Unpacking K-8 Preservice Teachers' Understanding of Measurement Unit Conversions

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Background

- Our K-8 preservice teachers (PSTs) were challenged by measurement unit conversion (MUC) problems in a mathematics content course for teachers, particularly, two-dimensional MUCs (e.g., 9 sq ft = _ sq yd).
- PSTs' common errors in solving MUCs include
  - applying one-dimensional conversion relationships directly in two-dimensional conversions (e.g., 1 sq m = 100 sq cm),
  - incorrect application of division operations (e.g., 43 ft = 14 yd 3 ft),
  - incorrect order of conversion operations (e.g., 8 sq yd = sq (8 × 3) = 576 sq ft), and
  - using multiplication instead of division (e.g., 864 sq in = (864 × 144) sq ft).
- Only a few studies interpreted possible causes of student errors in solving one-dimensional MUCs, such as place value deficiency, lack of understanding of metric system measurement units, misconceptions about relationships between measurement units, and little knowledge of ratio, etc. (Livy & Vale, 2011; Morris, 2001; Southwell & Penglase, 2005).
- However, PSTs' strategies for solving two-dimensional MUCs and possible interventions for improvement are rarely investigated in research.

Methods

- Six PSTs enrolled in a Foundations of Data and Geometry course participated in the study.
- A pre- and a post-test were conducted, each of which contained four MUC problems.
- Based on PSTs' entry knowledge levels reflected in their pre-test results, they were paired up to take the task-based interview with a similar level peer.
- The interview session lasted for about 60 min and 90 min for an individual session and a paired session, respectively.
- PSTs' knowledge and skills, misconceptions, and breakthroughs unpacked through working on the MUC tasks were analyzed with the following steps:
  - Open-coding to identify initial categories, such as participants' successes, challenges, and potential conceptual development
  - Iterative alternations of inductive and deductive analyses to modify and complete the initial categories
  - Group discussions to resolve discrepancies
- The pre- and post-test results were compared to reveal PSTs' potential improvements through taking the designed task-based intervention.

Research Goals

The goal of this study is twofold. First, we designed a sequence of tasks and used them to upack PSTs' understanding about MUCs through task-based interviews. Second, the tasks were designed in an attempt to scaffold PSTs' learning of MUCs from the easiest one-dimensional MUCs to the more challenging two-dimensional and three-dimensional MUCs. Our research questions are:

- *What is PSTs' understanding of MUCs?*
- *What is the potential impact of designed task-based interventions on PSTs' understanding of MUCs?*

Preliminary Findings

Successes:

- Use proportional reasoning as a successful alternative to dimensional analysis.
- Visualize and draw one-dimensional MUCs (e.g., 1 yd = 3 ft).
- Compute two-dimensional MUCs with prompting about the one-dimensional relationship (e.g., 1 m = 100 cm).

Difficulty:

- Visualize and draw two-dimensional and three-dimensional MUCs.
- Remember the one-dimensional metric relationship 100 cm = 1 m.
- Convert two-dimensional metric MUCs (e.g., When converting 100 sq m to sq cm, used the additive rather than the multiplicative relationship).

Potential impact of designed task-based intervention:

- The PSTs in the study seemed to retain the information well because all 6 PSTs improved their post-test scores or stayed stable compared to their pre-test scores.

References

Livy, S., & Vale, C. (2011). First year pre-service teachers' mathematical content knowledge: methods of solution to a ratio question. *Mathematics Teacher Education and Development, 13*(2), 22–43.

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