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# TWG08: Affect and mathematical thinking

## **Introduction to the papers of TWG08:**

### **Affect and mathematical thinking**

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### **Introduction**

This chapter introduces the contributions discussed during the working sessions of the TWG8 “Affect and mathematical thinking” in CERME 10.

In this edition our TWG has been enhanced by the inclusion in the group and the contribution in the discussion of the researchers from the TWG7 “Mathematical Potential, Creativity and Talent”.

The quantitative data about the participation to our group confirms the interest toward affective issues in the field of Mathematics Education: 41 manuscripts were initially submitted to the groups, 26 were accepted for the discussion, and finally in these proceedings 24 papers and 2 posters are included.

Moreover, our group confirms its spirit of inclusion: 12 different countries were represented and 11 newcomers welcomed.

The papers (24) and the posters (2) were presented and collectively discussed in the first six sessions. Presenters had 10 minutes (5 minutes for posters) to introduce the key-ideas of their papers, then we developed a 10 minutes discussion. At the end of each session, 20 minutes were used to discuss the main aspects emerged in the section.

In the fourth section, one hour has been devoted to the presentation of the ERME Chapter about affect: the draft of the chapter was sent to all participants before the conference, and each participants had to share two questions, comments or criticisms about this draft. The collected comments are been the thread of the discussion related to the chapter.

In the seventh and last session, we discussed the main themes emerged during our previous work, developing the structure of the report for the final day.

### **The issues emerged in TWG8 at CERME10 and the related discussion**

The analysis of the affective focus of the papers discussed in our TWG reflects the current diversity of interests and approaches inherent in the field of affect research. Many different affective constructs emerged: beliefs, motivation, values, emotions, needs, relaxed, memory, aesthetic, confidence, meta-affect, identity, self-efficacy, meaning, motivation, values, images, views, flow, perseverance, tolerance, interest.

It is important to underline as many of these constructs are clearly related, sometimes – and this is a well-known critical aspect in the affective research – different labels are used to indicate the same constructs, and vice versa. Sometimes the same term is used in a very different meaning by different

researchers. As we will underline later, this communicative issue is particularly critical for the emotions.

In our discussions, we underlined the lack of conceptual clarity again, and called researchers to use a clear definition in their studies and to label the constructs appropriate.

Despite this variety, we recognized five recurrent and crucial dimensions involved in the discussion of our group: students, problem solving, self-concept, emotions and context.

In the following, we briefly discuss some aspects related to these five dimensions.

### **Students**

Enriched by the contribution of researchers from the TWG7, we have long debated about the so defined “achievement problem”, discussing around the following clearly related questions:

- Looking at school transitions: what are the effects of these transitions on school achievement? How and why do the parameters of the school achievement change dramatically from a school level to the next?
- What is the relationship between school achievement and mathematical talent?
- What is the distinction between low and high achievers in mathematics apart from the grade?

We also argued as it would be interesting to develop research around the above themes, looking at students who are studying mathematics in different contexts (for example modelling, IT environment, etc.).

### **Problem solving**

There is a known and long tradition of research about affective construct and problem solving. This kind of research it is particularly important for our field, since it shows two crucial aspects: the strict relationship between affect and cognition (problem solving activities surely involve cognitive aspects but also strong emotional reactions); the relevance and peculiarity of the research on affect in the specific context of mathematics: indeed problem solving is one of the main activity for mathematicians.

As usual, one of the main issues is how teachers can create the context in order to develop the appropriate mathematical activities and environment for positive affect, increasing motivation and also performance. In several discussions within our group, it emerges as problem solving is not only an essential activity for developing the mathematical competence, but it has also the potential to draw attention and to motivate students, because – in some sense – problem solving is one of the beautiful side of math (the eminent mathematician Ennio De Giorgi used to say: a nice problem, even if you do not solve it, accompanies you).

Many papers presented in our group stressed the relevance of two aspects in order to take advantage of the *affective potential* of problem solving.

The first one is related to the setting: here setting is understood in a broad meaning, on the one hand we mentioned the classroom climate – a positive climate is needed to develop significant problem solving activities, in particular it appears crucial to not identify problem solving activities and

assessment – and the context (for example the spatial organization of the classroom). On the other hand, we mentioned the organization of the problem solving activities with the promotion of collaboration and discussion among students.

The second one is related to the choice of the mathematical problem. It is confirmed as only cognitive demanding (and not routine) problems can foster students' engagement, but, above all, can challenge students shifting their attention from products to processes. In particular, it is also crucial the monitoring of the possible imbalance between skill and challenge that student can experience during problem solving. In this setting, problem solving can be a tool to involve high-achievers, but also low-achievers, in mathematical activities and increase positive affects towards mathematics.

### **Self-concept**

The fact that students/teachers self-concept strongly affects their choices, the effort they devoted and their perseverance in doing some specific activity is one of the fundamental points in our field. Therefore, it is not a surprise that many discussions in our group focus around self-concept and related constructs, such as: self-efficacy, self-perception, self-regulation, identity, personal meaning.

In particular, three aspects related to the self-concept have been analysed and discussed in this edition of the TWG8:

- How students' self-concept influences their interpretation of the *mathematical environment*;
- How the context affects the self-concept, in particular it emerges the idea that context provides available identities;
- The connection between the self and the emotions (in the context of mathematics education). Self has seen as a filter for interpreting experiences.

### **Emotions**

Obviously the study and the discussion around emotions is a must in the group of affect.

In particular, we discussed some crucial dichotomy related to the concept of emotion:

- Emotions sometimes are a cause for some didactical outcomes, but sometimes are a symptom. In the first case, we see positive emotions as an educational goal, in the latter emotions are an indicator;
- Emotions have a double nature: more rapidly changing state-aspect and more stable trait-aspect. The study of state, as opposed to trait, is necessary to give a more detailed description of emotional experiences in the mathematical teaching-learning process;
- Emotions can be the cause for opposite pathways during problem solving, or more in general mathematical activities (go on vs. give up).

As usual, we also discussed how deal with two classical critical issues in the research about emotions: one related to the observation and the other related to the communication.

Emotions, in truth as many other constructs, are not directly observable, therefore we never observe emotions, but we infer them from some indicators. Sometimes we collect information about emotions through self-reports, and – already at this stage – communication issues intervene; studies

developed in different countries stress the level of *emotional illiteracy* of a large part of the population: it is difficult to reflect about emotions, and it is more difficult to have the dictionary to communicate them.

The *communication problem* involves the field of the research not only for the difficulties related to the emotional illiteracy, but also for the *internal* communication (the communication between researchers): as a matter of facts, the labels for emotions have different shades in every language, and sometimes they are associated to a different meaning.

### **Context**

Affective issues are mainly social for their nature: as we have seen, context plays a crucial role in the development of affective reactions. For this reason, context is always been one of the *leading actors* in discussion within TWG8.

A still open problem is the exact definition of context: what is the context? We are convinced that the context is dynamic in nature (it depends on the group/individuals), and this dynamicity makes more complex to circumscribe it.

In the group discussion was observed that in the context of emotion, the term ‘culture’ needs to be ‘unpacked’ and broached not from the assumption that cultures are uniform, but rather from more dynamic conceits such as put forward by identity theories.

Some studies in this edition focus on the difficulties related to the transition from a context to another one (for example in the school transition), analyzing how and how much these *context-transitions* change affect.