

# Conceptual Desires and Procedural Demands: Conflicting Aims in University Mathematics Students' Work on Tasks in Seminar Groups

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*Small groups teaching as part of first semester was studied through observations of the seminars, analysis of the tasks, and students' responses in surveys and interviews. The research question posed is how the teaching activities enabled the students to develop their conceptual and procedural knowledge. The results show a desire for a development of conceptual knowledge but the demands on procedural knowledge placed the students with conflicting aims.*

**Keywords:** university mathematics teaching, conceptual knowledge, procedural knowledge

In the area of university mathematics education there is a growing interest in the teaching (Biza, Giraldo, Hochmuth, Khakbaz, & Rasmussen, 2016). Small groups teaching has shown reasonable effects on students' conceptual understanding (eg. Jaworski, Robinson, Matthews, & Croft, 2012), but still there is need for research on the use of small groups teaching to understand students' learning in such settings. The poster presents results from a project at a mathematics department in Sweden where small groups teaching was part of the schedule for the first semester mathematics students (Pettersson & Larson, 2018). The aim of the project was to develop the small groups teaching and a study was set up to better understand the situation. The so called seminar groups met once a week, included about 10-15 students in each group and were led by an experienced lecturer. There were also four times a week ordinary lectures given in a lecture hall for all the students (>100 students). In the seminars students were discussing tasks that promoted conceptual knowledge. An example of a task is "What does it mean for a function that the derivative is missing in one point?" The students were before each seminar obligated to hand in written solutions of one or two tasks. These tasks are marked and commented on by the teacher of the seminar group. An example of such a task is "Give the global maximum and minimum for the function  $f(x,y) = \ln(1+x^2+y^2) - x$  on the disc given by  $x^2+y^2 \leq 4$ ."

The research question for the study presented here was: How did the small group teaching activities enable the students to develop their conceptual and procedural knowledge? Data collection includes observation of small group sessions, analysis of the given tasks, and students' responses to surveys and interviews. For the data analysis a deductive thematic analysis has been used where procedural and conceptual knowledge are used as defined by Baroody, Feil, and Johnson (2007). Starting from Hiebert (1986), further discussions argued that both procedural and conceptual knowledge could be of different quality (eg. Star, 2005) and that both procedural and conceptual knowledge need to be developed and to be intertwined (Baroody et al., 2007).

The results show that both the students and the teachers desire a development of conceptual knowledge. The discussion tasks were posed in a way to promote this kind development. The students appreciated this and wanted time to even more think about conceptual tasks. However, the tasks that the students are obligated to work with and deliver for grading were mostly engaging the students in development of procedural knowledge. The students used a lot of time to get every symbol right. So, even if the lecturer in the seminar raised conceptual aspects according to the comments made, the students were not able to fully take on that. The demand for procedural knowledge gave rise to a conflict with the desire for conceptual knowledge, and that hindered a development where procedural and conceptual knowledge got intertwined.

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