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Preservice Teachers' Strategies for Interpreting Fractions Represented in Discrete and Continuous Models

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Introduction

Teaching and learning fractions have been a grave challenge in mathematics education. Current practices of teaching fractions fail to fulfill true pedagogical needs (Carraher, 1996), leaving students and teachers in the wake trying to catch up. Fractions, ratios, proportions, and decimals are all fall under the umbrella term of fractions. Fractions are nonphysical representations of relations between numbers, yet these individual topics are all too often taught separately. Students pay the price for this injustice they unknowingly endure; a price that teachers can change. Current practices for teaching fractions fall rely on the partitioning perspective or part-whole teaching. Within this partitioning perspective, teachers focus on the conception that fractions are one part out of an entire whole. For example, one slice out of a whole circular pizza with eight parts. From the beginning of their school learning experiences, students are taught procedural methods of solving and working with fractions, effectively making fractional understanding difficult to achieve (Carraher, 1996). Fractions *are* rational numbers, yet are not taught as such, and because of this, students are not even given the chance to have a solid understanding of the topic. This highlights the need for an alternative approach to teaching fractions. In our study, we argue that the measurement perspective of teaching fractions instead of the partitioning method can support students develop conceptual understanding. In this study, 55 preservice teachers engaged in an intervention to reexamine fractions using the aforementioned measurement perspective. The measurement perspective involves engaging teachers in viewing fractions not as parts out of a whole but as comparable, relational numbers. Fractions result from comparing two quantities multiplicatively. This view of fractions allows students to build better connections with other fractional concepts such as ratios, decimals, and percentages.

Methods

This study was conducted in three parts: a pre-test, the intervention, and then a post-test. The pre- and post-tests consisted of ten problems about fractions, five of those problems represent fractions using dots or bars (but not both), and the other five use circular representations of fractions. Each question draws upon different fractional knowledge including proper fractions, improper fractions, and unit fractions. After the pre-test was administered, the 55 preservice teachers underwent a month-long fraction intervention. This intervention focused on revisiting fractions from a measurement perspective. To define fractions, they compared the lengths of two physical quantities and used fractions to express the relationships. Relying on comparing the lengths of quantities, the teachers engaged in activities that involved comparing the magnitude of two fractions, creating equivalent fractions, as well as adding and subtracting fractions. Lastly, the preservice teachers completed a post-test in which they had five problems that were dots or bars, whichever they did not have in the pretest, and the same five circle questions from the pretest. For this study, we focus on the strategies they used to solve fractions problems using the three different representations: dots, bars, and circles.

Findings

This study gave way to a multitude of interesting findings. Most notably, preservice teachers began to show an increase of conceptual reasoning in their answers and relied less on typical procedures. For example, the teachers spent less time manipulating fractions symbolically by converting to common denominators or converting improper fractions into proper fractions; instead, they demonstrated their reasoning by manipulating the representations. This lack of reliance on procedural manipulations demonstrates a change in how preservice teachers conceptualize and reason with fractions. This indicates that the teachers developed an understanding that they did not have before because there is not "a blind application" of some procedures (Lamon, 2007, p. 647). With this occurrence, teachers showed a high success rate with problems involving improper or unlike denominator fractions problems. Even more notably, the preservice teachers were able to successfully answer the circle questions that they had gotten wrong, or did not answer, in the pre-test. This alone shows a remarkable improvement. As this is preliminary qualitative analysis, there is always more information being discovered.

Conclusion

Though preliminary, our findings show improvement in preservice teachers' conceptual understanding of fractions; the first step towards being able to teach future our future students about fractions in a meaningful way. The teachers are where the process begins; it is the teachers that effectively set the basis for fractional understanding and learning. Students begin ratio understanding at the mere age of six (Carraher, 1996), yet once number symbols are assigned, they become confusing and difficult for children. By using the measurement perspective for both teaching and learning fractions, students and teachers alike have the opportunity to learn fractions in a way that is meaningful and relevant to their lives. The mathematics is no longer only procedures, but a whole schema of understanding that lends itself to the stage of learning a wider girth of fractional and rational number information.

References

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