Student Engagement with Dynamic Digital Representations of Decimal Fractions to Prompt Conceptual Change

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Children have difficulty in understanding the abstract nature of decimals, and a plethora of misconceptions arise from incomplete understandings (Steinle & Stacey, 2004). Developing conceptual understandings of *decimal density*, *place value* and *relative magnitude* of decimal fractions are considered key for consolidating number sense. Minimal research has been conducted into what effective representations should be employed by mathematics educators to assist students in developing 'decimal sense' and managing 'cognitive conflict' in the context of decimal fractions. This study used a collection of four dynamic digital representations, *Wishball-hundredths*, *Decimal Strips*, *Zooming in on Decimals*, and *Zoomable Number Line*, to explore how children's interactions with dynamic manipulatives of decimal fractions may develop their conceptual understanding in this numerical area.

A group of Year 4 (9-10 years old) students engaged with the four digital tools in a set of video-recorded, individual task-based interviews. Microgenetic analysis methods were used to detect conceptual changes through specific shifts in the learner's attention. The analysis approach involved closely examining intensive data of what learners did and said over several task-based interviews to capture a record of moment-by-moment learning processes. Then conclusions were drawn about what prompted knowledge change, how learning occurred, and other aspects of the processes of acquiring conceptual understanding (Voutsina et al., 2019).

The data collected revealed what features of each dynamic digital representation prompted attention shifts and how these translated to changes in conceptual understanding of decimal fractions. The facility of digital tools to adapt, change, and provide various interactive features and capabilities that traditional static representations may not offer were pivotal in enabling the students to successfully complete decimal fractions tasks. The dynamic nature of digital manipulatives forced shifts in the object of children's attention when they are actively interacting with the mathematics content as well as the structure of their attention in how they attend to features of the mathematics representation and the embedded mathematics concepts. All students involved in this study experienced moments of cognitive confusion generated by the dynamic affordances embedded within the digital tools which interrupted the students' flow of attention, to guide their conceptual learning of decimal fractions. Outside of the research-interview situation, these would have been ideal 'teaching moments'.

References

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