Flowcharts to Assess Professional Noticing: Methods for Coding Open-ended Responses

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Abstract

This presentation highlights an innovative approach to measuring prospective elementary teachers' responsive teaching. Researchers highlight the development of flowcharts to score video-based assessments of professional noticing capacities to increase coding efficiency and reliability across a large team. The measurement process in this research has potential to refine strategies for assessment of responsive teaching with respect to noticing frameworks and beyond.

Key words: Assessments, Professional Noticing

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Overview

This presentation highlights an innovative approach to measuring prospective elementary teachers' responsive teaching. The researchers developed a flowchart to evaluate open-ended responses to a video-based assessment of professional noticing. The assessment measured PSETs' responses pre- and post- to a researcher developed instructional module based on Professional Noticing (PN) (Jacobs, Lamb, and Philipp, 2010) within the context of the Stages of Early Arithmetic Learning (SEAL) trajectory (Steffe, Cobb, & Glasersfeld, 1988). The module decomposes professional noticing into its three interrelated skills, *attending, interpreting, and deciding*, that allows for the skills to be progressively nested and intentionally developed (Boerst et al., 2011). Our results indicate that prospective elementary teachers (PSETs) can grow significantly in the three skills of PN (Schack, Fisher, Thomas, Eisenhardt, Tassell, & Yoder , 2013). Our project explicitly connects to the following *Principles to Action* (NCTM, 2014): *Teaching and Learning*, and *Assessment*. The PN framework is grounded in classroom *teaching* practices with student *learning* at the center. The *assessment* we developed and highlight in this presentation can inform instruction along with mathematics content.

Theoretical Framework

There is evidence that teachers' attention to children's mathematical thinking can affect student learning (Carpenter, Fennema, Franke, Levi, & Empson, 1999); however, such attention is just one component of professional noticing of children's mathematical thinking as defined by Jacobs et al. (2010). They conceptualized professional noticing as "a set of three interrelated skills: attending to children's strategies, interpreting children's understandings, and deciding how to respond on the basis of children's understandings" (p.172). Jacobs et al. (2010) found that professional noticing does not develop through teaching experience alone and focused professional development was a key factor in developing professional noticing skills. Sherin, Jacobs, and Philipp's recently edited volume (2011) contributed to the compounding evidence of both the need and the value of professional noticing to effective mathematics teaching.

Several researchers have explored and developed frameworks for learning trajectory based mathematics teaching (Clements & Sarama, 2009; Sztajn, Confrey, Wilson, & Edgington, 2012; Steffe, 1992). The Stages of Early Arithmetic Learning, developed by Steffe and his colleagues (Steffe, et al.,1988), is an early numeracy progression exemplary of "learning trajectories built upon natural developmental progressions identified in empirically based models of children's thinking and learning" (Clements, 2007, p. 45). We have situated the intentional development of professional noticing skills in the context of video cases of children's mathematical thinking along an early numeracy progression, SEAL. This affords a potentially powerful reflective setting for PSETs and builds a scaffold for their subsequent practice of mathematics teaching in real-time classrooms.

Methods and Data Sources

To examine PSET growth across the interrelated skills of PN, the authors developed a measure consisting of a brief video clip in which an interviewer poses a comparison, difference unknown task (Carpenter et al., 1999). This clip, while brief, is rich in details of the child's thinking that can be easily attended to, but also includes nuanced details that might be missed by novices thus allowing for a range of scores. The three prompts were drawn from the work of Jacobs et al. (2010) and each focused on one of the three interrelated components, attending, interpreting, and deciding. The prompts were: 1) Please describe in detail what this child did in response to this problem, 2) Please explain what you learned about this child's understanding of mathematics, and 3) Pretend that you are the teacher of this child. What problems or questions might you pose next? Provide a rationale for your answer.

We examined samples of PSET data for each of the professional noticing components for emergent themes (Glaser & Strauss, 1967). The emergent themes were assimilated with researcher-identified key features for each of the components. The themes and key features resulted in benchmarks that defined several ranked response types. The PSETs' professional noticing responses from all implementation and comparison sites were compiled into a spreadsheet and blinded. Scorers did not know if responses were from an implementation or comparison site, nor were they aware if it was pre- or post-assessment data. All data were mixed randomly to deter any biases that may possibly occur when scoring the response.

Inter-rater reliability was developed through scoring by multiple scorers, discussion and tie breaking as needed. Ultimately, though, more efficient and reliable processes were needed to evaluate the complex PN responses of PSETs. Thus, we drew on the literature of flow processes (AMSE, 1947) to develop a series of flowcharts to guide the scoring process of each interrelated skill.

