Introduction

The Guidelines for Assessment and Instruction in Statistics Education (GAISE) report (Franklin et al., 2005) has suggested that the use of technology will help students develop a better sense and understanding of variability through more engaged data analysis tasks in grades 5-8. Advances in technology allow for the development of tasks that can engage students more readily in data analysis, allowing variability to appear as a discussion topic as early as the elementary grades. When using such tasks with K-8 pre-service teachers (PSTs), what do they learn about variability while exploring data with dynamic statistical software such as TinkerPlots?

Methods

Case study methodology made use of a framework on teaching and accessing reasoning about variability (Garfield & Ben-Zvi, 2005) together with the Structure of Observed Learning Outcome (SOLO) taxonomy (Biggs & Collis, 1991). The data were collected from students enrolled in a statistics course designed for elementary/middle school PSTs in a large university in the Midwest. Eleven PSTs participated in this study. Dynamic statistical software, TinkerPlots, was used almost daily. Two different types of data on the thinking of the PSTs were collected:

- the classroom observations where field notes were taken during the implementation of the tasks to inform the analysis of the work.
- the class work that PSTs generated, where most of the work included a component involving the use of TinkerPlots.

The qualitative analysis included in-depth examination of the individual PSTs’ work using the variability framework. PSTs’ thinking within components of the variability framework were further unpacked with the SOLO hierarchical order. SOLO levels were informed the further unpacking the PSTs’ understanding of variability.

Sample PSTs’ Work and Coding

Through the use of TinkerPlots, PSTs were able to visualize the data they had through different types of plots. Yet, PSTs needed to have correct features within the displays, such as the same scale, in order to make viable comparisons regarding variability.

The left display shows one sample of coding:

- PSTs’ work on variability questions was collected throughout the term.
- The coding was based on the developed framework (Garfield & Ben-Zvi, 2005) to identify different levels of understanding appearing in PSTs’ work.

PSTS' work was coded in such way:

- For V2, I am looking for concepts words like mean, range, min and max, etc.
- For V3, I am looking for comparative statements.
- For V4, I am looking for prediction statements. (We didn't see clear evidences of all the other aspects.)

Developed Framework and Coding Scheme

Three aspects of seven in the variability framework (Garfield & Ben-Zvi, 2005) were highlighted in the PSTs’ work (in hierarchical order). SOLO levels were informed the further unpacking the PSTs’ understanding of variability.

Data and Findings

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TinkerPlots provided several means for students to dynamically engage with the data while thinking about spread with the use of different plots and tools in each of the levels:

- In terms of describing and representing variability, there is some evidence that shows TinkerPlots played a role in helping the PSTs understand variability through making appropriate displays.
- In terms of using variability to make predictions, TinkerPlots visually highlights the importance of having the same scale on graphical displays easily when describing the variability between two data sets.
- In terms of using variability to predict outcomes, TinkerPlots provided PSTs tools to create distribution and find statistical measures that they could use to make predictions.

The graph shows the distribution of the data based on the three aspects of developed framework. Since the levels are in hierarchical order, we see a decline in the number of students in the higher-levels of V3 and V4 compare with V2. Student are somewhat solid in V2. As an educator, we still have work to do to improve students’ understanding on V3 and V4.

References