FEMINIST FRAMEWORKS FOR RESEARCHING MATHEMATICS

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The discussion on gender has been broadened in the last few years, with the demand for equity now as a central goal of the debate. In this context two main theoretical approaches, which are nowadays significantly influencing the discussion on gender in mathematics education, have been developed and will be introduced. Embedded in the theoretical debate between these two theoretical approaches are methodological reflections, which emphasise that ethnographical methods are especially appropriate for researching the social construction of gender.

Is it still necessary to discuss gender and mathematics education at the beginning of the 21st century? Did the "gender gap" not disappear long ago? On the one hand differences between young people of different socio-cultural origin are greater than gender differences, while on the other hand results of international studies indicate repeatedly that the discussion about gender and mathematics education is not yet obsolete. Results of the Third International Mathematics and Science Study (TIMSS), which were published during the nineties of the 20th century, made clear the following issues (see Mullis et al., 2000):

- As known from earlier scientific sources (e.g. Leder, 1992), the tendency for girls' and boys' performances to differ by increasing amounts with advancing age, is still evident. In the TIMSS, significant gender differences in favour for the boys occur only from the beginning of adolescence and become highly significant at the higher secondary level.
- Gender differences in the affective area as known from earlier research, e.g., low confidence of girls in their own mathematical abilities, still exist.
- Gender differences concerning career aspirations as stated in many empirical studies are still current, as for instance girls' stronger rejection of mathematics-related professions than by boys.

When looking back, it can be stated that during the last ten years gender differences in the cognitive and affective area have decreased (see e.g., Fox & Soller, 2001) but have not yet vanished. Furthermore, the higher the level of qualification the lower the representation of women. In particular, women with a PhD in mathematics are world-wide still strongly underrepresented. According to Becker & Jacobs (2001, p. 2) women were awarded only 22% of Ph.D.'s in mathematics in the USA in the years 1994-95. Curdes (2002) found out in her study that a negative attitude to one's own mathematical abilities and a personal relation to mathematics which depends on help from outside, are much more responsible for the low readiness of women to do a PhD in mathematics than the problem of incompatibility of career and family, which is stated as a main reason especially among university mathematicians.

Due to developments within the last years of the 20th century radically different views on women and mathematics emerged. These views are summarized briefly in this paper.

The theoretical attempt "Doing gender" (West & Zimmerman, 1991) which predominantly developed in the field of pedagogy, criticised difference theory that focussed on gender differences virtually as an innate category. In particular, the attempts to define femininity positively were aimed to raise the worth of feminine values in order to break down the hierarchy of differences. Thus these attempts are based on the acceptance of bi-genderness which constructs the relation between the two sexes with its hierarchy.

During the last years of the 20th century, in feminist discussion, the new attempt of "Genderless-ness" has developed which regards bi-genderness of human beings as a social classification, which we reproduce constantly through social action. This means that the basic structure of the bi-genderness is socially produced within the process of "Doing Gender." The representatives of this position indicate the historical shift of sex in professions, where each feminising of a profession is bound up with a degradation of status. Therefore, there is a demand to abolish the hierarchy of difference or the deconstruction of difference and simultaneously the appropriation of power. This means that through "Undoing gender" the principle of classification is suspended. Mathematics didactics has not yet intensely taken notice of this idea. However, there exist some empirical studies that refer to the teaching of mathematics in this way. For example Faulstich-Wieland (2002) analysed by means of ethnographic approaches the processes of gender construction in school interaction. It would be most interesting to find out the impact of the gender connotation of school subjects, such as mathematics, science, technology or language, on adolescence. Thus the study is a contribution to the debate on reflexive coeducation. Furthermore, the study forms part of a body of literature that start from totally different theoretical paradigms but also deal with coeducation or the single-sex setting (e.g., Forgasz & Leder & Lynch, 2001).

