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# Introduction to the papers of TWG08: Affect and mathematical thinking

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## INTRODUCTION

The quantitative data about the participation to TWG08 at CERME9 highlights the growing interest toward affective issues in the field of Mathematics Education. 40 manuscripts were submitted to the group, 34 were accepted for the discussion, and finally in these proceedings 29 papers and 4 posters are included.

Although we have seen a general upward trend in the number of countries represented within this TWG, CERME9 set a new record in this regard with 16 countries present, representing four different continents. This meant that we had more papers both submitted and presented than ever before. 40 manuscripts were submitted to the group, 34 were accepted for the discussion, and finally in these proceedings 29 papers and 4 posters are included.

Due to the high number of papers and in order to have adequate time for a deep discussion of all the contributions, we organized five of the seven working group sessions splitting the group in two subgroups, maintaining the whole group for the first and the last session. Moreover, in order to avoid the split of the group into two fixed subgroups A and B, we collected participants' interests before the conference and organized different subgroups for each split session. During the five sessions, each participant had the opportunity to attain either group A or group B according to their preferences and in this way to meet all participants of the TWG08.

All submitted documents (paper or poster) were discussed: presenters had 10 minutes (5 minutes for posters) to introduce the key-ideas of their papers, then an assigned reactor had 5 minutes to underline issues or pose questions to the whole audience and finally there were 15 minutes for discussion (5 minutes for posters). In this way, discussions were generally centred and engaging. The final versions of the papers and posters have benefited and developed from the inspiring and motivating discussions conducted during the Conference, that have also involved 5 researchers without submitted papers.

## THE STATE OF THE ART

Boero and Szendrei (1998) stress the cumulative and universal characters of the research in mathematics education: this universal character appears to be particularly important in the field of affect, characterized by several constructs derived by other domains of research. For this reason and due to participation of many newcomers in the TWG08, we used part of the first session to report the results emerged in the TWG08 in previous CERMEs conferences.

Marilena Pantziara (who chaired the previous two TWG08) developed and presented a very interesting overview, significantly titled "CERME TWG08: The past-The present-The future".

Starting with the past, i.e. the first studies in mathematics education where *affect* emerges as a field of research (McLeod, 1992), Pantziara retraced the reasons that induced many researchers to go beyond

the cognitive for better understanding the complex process of learning and teaching mathematics. Then Pantziara introduced the main affective constructs – from the more “classic” (emotions, beliefs, motivation and attitudes) to other constructs introduced in the more recent editions of CERME (identity, mathematical security, uncertainty orientation). The presentation included the evolution of definitions, methods and questions in our field, as emerged by discussions in previous Affect TWGs, and the model for the structure of the affective domain introduced by Hannula in CERME7 (2011).

In the description of the progress of the research in the field of affect (corresponding largely to the evolution of the papers presented in the overview of Affect TWG), the presentation stressed:

- the growing attention to the clarification of concepts (despite that, the problem of different meanings given to the same words is even now not overcome) and to the mutual relationship between concepts;
- the trend towards the use of mixed methods (quantitative and qualitative) in the research on affect, overcoming the initial preponderance of quantitative methods. The interesting aspect is that this trend is related to the shift from the description of a phenomenon to the interpretation of the same phenomenon;
- the growing attention to the interpretation of the collected data (this aspect is clearly linked to the previous one, and in particular to the shift on affect from a normative approach to an interpretivist one).

Within this frame, the presentation highlighted some important possible directions for future research on affect. Some of these directions were exactly discussed during the sessions of TWG08 in CERME9.

### **THE PAPERS PRESENTED IN TWG08 AT CERME9**

The analysis of research questions of the papers discussed reflects the current diversity of interests and approaches inherent in the field of affect research. The only commonality across these diverse perspectives is that the papers all deal, for the most part, with disaffection. We are still, as a field, working towards

precision in terminology and the papers reflect this effort. Finally, as in previous meetings, the papers continue to take into consideration the cultural contexts (language, traditions, and history) within which the research is set.

However, these similarities aside, CERME9 also saw a significant evolution from past affect TWG's.

In this CERME9, in continuation with a long tradition in the field of affect, a spread topic concerns the study of (pre-service or in-service) teachers' beliefs: Arslan and Bulut study middle grades mathematics teachers' teaching efficacy beliefs and their sources; Schmitz and Eichler investigate teachers' beliefs about the roles of visualization; Yurekli and Isiksal discuss the origin of pre-service teachers' self efficacy beliefs; Haser, Arslan and Kübra explore primary pre-service mathematics teachers' beliefs about mathematics teachers through asking them about their metaphors for mathematics teachers; Bräunling and Eichler exhibit a case study to reconstruct the whole belief system of a single teacher about the teaching and learning of arithmetic; Skilling and Stylianides investigate secondary teacher beliefs and practice that the teachers report using to promote cognitive engagement in their classes. Charalampous deals with students' beliefs and particularly with the question: “does mathematics pre-exist and hence is discovered or is it invented and owes its being to humans?”

