TSG 26: Gender and mathematics education

Team Chairs: ***Liv Sissel Grønmo,*** University of Oslo, Norway
Hanako Senuma, National Institute of Educational Research, Tokyo, Japan
Team Members: ***Stephen Lamb,*** University of Melbourne, Australia
Roberta Mura, Laval University, Québec, Canada
Ferdinand Rivera, San José State University, USA

Aims and focus

This Topic Study Group offered participants the opportunity to explore pluralism and multiculturalism in mathematics education from the perspective of gender, and the many ways in which they affect mathematical understanding, attitudes and participation. Altogether, 14 papers from nine countries were presented in the four sessions. The presentations were grouped according to content, also taking into account that the papers should illustrate the great variation in cultural, economic and other background factors that influence the formation of female and male differences in mathematics. An awareness and acceptance of such differences formed the basis for the study group. From this point of view it was essential that researchers from a great variety of countries contributed with their papers and in the discussions. Abstracts and papers from this study group are available at www.icme10.dk

Session 1

Three papers were presented in the first session as part of the theme *Mathematics and computers – male domains?* The first paper was "Mathematics – a male domain" by *Gerd Brandell, Peter Nyström*, and *Christina Sundqvist* (Sweden). They referred to the GeMa-Project which investigated whether students in compulsory and upper secondary school considered mathematics to be a male, female, or gender neutral domain. Based on the fact that there is a strong gender imbalance in recruiting students to mathematics in Sweden, the hypothesis was that if mathematics is considered to be a male domain, this might influence girls not to study the subject. If, however, mathematics is perceived as a female domain, girls' interest in mathematics may be positively affected. They concluded that mathematics is gender stereotyped in some aspects by Swedish students in both year nine in compulsory school and in year two in upper secondary school, and in accordance with studies from other countries older students stereotype mathematics as a male domain more than younger students do.

The second paper to be presented was "Computers for mathematics learning and gender stereotypes" by *Helen Forgasz* (Australia). She pointed out that computers and hand-held technologies are now very common in mathematics classrooms in Victoria, Australia. Graphic calculators are mandatory for some mathematics subjects in the final year of schooling, and soon computer algebra systems will become compulsory. The surveyed teachers strongly believed that computers helped their students' understanding of mathematics. The findings reported in this paper support the contention that males are perceived by teachers to have more suitable personal characteristics to benefit from using computers to advantage in the mathematics classroom. Compared to females, males were considered more confident and interested in using computers, and also more prepared to take risks and have a go at using the software.

The last paper in this session was by *Xin Ma* (USA): "Current Trend in Gender Differences in Mathematics Performance: An International Update". Based on data from

the Organisation for Economic Cooperation and Development (OECD) Programme for International Student Assessment 2000 (PISA 2000), the paper aimed to analyse and describe from a global perspective the current status of gender differences in performance in mathematics literacy as defined in PISA 2000. Research questions that were addressed were to what extent within-school gender gaps in mathematics literacy vary across schools, whether schools with higher average mathematics literacy have greater within-school gender gaps in mathematics literacy, what school characteristics accounted for within-school gender gaps in mathematics literacy, and whether gender differences in mathematics literacy differ between OECD and non-OECD countries. The analysis included 27 OECD countries and 14 non-OECD countries. The results revealed consistent gender differences in favor of boys in mathematics performance in 29 out of 41 countries, but these gender differences were in general small. OECD countries were more likely to demonstrate gender difference in mathematics performance than non-OECD countries.

Session 2

The title of the second session, which included four papers, was *Affective factors among students and teachers*. First, two papers from South Africa were presented, one named "Demystification of the learning of mathematics: Analysis of narratives from feminist perspective" by *Sechaba MG Mahlomaholo* and *Maureen Mathamela*, the second called "Gender differences and black learners' attitudes towards Mathematics in selected secondary schools" by *Sechaba MG Mahlomaholo* and *MZ Sematle*. Both papers focused on problems related to the myth about mathematics as a masculine discipline. The first paper described and analysed narratives of women who have been successful in the study of mathematics. Based on interviews of three women, the study concluded that two major categories of factors are responsible for enabling women learners of mathematics to excel at the subject, namely social, contextual factors and intra-psychic motivational factors. The first category is external and it is authored by things and people outside the learners' self while the latter is internal and personal. The second paper examined and compared the attitudes towards mathematics of black male learners against those of their female classmates by interviewing 10 boys and 10 girls in four high schools located in the rural area of Phuthaditjhaba in South Africa. The study concluded that there are gendered attitudes towards mathematics as a result of socialization into varied gender roles. For change in these attitudes to occur, it is required that changes occur regarding socialization, hence gendering of human beings.

