

Gender Competence in Mathematics Teacher Education

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INTRODUCTION

In Germany, the prejudice still exists that ‘girls aren’t good at math’.¹ The ‘male image’ which mathematics has in society is at least partially created in school. In order to change this gendered image of mathematics, but also to increase equal opportunities for pupils beyond gender-stereotyped knowledge and interest domains, it is necessary that mathematics teachers act in a gender-competent way. Indeed, some research indicates that mathematics – beyond a relevant school subject and scientific discipline – is also a ‘core discipline’ for the field of natural sciences and engineering (see DMV et al., 2007; Heine et al., 2008). Thus, in the long term, gender-competent mathematics teaching could also help to diminish a gender-based choice of fields of study and occupation, and to promote equal opportunities for men and women in the labor market. However, in Germany’s ‘mainstream debates’ within the current process of professionalization of academic teacher training there are few indications for the existence of a gender perspective, and gender competence is hardly ever included in the relevant curricula (see Langfeldt and Mischau, 2011).

Our interdisciplinary research project *GenderMathematik*² (‘GenderMathematics’) constitutes a first step towards the integration of gender competence

1 | This prejudice also exists in other countries, e.g. the German speaking countries Austria and Switzerland.

2 | The project ‘GenderMathematik: Genderkompetenz als innovatives Element der LehrerInnenausbildung für das Fach Mathematik’ (‘Gender Mathematics: Gender competence as an innovative element of the professionalisation of teacher training in mathematics’) was funded from 2008–2010 by the German Federal Ministry of Education and

within teacher training in Germany by developing an exemplary course for mathematics teacher training. In this paper, we will first present the background of the project, in particular the underlying definition of gender competence, and then give an overview of the designed course (see also Langfeldt and Mischau, 2011; Mischau and Mehlmann, 2011).

THE PROJECT *GENDERMATHEMATIK* (“GENDERMATHEMATICS”)

One starting point for the project was the observation that in many countries international standardized assessment tests like PISA or TIMSS have shown discrepancies between girls and boys concerning their achievements in mathematics and their mathematical self-concept. In Germany, statistically significant gender differences in favor of boys occur regarding achievement and mathematical self-concept, which are in most cases even stronger than in other countries and the OECD average (see Bos et al., 2008; Mullis et al., 2000; OECD, 2004, 2010). Thus, in Germany, mathematics can still be regarded as a typical ‘boys’ subject’ or ‘male domain’, where gender differences in mathematics already become apparent at the end of primary school, entrench themselves in the course of secondary school education and later on become manifest in a gender-based choice of fields of study and fields of occupation.

One of the essential reference points of the project were results of empirical research, which show that gender-stereotypical attributions play an important and problematic role in the processes of teaching and learning mathematics at school, as they reproduce gendered images of mathematics and gendered school subjects (see for example Bos et al., 2008; Zimmer et al., 2004). In order to break the ‘vicious circle’ (Ernest, 1995: 456) thus created, researchers within gender-oriented didactics and educational science have emphasized that besides the implementation of gender-sensitive didactics at school it is also necessary to make mathematics teachers aware of their impact on creating and reproducing gender stereotypes and gendered school subjects (see Curdes, 2007; Fischer and Rustemeyer, 2007; Jungwirth and Stadler, 2005a; Keitel, 2010). Together with other elements, the teachers’ gender stereotypes about

Research. The project was a collaboration of the universities of Bielefeld, Gießen, and Hamburg. See <http://www.uni-bielefeld.de/IFF/genderundmathe/index.html> (accessed 20 February 2013).

the learning of mathematics, mathematical skills and achievement, as well as their potential lack of gender competence, can be identified as fundamental reasons for gender biases in the development of young people's interests and competences with regard to school subjects (see Jones et al., 2000; Jungwirth, 1991; Keller, 1998; Ziegler et al., 1998). Therefore, (prospective) teachers need to acquire gender competence with regard to didactics and subject-specific contents in order to overcome gender-specific biases within school subjects.

