

Using the Clinical Interview Method to Examine Children's Mathematical Thinking

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Abstract

The purpose of this paper is to document when and how the use of clinical interviews may have impacted a prospective teacher enrolled in a mathematics methods course within an elementary education certification program. In particular, we present changes or shifts in the ways in which she: (1) reflected on the clinical interview videos she viewed (using VITAL software); and, (2) applied the ideas to her own clinical interviews with young children. Preliminary results point to an increased sophistication in the nature of observations made about the children in the VITAL videos. In addition, there is a progression in the ways in which this teacher was able to follow student thinking and ask follow-up/extension questions while conducting her own interviews.

Introduction

Providing prospective teachers with opportunities to gain insight into children's

mathematical thinking should be an important component of teacher education programs. One way to do that is to expose them to situations in which they can observe and interact with children, thereby providing them with the opportunity to better understand and appreciate the ways in which the children interpret, internalize and represent various mathematical concepts (Schorr & Ginsburg, 2000). In particular, they can become better acquainted with children's thinking through the use of the clinical interview method. Ginsburg (1997) notes that prospective teachers' understanding of children's mathematical thinking can be enhanced through clinical interviews—whether by actually interviewing the child themselves, or critically observing another do so. The clinical interview method was used extensively by Piaget (1952). His use of the flexible style of questioning allowed him to observe children's problem-solving behaviors as they worked on tasks, and then ask questions that were tailored to the child's observed behavior. This type of interview has the potential to provide prospective teachers with modes of observation and questioning we believe can be transferred to their actual instruction (Ginsburg, Jacobs, & Lopez, 1998).

While this paper is limited to a case study of one teacher, the larger study involved 17 prospective teachers, all of whom were enrolled in an elementary/middle grade level Mathematics Methods Course at Rutgers University. Two of the main research questions guiding the overall study are: what (if any) types of changes occurred in prospective teachers' reflections on the archived clinical interviews, and how, if at all, did they revise their ways of understanding young children's thinking as reflected in their own interviews with children?

Methods

The subjects for the study were enrolled in the mathematics methods course during the Fall 2008 semester (September through December). A mixed-methods design was used for the larger study, with quantitative data coming from a survey (White, Way, Perry & Southwell, 2006) measuring attitudes towards mathematics and mathematics teaching and perspectives on what that teaching entails. This 20-question survey was a composite of subscales from the Fennema-Sherman Mathematics Attitudes Scales (Fennema & Sherman, 1976) and parallel scales to measure Attitudes to Teaching Mathematics, as used by Nisbet (1991). The survey was given to the prospective teachers at the beginning and end of the course in order to document if indeed the teachers' ideas about what it means to know and teach math might have changed, and if those changes reflected an increased or decreased willingness to teach math.

The qualitative data for this study came primarily from the prospective teachers' written work and audio-recorded classroom discussions. Their written work consisted of lesson plans, field observations, reflections on the archived videos (using VITAL), and their reflections on their own clinical interviews with children. The VITAL reflections were assigned weekly, totaling 11 throughout the semester. Table 1 shows the distribution of the mathematical topics covered within these assignments:

Table 1:

Assignment Topic & Associated Videos

Topic	Associated Videos	Grade Level
Numbers &	Video 1: Counting Beads (free play)	Kindergarten

