

TSG 30: Motivation, beliefs and attitudes towards mathematics and its teaching

Team Chairs: Guenter Toerner, University of Duisburg-Essen, Germany
guenter.toerner@uni-due.de
Bettina Roesken, Ruhr University Bochum, Germany, bettina.roesken@rub.de
Team Members: Inés Ma. Gómez Chacón, Spain
Sung Sook Kim, Korea
Cristina Frade, Brazil

1. Introduction

Affect has been analysed from different perspectives for more than thirty years. At the beginning aspects of anxiety were primarily in the foreground (cf. Fennema & Sherman, 1976). Later, related constructs like motivation and beliefs have been studied in depth and encouraged a discussion encompassing also the concepts of emotions, goals, identity, needs, self-concept, and values as they play a crucial role in mathematics learning and teaching.

Twenty years ago McLeod (1989) referred to three concepts to describe the affective domain in relation to mathematics education: emotions, attitudes, and beliefs. The book *Affect and Mathematical Problem Solving—A New Perspective* (McLeod & Adam (Eds.), 1989) is still a milestone. The authors emphasised the role of affect as a door opener or door closer for students' problem solving activities. According to Goldin, Rösken, and Törner (2009), the three concepts identified by McLeod are named in increasing order with respect to both stability over time, and the involvement of cognitive elements. Thus, emotional feelings might be fleeting and highly affective, while beliefs are more likely to be stable and incorporate specific, detailed cognitions. Expanding on this discussion, DeBellis and Goldin (2006) suggest a tetrahedral model that includes a fourth subdomain—that of values, ethics, and morals.

Today we know that affective variables can be seen as either hidden or explicit factors that influence learning outcomes as well as teaching praxis. The different research perspectives that have been used in the study of affect include psychological, social, philosophical, and linguistic approaches. The following report on the papers that were submitted to our TSG and the discussion that was initiated by them relates to this diversity of approaches.

2. Outline of contributions

All submitted papers were reviewed by three reviewers and twelve papers were finally accepted. For presentation, papers were grouped according to three main themes:

Theme 1: Overview on research on affect

Theme 2: Students and the affective domain

Theme 3: Methodological considerations

Theme 4: Teachers and the affective domain

Each session started with a 10-minute introduction by one of the chairs. The presenters were assigned 10 minutes for presentation and 10 minutes for discussion. Each session ended with a final discussion on all contributions. In the following, we outline the four themes and contributions made by the TSG 30 members:

Theme 1: Overview on research on affect

G. A. Goldin: *Some issues in the study of affect and mathematics learning.*

I. Gómez-Chacón: *Suggesting practical advances in the research on affect in mathematical learning*

The first session provided an overview on research on affect, and outlined some methodological difficulties that face us when studying affect. Goldin pointed out that the domain of affect and motivation in the psychology of mathematics education urgently requires

greater research attention. He discussed some challenging problems in how we can approach the study of complex affect in the learning of mathematics, paying attention to both the individual and classroom levels. While providing an overview of research related to affect he discussed some scientific and methodological issues. In particular, he discussed the construct validity, the reliability of inferences, and the reproducibility and generalisability of the research.

In her talk, Gómez-Chacón elaborated how we can build bridges between research on affect and mathematical learning and classroom practice. She gave some suggestions for advancing with respect to the meta-affect issue and the interaction between affect and cognition. The use of the term meta-affect refers to the awareness of one's own emotions and their management, and encompasses paying attention to internal states without reacting to them and without judging them. Hence, to develop students' emotional competences in mathematics, she considered it important to focus on three competence areas: self-awareness, cognitive and emotional self-regulation, and social relations and interactions in the classroom and in the socio-cultural context.

Theme 2: Students and the affective domain

M. Liston: *The influence of affective variables on students' transition to university mathematics* (together with John O' Donoghue).

N. Ingram: *The importance of length, breadth and depth when studying students' affective responses to mathematics through the lens of identity.*

I. Gómez Chacón: *Students' attitudes to mathematics and technology. Comparative study between the United Kingdom and Spain* (together with Chris Haines).

The second session focussed on students and the wide range of affective responses they have to mathematics. In her talk, Liston reported on the influence of affective variables on students in first year university mathematics in Ireland. Making the transition to university is a challenging hurdle for most first year students, both personally and academically. The investigation provided rich data concerning students' attitudes, beliefs, self-concept, conceptions of mathematics and approaches to learning. Besides the impact of those variables, the influences that gender and level of mathematics studied at secondary school have on students' performances were discussed.

Ingram elaborated Sfard and Prusak's notion of actual and designated identities, which can be used as both a theoretical framework and an analytic tool to understand students' affective responses to mathematics classroom situations. In particular, she explored the need for research methodology to have length, breadth and depth by considering a longitudinal, qualitative case study of one student. The student, Philip, feels that he should be able to do mathematics easily, quickly, and as well as his peers, and that he should meet his father's expectations in terms of results. The results of the study showed that his affective responses to mathematics were found to be negative or positive depending on whether these expectations were either exceeded or not achieved.