Two papers are related to the development of instruments to analyse students' beliefs: Kibrislioglu and Haser develop mathematics-related beliefs questionnaires while Andrà, Brunetto, Parolini and Verani propose a codifying system for inferring the students' “I can” and “you can” during a groupwork activity.

Another issue of interest concerns the role of motivation/engagement in mathematics learning and the way to improve perseverance in students' mathematical activities: Lewis studies and describes patterns of motivation in mathematics classrooms; Pantziara and Philippou discuss the role of multiple goal in students' motivation and achievement; Barnes discusses how to improve children's perseverance in mathematical reasoning; Kazima investigates students' reasons for preferences of contexts in learning mathematics; Beumann analyses the impact of mathematical activities on motivation and interest (these last two papers are not included in the proceedings).

Several papers deal with the issue of affect in problem solving – Viitala discusses a case study of a grade 9 girl; Antognazza, Di Martino, Pellandini and Sbaragli and Daher, Swidan and Shahbari study the intertwining of affective and cognitive factors in problem solving in two different school levels (respectively kindergarten and grade 7 students); Müller-Hill and Spies analyse the role of aesthetic experiences in problem solving processes; Tuohilampi, Näveri and Laine present a three-year intervention designed to improve primary school pupils' problem solving skills, and mathematics-related affect; Morselli and Sabena present a study about primary pre-service teachers' affective pathways in problem solving – and, more in general, with emotions. Helmane describes basic emotions of primary students during mathematics lessons; Martínez-Sierra describes students' emotional experiences in high school mathematics, Schukajlow analyses a connection between boredom and students' performance; Fyhn deals with the original theme of the consideration of affective aspects of knowing mathematics in oral examinations in Norway.

De Simone and Lake discuss in their papers the emotional experience of teaching mathematics at the secondary school level.

Regarding the posters, Grothérus describes a method for teaching, evaluation and assessment in mathematics finalized to reduce students' math anxiety; Hansson investigates how students explain their selected failure in mathematics; Andrà, Brunetto, Parolini and Verani study teachers' interpretations of students' mathematical competencies; García González and Farfán Márquez analyse students' attitudes towards mathematics.

As usual in our group, there are papers that examine in depth theoretical aspects: Liljedahl uses the theory by Leont'ev to interpret pre-service teachers' changes after an intensely negative emotional experience and introduces the idea of hierarchy of teachers' motives; Moscucci and Bibbò describe relationship in the affect domain using theory by neuroscience; Pieronkiewicz introduces the notion of affective transgression in order to interpret students' negative emotions towards mathematics; Branchetti & Morselli study the relation between identity and rational behavior.

The discussion of theoretical aspects was particularly stimulating because it highlighted new trends. In

particular, in CERME9 for the first time we had papers looking at affect from the participationist (social) perspective overcoming a pure acquisitionist (individual) perspective. Moreover, the discussion about identity (a construct that has a growing attention in the field of affect) has underlined the possible contributions for the study of this construct from a socio-psychological and interactionist approach emphasizing the construction of identity processes and conceiving identities as strategies.

The importance of considering the dynamic dimension of culture has been also underlined. In particular, it has been highlighted the need to unpack “cultures”, considering how they have been enculturated into a set of pedagogical assumptions (that is, beliefs and orientation).

Summarizing this brief panning shot at a more qualitative level, the papers presented are focused much more on teacher affect (as opposed to student affect) than we have seen in the past.

*Trait* and *state* (Hannula, 2011) research has long been presented in the papers at past CERMEs. However, unlike previous years, the research at CERME9 was much more focused on the *state* side of this dichotomy. CERME9 also saw an increase in the number of different affective frameworks being used to analyse phenomena and more qualitative papers. This stands in stark contrast to, for example, CERME5, where almost all of the papers were quantitative.

We also saw several papers dealing with emotions, which is a significant change from past CERMEs. Likewise, there was an increased presence of research into meta-affective aspects, the role of interests, creativity, and self-regulation – topics that had previously received little attention at CERME.

Finally, for the first time we had two papers looking at affect from the participationist perspective.

Despite all this evolution the participants felt that more changes are still needed. In particular, there was a call for further work in improving our definitions. In addition, there was a feeling that more work was needed on the emergent topics of emotions, and meta-affect.

Although we continue to consider cultural contexts it may also be time to consider micro-cultures, such as the classroom or student-teacher relationships. More longitudinal research is needed and, with the shift from quantitative to qualitative research methods, it is now time to consider mixed methods. The introduction of participationist perspectives signals a need to pay more attention to theorizing and networking of theories as well as more comparative and cross-domain research. And, of course, more work on the implications of research on the constructs for curriculum development, teacher education, assessment, and intervention is warranted.

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