CERME 8-WG8

Affect and Mathematical Thinking!

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How did we work?

- For Sessions 1-5, papers discussing similar topics were mainly grouped together in one session.
- Each presenter had 5-7 to introduce some interesting ideas arising from his research or discussion paper.
- Each presentation was developed through the key-topics (theoretical framework, methodology, findings and implications).
- A discussant reacted to each paper. The questions were posed to the whole group.
- WG sessions 6 and 7 were exclusively on the discussion of theoretical framework and methodology, discussion and further study of all papers. Questions were discussed in small groups and the results of each group were presented to the whole Affect group.

The structure of the affective domain

Beliefs	Attitudes	Emotions
Most cognitive		Least cognitive
Most stable		Least stable
Less affective		Most affective

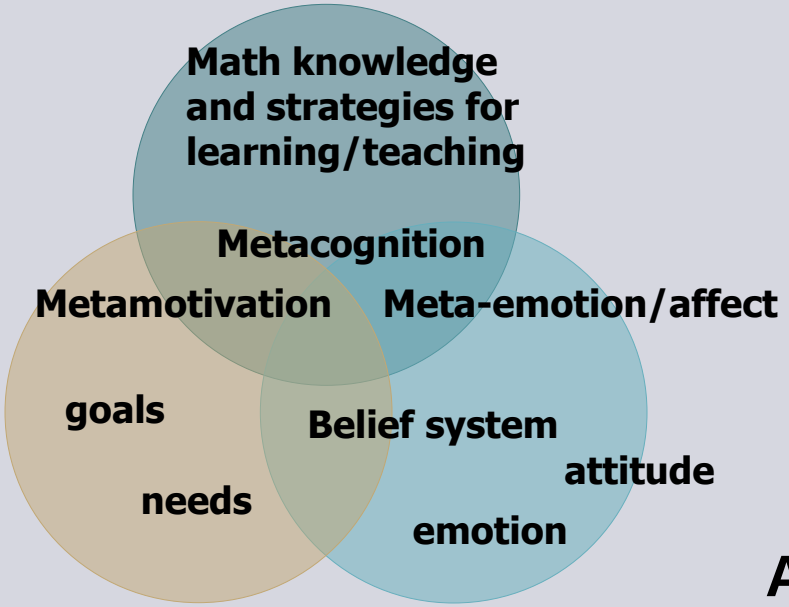
- **Using different theoretical perspectives.**
- **Using more specific concepts, clarifying existing ones.**
- **Broadening the field: introducing new concepts and clarifying relations with cognition and motivation.**

- Intensive discussion on the topic of theoretical frameworks and terminology.
- **Increased awareness of being specific about the concepts that we use. We have to make clear their relations to the other dimensions of affect research.**
- The graphic representation of the conceptual field by Peter Op't Eynde (CERME 5).
- The figure identifies three main conceptual categories and their partial overlapping (Hannula, Op't Eynde, Schloglmann & Wedege, 2007, p. 204).

Socio-historical context

Classroom context

Student/teacher



The socio-constructivist perspective on learning underlines the interplay between cognitive, motivational and affective factors but also it highlights the influence of the specific classroom context in the whole process (Op't Eydne et al., 2006).

Beliefs

Philipp (2007) provides an overview of some of the more commonly used terms related to beliefs: affect (including emotions, attitudes and beliefs), beliefs systems, conceptions, identity, knowledge and values. All of these concepts have been used with various meanings by different researchers.

Pehkonen & Pietilä (2003)

- Subjective knowledge
- Affective factors in the belief systems
- Degrees of stability
- Context (population, subject)

Beliefs

Beswick (2012) provides a categorization of mathematics teachers' beliefs into beliefs about the nature of mathematics, mathematics teaching and mathematics learning.

Table 1: Categories of teachers' beliefs (Beswick, 2012, p. 130)

Beliefs about the nature of mathematics (Ernest, 1989)	Beliefs about mathematics teaching (Van Zoest, Jones, & Thornton, 1994)	Beliefs about mathematics learning (Ernest, 1989)
Instrumentalist	Content focused with an emphasis on performance	Skill, mastery, passive reception of knowledge
Platonist	Content focused with an emphasis on understanding	Active construction of understanding
Problem solving	Learner focused	Autonomous exploration of own interests

Beliefs and Self-efficacy beliefs

- Beliefs' effect on predispositions towards behavior... (Philipps, 2007).

- Perceived self-efficacy beliefs' effect on the decision and perserverance of a specific behavior...(Bandura, 1997; Brand & Wilkins, 2007).

Self- Efficacy beliefs

- Perceived self-efficacy beliefs refer to individual judgments regarding the capability of a specific behavior (Bandura, 1997).