Within our project, *GenderMathematik*, we developed a gender competence course for teacher training in mathematics. The interdisciplinary course format combines results of gender studies from various disciplines like mathematics, didactics of mathematics, educational science and social sciences. With regard to the various gender theory approaches, the concept of the course relies upon a constructivist perspective on gender, i.e. gender differences are seen as effects of social practice and the related exclusions, and social hierarchies are seen as products of gendering processes (see for instance Wilz, 2008: 9f).

In the first step of the project, we conducted an inquiry into the status quo, hoping to find best-practice models. We discovered that gender competence with respect to mathematics teaching is not implemented as a mandatory course in the study and examination regulations at any German university. Some of them occasionally offer elective courses related to gender and the teaching of mathematics, but not regularly. These courses are, however, highly dependent on the commitment of individual lecturers. In the second step, we merged the relevant gender-oriented constructivist research on school and teaching from educational and social sciences with gender-oriented discussions in mathematics and mathematics education. The third step of the project consisted of discussions held with expert groups focusing on central topics and issues concerning the possible contents, methods, and design of a gender competence course in maths teacher training.

Based on the results of the preceding steps, we finally designed the curricular, didactical, and methodological concept of our course in the light of a further developed, multi-dimensional concept of gender competence which we used as a theoretical framework (see Langfeldt and Mischau, 2011; Langfeldt et al., 2012; Mischau et al., 2009, 2010).

A first version of the gender competence course 'Mathematics – School – Gender' was taught during the winter term 2009/10 at eight German universities.³ The course was offered mainly for bachelor students, but also for master

3 | Augsburg, Bielefeld, Bremen, Gießen, Hamburg, Ludwigsburg, Lüneburg, Potsdam.

students, and was taught by cooperation partners of the project within their didactics of mathematics programmes.⁴ Prior to the course, the lecturers had been trained in a workshop and had received a CD-ROM containing the course manual, teaching materials and a list of selected literature for the reserve shelf. In total, 160 students participated in the gender competence course, whereby 26.9% were male and 73.1% were female students.

At the end of the term the first version of the course, as it was taught in the exemplary teaching, was evaluated at seven universities.⁵ This extensive formative and summative evaluation comprises two standardized questionnaires filled out by the students (one at the beginning, capturing, among other things, their gender competence before the course and expectations related to the course, and one at the end, measuring such features as satisfaction with the course and their gender competence after the course), semi-structured qualitative interviews with the lecturers, and semi-structured (self- and external) observations with some central questions concerning every single session, which the lecturers had to answer parallel to the course. Results of the evaluation can be found in Mischau et al. (2010), so at this point only a few brief comments should be given concerning the ‘students’ evaluation’.

The surveys conducted at the beginning and at the end of the course revealed that the course widely meets the students’ demands and expectations concerning a gender competence course. At the beginning of the course, nearly 85% of the students mentioned a personal lack of didactical and methodological knowledge in dealing with gender (differences) as well as with other aspects of diversity at school and therefore professed a keen interest in innovative and differentiated teaching methods. About 50% of the students also reported having little competence and experience in self-reflection and a fair amount of uncertainty as to their future role as teachers. After attending the course nearly 80% of the students declared that particularly their ability to reflect on their own gender-biased views and attributions and their awareness of the influence of teachers’ gender stereotypes on the pupils’ achievements and self-concept had increased. In addition, about 68% also declared that their knowledge of how to plan mathematics lessons with gender-sensitive educa-

4 | Only in Hamburg the course was offered as a mathematics seminar (taught by project member and mathematician Andrea Blunck). In the Bielefeld project, member Anina Mischau co-taught the course with a colleague from mathematics education.

5 | At PH Ludwigsburg the course was taught in a modified way, so for comparability reasons the evaluation was not carried out there.

tional materials and methodological and didactical approaches had increased, as well as their knowledge on concrete gender-sensitive teaching and learning methods that foster a bias-free environment. 60% of the students stated that the theme ‘gender’ should become an integral part of didactics of mathematics at university and nearly 49% requested more gender-sensitive pedagogical contents in mathematics teacher training. One reason for this might be the opinion that dealing with gender themes is of great importance for later practice; this opinion was shared by 60% of the students.

