Exploring student teachers' instrumental genesis of programming

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As a result of digital competence becoming more important in society, programming was introduced in the mathematics curriculum for Swedish upper secondary school in 2018. In the mathematics courses – where it is included – programming is described as a strategy for mathematical problem solving. By integrating programming and mathematical problem-solving, new opportunities for mathematics education in upper secondary school are opened. Nevertheless, the teaching of programming also implies new challenges and potential pitfalls. Since programming heretofore has only to a minor extent been part of the mathematics teacher education in Sweden, the new content of the curriculum also sets higher demands on the development of the teacher education program. The present study is part of a larger project, aiming at contributing to the research on the ongoing integration of programming into secondary school mathematics, through investigating in what way programming can offer additional possibilities for learning mathematics, compared to a more traditional education. In this study we investigate student teachers' work with programming, in a calculus course in their first year of the secondary school teacher education program.

To theoretically frame the study, we use the instrumental approach, in order to study students' instrumental genesis, i.e., the process where an instrument is formed from an artefact, when using programming as a tool in mathematics (Trouche, 2004). The instrumental genesis consists of two important processes: the instrumentalization, which is the process where the user gets to know the tool, and the instrumentation, which is the process that allows the user to develop an activity within some boundaries.

Most students enrolled at the secondary teacher education program at the University of Gothenburg do not have any, or have very little, prior experience in programming. In the calculus course the students take part in a computer lab where they – with the help of Python – are asked to explore Riemann-sums of continuous functions. Through observations during the students' work with exercises, and through a follow-up questionnaire, we explore the potentials for learning mathematics through programming. In particular, we investigate what difficulties regarding programming and mathematical content the students encounter during the beginning of their instrumental genesis. A majority of the students answering the questionnaire argued that the programming part of the lab was difficult, but that it helped them to gain a deeper understanding of Riemann-sums. Some students argued that, to be able to construct a correct program, they had to decompose the concept of Riemann-sums in order to understand how they are structured.

Reference

Trouche, L. (2004). Managing the complexity of human/machine interactions in computerized learning environments: Guiding students' command process through instrumental orchestrations. *International Journal of Computers for Mathematical Learning*, *9*(3), 281–307.