselves from the other girls. The boys were vulnerable in their social climbing where they had to leave their old background for gendered identity (muscle power and technical ingenuity). Their gendered subjectivity was threatened because the masculine-feminine hierarchy made it difficult for the boys to move into the fields of the girls if they should wish to do so.

Fourth point of view: *interactional gender*
Gender is seen as something created and reproduced through social interaction (negotiation). When people interact they continuously negotiate who they are and who others are. This point of view emphasises

gender as something we "do" whereas the personal point of view emphasises gender as something we "are". Individuals position themselves and others as gendered, and they get feedback on these positions. In TX-classrooms, the girls did not have the same legitimate access to high status in the mathematics classroom as the boys. Although a girl was the best in mathematics in one of the classes, she was not accorded this status. Also the teachers found it difficult to recognize the girls' competences. Good performance of a girl was often followed by a doubtful shake of the head: she was "certainly very hard-working" (see also Walkerdine, 1989).

Intentions in Danish and Norwegian research within the field of gender and mathematics

Among the Nordic countries, Sweden is the "big sister" within the field of gender and mathematics. The first national conference, within the framework of The International Organization of Women and Mathematics Education (IOWME), was organised by Barbro Grevholm in Malmö, in 1990. The title of this conference as well as the following five conferences held in Sweden was "Kvinnor och matematik" (Women and mathematics) (Grevholm, 1992). The first and only Danish conference "Kvinder og matematik" under the auspices of IOWME was held in Copenhagen, 1991, with 80 participants (Tingsleff, 1991). In Norway, 1992, the first conference on women and mathematics was held in Kristiansand in cooperation with the Norwegian Mathematics Council and with 100 participants: "Sånn, ja! Kvinder i matematiske fag" (Sekretariat for kvinneforskning, 1993). The second conference was organised in Trondheim, 1999, "Handling bak ordene: jenter og matematik" (Hag, Holden & Marion, 2000). The last Norwegian conference "Women in science (including mathematics)" was held in Bergen, 2003 (Skarsbø, 2004).

Only a few papers presented by Danes or Norwegians from the field of mathematics education at these conferences were based on research designed with a gender perspective. However, as mentioned above, a series of Nordic researchers have the intention of bringing gender into the foreground and, through the latest 15 years, they have presented papers with a focus on gender. These presentations were based on data from their own previous research (quantitative or qualitative studies) with gender in the background. That is the researchers returned to their "own" data with questions related to their original problem.

In the following, I give three examples from these presentation: the first with a main focus on structural gender, the second on symbolic gender, and the third on personal gender.

At the fourth Swedish conference "Women and Mathematics" in Uppsala 1999, I was invited to give a lecture based on my doctoral study on adults and mathematics in the workplace. Although it would have been obvious, I had not taken an explicit gender perspective in this study. One of the reasons was that the new area of research was not cultivated and that the problem field was highly complex. Based on a mathematics life history interview with a 75 year old woman, I gave the lecture "Mathematics in a woman's school and everyday life" at the conference. In this study, I combined the theoretical frameworks of Lave (situated learning) and of Bourdieu (Habitus). Pieces of a puzzle with structural, symbolic, personal and interactional gender were ready to fall into place in the analysis providing an explanation for this mystery: the woman never realised her mathematical competence although she had the highest grade in mathematics in the technical school as a 50 years old, and she was highly competent in daily life situations with challenging mathematics (Wedege, 2001).

At a Nordic seminar "Gender, mathematics and technology", in Trondheim, 2005, Anne Berit Fuglestad gave the lecture "ICT tools in mathematics: boys' and girls' choice and attitudes" (Fuglestad, 2006). The findings were based on two studies (from 1995 and 2004) and they were produced for the special occasion of this seminar. The original research questions in Fuglestad's mainly quantitative investigations did not involve any gender issues, but gender being a background variable in the study made it possible for her to answer the question "Is there any difference between boys' and girls' attitudes towards and thoughts about using computers in mathematics education?" During the session, Fuglestad distributed a couple of pages with students' responses to the questions "why did you like this problem?" - "what tool did you use and why?" – "what did you learn?". The participants were invited to decide if the different answers were from boys or girls. In the debate, we were quite sure that for example the following reply came from a boy: "I liked this problem because it was solved really fast on the computer" (page 1), and that this came from a girl: "Computation of interest is fun and very useful. Our teacher has attached much importance to computation of interest and, hence, the problem is very easy to solve" (page 2). However, Fuglestad revealed that she had organised the students' replies with the

girls on page 1 and the boys on page 2. During this exercise symbolic gender was illustrated through the participants' stereotyping of boys and girls, an issue which was precisely questioned at the seminar.

In the Norwegian project KIM (Quality in mathematics education), differences between boys' and girls' attitudes towards mathematics were investigated in a survey with gender in the background, which opened up for a focus on symbolic and personal gender. At the gender and mathematics conference in Trondheim, Brekke and Streitlien (2000) stated that

> It is complicated to measure the affective dimension of a school subject. (…) Hence, we wish to make a follow up to this investigation using qualitative methods as for example classroom studies and interviews with selected groups of informants (p. 47).