Results and Conclusion

The benchmarks of PSETs' responses provided the foundation for the yes/no questions of the flowchart used to guide the raters' scorings. Table 1 illustrates the flowchart for the interpreting component. The resulting inter-rater reliability averaged 83% for all components across six scorers.

Table 1. *Interpreting Scoring Flowchart*

<table>
<tr>
<td rowspan="7">Does the response include at least one of the following suggestions?
1. The concept of perceptual counting and/or replacement (use of fingers or materials to count).
2. The concept of re-presentation (tracking of counts with fingers).
3. Child must count from one and continue the count.</td>
<td rowspan="4">Yes</td>
<td rowspan="4">Does the response include one or more of the following?
1. Assumptions about child’s actions or words in relation to the problem.
2. Projection of PSET’s thinking onto the problem or the child’s thinking (i.e. “this is a subtraction problem, but the child used addition”).
3. SEAL name (if identified) is mismatched with description.</td>
<td rowspan="2">Yes</td>
<td rowspan="2">Does the response fit any of the following?
1. Not generalizable beyond this specific problem context.
2. Includes attending evidence, but not an interpretation.
3. Includes ONLY a projection of PSET thinking.
4. Is mathematically incorrect or inaccurate.</td>
<td>Yes</td>
<td>Score 1</td>
</tr>
<tr>
<td>No</td>
<td>Score 2</td>
</tr>
<tr>
<td rowspan="2">No</td>
<td rowspan="2">Does the response fit any of the following?
1. Not generalizable beyond this specific problem context.
2. Includes attending evidence, but not an interpretation.
3. Includes ONLY a projection of PSET thinking.
4. Is mathematically incorrect or inaccurate.</td>
<td>Yes</td>
<td>Score 1</td>
</tr>
<tr>
<td>No</td>
<td>Score 3</td>
</tr>
<tr>
<td rowspan="3">No</td>
<td rowspan="3">Does the response include other correct interpretations? (i.e. one-to-one correspondence)</td>
<td rowspan="2">Yes</td>
<td rowspan="2">Does the response fit any of the following?
1. Not generalizable beyond this specific problem context.
2. Includes attending evidence, but not an interpretation.
3. Includes ONLY a projection of PSET thinking.
4. Is mathematically incorrect or inaccurate.</td>
<td>Yes</td>
<td>Score 1</td>
</tr>
<tr>
<td>No</td>
<td>Score 2</td>
</tr>
<tr>
<td colspan="3">No</td>
<td>Score 1</td>
</tr>
</table>

To illustrate the use of the scoring flowchart, one PSET’s response to the interpretation prompt is examined.

> I learned that this student is still using manipulatives or his fingers to count items, but he can also use a counting on strategy to solve problems. I feel that if I was to place this student in one of the SEAL stages, I would have to say he is somewhere between stage 2 and 3. He is still using his senses such as touching (perceptual counting) to count the bears. However, he also counted up from seven to get to eleven.

The criteria for "yes" in response to the first rater question of the ranking flowchart in Table 1, is satisfied because at least one of the three benchmarks is met. The PSET referenced the child's use of fingers. Following the "yes" route of the flowchart, the PSET response does not include any of the three limitations in the second question, resulting in a "no" response by the rater. The third question, "Does the response fit any of the following [four criteria listed]?" also rates a "no," resulting in a rank of 3 for this response.

The scoring flowcharts proved valuable to the scoring process not only for ensuring inter-rater reliability, but also raters could track their responses through the chart with codes such as, "y1nn rank 3" for the response above. If questions or discrepancies arose, the subsequent discussion could be focused quickly on the aspect of the response in dissension.

Qualitative data can provide insights on participants' understanding. However, qualitative data is often rich in text, which can pose a challenge to researchers to make meaning from the data (Creswell, 2013). While the open-ended PN responses were concise, our sample included 224 PSETs, which meant 448 responses (due to the pre-post research design) required coding. It was critical for our research team to establish a systematic process of coding to make the data analysis process manageable and comprehensible across six scorers. The flowcharts allowed for such systematic processes and increased our inter-rater reliability to 83%. Kaplan and Maxwell (2005) argue that flowcharts can serve multiple purposes including: making data visible, reducing data, and presenting analysis in a holistic form.

Scholarly Significance

The measurement processes developed in this research have the potential to refine the strategies for measurement of responsive teaching practices with respect to noticing frameworks and beyond. Thus, researchers and teacher educators may design or adopt tools to better ascertain individuals' development of key skills We contend that disseminating proprietary processes and measures from the study of PSET PN experiences in the area of number and operation is directly connected to the NCTM 2013 Strategic plan's research goals to "focus research as both process and product" and "develop members as…generators of research."

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