Counting	Video 2: Writing Numbers Backwards (clinical interview)	1 st
Freeplay & Mathematical Thinking in the Early Years	Video 1: Building a road and a tower (free play)	Pre-Kindergarten
	Video 2: Writing numbers (free play)	Pre-Kindergarten
	Video 3: Making patterns with bears (free play)	Pre-Kindergarten
	Video 4: Playing with building blocks (free play)	Kindergarten
Numerical Operations	Video 1: Division story problem (clinical interview)	1 st
	Video 2: Double-digit addition with regrouping—Using base-ten blocks and paper (clinical interview)	1 st
	Video 3: Noticing patterns in multiplying nines (classroom lesson)	2 nd
	Video 4: Solving addition & subtraction problems – Derived facts & base-ten blocks (clinical interview)	1 st
	Video 5: Subtraction using number line (clinical interview)	2 nd
Exploring Curricula	Video 1: Count Clap & Stomp A (classroom lesson)	Pre-Kindergarten
	Video 2: Dum Di Dum Dum (classroom lesson)	Pre-Kindergarten
	Video 3: Hokey Pokey (classroom lesson)	Kindergarten
	Video 4: Take Away Stories (classroom lesson)	Pre-Kindergarten
Place Value	Video 1: Numerals and place value (clinical interview)	1 st
	Video 2: Place value – 300 vs. 103 (clinical interview)	1 st
Reasoning, Communication, Testing	Video 1: Assessment – Encouraging a child to explain his thinking (clinical interview)	Kindergarten
	Video 2: Communication – comparing sums without computation (clinical interview)	2 nd

	Video 3: Proving “ $12 - 9 = 2$ ” with counters (clinical interview)	1 st
	Video 4: Reasoning and proof – $5 + 6 = 11$ (clinical interview)	1 st
Rational Numbers	Video 1: Fraction concepts in three children (clinical interview)	Kindergarten, 1 st , 3 rd
	Video 2: Introduction to fractions (classroom lesson)	2 nd
Using Manipulatives to Enhance Understanding	Video 1: Discussing addition with Stern blocks (clinical interview in whole class setting)	1 st
	Video 2: Double digit addition with regrouping—Using base-ten blocks and paper (clinical interview)	1 st
	Video 3: Representation—Which represents 3×4 best? (clinical interview)	3 rd
	Video 4: Representing numbers & regrouping (clinical interview)	2 nd
Geometry	Video 1: Identifying and coloring in triangles (clinical interview)	Pre-Kindergarten
	Video 2: Identifying shapes (clinical interview)	Pre-Kindergarten
	Video 3: Identifying shapes tactilely (classroom lesson)	Pre-Kindergarten
	Video 4: Making pictures with pattern blocks (observation)	1 st
	Video 5: Matching shapes during clean up (observation)	Pre-Kindergarten
Measurement & Data	Video 1: Arranging children in order of height (classroom lesson)	Pre-Kindergarten
	Video 2: Make It Heavier (classroom lesson)	Pre-Kindergarten
	Video 3: Comparing lengths of ribbons (clinical interview)	Pre-Kindergarten
	Video 4: Seriation (clinical interview)	Pre-Kindergarten
	Video 5: Sorting and graphing bears and hearts (classroom lesson)	2 nd
Patterns & Algebra	Video 1: Difficulties in an interview about patterns (clinical interview)	Pre-Kindergarten
	Video 2: Caterpillar patterns	2 nd

	(clinical interview)	
	Video 3: Extending a pattern (clinical interview)	Pre-Kindergarten
	Video 4: Finding mistakes in a pattern (clinical interview)	Pre-Kindergarten
	Video 5: Noticing patterns in multiplying nines (classroom lesson)	2 nd

This paper looks closely at the VITAL assignments and clinical interviews of one particular teacher. For the mathematics methods course, the prospective teachers conducted their own clinical interviews at least twice, and often three times, throughout the semester. They were asked to include either audiocassettes or videotapes of the interviews, along with a written account of their experiences, observations, and insights gleaned from the interview(s). The first clinical interview assignment occurred approximately six weeks after the prospective teachers began to work with the VITAL software. This time frame allowed them to view others engaged in the practice of clinical interviewing, read about particular techniques used, and then prepare and conduct their own interviews.

Results

Our preliminary analysis has begun to reveal several findings based upon responses to the VITAL essays and clinical interviews. One major finding relates to the type of assumptions that the teachers made regarding the mathematical thinking of the children they observed. More specifically, early on, with almost no exceptions, most of the teachers felt that children either “knew” or “didn’t know” a whole range of mathematical ideas based upon very little actual evidence. So, for example, if a child could recite several number facts, the teachers often were willing to state that the child “knew

addition”. Over the course of the semester, these types of conjectures continued to occur, but with less frequency and the prospective teachers were more careful to support their ideas with evidence (based upon assigned readings/literature). Another major finding related to when and how the students analyzed the VITAL interviews. The teachers began noticing critical aspects of the interview as time went on (to be described in detail below). Further, they were able to apply some of this knowledge in their own interviews.

