THE ROLE OF THE RESEARCHER'S QUESTIONS IN A CLINICAL INTERVIEW ON STUDENTS' PERCEIVED PROBLEM SOLVING

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In this work we considered interactions between researcher/interviewer and two case subjects in the context of two task-based interviews to isolate ways that subjects' problem-solving performance was influenced by the choice of interventions that researcher opted to employ. In order to capture shifts in the students' actions that could be attributed to specific interventions a problem-solving map was constructed for each individual. Shifts and transitions in actions were then corresponded to the nature of exchanged taking place prior to the shift. In the case of Tuna, probing guidance lead her struggle to a productive end. For Sam, suggesting the use of a two-way table as scaffolding shifted his struggle in a productive manner.

Keywords: Problem Solving, Intervention, Clinical Task-Based Interview

The goal of the research reported here was twofold. First, we examined problem solving processes of two 5th grade students when working on a task that entailed algebraic thinking. The goal was to identify junctions where students' progress on the task was constrained. The second goal was to identify ways in which the researchers' modes of interventions seemingly impacted the problem solvers' performance, particularly at constrained junctions. Our research was motivated by the desire to better unpack ways in which researchers' choices of questions might influence results concerning children's problem-solving abilities and performance, an area rarely explored in mathematics education. With increased interest in using clinical interviews and teaching experiments that rely on direct interactions between subjects and researchers such an exploration is both timely and needed.

Literature Review

Mathematical problem solving is defined as "an activity that relies heavily on the problem solvers' in-the-moment decision making and improvising and the type of insights that they may develop in the course of their actions" according to Manouchehri & Zhang (2013, p.68). What remains unknown is how students decide what strategies to use and what might contribute to shifts in their approaches. Much of the literature concerning the mathematical problem-solving performance of learners relies on task-based interviews, either in structured or semi-structed setting. Rarely has the interviewer's role and their comments in the course of problem-solving process has been scrutinized, linking learners' performance to potential impact of the probing questions the interviewer might have asked. This considers even in occasions where questions may consist of eliciting the learners' own thinking (i.e. explain what you were thinking, why did you do this, etc.) All these comments are forms of intervention that force reflection, either implicitly or explicitly and elucidate cognitive reactions resulting to some kind of mathematical outcome.

Methodology

Videotapes of two task-based interviews (Litchman, 2012) with two 5th grade students were used as data sources to carefully unpack researcher/participant interactions as one task was used towards capturing students' problem-solving performance. During these interviews, the researcher had used a common task focused on capturing students' algebraic thinking (see Figure 1). Each interview lasted approximately 20 minutes.

Analysis consisted of two phases. First, Using Schoenfeld's (1985) problem solving path as a platform we traced the learners' actions throughout their encounters with the problem with the goal

of launching a solution. Phases included reading the problem, analyzing the problem, exploring, planning, implementing and verifying the solution method. Of particular interest was determining stages at which progress seemed constrained.

Task 1: Where am I?

The seats in the auditorium of Joyful Elementary School with a capacity of 300 people are labeled as follows and the rest of the seats follow the same pattern.

Front

Row 1	1	2	3	4	5	6	7	8	9	10
Row 2	11	12	13	14	15	16	17	18	19	20
Row 3	21	22	23	24	25					

Figure 1

1. Chris is in seat 48? What row is he in?
2. Tyler is two rows behind and four seats to the right of Seat 42. What is his seat number?

During the second phase of data analysis we considered the influence of the researcher/interviewer's comments on the problem solvers' transitions along the problem-solving map. Note that during the interviews, as a protocol, the researcher was allowed to ask "why" and "how" questions to understand the reasoning of students' problem solving strategies. Further, common to task-based interview tradition, students were asked whether their answer made sense and to explain their reasons. Additionally, questions regarding how students assessed their own progress, what may have caused them to be stuck or what they found confusing were considered ways that the research could gain a better understanding of sources that contributed to the problem solvers' choices. Indeed, we examined how these seemingly "unobtrusive comments" impacted the mathematical work that problem solvers produced.

