STAGES OF STUDENTS' INSTRUMENTAL GENESIS OF PROGRAMMING FOR MATHEMATICAL INVESTIGATIONS

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With the growing integration of programming in our mathematics classrooms, we see a crucial need to understand how (undergraduate) students may come to appropriate programming as an instrument (Rabardel, 1995/2002) for 'authentic' mathematical investigations, i.e., complete programming-based mathematical investigations "as mathematicians would do" (Weintrop et al., 2016). We are proposing to extend the instrumental integration model (Assude, 2007) to describe four stages of students' appropriation process (i.e., instrumental genesis):

- Stage 1. Instrumental initiation—student engages only in learning how to use the technology, i.e. *mainly* develops usage schemes of programming type, *e.g. scheme of writing a loop*;
- Stage 2. Instrumental exploration—math problems motivate the student to further learn to use the technology, i.e. *mainly* develops instrumented action schemes of programming type, *e.g. scheme of code remixing*;
- Stage 3. Instrumental reinforcement—student solves math problems with the technology, but must extend his/her technology skills, i.e., *mainly* develops instrumented action schemes of both intertwined programming/math and math types, *e.g. scheme of validating the programmed math* or *scheme of conjecturing*;
- Stage 4. Instrumental symbiosis—students' fluency with technology scaffolds the mathematical task, i.e., can with ease mobilize and further develop schemes needed for his/her mathematical work.

We illustrate our approach by analysing a student's instrumental genesis as he engaged in diverse activities as part of an undergraduate programming-based math course.

References

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