As noted above, we focus this report on the work of one prospective teacher (Tania¹) who was chosen because she exhibited a notable change in her own beliefs about what it means to know and teach mathematics (per the survey results) and she also showed marked change in her own understanding of the mathematical ideas of the children that she interviewed and viewed using VITAL. In looking at her VITAL essays over time, Tania’s observations became increasingly sophisticated, revealing a deeper level of analysis and explanation. As an example, we noticed a shift in the ways in which she described what she thought the young children were capable of doing. As time went on, she recognized that many of her initial thoughts were quite inaccurate. For example, in the third VITAL assignment of the course, the teachers were asked to respond to a writing prompt on Numerical Operations (using five associated VITAL videos, as noted in Table 1). We describe her analysis of Rufus, a young boy being interviewed in the VITAL video. Rufus, a 1st grade boy at the time, was responding to the interviewer’s probe: *“Emily and Ginger have 12 cookies. And they want to split them all up... so both girls get the very same number... they want to split them between the two of them so that*

¹ Pseudonyms are used to protect the identity of the participants in the study.

each girl gets the same number of cookies.” In the video, Rufus began by drawing twelve dots on a piece of paper. He then drew two boxes to represent the two girls. Next, he drew a line from each dot (cookie) to each box (girl) and counted as he was doing this, to show that each girl would end up with 6 cookies. The interviewer followed this with an extension question: *“Now, let’s pretend that their friend Paul comes over, and he wants some cookies too. So how many would each child have, if these two girls each give some of their cookies to Paul.”* Rufus responded by drawing twelve new dots to represent the twelve cookies along with three boxes to represent the three children. Then, using the same strategy he used in the initial question, he started to draw lines from each dot to each box. The lines started to get a bit messy, so Rufus redrew the dots as circles (so the cookies appear larger and can be distributed easier). His strategy to distribute the cookies was essentially the same as before (drawing lines to connect cookies to children), but he added in an additional piece—drawing a ring around each group of three cookies, and then drawing the lines from each cookie to a child. The instructions guiding this writing prompt were: *Tying in connections to Van de Walle [the text for the course] & the other readings, talk about the numerical operations expressed in each video, the tasks that students worked on while exploring the operations, and what you can tell about the students’ understanding of these numerical operations through the clinical interviews & group lesson posed.*

After watching the Rufus video, Tania stated: “Rufus knows how to divide, I believe Rufus has a very strong understanding of how to divide. The way in which he begins to distribute the cookies to the 2 people is so orderly and rational.” (October 7, 2008) In

actuality, based upon the three minutes and 58 seconds we are shown in the video of Rufus, it is clear that his solution has many aspects of a strategy that could be linked to informal knowledge involving sharing (a strategy associated with division); however, there is little, if any, conclusive evidence that would have allowed Tania to state that Rufus knew “how to divide”.

In one of the last VITAL assignments of the semester (focusing on Patterns and Algebra), Tania appeared to be more critical in her analysis regarding what a pre-school child, Genesis, in another video could or could not do. For this assignment, the prospective teachers were asked to respond to the following prompt: *Based on what you've read, and what was seen in the videos, how does the study of patterns facilitate algebraic thinking (at any age)? What can you understand about the children's knowledge of patterns as seen in the videos? Provide evidence for your reasoning.* During this interview, Genesis was shown a pattern of blue and yellow bears on a table; she was then asked to continue/extend the pattern with more bears based on what she sees on the table. Rather than choosing either a blue or yellow bear to extend the pattern of repeating blue and yellow bears, Genesis chose one green and one orange bear. When asked to explain her choice, Genesis simply stated that it looked pretty next to the other bears in the pattern. After watching Genesis, Tania responded:

“In the beginning of this video, I felt that Genesis was going to be able to extend on the pattern because when the interviewer asked her what is this (referring to the pattern he created) she said its blue and yellow and blue and yellow. It appeared that she had noticed the sequence and would know what would come next. However, after reading the article, "Economopoulos" the author mentioned that to generalize and predict students must move from looking at a pattern as a sequence of what comes next to analyzing the structure of the pattern meaning to see that it is made up of

repeating units. Therefore, Genesis may have not seen the repeating unit of blue-yellow but rather just a collection of colored bears and doesn't even realize that it is a pattern. Genesis doesn't understand the concept of pattern. She doesn't understand the predictability and repetition that patterns imply because she would have been able to extend on the pattern correctly.” (December 2, 2008)

In this particular reflection, Tania made a prediction about a possible response from the child prior to pressing play in the video. In other words, Tania was able to anticipate behaviors for the children in the video, and then confirm or disconfirm her conjecture based upon what actually happened. After she watched the rest of the Genesis interview, Tania realized that the girl didn't do what she expected. Tania then cited evidence from another part of the assigned readings (again, using Economopoulos, 1998) to try to explain or provide reason for Genesis' behavior. We suggest that Tania had, at this point, begun to base her conjectures upon evidence from the video and literature.

As mentioned previously, a main goal of this study was to determine whether and how allowing the prospective teachers an opportunity to conduct their own clinical interviews after having watched assigned VITAL videos might be impacted. All students, including Tania, noted that the questioning techniques—used in the VITAL videos—were really critical. The teachers were exposed to the types of questions that are appropriate for clinical interview settings from both the VITAL videos and readings on the work of Ginsburg (1997) and Ginsburg, Jacobs, and Lopez (1998). From these sources, the prospective teachers noted that a clinical interview usually begins with an open-ended question that allows the child to answer freely, based upon his/her thinking. After having engaged the child in a given task or tasks, the interviewer can then move to more focused follow-up or extension questions, in order to begin to understand what the child may be

thinking. There can also be spontaneous questions or questions about a particular piece of student work (that don't necessarily take place within a structured interview setting).

In her first experience conducting a clinical interview, Tania chose to interview a third grade boy named Billy². She explained to Billy that she was completing an assignment for school, and that the purpose of the interview was not to check for right or wrong answers, but that she was interested in how he might think about a couple of mathematical problems while he solves them. The mathematical topics that Tania focused in on for this interview were addition and subtraction. For addition, she posed a multi-digit addition problem for Billy— $23 + 25$ —and had Billy come up with an answer without paper and pencil first. She then posed a story problem for Billy in which he needed to find the total cost of buying a pencil for fifty-nine cents and a notebook for three dollars and twenty-five cents. This time, she allowed Billy to use paper-and-pencil to solve the story problem.

It is when Tania poses a subtraction problem with money (related to the story problem above) that she began to make observations about Billy's mathematical behavior. She then asked Billy, "what if he gave the person that was checking those two items [the pencil and notebook] out a five dollar bill, what would his change be." (October 30, 2008) Here, Billy incorrectly responded four dollars and eighty-four cents. Tania then asked Billy to use money to show her in another way how much change would be needed. He again comes up with four dollars and eighty-four cents. It isn't until he uses

² Pseudonyms are used to protect the identity of the interview subjects.

the money again that he realizes his mistake and states that the change should be two dollars and twenty-six cents. After repeated attempts of asking Billy to show her in another way what amount should be received for change, Tania decided to end the interview. As noted from Tania's written account of the interview, she recognized that Billy could use the traditional algorithm for addition of multi-digit numbers (in which he added up the ones column prior to adding up the numbers in the tens column), but faltered a bit when he used a similar approach for the subtraction problem. She writes:

“When Billy subtracted and came up with the wrong answers I didn't think Billy was unable to subtract. I just thought it was because he did not know how and when to apply borrowing or trading using the traditional algorithm for subtraction because he had said he made a mistake and was supposed to change both 0's into 10's. I knew Billy was capable of subtracting because when I asked him if 5 minus 3 was actually 4, he demonstrated using the money that it was in fact 2. I don't feel Billy saw the connection between what he had just done and what he could have done for subtracting 3 dollars and eighty-four cents from 5 dollars.” (October 30, 2008)

Tania began to exhibit more in-depth knowledge of how well considered follow-up questions could help provide her with additional information about that child's mathematical understanding. In her second clinical interview, Tania decided to take the tasks used with Rufus (in the video described above) and try them out with Billy, the same child interviewed for the first assignment. Tania observed the behavior of Billy and compared it with that of Rufus (the same boy that she watched on VITAL for the Numerical Operations assignment). While Rufus used circles and boxes to represent cookies and children (as described above), Tania noticed that Billy used a strategy of doubling or tripling numbers to give him a solution to the division of cookies problems, and so Tania decided to follow up with a new question:

“...the next question I asked Billy was now to pretend that he only had 5 cookies and

he wanted to share those 5 cookies evenly with 2 boys, how many would each person get. Since I saw that Billy was finding his solutions by doubling and tripling numbers that he picked, I thought I might give him another problem where he wouldn't be able to do this, but would still allow for the 2 boys to get an even amount of cookies. Billy thought awhile about this problem and then said it is impossible. I said, "impossible", and he said "yes, because nothing equals 5, like $1+1 = 2$, $2+2 = 4$, and $3+3$ only equals 6." Then I said to Billy, so you can't distribute 5 cookies evenly among 2 people? He said no again. Therefore, I thought awhile about how I could rephrase it to Billy so that he might see at least two and a half cookies could go to each person. Then I said to Billy, "Well, what about if they are not even, how much could each person at least get, because if you have 5 cookies at least some of them can go to two people." I don't know if saying what about if they are not even were the right words to say, because Billy then said well one would get 2 and the other would get 3." (November 25, 2008)

From the excerpt above, we see that Tania wanted to test Billy's strategy of doubling and tripling "friendly" numbers to figure out how many cookies would get distributed to each child. Because of this, she posed a hypothetical situation where Billy had to distribute an odd number of cookies to an even number of children; this required Billy to ultimately end up with 2 cookies for each child, and a fifth cookie to be split in half between the two children. We can see from this excerpt that Tania has moved from simply conducting the interview with open-ended questions (as evidenced in her first interview), to using follow-up/extension questions in order to test her conjectures about a child's knowledge of a given mathematical topic.

Concluding Remarks

We have presented results from Tania, one of the students enrolled in our elementary mathematics methods course during the Fall 2008 semester. We note how she was able to refine her observations and conjectures regarding the mathematical ability of young children in the VITAL videos as the semester progressed. In addition, Tania often made conjectures about a child's behavior prior to watching the video, and then used the video

to either confirm or disconfirm what she believed. Furthermore, her conjectures were supported by assigned course readings, where appropriate.

What was particularly interesting was how the same appeared to occur when Tania conducted her own clinical interviews. During her first interview, she was able to pose addition and subtraction problems to a child and analyze his thinking based on both his written responses (using traditional multi-digit addition and subtraction with borrowing strategies) and his physical actions with money. It wasn't until the second interview that we noticed Tania not only analyze student behavior, but use more directive, follow-up/extension questions to be able to test conjectures about her interviewee's mathematical understanding.

Preliminary results of the analysis from this data set serves to add to existing literature regarding the utility of the clinical interview method and clinical interview video cases in teacher education. This case study appears to indicate the potential that these types of experiences (where prospective teachers view videos and analyze student thinking through them) might be useful at the teacher education level, to better prepare future teachers to gain insight into their children's thinking. One final point to reflect on is the power of coupling videos like the ones available on VITAL with assignments that allow future teachers to be the protagonists of an interview with a child. In this latter situation, teachers are not only viewing videos and making observations about "others" (be it another person asking the questions or another child responding), but are able to analyze their own behavior and that of a child that may be familiar to them.

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