Especially the semi-structured qualitative interviews with the lecturers but also their reports about their observations during the course conveyed helpful ideas for an optimization of the course structure, contents, methods, and materials. Based on the evaluation, the initial course concept was revised. In particular, the connection to professional practice was highlighted by introducing the distinction between the teaching framework and the classroom interactions (see Mischau et al., 2010). The revised concept is presented below.⁶

THE COURSE CONCEPT

The gender competence course was developed for primary and secondary teacher training in mathematics and comprises 14 lessons.⁷ The first lesson is an introductory one which presents the course programme and, in addition, also describes formal conditions like examination modalities. The final lesson gives the students the opportunity to review what was learned. This lesson can also be used for a course feedback. The main part of the course consists of twelve lessons, which are divided into five blocks of two or three lessons each.

In the course manual provided for lecturers the description of each lesson is organized as follows: 1) Short introduction to the topics and issues of the respective lesson, 2) Overview of related state of research, 3) Proposal for methods to be used, 4) Learning goals, 5) Schedule of the lesson, 6) Outlook for the next lesson. Moreover, there is an overview of the whole course in order to provide the reader with a ‘red thread’ to follow. The course manual

6 | It should be pointed out that the revised course was taught only after the end of the project and that it was not evaluated. Some experiences with teaching the revised course are described in Mischau (2012).

7 | At German universities a term usually comprises 14 weeks, and a seminar usually consists of one lesson (90 min) per week.

is supplemented by a collection of teaching materials used in the course. The main contents, goals, and methods of the course are described below.

In the project, we formulated a definition of *gender competence* as an occupation-related key qualification (see Bremer and Mehlmann, 2006; Metz-Göckel and Roloff, 2002; Rosenkranz-Fallegger, 2009) which is fundamental for the course. According to this definition, gender competence comprises four aspects or dimensions: professional competence, methodological and didactical competence, interactional competence, and self-competence (see Langfeldt and Mischau, 2011; Langfeldt et al., 2012).

Professional competence comprises basic and specialized knowledge in the field of gender studies, in particular about socio-cultural constructions of gender and their impact on societal structures, institutions, and individuals, as well as about the development of gendered disciplinary cultures (*dimension of gender knowledge*).

Methodological and didactical competence signifies competence with regard to a gender-sensitive arrangement of teaching and learning processes (*dimension of the teaching framework*).

Interactional competence means competence in creating a gender-sensitive teaching culture (*dimension of classroom interactions*).

Self-competence consists of the ability to reflect on one's own gendered biography, gender-based views and assumptions, social norms, stereotypes, and the ability to reflect gender-based attributions, expectations, and evaluations (*dimension of self-reflectivity*).

Gender competence in this sense includes sensitivity for the mechanisms and consequences of gender-stereotypical attributions for the reproduction of gender-based domains of interest and knowledge. Moreover, it includes the knowledge of theoretical concepts as well as didactical and methodological approaches which should enable (prospective) teachers to offer gender-sensitive mathematics lessons and open opportunities for pupils to learn mathematics beyond gender-based restrictions. Finally, gender competence includes the ability to critically reflect one's own gender-based views and attitudes as well as on institutional frameworks like curricula or teaching material, the ability to reflect (and – if necessary – to change) one's own professional ways of acting, interacting and communicating with respect to – possibly unintentional – gender-stereotyping effects (see Mischau et al., 2010). As the four dimensions of gender competence described above systematically intertwine, they have been integrated – with varying degree of concentration – in the learning goals formulated for each lesson.

According to our definition, gender competence cannot be regarded as ‘formula’ knowledge. The basic methodological concept of the course relies on the idea of teachers as ‘reflective practitioners’ (see Adler, 1991; Schön, 1983), who reflect and continually refine their skills through a rigorous process of self-reflection while acting in the classroom. (Prospective) teachers should therefore be instructed to identify traps of co-construction in their own attributions, forms of teaching structures, patterns of interaction, etc., as well as to question their own performance with regard to possible (unintended) gender-biased effects, and to develop strategies to change their behavior (see Mischau et al., 2010).

