TSG 24: Students' motivation and attitudes towards mathematics and its study

Team Chairs: ***Philip C. Clarkson***, Australian Catholic University, Fitzroy, Australia
Markku Hannula, University of Helsinki, Finland
Team Members: ***Astrid Brinkmann***, University of Duisburg, Germany
Gudbjörg Pálsdottir, Iceland University of Education, Reykjavik, Iceland
Tim Rowland, University of Cambridge, United Kingdom

Introduction

Affect in mathematics education has been studied for various reasons. Some researchers have been interested in the role of affect in mathematical problem solving, mathematical thinking, or in learning of mathematics in general. Some have been interested in the role of affect in the social interactions in the classroom. Affective variables are sometimes seen as indicative of learning outcomes, sometimes as predictive of future success. Affect is also often seen as a case or a consequence of gender differences. However, up until recently, few have argued that the effect of affect variables on students has a right to be considered as an important issue in its own right, and not only in their relationships to students' cognitive abilities.

McLeod (1992) identified three concepts to describe the affective domain in mathematics education: beliefs, attitudes and emotions. In his invited presentation at this TSG meeting he acknowledged that there are yet other important concepts within this field, such as values, motivation, feeling, mood, conception, interest, anxiety, and view, all of which he noted have been the subject of important studies in more recent years. He also suggested there is a growing interest in this area of study in mathematics education.

Aims and focus: Outline of contributions

As part of this growing awareness, the topic group that was studying the issue of affect at Third Congress of the European Society for Research in Mathematics Education (CERME 3 (2003)) suggested some new directions for research on affect in mathematics education (Evans, Hannula, Philippou & Zan, 2003). The TSG on Students' Motivation and Attitudes at ICME-10 subsequently addressed some of the goals identified in the aforementioned research agenda. One theoretical goal was to specify the different dimensions of affect and their relationships. This dimension was addressed in the papers presented by Hannula, Bikner-Ahsbahs (Germany), Rowland, Brinkmann, and Op 't Eynde and De Corte (Belgium). *Hannula* made an analysis of motivation as a concept and *Bikner-Ahsbahs* made an elaborated analysis of interest in mathematics. *Rowland* introduced a new concept, propositional attitude, and *Brinkmann* reported how students can see beauty in mathematical tasks. Instead of looking at specific aspects of affect, *Op 't Eynde* and *De Corte* had, in their study, approached students' affect in mathematics as a belief system.

Another theoretical goal was to understand the relationship between affect and cognition. A special emphasis was placed on problem solving and problem posing. In his mainly theoretical paper, Hannula looked at both affective and cognitive self-regulation of motivation, including the processes that are not usually conscious. Bikner-Ahsbahs' view of interest-dense situations encompassed both the relevance of the mathematics

included and the affective processes of the individuals involved. The papers by Rowland and Brinkmann also fall within the area where cognition and affect meet.

A third theoretical goal addressed during the Topic Study Group sessions was the understanding of the role of affect in a social context. This was specifically addressed by Op 't Eynde and De Corte who reported how students' belief systems are affected by the social context in which they are situated. *Forgasz* (Australia) focused on one social variable, gender, and Rowland focussed on the language in the classroom.

Methodology

Regarding methodology issues in the study of affect, it was acknowledged that there is a deep need to develop better instruments for measurement of different dimensions of affect, and a need to use multiple methods. Op 't Eynde and De Corte have developed questionnaire instruments for different dimensions of belief systems, and Brinkmann for the aspects of beauty in mathematical tasks. *McDonough* (Australia) has developed interview methods to use with young students. *Uusimaki* and *Kidman* (Australia) used an elegant combination of multiple methods, including use of on-line questionnaires. Bikner-Ahsbahs even described a method for summarising several theories into a meta-theory. One of the conclusions of this TSG was that far more attention should be specifically given to appropriate methodological issues in this area of study, and to the inbuilt assumptions behind different methods. Although mixed method approaches can at times prove to be most insightful, the inadvertent mixing of incompatible theoretical frameworks can set up paradoxes that are not always obvious for beginning, and sometimes experienced, researchers. The responsibility to prevent this lies with the original researcher.

Practice

An important aim of this TSG was to address the needs of practice. Naturally, participants of this group see affect as an important factor in good mathematics teaching. Bikner-Ahsbahs' paper on interest-dense situations contributes to supporting a positive affective climate in classrooms. *Glendis* and *Strassfeld* (USA) reported a case study of a group of underperforming students with negative attitudes and low self-confidence who through an intervention were able to overcome many of their initial problems. Also Uusimaki and Kidman reported an intervention study, where math anxious teacher students were able to develop more positive views of themselves as mathematics learners and teachers. McDonough indicated ways in which her research approach has been adopted by teachers in the classroom. A summary position reached by the group was that this is a very worthwhile aim to pursue. Clearly the onus is on the researchers to work closely with teachers so that useful classroom strategies can develop, that in turn allow greater insight into the interplay of affective attributes of the students.

Conclusion

This TSG was able to address issues that had been identified as important for the development of this field, but – as was acknowledged in the closing session of the group – more research is still needed. Such research should be premised on a triple bottom line approach. Cognitive outcomes are clearly important in their own right. How students develop understanding of mathematical ideas, and the skills to process them, needs to

be researched. However, the second bottom line of affective outcomes, and the third bottom line of the relationship between the cognitive and affective features, also must be seen to be as important and stand in their own right. In this era it is not good enough for a hypothetical student to be able to 'do' mathematics, if he or she 'hates' doing it.

References

Evans, J., Hannula, M., Philippou, G. Zan, R. (2003). 'Thematic Working Group 2: Affect and Mathematical Thinking'. In M. A. Mariotti (ed.) *Proceedings of CERME 3: Third Conference of the European Society for Research in Mathematics Education 28 February – 3 March 2003 in Bellaria, Italy.* Published on the web: www.dm.unipi.it/~didattica/CERME3/proceedings/

McLeod, D. (1992). 'Research on Affect in Mathematics Education: a reconceptualisation'. In Grouws, D.A. (ed.) *Handbook of Research in Mathematics Education Teaching and Learning* (pp.575-596), New York: Macmillan.

This report has been written by Philip C. Clarkson and Markku S. Hannula. They will be happy to be contacted at Philip.Clarkson@acu.edu.au, and markku.hannula@zpg.fi, respectively, for further information on the work of this TSG.

Appendix

The following were the papers presented at the meeting of TSG 24.

Beliefs
Peter Op't Eynde and *Erik De Corte*: "Junior high students' mathematics-related belief systems"
Helen Forgasz: "Year 11 students' beliefs"
Andrea McDonough: "Investigating children's beliefs"

Motivation
Markku S. Hannula: "Regulating motivation in mathematics"
Angelika Bikner-Ahsbahs: "Interest-dense situations and their mathematical valences"

Interpreting mathematics
Tim Rowland: "Propositional attitude"
Astrid Brinkmann: "The experience of mathematical beauty"

Changing attitudes
George Frempong: "Influence of practice on attitudes and confidence"
Sirkka-Liisa Uusimaki and *Gillian Kidman*: "Challenging maths-anxiety"
Margaret Glendis and *Brenda Strassfeld*: "Emotions and Motivation: Changing Goals"