

UNDERGRADUATE STUDENTS' SENSE OF EMPOWERMENT IN PROGRAMMING-BASED MATHEMATICAL EXPLORATIONS

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Papert (1971) emphasized the importance of constructionism-based approaches for learning mathematics. By integrating computer programming in mathematics courses, students can employ computational thinking practices in explorations of mathematical phenomena (Buteau, Muller, Mgombelo, & Sacristán, 2018). In so doing, students may gradually engage in a community of practice through legitimate peripheral participation (Lave & Wenger, 1991) as they take up the practices of professional mathematicians (Buteau, Muller, Marshall, Sacristán, & Mgombelo, 2016).

Since 2001, Brock University's Mathematics Integrated with Computers and Applications (MICA) course sequel has taught undergraduate students to utilize computer programming for mathematical explorations. Project assignments, called "exploratory objects" (EOs), enable students to work as mathematicians by posing mathematical questions and exploring them using computer programs (Buteau, Muller, & Ralph, 2015, p. 1). My poster presented data from participants in the first-year course (MICA I) collected as part of the larger study *Educating for the 21st Century: Post-secondary Students Learning Computer Programming for Mathematical Investigation, Simulation, and Real-World Modelling* (Buteau, Mgombelo, Sacristán, & Muller, 2017-2022, S.S.H.R.C. #435-2017-0367).

In MICA I, students have the opportunity to be empowered through the creation of shareable programs, allowing them to contribute to their knowledge, and possibly that of their peers, about their chosen mathematical phenomena (Buteau et al., 2016). The first EO challenges students to pose and explore a conjecture about primes or hailstone sequences through the design and use of a computer program. My poster featured the following excerpts from participant interviews following this assignment, and asked CMESG attendees to consider which quote they thought best illustrated a sense of empowerment to explore mathematics through programming.¹

Hannah: "Finishing my program made me feel like a professional, like I could have a job creating software to do or teach mathematics."

Ashley: "I told a friend about my data because I was really excited about the patterns I found. I kept testing values until it crashed."

Jim: "I want to build on what I've learned. I know this is the beginning of what programming can do, and I want to see where it goes."

It is our view that these excerpts demonstrate students' sense of excitement, potential, and desire to share with others as they begin to learn programming for mathematical explorations.

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¹ Hannah's quote was most often selected as best illustrating a sense of empowerment.

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