The methods applied in the course are quite different from those that German mathematics students, studying to become teachers, usually encounter in their university seminars. A seminar in mathematics usually means that each week a student presents a mathematical topic by giving a talk and writing accompanying notes on the blackboard. A seminar in educational science or pedagogy means reading, presenting und discussing papers. For our course, however, using a variety of methods is a fundamental part of the didactical concept. One reason for this is that variation of methods is suggested by mathematics experts with regard to ‘good’ and ‘gender-sensitive’ mathematics teaching at school (see Jahnke-Klein, 2001: 229; Leuders, 2001: 63; Meyer, 2004).

The concept of our course follows the ‘didactical-methodical double-decker’ approach (‘didaktisch-methodischer Doppeldecker’; see Wahl, 2002; Mischau et al., 2010). Thereby, besides phases of individualized work, the students experience within the course various forms of cooperative and research-based learning methods, which are also used at school and which are suitable for developing gender-sensitive mathematics lessons. Among other things, we, for example, use jigsaw puzzles (‘Gruppenpuzzle’), think-pair-share (‘Ich-Du-Wir’), and learning stations (‘Stationenlernen’) (see Barzel et al., 2007).⁸

In order to increase self-reflectivity, the students have to work on a portfolio throughout the course. This portfolio is used for documenting and reflecting results, but also for recording experiences, feelings, ideas, problems, and personal impressions. Furthermore, the portfolio is used to write down and reflect upon a student’s insights and problems concerning the subjects as they were discussed from the point of view of the four dimensions of gender competence. Portfolios are also used at school (Barzel et al., 2007; Zwölfer, 2006), so this can also be seen as a part of the ‘didactical-methodical double-decker’. Moreover, if neces-

8 | A description of these and many other methods can also be found in K. Reich’s ‘Methodenpool’ (method pool): <http://methodenpool.uni-koeln.de/> (accessed 20 February 2013).

sary, we suggest using the portfolio as course work that will be graded at the end of the course. In the following, the topics of the course blocks and the main thread running through the entire course are described (see also Langfeldt and Mischau, 2011; Langfeldt et al., 2012; Mischau and Mehlmann, 2011).

MAIN CONTENTS, GOALS AND METHODS OF THE COURSE

Sensitizing the students for the problematic effects of gender-stereotyped attributions by teachers and pupils in regard to the subject math in general and mathematical aptitude in particular is a central focus of the course. This includes dealing with one's own experiences and ideas of mathematics, which were chosen as a starting point of the seminar.

The introductory session of the seminar introduces the thematic field 'Mathematics, School and Gender', and opens up the different dimensions of gender competence as a professional key qualification for (prospective) maths teachers. This is followed by the first block which examines '*Images of Mathematics*' and their connections to the category gender in respect to their implications for the later school practice of the students studying to be teachers. As a preparation, the students are given the task to write their 'mathematical autobiography' (see Scharlach, undated) for the 'reactivation' of their own experiences with math and the images of math. In subsequent sessions, students go back to their mathematical autobiography to connect and illustrate scientific knowledge with subjective experience.

For the first block session we chose an intuitive introduction based on emotions and experiences. In a PowerPoint-presentation, the students are shown images of mathematics and/or of the teaching/learning of mathematics in different contexts. The students are given the task to choose the image that most corresponds to their own idea of mathematics or the teaching/learning of mathematics, and then reflect on their choice. The subsequent discussion in the course creates mutual understanding for the diversity of the images of mathematics the students have, and at the same time reflects the underlying attitude towards mathematics and learning and teaching it.

The students' reflection on their own image of mathematics is something that usually has no space in university courses for prospective mathematics teachers. However, such a reflection is important, because the beliefs about mathematics influence the way one deals with mathematics (Curdes et al.,

2003: 23). So the students' beliefs will have an impact on the way they will teach mathematics later on. Moreover, reflecting on mathematics and on the preferences for or aversions against certain aspects of mathematics might help the students studying to become teachers – who often have problems with the abstract 'university mathematics' – to (re-)gain a positive attitude towards their subject.