Like in more of the other papers presented at the Women and mathematics conferences they express an intention of doing research with gender in the foreground. However, their plan was not carried through.

Conditions for design of a study with gender in the foreground

In the papers mentioned above, the researchers revisited their own data from at gender perspective. But what are the possibilities and the limitations in general of throwing light on gender in studies with neither focus nor interest in gender? The question that I wanted to discuss at the conference is the following:

- Under what circumstances is it possible to design a scientific study in mathematics education with gender as a foreground dimension based on data from a study where gender was in the background?

A pilot case study

My personal experience with this kind of design stems from a pilot study in on-going work on people's motivation and resistance to learn mathematics, where gender is an important analytical dimension (Wedege & Evans, 2006). So far we have not designed a new empirical study with gender in the foreground but we have access to rich empirical data from 81 semi-structured interviews with the students (2/3 female and 1/3 male) from an English research project on adult students' reasons for learning mathematics, "Making numeracy teaching meaningful to adult learners" (Swain et al., 2005). In this project, gender is in the background: none of the research questions are about gender but information about gender is

available in the data. In a pilot case study on one of these students, Monica, I have tried to bring gender perspectives into a small part of these data (Wedege, 2008). The framework for this analysis consists of four analytical gender view points (structural, symbolic, personal, and inter-actional) presented above (Bjerrum Nielsen, 2003). The analysis shows that this analytical framework might be productive in locating gender in the data collected in English project. The four gender points of view create new meanings to Monica's narrative – as separate or inter-connected viewpoints.

In our ongoing work, we understand motivation as a social phenomenon, which they also do in the English project. Their theoretical framework is based on the work of for example sociologist Pierre Bourdieu and anthropologists like Jean Lave (Swain, 2005 p. 31 ff) whom we have also used in our research. This theoretical choice has had consequences for the questions asked to the students during the interviews, which in the case of Monica for example made it possible for her to talk about her childhood. She is in her late 30s and she joined the numeracy class at the middle of the entry level 2. Now Monica is a single parent of a son almost 16 years old. She has several reasons for attending the class - and continuing. One of the reasons is to prove to herself that she is worth something and to set a good example to her son. Monica not having a high level of education has been a structural consequence of being a woman. As in many other families, girls were not educated in her family. They were brought up to fulfil traditional women's roles:

> Monica:"But I was brought up in my family that girls weren't important for education. Boys that grew up.... the old fashioned thing of men out at work and women just bred. So I suppose I got married young and did the woman thing, rather than seeking education." (M_1, l. 357-360)

The structural gender view point also explains why Monica now has joined the numeracy class. She is an un-employed single parent and as such she has to go back to work or alternatively into training according to new governmental demands (Wedege, 2008).

When we wanted to revisit the English data we had to check and discuss if their problematique is theoretically compatible with ours as mentioned above. If we want to import their results we have to check if their concepts are theoretically compatibles with ours. In their project, as an example, no conceptual distinction is made between motivation to attend and motivation to learn (to continue to study) mathematics. As it is made

visible in the above example, it is important to distinguish between the two theoretical and interrelated constructs: Why study mathematics (justification) and why learn mathematics (motivation). In our research, motivation to learn mathematics is coined with resistance to learn and it is problems related to these phenomena that we want to study in the data. Thus it is not suitable to import their results on motivations in our work.

The design process

In any educational study, like the one in the case study, the data is a result of decisions in five interrelated phases of the design process: purpose, theory, research questions, method and sampling strategy. However, this process is directed by a *paradigm* – a term which is briefly explained by Mertens (2005) as a way of looking at the world and the paradigm "is composed of certain philosophical assumptions that guide and direct thinking and action" (p. 7). Of course an answer to the question on the possibilities of designing a scientific study with gender as a foreground dimension based on data from a study with gender in the background will be relative to the study producing data and the study to be designed. As a starting point I claim that the two studies have to be undertaken within the same paradigm: positivist/postpositivist, constructivist, transformative or pragmatic. My second assumption is that the two problematiques of the studies have to be theoretically and methodologically compatible (Wedege, 2006). For example an answer will be relative to the historical, cultural and social situation where the data were construed. We have one striking example of the need for new methodology caused by the change of structural and symbolic gender in relation to mathematics. Forgazs et al. (1999) argued that several items in the "Mathematics as a Male Domain" scale from 1976 were no longer valid. They did this with reference to research showing, for example, that the stereotyping of mathematics was no longer exclusively a male domain.

Another point of view from an ethical perspective came up during the discussion at the conference, where Gerd Brandell asked if I had considered the ethical problems in re-using data from another study. These students had accepted to participate as informants in the English research project. But it was not anticipated that the data from the interviews could be used in another project with a different aim such as studying gender. I shall conclude with this important question which also shows that the discussion has not ended here.

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