- Teacher efficacy: How competent a teacher feels in his or her ability to affect the performance of all students, no matter how unmotivated the students are or how difficult the teaching topic is (Tschannen-Moran et. al., 1998).

Attitudes

- Two different theoretical frameworks.
- **Attitude towards mathematics and its teaching:** Three strictly interconnected dimensions, emotional disposition towards mathematics (“I like/dislike mathematics”) and its teaching, vision of mathematics and its teaching (“mathematics is ...”)and perceived competence in teaching mathematics (“I can/cannot do mathematics”) (Di Martino & Zan, 2010).

Attitudes

- Evaluative predisposition (negative or positive) that determines the personal intentions and influences on the behavior.
- It consists of three components: one cognitive that manifests on the mentioned attitude underlying beliefs, another one affective, that manifests on the work or matter acceptance or rejection feelings and one intentional or trending to a certain behavior. (Gómez-Chacón, 2000, p. 23).

Other Concepts related to Affect

Identity

- The construct of identity refers to “the way we define ourselves and how others define us” (Anderson, 2007, p. 8), and serves to explain what makes a person to feel like an able mathematics student and as a consequence get involved and engaged in mathematical activities.

Other Concepts related to Affect

Teachers' goals

Taxonomy of Five Goals (Liljedahl, 2012)

0. Resistance
   - *"That will never work."*
1. Do Not Disturb
   - *"A different way to …"*
2. Willing to Reorganize
   - *"I'd like some ideas about …"*
3. Willing to Rethink
   - *"Anything to do with numeracy ..."*
4. Out With the Old
   - *"It's not working. I need to start over …"*
5. Inquiry
   - *"I'm eager to hear about …"*

Other Concepts related to Affect

Mathematical security

- Is framed in two steps: (i) by reference to dictionary definitions of security as ‘freedom from fear or anxiety’ (e.g. www.merriam-webster.com); (ii) a typology of fear due to Riemann (1970). Riemann proposed four types of fear which correspond to four types of personal need and are organised into two opposing pairs.
- (a) fear of *assimilation* [our translation] versus fear of *isolation* and (b) fear of *change* versus fear of *stagnation*.

Other Concepts related to Affect

Perception of relevance

- The Engeström model (Cole & Engeström, 1993) is used as an analytic tool to describe and analyze the students' perceptions of relevance. The model depicts the activity system, which involves the interaction between the subject (students) and the object (motives, goals, learning school subjects including mathematics and material resources) mediated by tools and artifacts. This interaction is also mediated by the rules, the division of labor, and the community.

Motivation

Family of social cognitive constructs	**Our focus**
1. Self-efficacy beliefs and competence perceptions	
2. Adaptive attributions and control beliefs	Self-determination theory: Three needs: competence, relatedness, and autonomy
3. Interest and intrinsic motivation	Self-determination theory: Intrinsic motivation
4. Students' thoughts about the importance of a task. Expectancy-value theory	
5. Goals and goal orientation	Goal orientations

Other Constructs related to Affect

Fear of mathematics

Fear is a valenced reaction to an undesiderable EVENT (Clore & Collins, 1988).

- In this case, the undesiderable event is: failure in mathematics
- The (perceived) likelihood of the event determines the intensity of fear.

Uncertainty orientation

- The uncertainty orientation (Sorrentino & Roney, 1999) describes a person's typical ways of dealing with complexity, uncertainty, and abundant information (Hänze & Berger, 2007). Uncertainty-oriented persons are interested in complex situations and use these situations to gain the new knowledge.

Mathematical confidence

Enjoyment Vs Help-seeking

Research questions

Research on Beliefs

1. What can be learned about student teachers' beliefs from content analysis of their focused discussions prior to field practice (Reidar Mosvold, Janne Fauskanger, Raymond Bjuland & Arne Jakobsen).
2. Investigation of teachers' beliefs concerning the calculus domain to understand their teaching practices(Ralf Erens & Andreas Eichler).

Research on Beliefs

3. Investigation of teachers' beliefs and knowledge related to the Cyprus mathematics curriculum reform (Marilena Pantziara, Marianna Karamanou and George Philippou).
4. In which ways focused discussions based on MKT items can be used to tap into teachers' beliefs about aspects of MKT(Janne Fauskanger and Reidar Mosvold).

Research on Self-beliefs

5. Investigation of the effects of the elective origami course on preservice teachers' beliefs and perceived self-efficacy beliefs in using origami in mathematics education(Okan ARSLAN & Mine IŞIKSAL).
6. Sharing the process of investigating teachers' trigonometry teaching efficacy and categorizing them in terms of their efficacy levels (Ayşe SARAÇ , Fatma ASLAN-TUTAK).