Finally, the students' subjective assessments are related to empirical results of research on mathematical beliefs (see for example Blömeke et al., 2008; Grigutsch et al., 1998; Stipek et al., 2001), which underline the influence of convictions about the structure of mathematics and the genesis of mathematical competence for teaching and learning mathematics.

The second block session subsequently focuses on the connection of mathematics and gender. An introductory exercise via the method of 'gender cards' on the one hand aims at a critical look at gender-stereotyped attributions rooted in everyday knowledge, and on the other, at increasing the awareness for the students' own – possibly unconscious – stereotyped ideas in regard to mathematical aptitude. The main focus of the second session therefore lies in the historical-cultural derivation of the question why mathematics is still seen as a 'male domain' by the majority of people in our culture. The 'gendering' of mathematics is thereby systematically unfolded from different points of view with respect to the category of gender: Besides dealing with gender-stereotyped attributions regarding mathematical aptitude, which are, among others, reproduced and popularized via pictorial representations, the stereotyping of mathematics as a 'male domain' based on current gender relations data are examined more closely, also from a historical perspective regarding the exclusion or marginalization of women in mathematics as a 'male discipline'. Aided by the method of learning stations, the students are encouraged to explore the aspect of a subject's gendering, mostly disregarded in the didactics of mathematics, and to show its implications for mathematics lessons in a self-directed and individual manner by means of prepared materials.

The first block primarily aims at sensitizing the student's self-awareness and triggering in particular the necessary processes of reflection on the implications of their own image of mathematics and the stereotyping of mathematics as a 'male domain' for the teaching and learning of mathematics with respect to the students' future professional practice.

The comparative analysis of findings of different assessment studies about '*Gender Differences Concerning Mathematic Achievements and Mathematical Self-Concept*' comprises Block II of the gender competence course. As a

contrast to the widespread gender-stereotyped assessments which attribute an inferior mathematical aptitude and thus lower performance in this field to girls and women, both sessions of the block take a closer look at the empirical findings regarding gender difference in the subject mathematics in the context of an international comparison. The students access these empirical findings by way of example via a secondary analysis of selected results from PISA 2000 to PISA 2009 and the elementary school study TIMSS 2007 (Bos et al., 2008; Martin et al., 2008; OECD, 2001, 2004, 2007, 2010). The main results are that gender differences in mathematics performance in general and with regard to mathematical content areas, competency clusters, or grades vary considerably; in addition, they vary between countries. The differences are not always in favor of boys, and sometimes they are not present at all.

The first session involves an examination of initially gender-based differences in mathematical performance – by means of a jigsaw puzzle. This includes integrating into the analysis findings about the mathematical performance overall, in relation to performance on different competence levels, as well as in terms of different mathematical content areas. The block's second session focuses on the selected results regarding gender-based differences in so-called student characteristics, which were surveyed in the context of PISA and TIMSS in terms of individual learning abilities, and which are being discussed as possible influencing factors for mathematical performance. The exemplary analysis comprises, for instance, the interest in mathematics, fear of mathematics, the positive attitude towards mathematics, as well as the mathematical self-concept, and takes place in partner and group work settings. In general, in the OECD average and in almost all countries, boys have more interest in and less fear of mathematics and their mathematical self-concept is significantly higher than that of girls. In Germany, these differences are particularly pronounced.

A close look at the data illustrates the simplicity of many explanations, especially found in the media, which attribute the different mathematical performances between the sexes to 'nature'. However, gender-bias assertions such as 'girls can't do mathematics and boys can't read' ignore the fact that the assessment studies do not show a uniform picture of gender differences in pupils' performance in reading, mathematics or natural sciences. In contrast, students should recognize that a correct and critical interpretation of the statistical data provided by international studies demonstrates a wide variation of gender differences in mathematical achievement among countries, mostly, but not exclusively, to girls' disadvantage. At the same time, students should realize that

the forms of gender-based differences in the examined student characteristics also vary between countries and respective characteristics, but that, overall, these gender-based differences, in comparison to those in mathematical performance, clearly prove to be rather more homogeneous and stable over time.

