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Documenting metacognitive activity in qualitative interviews with high school graduates

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Keywords: Metacognition, calculus, university.

Theoretical background

The poster gives an overview of the research and theoretical background of an ongoing dissertation project the major focus of which is on metacognition in mathematics education. A central objective is the documentation of metacognition during mathematical activity in prospective mathematics university students and using the results of this study to expand upon existing category systems of metacognition – especially for the field of Calculus.

Metacognition is generally understood as knowledge about and cognitive processes dealing with (one's own) knowledge and cognitive processes (Flavell, 1976) as well as regulating those.

Metacognition is usually divided into a declarative and a procedural component and their respective sub-categories. Declarative metaknowledge signifies available, explicable knowledge a person possesses about the workings of their own cognitive functions and knowledge. Further specifying the concept, declarative metaknowledge can be subdivided into the three categories *person knowledge*, *task knowledge* and *strategy knowledge*. Procedural metacognition on the other hand is focused on planning, cognitively monitoring, reflecting and evaluating cognitive activity as well as regulating the latter. (Schneider, 2010)

It is expected here that in order to be metacognitively active during mathematical learning or problem-solving processes two or more of these (and possibly further) subcategories “interact”.

The usefulness of metacognition (for learning and doing mathematics) has been documented in the past.

On the mathematical side of the project, the field of Calculus/Analysis was chosen due to its potential for metacognitive activity. For example, developing a stable idea of the concept of limit demands for a change in perspective when dealing with its dynamic and static aspects and integrating them into a coherent idea. It seems likely that the ability to metacognitively reflect and regulate one's own learning processes is beneficial to enable this change and for mathematics learners and practitioners in general.

Research questions

- 1) Which kinds of metacognitive activity can be observed in high school graduates/ prospective mathematics students when dealing with mathematics?
- 2) Can these activities be fully described using existing category systems or can they be used to expand those?

- 3) How and where can metacognitive activity be beneficial with regard to the field of Calculus/Analysis? What will a category system look like that classifies the term metacognition for that field and expands existing – and possibly more general – models?

Empirical study

Prospective mathematics students' pre-existing use of metacognition was documented via a qualitative interview study at Wuerzburg University. As a sample group, eleven prospective students from mathematics study courses were selected on a voluntary basis. Five participants were invited for a single interview (one participant, one interviewer) in order to avoid inhibitors between two or more participants (such as shyness, different levels of extroversion or different levels of (perceived) "competence"). Six participants were interviewed in pairs (two participants, one interviewer) to reduce inhibitors between interviewer and participant (such as shyness, artificiality of the situation or different levels of mathematical experience) and to give the students the possibility to interact with each other – such as mutually explaining ideas and one's understanding of a mathematical concept, motivating each other to go on, detecting each other's errors and correcting them, discussing strategies, etc.. A partially-structured interview design was chosen, focusing on metacognitive activities during high school and on developing problem-solving strategies for a Calculus problem at hand. The interviewer had a manual at his disposal to guide the participants through various metacognitive topics, but in order to reduce influencing effects direct questions were avoided and the conversation was mostly left to the participants. The resulting interview transcripts are currently being evaluated by means of Qualitative Content Analysis methods (Mayring, 2010).

Perspectives

It is the aim of the project to specify the term metacognition and its sub-categories with regard to the field of Calculus/Analysis, building upon existing category-systems and expanding them. It is hoped that such an expanded category-system can be used as a base for introducing metacognitive activity in Calculus classes (at school and university level) in a structured way and to precisely evaluate students' metacognitive "abilities". Documenting prospective mathematics students' pre-existing metacognition should help to both further specify the afore-mentioned categories and possibly add more sub-categories to the system, as well as to gain information about which metacognitive skills students may already possess and actively apply in their learning practice and which kinds of skills need to be strengthened and/ or introduced into a "metacognitively-supported" curriculum.

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