Gómez-Chacón presented a comparative study between the United Kingdom and Spain concerned with students' attitudes to mathematics and technology. She pointed out that the use of computers in the teaching and learning of undergraduate level mathematics raises many as yet unanswered questions about the relationships between students' perceived abilities and attitudes towards mathematics and computers. Preliminary results of two studies carried out in the United Kingdom (UK) and Spain outlined undergraduate students' attitudes to mathematics and technology. The outcomes provided some suggestions for teaching and learning mathematics in higher education.

Theme 3: Methodological considerations

K. Kislenko: *The Likert scale used in research on affect—a short discussion of terminology and appropriate analysing methods* (together with Babro Grevholm).

J. M. Diego-Mantecón: *Construct consistency in the assessment of students' mathematics-related beliefs: A four-way cross-sectional pilot study* (together with Paul Andrews).

The third session discussed methodological considerations that are particularly relevant with respect to the quantitative research paradigm.

Kislenko contributed thoughts on the use of terminology, in particular with respect to differentiating between Likert scale, Likert items and Likert type items, which are common constructs in studies on attitudes and beliefs. She further elaborated the choice of analysing methods when using a Likert scale as an instrument. There is no agreement on what statistical methods are appropriate in relation to the use of a Likert scale. The issues initiated a debate among the participants.

Diego-Mantecón reported on an adaptation of the mathematics-related beliefs questionnaire (MRBQ) that was initially developed at the University of Leuven (Op't Eynde & De Corte, 2003), and its use in a four-way comparative study. He showed that the MRBQ was refined to yield a common set of scales across a sample of 11/12-year-old Spanish, English, Slovak, and Irish students, and that the scales highlighted a number of differences related to culture and gender. These results confirmed that the refined instrument achieved the conceptual and linguistic equivalence necessary for successfully comparing beliefs in Spain, England, Slovakia, and Ireland.

Theme 4: Teachers and the affective domain

C. Frade: *Culture and affect: Two studies about influences of teachers' values on students' affect.*

Chen Q.: *Teachers' beliefs and mathematics curriculum reform: A story of Chongqing.*

K. Maass: *Teachers' beliefs about mathematics and its teaching—A qualitative study in Germany.*

The last session focussed on teachers. Frade presented two studies on teachers' mathematical values and the corresponding affective reactions of the students, which they expressed both in relation to their learning and responses to their teacher's practice. The main theoretical frameworks that guide the studies are based on Bishop's (1988, 2002) ideas on values, mathematics enculturation and mathematics acculturation. Some findings were presented to support the arguments and conjectures while finally discussing pedagogical implications resulting from the studies.

Chen dealt with the consistency between teachers' beliefs and the underlying philosophy of reform-oriented curriculum, which can be an important indicator for the success of curriculum reform. She presented part of data collected within a larger and on-going research project investigating the consistency between teachers' mathematics beliefs and the underlying philosophy of the new curriculum at junior secondary level in Chongqing. The findings indicated that the underlying philosophy of the reform-oriented mathematics curriculum in mainland China was to a great extent congruent with Constructivist ideas, and that the beliefs held by a large proportion of teachers were mostly consistent with the underlying philosophy, although some inconsistencies existed.

Maass presented a qualitative study on teachers' beliefs that was guided by the research questions: What beliefs about effective mathematics teaching do teachers have? What differences exist between teachers from different types of schools in Germany? Can a relationship between the various types of beliefs be reconstructed? Can different types of teachers be identified? The results led to classifying two types of teachers. One type considers effective mathematics lessons as those in which the teacher explains mathematical results that are then used by students in stereotype exercises. The other type focuses on learning processes, problem-solving processes and on students working independently.

3. Conclusions

The papers contributed to a comprehensive overview of the main topics in the field of affect. Although the presentations pointed out some cultural particularities, the discussions revealed that the issues were of interest to all participants.

In the past, affect has often been understood as a barrier, as an obstacle, or as a hidden variable. For the future, we believe that affect should be studied more intensively as a positive driving force. The positive affect of students can only be reached when teachers have positive views on and attitudes towards mathematics. It seems to us that teacher education as well as teacher in-service training needs to pay more attention to this problematic issue.

References

DeBellis, V. A. & Goldin, G. A. (2006). Affect and meta-affect in mathematical problem solving: A representational perspective. *Educational Studies in Mathematics*, 63 (2), 131-147.

Fennema, E., & Sherman, J.A. (1976). Fennema - Sherman mathematics attitudes scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for Research in Mathematics Education* 7 (5), 324-332.

Goldin, G., Roesken, B., & Toerner, G. (2008). Beliefs - no longer a hidden variable in mathematical teaching and learning processes. In J. Maass & W. Schloeglmann (Eds.), *Beliefs and attitudes in mathematics education: New research results* (pp. 9-28). Rotterdam: Sense Publishers.

McLeod, D. B., & Adam, V. M. (1989). *Affect and mathematical problem solving – A new perspective*. New York: Springer.

McLeod, D. B. (1989). The role of affect in mathematical problem solving. In D. B. McLeod, & V. M. Adam, *Affect and mathematical problem solving – A new perspective* (pp. 20-36). New York: Springer.