The aim of this detailed examination of the empirical findings in question is on the one hand to problematize the – still existing – gender-based ‘knowledge and interest territories’, as well as to sensitize the students for the issue of possible socio-cultural framework conditions and/or influencing factors regarding their formation and reproduction.⁹ Both aspects underline not only the need for action regarding a change in lesson design for the subject mathematics, but also a reflection on one’s own role as a (future) teacher in creating and overcoming gender differences in mathematics. On the other hand, it creates the prerequisite for a critical examination of the various explanatory approaches, which are covered in the next block, and which are to be questioned for the plausibility and scope based on the empirical findings.

The question about the reason for the detected gender differences in mathematical performance and in the mathematical self-concept forms the centre of Block III ‘*Explanatory Approaches to Gender Differences in the Subject Mathematics*’, which, just like Block II, accentuates the dimensions of gender knowledge.

The first session of this block focuses on the knowledge base of the students themselves. Using the ‘think-pair-share’ method on the basis of quotes taken from mathematics students, ideas (affected by everyday theory) and convictions about aptitude theory, as well as the students’ scientific knowledge base in the field of mathematics are tapped and made accessible for critical examination.¹⁰ In this context, a distinction is introduced by differentiating between the nature and the nurture perspective, which permits a first systematization of the spectrum of the scientific explanatory approaches at hand. In light

9 | Students should be made to realize that gender differences in mathematical performance and self-concept are neither inevitable nor a ‘natural’ outcome of differences between the sexes, but rather that factors such as the broader socio-cultural context (for example the formation of societal gender stereotypes and gender inequality) as well as gendered images of mathematics or educational policies and practices influence and reproduce gender differences (see Coradi Vellacott et al., 2003; Else-Quest et al., 2010; Guiso et al., 2008; Nosek et al., 2009; OECD, 2009).

10 | The interviews were carried out in a research project on doing gender in mathematics (see Mischau et al., 2004).

of the persistence of gender-stereotyped attributions regarding mathematical competences, which are based on ‘natural’ differences in aptitude, one of the focal points of the session lies in the critical examination of biological explanatory approaches in the context of the nature perspective. These approaches consider for example genetic, hormonal, and cerebro-physiological factors as a cause for gender differences in mathematical performance (for an overview see for instance Biedinger, 2008; Tausendpfund, 2007).

The second session is dedicated to a closer look at explanatory approaches of the nurture perspective. Here, the main focus is on socialization-theoretical approaches which assume that cultural gender-stereotypes and the stereotyping of gender as a ‘male domain’ – communicated via gender-based attitudes, expectations, and attributions by parents, peer groups, and teachers – have a significant influence on the observed gender differences regarding the subject-related self-concept, and thus also on mathematical performance (for an overview see for example Budde, 2009; Coradi Vellacott et al., 2003). A differentiation between ‘internal’ and ‘external’ factors, originally introduced by Coradi Vellacott et al. (2003), and further developed in this project, serves as a basis for opening up the spectrum of relevant influencing factors. As a preparation for the session, the students are given the homework assignment to work on excerpts which examine the individual aspects of this systematization on the basis of key questions. In the session itself, the students’ work results are gathered and the respective influencing factors are reviewed in regard to their importance and their interactions. Concerning the relevance of influencing factors in school, the discussion will also in particular focus on key findings regarding attitudes, expectations and attributions by teachers, as well as towards learning materials, forms of teaching and learning, and also interaction patterns between teachers and pupils in math lessons. These are further examined in the subsequent blocks ‘*Teaching Framework*’ and ‘*Classroom Interactions*’.

Regarding the students’ subsequent professional practice, block III explicitly explores and reflects upon the implications of the respective explanatory approaches for the design of teaching and learning processes and its possibilities, as well as one’s own understanding of one’s role and profession. It does so by examining one’s own (everyday) knowledge base, as well as by working with the research results at hand regarding the genesis of gender differences in the subject mathematics.

