Coding in math learning: A ‘triple instrumental genesis’ approach to support the transition from university learner to school teacher

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INTRODUCTION AND RESEARCH QUESTION

We are witnessing a rapidly changing landscape of coding and computational thinking integration in compulsory education in many parts of the world. In particular, in their 2022 math assessment framework, PISA states that “students should possess and be able to demonstrate computational thinking skills as they apply to mathematics” and that they anticipate “a reflection by participating countries on the role of computational thinking in mathematics curricula” (OECD, 2018, p. 5, para. 12). Such a push to rethink school mathematics creates a pressing need to rethink the preparation of math teachers.

Since 2001, the Mathematics Department at Brock University in Ontario (Canada) has implemented a sequence of three courses (MICA I-II-III) in which math students (including future math teachers) learn to use coding to investigate mathematical concepts, conjectures, theorems, and applications. In line with the international trend, the Grades 1-9 math curriculum in Ontario was revised in 2020-21 to include the expectation that students develop and use coding skills to learn math. This created a need to revisit the design of the MICA III section dedicated to future teachers.

Indeed, the challenges faced by teachers in the transition from university math learning to school math teaching have been known for a long time and have been addressed by the INDRUM community (see, e.g., an ongoing international seminar; Grenier-Boley, n.d.). To address the second of “Klein’s double discontinuity,” we based our redesign on the following research question: *How can a mathematics content course for future teachers assist them in gaining skills and attitudes needed for making the transition to their future role of teachers, specifically in the case of using coding for mathematics learning?* In this poster, we present our redesign of MICA III as our initial attempt at responding to this question, explore a potential theoretical lens for reflecting on the redesign, and provide some illustrations using student work. We hope to have input from the INDRUM community as we prepare to give the course again in 2023.

COURSE DESIGN AND PROPOSED THEORETICAL FRAMEWORK

Sporadic meetings between the two first authors took place over 8 months in order to revise and/or develop new course objectives and elements using an “experiential” education (Kolb, 1984) perspective to provide opportunities for future teachers to make productive links between their learning of university math and their future profession as school teachers (thus helping to bridge Klein’s second discontinuity).

The three course objectives are: O1) to further one's experience of using coding to learn math (including conducting investigations); O2) to develop an understanding of that experience (the learning), including affordances of coding for math; and O3), a new objective, to develop an understanding of teaching (supporting the learning) and curriculum. The course continues to be structured around four individual coding-based math inquiry projects (similar to MICA I-II; O1), complemented with a posteriori revised guided reflections based on selected new readings (O2-3). Two new lab activities were also introduced on learning and comparing coding languages (O2-3). The course concludes with a revised collaborative project, where future teachers work in pairs with a local school teacher to prepare and implement a coding and math activity in the classroom, and to reflect on the experience (O3).

We propose to frame learning in MICA III with a triple instrumental genesis approach that aligns with the three objectives: teachers undergo a *personal genesis* (developing schemes to use coding in their own math learning; O1) and a *professional genesis* (developing schemes to use coding for didactic purposes in math classrooms; Haspekian, 2011; O3). As part of the latter, the teacher must also support *school students' geneses* of coding for math learning (Gueudet et al., 2020; O1-3).

NEXT STEPS

Our next steps include analysing student data (student work and perceptions collected through pre-/post-questionnaires and interviews) to evaluate the design of the course and prepare for the next iteration of course design refinement.

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