Preliminary Findings

Our findings will be grounded in illustrations of shifts in two students' problem-solving practices in the presence of interactions with the interviewer. Due to the limitation of space, we consider only two examples to highlight ways that the task-based interactions influenced the learners' problem-solving actions and progress.

Sam and Tuna both encountered the same impasse during the episodes of exploring and planning, but their resolutions were different. Sam and Tuna both struggled as they worked on the task but there were significant differences in the nature of their struggle. Sam directly implemented his solution method after analyzing the problem based on his understanding from the task. On the other hand, Tuna asked analytical questions to the interviewer to clarify her understanding from the question and then she went back and forth between either correcting or recalling her prior knowledge and creating new knowledge in the exploring phase. While Sam struggled making sense of the 1st question, Tuna's constraint was misinterpreting her prior knowledge of multiplication for the 2nd question.

Initial actions

Figure 2 illustrates problem solving maps of the two interviewed subjects (Sam and Tuna). Figure 2(left column) depicts a map of Sam's problem-solving process. He first reads the problem and analyze the pattern going by ten then implement his strategy of counting by 10 backwards from 48 until he reaches 8. Then, he verifies his solution by his multiplication fact. (6x8=48). Once he was asked how he had arrived the number 6, he we went back to planning phase and adjusted his solution method. Then, he verified his new solution with another multiplication fact. (8x5=40). Lack of

reliance on an organizational scheme hindered his ability to move forward in generalizing his answers. However, once Sam was provided with two-way table, he analyzed the problem again, relied on his initial interpretation of the task and solved it. The transcript below shows Sam's shift in his struggle with multiplication facts to a productive end. Using two-way table reminded him his first interpretation of the task and obtained the final result. However, once he was suggested to use a two-column table to organize his data, he managed to successfully launch a solution.

S: So then, if you are like 6 rows over, it will probably be 48 because if he is if he is wait, if it says he was 48?

I: Yeah! Chris is in seat 48. It is asking for uhm what row is he in? **What we can do is I can give you this table Ok? Did you use two-way table before?**

S: Yeah

I: Ok. Just go with that.

(C is filling in the table as Row: 5 Seat Number: 41,42,43, 44…)

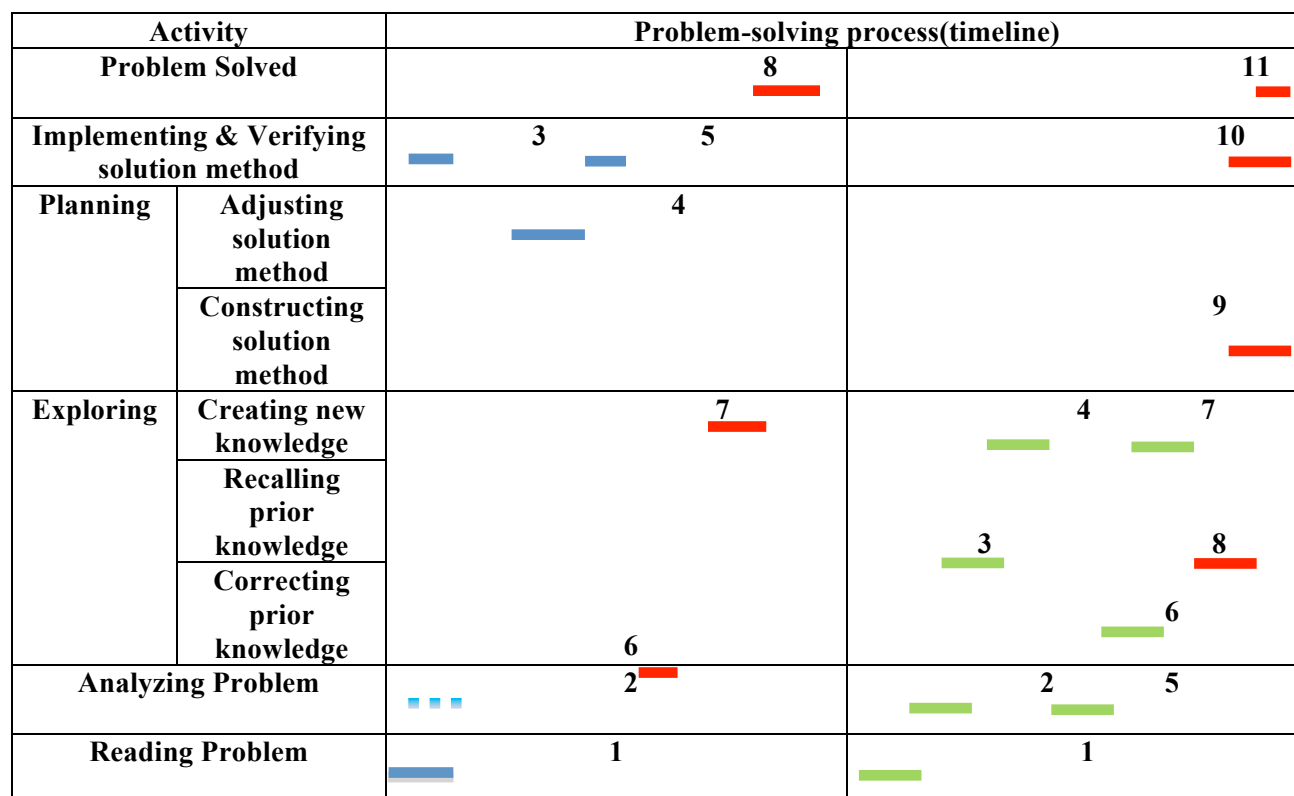S: (While he is writing the number 44) AHA!