The fourth block’s central focus comprises selected aspects of designing mathematics lessons, which may contribute to the reproduction of gender-

based knowledge territories. In content, the three sessions, united under the headline *Teaching Framework*, connect to the research results regarding forms of teaching and learning and lesson materials as ‘external’ factors for the development of gender differences in mathematical performance and in the mathematical self-concept, outlined in the second session of block III. Following the problematization of the implications of the ‘developing-by-questioning’ math lessons for the pupils’ classroom participation, the first block session focuses on a critical examination of the books used in math lessons and the gender images they convey. For this, the students analyze excerpts from school books used in different grades; they do so in individual and group work settings. The task lies in inspecting the selected examples to see if and in what form gender-stereotypes are still reproduced today in texts and images. A further aim is to examine whether, in the selected topics and task contexts, the fields of interest and experiences of male and female pupils are equally considered, or, preferably, whether these are equally appealing for both male and female pupils. Analyzing and subsequently sharing their work results in the group will help to sensitize the students for the necessity of a conscious utilization of lesson materials under gender aspects.

The two following sessions in this block have the goal of developing alternative courses of action for the teaching framework. The second session mainly focuses on the development of criteria for gender-sensitive planning of math lessons based on existing didactical approaches for gender-sensitive math lessons. As a reference point for the development of such a set of criteria, the concept of ‘meaningful mathematics lessons’ by Jahnke-Klein (2001) as well as the suggestions presented by Schlüter (2001), Curdes (2007), and Bartosch (2008) are utilized for gender-sensitive lessons in mathematics and natural sciences, and worked on in more detail. In particular, gender-sensitive math lessons are characterized by a well-balanced combination of different forms of learning and a diversity of methods in order to address pupils with different learning and communication styles. The exercises used in such lessons permit individual learning and differentiation and incorporate the interests and everyday world of both boys and girls. Moreover, they take into account the diversity of mathematics and its historical development. Thus, gender-sensitive math lessons are also ‘good’ math lessons as discussed by researchers from didactics of mathematics (see for example Büchter and Leuders, 2005: 12f).

The third session, finally, introduces and discusses the different methodological instruments which make it possible to design math lessons in a way that is equally interesting for male and female pupils and that leaves room

for finding one's personal access to mathematics and gaining experience in acquiring subject-related competency. Considering the key importance of methodological diversity in math lessons, this session also features partner and group work not only with gender-sensitive lesson materials (see Eckelt, 2005; Schätz and Eisentraut, 2003) but particularly with methods for individualizing and differentiating lessons that seem especially suitable for gender-sensitive classroom work. Some of these methods, such as jigsaw puzzles, learning stations, think-pair-share, placemat (Barzel et al., 2007) have been applied in the seminar itself, much in the sense of the 'didactical-methodological double-decker'. The methodological instruments of the learning diary and the notebook entry (see Zwölfer, 2006), as well as 'Learning Mathematics with History' (see Jahnke and Richter, 2008) are also introduced.

In regard to our definition of gender competence and in view of later professional practice, block IV puts a special focus on relaying didactical-methodological competences for a gender-sensitive design of teaching and learning processes.

Block V '*Classroom Interactions*' addresses especially the third (interactional competence) and fourth dimension (self-reflectivity) of gender competence and focuses on the interactions between teachers and pupils. Here the main focus lies, on the one hand, on gender-based differences in the interactive behavior of teachers and their influence on the reproduction of gender differences with respect to the pupils' mathematical self-concept and mathematical performance (see for instance Coradi Vellacott et al., 2003; Ruppen et al., 2009; Rustemeyer and Fischer, 2007). On the other hand, from the perspective of 'doing gender', it is more closely examined how and in what way gender differences with regard to dealing with mathematics are 'created' in the interactions between teachers and students (see for example Faulstich-Wieland et al., 2009; Jungwirth, 1990, 1991, 2005; Jungwirth and Stadler, 2005b).

As the first session's main focus the students are required to examine in detail the research findings regarding gender-based distributional differences of the attention and feedback pupils receive from their teachers. The second session deals with the consequences of teachers' feedback on performance and their underlying gender-based attribution of aptitude as well as pupils' self-attribution of success and failure which are important for their self-assessment and their striving for good performance. In both sessions, the main thematic focus areas are developed on the basis of video footage and a verbatim transcript of two lesson sequences taken from a math lesson which are analyzed by the students in group work settings.

