# Exploring the relationship between students’ background, cognitive activation and mathematical knowledge development

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This presentation reports on parts of a project with a focus on cognitive activation which is a construct aiming at exploring how students potentially can engage in mathematical thinking to develop conceptual understanding. Previous research provides mixed results regarding the relationship between potential cognitive activation, students disposition, background and knowledge development. Preliminary results do not support a hypothesis that cognitive activation is more beneficial for students with more advantaged backgrounds. Further, the presentation aims to elicit and discuss aspects of cognitive activation, students’ disposition, background and the relationship with knowledge development.

## Introduction

Mathematical tasks and classroom discourse are critical elements for students engaging in mathematical thinking and developing mathematical knowledge. The construct of cognitive activation place the focus on these two aspects and how it relates to developing conceptual understanding (Praetorius et al., 2018) and as such plays an important part in the relationship between teaching and learning of mathematics. Previous research (e.g., Atlay et al., 2019) suggests that cognitive activation is more beneficial for students with more advantaged backgrounds, and potentially could enhance an educational gap. Also, there is still a need to explore potentially mediating processes involved (Praetorius et al., 2018). Hence, the guiding question is: What is the relationship between students’ background, cognitive activation and mathematical achievement?

 Due to limitations of this format, only relationships regarding parents’ educational level are presented in this text, but will be extended during the conference.

## Method

The study includes upper secondary students ($n\_{students} = 1007, n\_{groups}=49$) studying their second math course enrolled in two separate academic math tracks, b and c, where the latter is for students at more mathematically oriented programs. Achievement measures includes national tests in their first and second course. Other variables stem from a questionnaire briefly explained in the following. Parents education, *ParEdu*, longest education of parent (or caregiver) in household (Scale 1-7 based on ISCED). *ParEduLong*, dichotomized (0 = less than 3 years university studies). ParEduLong.G is an aggregate to group level representing the percentage of parents with long university education. Cognitive Activation, *CogAct*, is based on nine questions (e.g., “The teacher gives us problems which require that we think for an extended amount of time”) and aggregated as a level 2 variable (Cronbach $⍺=0.86$, $ICC\left(1\right)=0.21,$ $ICC\left(2\right)=0.83$). Multilevel analysis is utilized where students (level 1) is nested within groups (level 2).

## Results

Table 1 presents some preliminary results where model 2 and model 4 show no significant interaction between parents’ educational level and cognitive activation on mathematics achievement. Model 1 and model 3 provide support for the positive association between cognitive activation and mathematics achievement. Further, model 1 and 3 also show significant relationships between length of parents’ education and achievement, acknowledging the educational gap related to students’ home environment.

|  | Model 1 | Model 2 | Model 3 | Model 4 |
| --- | --- | --- | --- | --- |
| ParEdu | 1.038\*\*\* | 3.073 |  |  |
|  | (0.270) | (2.868) |  |  |
| CogAct | 7.223\*\* | 10.994+ | 5.619\* | 12.049 |
|  | (2.243) | (5.745) | (2.292) | (11.749) |
| ParEdu × CogAct |  | -0.715 |  |  |
|  |  | (1.004) |  |  |
| ParEduLong |  |  | 2.517\*\*\* | 2.519\*\*\* |
|  |  |  | (0.709) | (0.709) |
| ParEduLong.G |  |  | 11.086+ | 41.603 |
|  |  |  | (5.767) | (55.038) |
| ParEduLong.G × CogAct |  |  |  | -10.992 |
|  |  |  |  | (19.711) |
| + p < 0.1, \* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001. Math track is included as covariate in all models. |

Table 1. Multilevel regression analysis of mathematics achievement on cognitive activation and parents’ educational level.

Further results will be presented at the conference, including other factors related to students’ disposition and background which will be discussed in light of current research pertaining mathematical knowledge development.

## References

Atlay, C., Tieben, N., Hillmert, S., & Fauth, B. (2019). Instructional quality and achievement inequality: How effective is teaching in closing the social achievement gap? *Learning and Instruction*, *63*, 101211. https://doi.org/10.1016/j.learninstruc.2019.05.008

Praetorius, A.-K., Klieme, E., Herbert, B., & Pinger, P. (2018). Generic dimensions of teaching quality: The German framework of Three Basic Dimensions. *ZDM*, *50*(3), 407–426. https://doi.org/10.1007/s11858-018-0918-4