Comparing Oral and Traditional Assessments in Math Content Courses for Pre-Service Elementary Teachers

Study Overview

Course Description
- First semester math course for pre-service elementary teachers.
- Two sections totaling 42 students: all juniors, majority female (95%).
- Course content: number and operation from a perspective that emphasizes models, reasoning, problem-solving, and communication.
- Course pedagogy: inquiry-based learning.

Problem Space
We were dissatisfied with traditional written assessments. Reasons included:
- Did not capture what we saw students demonstrate in class.
- Not well-aligned with class format, which values oral communication.
- Problems that are challenging to start are necessary, but this effected students disproportionately and did not let us see what some students were capable of.

Two Helpful Frameworks

Research Questions
Q1: What characteristics of a student leads her to perform better on an oral vs. written assessment relative to her peers?
Q2: What opportunities for student learning can oral assessments provide?

Exam Logistics and Methods of Study
- Three exams: each written with 1-2 oral questions given at a separate time.
- Content of oral component coordinated to match items on the written exam.
- Office hours: scripted prompt
- Information gathering
- Interactive learning
- Format: office hours

Written vs. Oral Performance
- For each of three exams, we have an oral question $o_i$ and corresponding written question $w_i (i = 1, 2, 3)$ assessing the same content.
- For each student, we create a written score $\sum_w w_i$ and oral score $\sum_o o_i$ and record these in terms of their z-scores (standard deviations from the mean):

Mathematical Anxiety Rating Scale
- Original AMARS instrument has 25 items sorted into 3 factors.
- We added 7 supplemental items; a new factor analysis shows two additional factors.

Regression Analysis
- Observations: each student at three points in time (Exams 1, 2, 3).
- Outcome variable: difference in z-scores between oral exam and corresponding content in written exam.
- Model: linear regression with mixed effects.
- Control variables: Test Anxiety, Explanation Anxiety, Problem Solving Anxiety

Learning during Oral Assessments
- What is Learning?
  - Our evidence of student understanding is based on their verbal descriptions.
  - Student learning is qualitative change in students’ understanding.

Case Study
Segment 1
- Description: Starts by demonstrating the algorithm on a product of 2-digit numbers. Checks with the standard algorithm.
- Student Demonstrates: Procedural knowledge of line algorithm.

Segment 2
- Description: Demonstrates the algorithm on a product of 3-digit numbers. Place value in the diagram is not clear and circling is a mostly incorrect.
- Student Demonstrates: Lack of understanding of the organizing principles behind the procedural steps.

Segment 3
- Description: When asked to justify algorithm in 2-digit case, justification seems based on procedural similarity to standard algorithm.
- Student Demonstrates: Understanding of a connection between steps in line algorithm and standard algorithm.

Segment 4
- Description: Instructor asks: “Why is that 1 in the hundreds place, other than it happens to be on the left?”
- In response, student starts to explicitly refer to the value of the lines in her diagram.
- Student Demonstrates: Understanding of the value of different lines in the algorithm and its role in finding partial products.

Segment 5
- Description: When instructor asks what properties of multiplication this is using, student goes through detailed algebraic justification of the multiplication and connects the steps to pieces of her line diagram.
- Student Demonstrates: Understanding of the connection between using algebraic properties and the line algorithm in terms of both place value and the distributive property.

References
Huxham, M., Campbell, F., & Westwood, J. (2012). Oral versus written assessments: a test of student performance and