The third paper with the title "Pupils' Gender and Attitude Towards Mathematics in Mozambique" was presented by *Bhangy Cassy* (Mozambique). Mozambique has a ratio of 72% illiteracy, and although one main aim of the Education policy of the country is to promote gender equity in the access to all education levels, there are more females than males who do not benefit from this. This gender discrepancy increases over the education levels, being more evident at the tertiary level and particularly in mathematics and its related fields. Based on a questionnaire to secondary school students the study concluded that, from the beginning of the secondary school stage, females perceive their mathematical ability to be lower than that of males. Although girls did not strongly stereotype mathematics as a male domain, they believed much more than boys that mathematics is more appropriate for males than for females and this was particularly evident among the younger pupils. Girls agreed equally with boys that mathematics is

useful. Gender differences found in attitudes were by themselves not large enough to justify the gender disparities in mathematics participation.

The last paper in this session was by *Riitta Soro* (Finland) with the title "Teachers' beliefs about girls and boys and equity in mathematics". In Finland there are only minor differences between girls' and boys' mathematics achievements in the evaluations of comprehensive school or in the matriculation examinations arranged in upper secondary schools, but females do not participate in advanced mathematics courses or in mathematics-related careers at the same level as males do. The focus of the survey study was to examine, on the one hand, teachers' beliefs about differences between boys and girls as learners of mathematics, and, on the other, teachers' beliefs about gender equity in mathematics and the means they used to promote equity. Even though many of the teachers did not express strongly stereotyped beliefs, a great majority held different beliefs about girls and boys and those differences favoured boys. A great majority of teachers did not believe that they had a responsibility to address gender equity and they did not pay any attention to the issue. Gender equity was considered self-evident and mathematics gender-neutral. Many teachers believed that they treated each student as an individual and not as a girl or a boy.

Session 3

The third session, whose theme was *Cooperative learning and mathematical experiments*, included two papers. *Huang Xiong* (P.R. China) presented shortly his paper "Mathematical Experiments; A Survey of Difference Between Girls and Boys in Middle School in China". Mathematical experiments were difficult to conduct in China before the eighth reform of courses. Both girls and boys liked doing experiments, but, contrary to girls, boys seemed to have the view that the more experiments the better.

The second paper was by *Mary Barnes* (Australia), "Student-student interactions during collaborative learning: How does gender influence participation?" Even if recent research on gender in many countries has focused on boys' underachievement and disaffection in academical studies in general, gender differences in mathematics in favour of boys still persist. This indicates a continuing need to focus on the role of gender in mathematics learning. In this study gender issues in a pedagogical approach called collaborative learning were explored, by observing senior classes engaged in collaborative learning. Each class was observed for two three-week periods in order to develop an understanding of classroom routines and to interpret nuances of meaning – unspoken assumptions, shared understandings, jokes and references to past events. Positioning Theory was used as a theoretical framework for analysing the complex interactions within collaborative groups. Student learning gains during small-group discussions arise from activities such as engaging with, and being supported in completing complex tasks, explaining and justifying their own thinking, and trying to understand and critically monitor other people's thinking. Optimal collaboration requires fluid positioning, with students able to move freely in and out of positions such as Expert, Critic, Collaborator and In-Need-of-Help. Exclusive occupancy of any position by one individual may have negative consequences for all.