The third session of this block introduces the approach of ‘doing gender’, which looks at the construction of gender differences regarding mathematical competences in, or caused by, classroom interaction in math lessons, involving both teachers and pupils. The materials used for examining this perspective on such interactive events are drawn from lesson transcripts of math lessons in Austrian grammar schools (Jungwirth, 1990, 1991; Jungwirth and Stadler, 2005b). The students analyze them – again in a work-sharing group work setting based on key questions – for an implied gender-based ‘positioning’ (comp. Jungwirth and Stadler, 2005b) of the pupils with regard to their aptitude for the subject mathematics.

Similar to the procedure in block IV, block V also deals with alternative courses of action and possibilities for intervention. Re-attribution training, for instance, is something that is suggested as a suitable and appropriate pedagogical possibility to intervene in favor of encouraging self-worth and motivation-promoting attribution styles in pupils (see for example Budde, 2009: 44f.).

Regarding the relaying of interactional competences emphasized in this block, the main goal is to sensitize the students for problematic gender-based patterns of interaction and the gender-based expectations, attributions, and assessments that produce them, and to create an awareness for the need to continually reflect on one’s own lesson practice.

In the final lesson, the students are invited to reflect on what they have learned based on key questions. In doing so, the students will recapitulate their respective learning experiences on the basis of their portfolio along the four dimensions of gender competence (professional competence, methodological and didactical competence, interactional competence, and self-competence), which were introduced in the introductory session. Furthermore, the students are encouraged to each give their assessment of the relevance of gender competence for teaching and learning mathematics and for their future role as teachers, and subsequently discuss these with each other.

FUTURE PERSPECTIVES

To date, the revised course has been successfully taught five times.¹¹ The publication of the course manual is forthcoming (Mischau et al., 2013), so that

11 | By the head of the project, Anina Mischau, as a visiting professor at the FU Berlin (summer term 2011, winter term 2011/2012 and winter term 2012/13), by Renate Motzer,

in the future the course can also be taught by other lecturers. Thus, more universities will get the opportunity to offer the gender competence course in their teacher training in mathematics. The course's modular design principle permits individual blocks to be also used independently and integrated in other courses.

From the point of view of the project, it is necessary to implement gender competence as an occupation-related key qualification within teacher training in mathematics. Although important institutions of the higher education system in Germany (see HRK, 2006; Wissenschaftsrat, 2001) recommend a) implementing better praxis-oriented modules in the curricula of teacher training (at university) and b) conveying more key competencies, we see various problems concerning a sustainable implementation of our gender competence course (see Langfeldt and Mischau, 2011).

In particular, modularization within the latest reform affecting teacher training at German universities in the course of the Bologna process led, in many places, to inflexible curricular structures that impede the integration of new courses. Our experiences show that a gender competence course for (prospective) mathematics teachers can most easily be implemented in modules of didactics of mathematics programmes that are open with regard to contents, like 'special aspects of didactics of mathematics'. But respective modules are not available at all German universities.

Another problem is to find lecturers in mathematics or didactics of mathematics who have specialist knowledge on gender and are able and willing not only to teach mathematical contents with gender aspects, but also to adopt an interdisciplinary perspective and to perform in a gender-sensitive manner. The course manual is designed to help lecturers acquire the necessary background knowledge. Nevertheless, the necessity to train (potential) university lecturers themselves in gender competence remains, but so far German universities lack suitable higher education didactic qualification programs.

Even if the path to attaining the goal may be a rocky one, the systematic and sustainable integration of gender competence into the teacher training in mathematics forms an essential building block in professionalization, scientificity, and the strengthening of abilities, as well as quality assurance of a professionally-oriented university education of mathematics teachers: Teach-

a cooperation partner at the University of Augsburg (winter term 2011/2012), and by Claudia Lack, a cooperation partner at the Justus-Liebig-University Giessen (summer term 2012).

ing experiences thus far have shown that students who take part in the gender competence course profit in several respects regarding their future professional life and their own understanding of their profession (see Mischau, 2012). This offers cause for hope that an increase in gender competence in (future) mathematics teachers will actually break the ‘vicious circle’ of reproduction of gender-related knowledge domains.

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