



Potential Fraction Concept Images Afforded in Textbooks: A comparison of Northern Ireland and Singapore

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Fractions are among the most challenging concepts in the teaching and learning of primary mathematics (Smith, 2002). A key factor associated with the complexities of teaching and learning fractions is that fractions are best conceptualised not as a single conception, but as a set of interrelated conceptions: part-whole, ratio, operator, quotient, and measure (Kieren, 1976). However, since fractions are often introduced only as ‘part of a whole’ in many countries, this may hinder students in developing more ‘powerful conceptions’ (Simon et al., 2018). It is recommended that students use a range of pedagogical models. However, textbooks often favour the use of area models over other modes of representation (Simon et al., 2018), leading to a limited mental image of fractions.

We examined the potential concept images afforded by how fraction concepts are first introduced in mathematics textbooks from two relatively different education systems: Northern Ireland and Singapore. Textbooks were analysed with respect to the contextual variables of the two countries (Huntley, 2008), followed by the content and instructional variables (Lee et al., 2021). We compared and contrasted two key potential concept images afforded by the chosen textbooks from the two countries: “fractions are equal parts of a whole” and “fractions can have different sizes”. Findings highlight that the same representation can potentially evoke in students both an acceptable fraction concept image and a flawed one. Further, the choice of pedagogical model provides a basis for the potential fraction concept images which students may develop, and may not be robust enough to deal with other fraction contexts.

These potential concept images can be seen as students’ possible understandings of fraction ideas. As such, they can help teachers to anticipate student thinking and sensitise them to the possible perceptions that students may develop from textbook tasks. An awareness of flawed potential concept images that may arise can also provide the locus of action for planning instruction. It is also vital that textbook writers carefully consider the potential concept images that may be evoked from the pedagogical approaches recommended.

References

- Huntley, M. A. (2008). A framework for analyzing differences across mathematics curricula. *Journal of Mathematics Education Leadership*, 10(2), 10-17.
- Kieren, T. E. (1976). On the mathematical, cognitive and instructional foundations of rational numbers. In R. Lesh & D. Bradbard (Eds.), *Number and measurement: Papers from a research workshop* (pp. 101-144). Information Reference Center (ERIC/IRC), The Ohio State University.
- Lee, M. Y., Choy, B. H., & Mizzi, A. (2021). Exploring the introduction of fractions in Germany, Singapore, and South Korea mathematics textbooks. *Journal of the Korean Society of Mathematics Education Series D: Research in Mathematics Education*, 24(2), 111-130. <https://doi.org/10.7468/jksmed.2021.24.2.111>
- Simon, M. A., Placa, N., Avitzur, A., & Kara, M. (2018). Promoting a concept of fraction-as-measure: A study of the Learning Through Activity research program. *The Journal of Mathematical Behavior*, 52, 122-133. <https://doi.org/10.1016/j.jmathb.2018.03.004>