The social construction of gender, even if not meant in the radical sense of the Doing Gender attempt, forms the theoretical basis for many new empirical studies dealing with the topic Mathematics and Gender. However, this kind of study, because of its theoretical orientation, often relies on qualitative methods and therefore lets pupils speak. A good example is the study by Boaler (1998). At two schools she carried out cases studies and gave voice to the girls. By doing so she gave them the opportunity to disprove old stereotypes. Through delimitating classical theories of attribution, the girls learned that their weak mathematical performances was not caused by themselves. Boaler linked the reason for this to poor and closed teaching and a learning style that was strongly related with textbooks. Furthermore, it seemed that the girls preferred a different approach from transmission, and the epistemologies this are based on, towards a model of mathematics that is based on equality which allows an open, process oriented way of learning, and includes enquiry, challenge and connected forms of knowing and a deeper understanding.

Quite similar results were reported in the study by Jahnke-Klein (2001), whose data relied on detailed interviews with female and male pupils. Two different cultures of teaching were favoured by girls or boys. The girls emphasised particularly that they felt good in mathematics lessons if they understood everything for which a deeper understanding is of critical importance. This explains why many girls demand more detailed explanations from the teacher, more opportunities to ask questions and to explain

the contents to their peers, more time for learning and the chance to spend more time with one topic. In contrast to that, boys expressed their dislike of going slowly. They demanded new topics even if there were problems of understanding. Thus the boys give the impression of being highly competent, which is not supported by their mathematical performances.

From various studies of interaction, for example Jungwirth (1991), it became obvious, that boys in situations of not knowing, or not understanding, frequently manage to let this appear as a short-term uncertainty. Girls, on the other hand, tended to be silent which in most cases was interpreted by the teacher that they did not know. Furthermore, girls very often refused to play a game of questioning and answering with the teacher. They were more likely to develop complete answers that afterwards tend to be analysed and criticised by the teacher. Hence the contributions in class of boys and the girls reinforces the impression that boys are more competent and creative than girls.

These studies reflect the shift of methods that has taken place during the nineties of the 20th century: away from the dominance of quantitative-statistical methods – which are still practiced and undisputed – towards qualitative-empirical methods, which very often adapt ethnographical methods or which are grounded in interpretative paradigms. Within the interpretative paradigm reality is regarded as a social construction created through sense-giving interpretations of interactions. For such a constructive understanding, the category "gender as social construction" plays an important role within each interaction. With ethnographic approaches a descriptive interest is dominant. Through participatory observation, open interviews and field studies predominating patterns of interpretation and subjective structures of sense are reproduced. For this reason, these attempts are particularly suitable for the examination of the social construction of gender.

The often cited study of Belenky et al. (1986) "Women's Ways of Knowing" is based on such interpretative methods, where women were allowed to speak at length (or indepth). However, this attempt which describes the special way of knowing of women, is contrary to the idea, described above, of rejecting bi-genderness and the claim for Undoing Gender. Following their model, which was developed through detailed interviews with women, five phases of the development of women's knowing can be recognised: silence, received knowing, subjective knowing, procedural knowing (separate and connected) and constructed knowing. Men emphasise more the role of logic, strength and precise argumentation, while women stress more the role of intuition, experience and creativity and a relation to the knowledge of others. The question is how far the generally practiced traditional ways of teaching and learning of mathematics with its stress on certainty, deduction, logic, algorithms and formality are incompatible with the way women gain knowing. This implies that the discipline mathematics as a whole, with its special character, is put into question (see e.g., Burton, 1995).

Recent discussions on gender and mathematics education are also characterised by cultural aspects from various perspectives. It is pointed out repeatedly that in the context of mathematical performance the differences between young people with different cultural backgrounds are much bigger than between boys and girls and men and women. Additionally, it is emphasised that the European American male model must not be equated with other cultures and their needs. And the assumption of cultural liberty with the meaning that mathematics does not depend on the culture in which mathematics is

produced or practiced, is criticised increasingly. Therefore, a new kind of mathematics education is aimed for, which should be multicultural, culture-sensitive and gender-equitable.

The extension of the discussion towards the claim for a better attitude towards heterogeneity implies also questions about boys and a specific way of teaching for boys that should focus on the social competence of boys. Altogether Becker's and Jacob's (2001) principles of a multicultural and gender-equitable teaching of mathematics, such as using student's own experiences, incorporating writing in teaching, using cooperative learning, and developing a community of learners match with the theoretical attempts that have been discussed briefly in this paper. Furthermore these approaches seem suitable to do justice to various concerned groups in the true sense of gender-equity.

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