I: What happened?

S: It is row 5.

Activity		Problem-solving process(timeline)		
Problem Solved			8	11
Implementing & Verifying solution method		3	5	10
Planning	**Adjusting solution method**		4	
	Constructing solution method			9
Exploring	**Creating new knowledge**		7	4 7
	Recalling prior knowledge			3 8
	Correcting prior knowledge		6	6
Analyzing Problem			2	2 5
Reading Problem		1		1

Figure 2: Tracking of Sam and Tuna' s problem solving (Red lines represent intervention)
Sam: Blue lines 1-5 & red lines 6-8
Tuna: Green lines 1-7&red lines 8-11

I: Uhm how do you know that? Why did you use 6 times 7 is equal to 42? How did you decide to use that?

T: Uhm. Uhm yeah, uhm wait oh wait never mind. I will just solve it never mind. Because I was thinking like going like that uhm wait. I think it will be row 6 because like seat 42. Because in each row, one of the multiples are in 7 are (inaudible) in it. So, 42 will be in the row 6.

I: So, in each row, there are multiples of what?

T:7 and uhm because I know. Wait no! You are actually in row 5. Because in row 4, last seat will be 40 and row 5, seat 42 will be in it needs to keep going through and you find in in row 5.

Transcript above shows Tuna's transition from her previous strategy to the new solution due to the interactions with the interviewer. Immediately after the interviewer re-voiced her claim as in each row there are multiples of seven, Tuna recalled her prior knowledge of last seat in each row is 10 times the row number and she constructed new solution method based on her first interpretation of the task. She then implemented her solution method as adding 2 rows to row 5 and claimed that Tylor will be in row 7 and she said that "since it will be in row 7 last seat in row 7 will be 70 but the seat it is in row 7 so I know that his seat would be the 6th seat in row. If 70 is the last seat you have to take away 4 will get you to 66.". She finally obtained the correct response after going back and forth between problem solving phases.

Conclusion

Our results highlight several important theoretical considerations. While clinical interviews are widely used as vehicles to learn about what students know and how they work mathematically around selected tasks with the desire to identify gaps and strengths in their approaches, little attention has been paid to how these actions may have been influenced by the researchers' choices of questions. It is commonly assumed that interviewer's role is to be an objective observer that asks why and how questions without a careful examination of how such interventions might have influenced the work that learners produce in the course of interactions. In our analysis we offered how students' problem-solving pathways were influenced by the interviewer's comments. As such, we problematize we perceived notions of students' problem solving competencies reported in the literature without a careful examination of interactions in the course of interviews that could have impacted participates' work either through provoking reflection or prompting schemes that may not have been recalled during their work on tasks.

References

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