Session 4

The fourth and last session included two themes and five papers. The first theme was *Gender equity in high schools and universities/colleges*. *Mohammad Hossein Pourkazemi* (Iran) presented his paper "Gender and Mathematical Education." The Nation-wide University Entrance Exams play an important role for students to continue their studies at state universities in Iran. The paper investigated the exam results of male and female students and showed that female students achieved better than male students in topics like Persian literature, Arabic language and religion studies, while the opposite was true in mathematics and physics. Also in chemistry female students achieved best. The overall position of the female students in high school and undergraduate studies is better than male students, but the male students hold better position than the female students in the Graduate Entrance Exam of the Mathematical Sciences. Then *Indira Chacko* (South Africa) gave her paper called "Going from TIMSS-R to the problem solution". This small scale qualitative study was prompted by the results in mathematics of TIMSS–Repeat South Africa. The study attempted to find out from high school students about their problems in learning mathematics and, indirectly, it also tried to identify the approaches used in teaching mathematics in Outcome Based Education (OBE). The results indicate that the approaches used in teaching mathematics in the OBE and the non-OBE curriculum were more or less the same. Most of the problems in learning mathematics were common for girls and boys. Provision of text books, committed teachers that are kind and patient and extra coaching after school were suggested by students as means to attract more students to mathematics. Girls in particular would like to see the content related to situations in real life where these could be applied. Girls in township schools seem to spend more of their out of school time on house hold chores, which could affect their studies.

The second theme in this last session was *Perspectives in research – actions for equity*. The first paper under this theme was "Emerging Perspective of Research on Gender and Mathematics: A Global Synthesis" by *Joanne Rossi Becker* with *Ferdinand Rivera* (USA). The paper was based on discussions from working groups at the last several meetings of the North American Chapter and the International Group for the Psychology of Mathematics Education, meetings and publications of the International Organization of Women and Mathematics Education, which meets every four years in conjunction with the International Congress on Mathematics Education, and other published research that relates to gender and mathematics. The paper examines perspectives used to investigate gender and mathematics in different countries and explores how new perspectives might allow us to un/re/think gender as it pertains to the teaching and learning of mathematics. Different perspectives and methodologies used to investigate gender and mathematics in different countries are examined and explored. The paper underlines that there is a need for alternative methodologies to the positivist framework. The emancipatory viewpoint that celebrates the qualities specific to females was discussed, as well as the deconstructive viewpoint which problematizes the basic notions of "gender" and "differences." The need for research exploring the relationship between class and gender, and especially research of gender and mathematics in developing countries, was pointed out.

The second paper, by *Heather Mendick* (England), was about "Objective subjectivities, subjective objectivities and guilty pleasures: exploring the possibilities of decon-

structing the separated/connected opposition for thinking about gender and mathematics." Issues related to aligning separated-ness with masculinity and connected-ness with femininity were discussed in this paper. Even if this alignment has led to valuable interventions, we have to be aware of its limitations. This way of thinking may feed the oppositional binary patterning of our thinking and, in the final analysis, re/produce it. The author explores and argues for a more productive approach. Instead of re-inscribing the dichotomy of masculine/feminine and the location of mathematics within it, its demands are disrupted and refused, by deconstructing the two related oppositions. A main conclusion is that in understanding what is happening when people are learning mathematics, we need to be sensitive to all the varied things that students may or may not be doing when they do mathematics and to make space for a wider range of subjectivities in our classrooms, ones outside and beyond the traditional binary frameworks.

The last paper was presented by *Lynda R. Wiest* (USA): "The Critical Role of Informal Mathematics Programs for Girls." This paper described a mathematics and technology program for Northern Nevada middle school girls. The program consists of a one-week, residential summer camp with two full-day fall and spring follow-up sessions. The research reported here relates the impact this program has had upon its participants in three years of operation and the critical program features that have fostered the successful outcomes presented in these data. Both the girls who participated and their parents provided analytical perspectives on the program. This program demonstrates the continued importance of informal education, in the form of intervention programs, for underrepresented groups – in this case, girls – in mathematics. The single-sex environment – at least for an academically supplemental program such as this – was pointed out as having positively influenced girls' attitudes and performance. The data provided in the paper showed that a well-planned program that targets girls in mathematics and technology can have a positive impact on girls' attitude and performance in these domains both in and out of school.

This report has been prepared by Liv Sissel Grønmo and Hanako Senuma. They are happy to be contacted at l.s.gronmo@ils.uio.no and hanako@nier.go.jp, respectively, for further information on the work of this TSG.