Elementary Mathematics Preservice Teachers' Ability to Notice Their Students' Mathematical Thinking

Kaitlyn M. Sorochka
Ed.D Student
Monmouth University

Vecihi S. Zambak
Department of Curriculum and Instruction
Monmouth University

MONMOUTH UNIVERSITY
SCHOLARSHIP WEEK

Rationale

- The ability of preservice teachers (PSTs) to notice the mathematical thinking of their students is an important aspect of the teaching process, as determined by the Association of Mathematics Teacher Educators.
- Multiple types of tasks need to be used in order to gain a better understanding of PSTs professional noticing skills (Estapa et al., 2018).
- The ability of PSTs' noticing skills for student work is connected to the PSTs understanding on the mathematics content (Sánchez-Matamoros et al., 2015; Dreher & Kuntze, 2015).
- As the research on the noticing skills (i.e., responding and interpreting) is lacking, we had elementary mathematics PSTs complete three different types of tasks in order to determine if there would be a significant difference in PSTs ability to interpret and respond to elementary mathematics students' thinking.

Research Question

RQ: Is there a significant difference in the professional noticing skills, interpreting and responding, of elementary mathematics PSTs when examining *written mathematics student work*, an *interaction-focused mathematics clip, or* an *instruction-focused mathematics video?*

Theoretical Framework

Professional Noticing (PN) Framework: (Jacobs, Lamb, & Phillips, 2010)
There are three components of professional noticing:
- attending to children's strategies
- interpreting children's understandings
- deciding how to respond based on children's understandings

The researchers defined *interpreting* and *responding* for the investigative purposes of the present study:

Interpreting: professional noticing skill where PSTs can explain student mathematical thinking using evidence from the student's work and discussions.
Responding: professional noticing skill where PSTs can expand upon students' mathematical thinking in a manner that will help to advance student mathematical understanding.

Methods

Participants

- 22 male and female elementary education PSTs enrolled in Monmouth University as undergraduate and graduate students.

Instruments

1. Task, analyzing *written student mathematics work* of two students completing a prompt based on a word problem utilizing models for multiplication and division.
2. Task, analyzing an *interaction-focused mathematics clip* of a student explaining their response on a fraction-based word problem to their teacher and responding to the teacher's questions.
3. Task, analyzing an *instruction-focused mathematics video* on a lesson on ratios and rates with a teacher instructing a whole class.
4. Two-question survey, asking PSTs for their perspective about the three types of tasks and the tasks' affordance to help PSTs interpret and respond to elementary students' mathematical thinking.

Data Collection and Analysis

- PSTs completed the three tasks described above during one semester as part of their coursework.
- PSTs responses were coded for each task using a rubric scoring both interpreting and responding from 0 to 2.
- Coding was completed by two researchers to check for inter-rater reliability, which was achieved with an average of 85.2% between the three tasks.

	Interpreting	**Responding**
2	PST accurately interprets student's understanding and uses **robust** evidence to support his/her interpretation.	PST clearly builds on the student's thinking and understanding and effectively advances his/her mathematical thinking using specific questions or strategies. PST proposes questions or strategies which emphasize conceptual understanding with procedural fluency.
1	PST accurately interprets student's understanding but uses **limited** evidence to support his/her interpretation.	PST proposes general questions or strategies that are somehow built on student's thinking and understanding. PST proposes questions or strategies which do not emphasize conceptual understanding with procedural fluency.
0	PST does not interpret student's understanding, or incorrectly interprets student's understanding. *[Or, PST misinterprets the prompt.]*	PST proposes questions or strategies that are not built on student's understanding or thinking. *[Or, PST misinterprets the prompt.]*

Figure 1: Scoring rubric for PSTs task responses.

Methods (Cont.)

Data Collection and Analysis (Cont.)

- We used the Wilcoxon Signed Ranks Test to compare the means of PSTs responding and interpreting scores for each task.
- PSTs reported on their preference for both interpreting and responding between the three tasks and the results were organized. We coded PSTs' preferences with dummy variables (1, 2, 3).
- A one-way ANOVA was conducted to determine if there were differences between PSTs perception of the easiest type of task to interpret and respond to elementary students' mathematical thinking.
- An independent samples t-test comparing the means of PSTs who preferred responding to the *interaction-focused mathematics clip* but were scored higher on responding to *written mathematics student work.*

Findings

- There is a significant difference between PSTs' ability to interpret and respond to *written mathematics student work* as opposed to an *interaction-focused mathematics clip* and an *instruction-focused mathematics video ($p<0.05$).*
- On average, PSTs were scored higher for interpreting (1.364) and responding (1.25) on the *written student mathematics work* than either the *clip* or *video.*
- On average, all PSTs demonstrated an ability to interpret and respond to all three tasks, as the lowest average score for each of the six categories was a 1.
- On average, out of the three tasks PSTs preferred the *interaction-focused mathematics clip* for interpreting.
- On average, out of the three tasks PSTs preferred *written mathematics student work* for responding.
- The greatest difference between the three tasks was seen between the mean scores for interpreting the *instruction-focused mathematics video* and the *written student mathematics work* ($p = .013$).
- PSTs who preferred the *interaction-focused mathematics clip* had significantly higher responding skills for *written mathematics student work* ($p = .017$).

Conclusion

- Overall, results demonstrated that there is a significantly greater chance that PSTs will correctly interpret and respond to *written student mathematics work* as compared to an *interaction-focused mathematics clip* and an *instruction-focused mathematics video.*
- In conclusion, PSTs are strongest with their ability to interpret *written student mathematics* work, despite preferring the *interaction-focused mathematics clip.*
- While it is necessary to be able to respond to and interpret written student work when teaching elementary mathematics, it is also important that PSTs develop the skills needed to interpret and respond to students while having one on one interactions and during whole class instruction.
- The results demonstrate that while elementary math PSTs are gaining the ability to notice students' mathematical thinking, there are still changes needed in education of PSTs to enhance the development of their noticing skills.
- Noticing *might* be impacted by PSTs' Content Knowledge (CK). The level of difficulty of the mathematics content increased from the *written student mathematics* work, to the *interaction-focused mathematics clip*, to the *instruction-focused mathematics video.*
- In relation to the increased progression was an overall decrease in the scoring for PSTs. This could be due to a lack of CK for the advanced math skills.

Recommendation for Future Studies

- A future study could repeat the same methodology but assess the same mathematical skill through the different types of tasks.
- This will help determine if CK is responsible for the varying abilities of PSTs noticing skills between tasks, or if PSTs abilities vary based on the type of task.

References

•Dreher, A., & Kuntze, S. (2015). Teachers' professional knowledge and noticing: The case of multiple representations in the mathematics classroom. *Educational Studies in Mathematics*, *88*(1), 89-114. doi:10.1007/s10649-014-9577-8
•Estapa, A. T., Amador, J., Kosko, K. W., Weston, T., de Araujo, Z., & Aming-Attai, R. (2018). Preservice teachers' articulated noticing through pedagogies of practice. *Journal of Mathematics Teacher Education*, *21*(4), 387-415. doi:10.1007/s10857-017-9367-1
•Jacobs, V. R., Lamb, L. L. C., & Philipp, R. A. (2010). Professional Noticing of Children's Mathematical Thinking. *Journal for Research in Mathematics Education*, *41*(2), 169–202. Retrieved from www.jstor.org/stable/20720130
•Sánchez-Matamoros, G., Fernández, C., & Llinares, S. (2015). Developing pre-service teachers' noticing of students' understanding of the derivative concept. *International Journal of Science and Mathematics Education*, *13*(6), 1305-1329. doi:10.1007/s10763-014-9544-y