Research on Attitudes

7. To explore teachers' attitudes towards mathematics as a first approach on the research of affective factors in the teaching and learning process within the Telesecundaria educative subsystem (Maricela Fuentes Rivera Inés María Gómez-Chacón).

Research on other Affective constructs

8. The study takes a closer look at teachers' goals across five different professional learning settings(Peter Liljedahl).

9. The feeling of security which mathematicians can draw from mathematics(Eleni Charalampous and Tim Rowland).

10. The identification of the factors that motivated Mexican female students to choose mathematics as a career (Mario Sánchez Aguilar et al.).

11. The investigation of Ethiopian students' perceptions of the relevance of mathematics to their learning goals. (Andualem Tamiru Gebremichael).

Research on Motivation

12. Presentation of five different families of social cognitive motivational constructs. The review of research on the relationship between teachers' practice in the mathematics classroom and students' motivation, in terms of intrinsic motivation and goal orientation. (Kjersti Wæge and Marilena Pantziara).
13. Examination of the influence of close friendships, and friendships by association, in mathematics classrooms of 14-15 year olds on students' motivations to engage with mathematics (Julie-Ann Edwards and Debra Deacon).

Research other Affective constructs

14. Understanding the origin of fear of mathematics by giving voice to the students, analysing students' narratives about their relationship with mathematics (Pietro Di Martino & Rosetta Zan).

15. What does learners' mathematics confidence entail when reflecting on mathematics problem solving experiences?(Divan Jagals and Marthie van der Walt).

Research other Affective constructs

16. Description of the help seeking and enjoyment patterns reported by the participants in an inclusive mathematics competition (Susana Carreira, Rosa A. Tomás Ferreira, & Nélia Amado).
17. Secondary students' preference for solving tasks with multiple solutions, uncertainty orientation and treating tasks with multiple solutions in their everyday mathematical classes(Stanislaw Schukajlow, André Krug).
18. Investigation of students' coping with negative emotions when faced with difficulties in mathematics (Engin Ader & Emine Erktin). (poster)

Methodology

Methods – beyond correlations and descriptive studies

- A trend towards mixed methods: Combination of qualitative and quantitative approaches (Observations, Interviews, Teachers'narratives, Students' narratives, noticing, questionnaires)
- Focus Group Discussions
- Methods for examining changes in beliefs and motivation.

Discussion and Results

Current Results

1. The development and clarification of the concepts and instruments in the domain.
   - The contribution of a combination of qualitative and quantitative methods.
   - Clarity of the concepts within the domain was further enhansed by an increasing unity in the language of affect.
   - New concepts introduced. The need to combine the new concepts with the existing ones.
2. How are new constructs in the group (e.g. security and uncertainty orientation) developed?
   - Ability
   - Identity
   - Social-Interaction with the environment

Current Results

3. How are these new constructs related to the more traditional constructs in the affective domain (beliefs, attitudes and emotions)?
   - Uncertainty may be a part of Identity.
   - How stable these new concepts are. (Trait and state aspect of Affect).
4. Relation between different constructs in the affective domain and their connection to other areas in the realm of mathematics education (Close relation between beliefs, motivation and competence).
   - The complex nature of these relations-same affective constructs-different behaviour.

Current Results

5. How do the instruments and the context influence students and teachers' affect? How can we reduce this influence?
   - Researcher's Identity
   - Combination of qualitative and quantitative analysis.
   - Students' and teachers' emotional state as they complete a questionnaire.
   - Comparative studies-Language issues, culture.
6. How does the framework influence the way we interpret data?

Further study

The need to deepen our knowledge of the structure and dynamics in the affective domain.

- Introduction of the new framework proposed by Markku Hannula (2011).
- Could be seen as a metatheoretical foundation for research in mathematics related affect.
- The framework helps to identify similarities and differences between studies in the field, and it is probably useful for relating a variety of theories to each other.
- The most important notions: 1. a distinction between trait and state-aspect of affect; 2. perceiving emotions, cognition and motivation in a synergistic relationship; 3. the identification of biological, psychological and social levels of affect.

Ideas for further study

1. Investigate in depth the psychological and social state of the theoretical framework (Hannula, 2011).
2. Comparative studies on affect (teachers' beliefs related to the mathematics curriculum reform). Initiation of studies from participants in the Affect group.
3. Long term longitudinal studies on affect.
4. Same data analyzed from different theoretical perspectives.
5. Comparison of studies investigating constructs related to different theoretical perspectives in a domain, e.g motivation.

The work will go on…

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