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ARTICLE REVIEW

The Relationship between Mathematics Teachers' Noticing and Responsive Teaching: In the Context of Teaching for All Students' Mathematical Thinking

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Abstract

Competent mathematics teachers need to implement the responsive teaching strategy to use student thinking to make instructional decisions. However, the responsive teaching strategy is difficult to implement, and limited research has been conducted in traditional classroom settings. Therefore, we need a better understanding of responsive teaching practices to support mathematics teachers adopting and implementing them in their classrooms. Responsive teaching strategy is connected with teachers' noticing practice because mathematics teachers' ability to notice classroom events and student thinking is connected with their interaction with students. In this regard, this review introduced and examined a study of *the relationship between mathematics teachers' noticing and responsive teaching: In the context of teaching for all students' mathematical thinking* conducted by Kim et al. (2017).

Keywords Teacher noticing, Responsive teaching, Secondary mathematics education, Classroom culture

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I. OPENING REMARKS

The National Council of Teachers of Mathematics (NCTM, 2014) reported that teachers should assess and understand the mathematical thinking of students and use it as evidence "to adjust instruction continually in ways that support and extend learning" (p. 53). Lampert et al. (2013) argued that mathematics teachers could understand and respond to the current mathematical thinking of students to orient them toward more advanced mathematical understanding. Therefore, competent mathematics teachers need to implement responsive teaching strategy to use student thinking to make instructional decisions (Hammer et al., 2012). As teachers with responsive teaching practices tend to use the substance of students' ideas as the basis for instruction (Dyer & Sherin, 2016), their practices help students engage in meaningful mathematical discourse and develop their mathematical understanding (Stockero et al., 2020). However, Lampert (2001) claimed that responsive teaching strategy is difficult to implement, and limited research has been conducted in traditional classroom settings. Therefore, we need a better understanding of responsive teaching practices to support teachers adopting and implementing them in their classrooms.

Responsive teaching strategy is connected with teachers' noticing practice (Jacobs & Empson, 2016). Teachers' noticing refers to "attending to particular events in an instructional setting and making sense of those events" (Sherin et al., 2010, p. 9). The definition of teachers' noticing is similar to tenets of responsive teaching that emphasize attending to and responding to the substance of students' ideas (Coffey et al., 2011). Therefore, we could assume that there is a relationship between mathematics teachers' ability to notice classroom events and their responsive teaching practices. However, most studies on teachers' noticing examined teachers' noticing in the experimental environment such as out of classrooms; however, they did not examine the relationship between teachers' noticing and responsive teaching. For example, Jacobs et al. (2010) showed short video clips to teachers and asked them to describe what they noticed in the clips. Star and Strickland (2008) also requested preservice teachers to describe important events in video clips to examine their ability to notice. Some Korean studies observed similar research patterns. Kang and Hong (2021) examined the high school mathematics teachers' ability to notice critical events when watching short video clips about perimeter and area of figures. The study did not examine how mathematics teachers' noticing practice affected their responsive teaching methods. Also, similar research methods were used in studies examining the noticing capabilities of *Korean* elementary and middle school mathematics teachers (e.g., Pang et al., 2020).

Mathematics classrooms contain various engagement to students. Therefore, it is important to examine the teachers' ability to notice classroom events (e.g., student questions, responses, and mistakes) and how to use them for responsive teaching in the actual classroom environment. What is essential is not the teachers' ability to notice important events when watching video clips, but their noticing when teaching in classrooms and how they modify instructional strategies according to their noticing (i.e., responsive teaching). Given the importance of connecting teachers' noticing with their

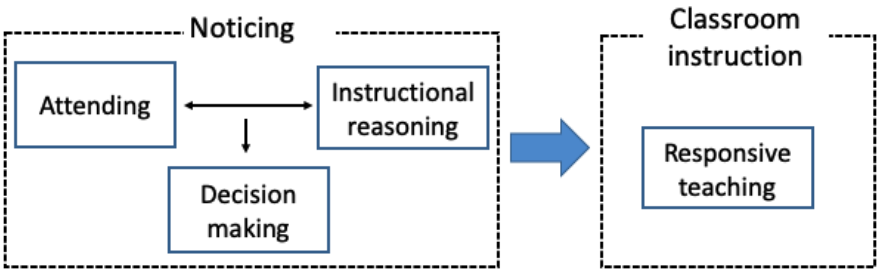
responsive teaching practices, I, in this review, examined a study of *the relationship between mathematics teachers' noticing and responsive teaching: In the context of teaching for all students' mathematical thinking* conducted by Kim et al. (2017).

II. ARTICLE REVIEW

Contribution of the Article

Kim et al.'s (2017) approach takes a student-centered instruction into account. Compared to teacher-centered instructional practice, focusing on the direct instruction of teachers, current mathematics educators emphasize the use of student-centered instructional approaches, highlighting student discussion and participation (NCTM, 2014). Teachers with student-centered instructional practices help students acquire mathematical knowledge and develop mathematical thinking, building upon their understanding of student thinking. Moreover, those teachers could provide meaningful support for the learning of their students because they adequately attend and respond to their mathematical thinking. In this vein, Kim et al. (2017) highlighted opportunities for studying teachers' noticing to shed light on strategies (e.g., discourse patterns) for designing responsive teaching environments that led to student-centered instructional practice. In general, the term noticing indicates the awareness of events by people. However, teachers' noticing is more intentional attention and active response to particular events for teaching (van Es & Sherin, 2008). Teachers should filter out unimportant events and pay more attention to mathematically meaningful events. They, then, used the events as grounds for mathematics instructions. From this perspective, Kim et al. connected a mathematics teacher's responsive teaching practices with her ability to notice classroom events.

Figure 1. A model connecting teachers' noticing and classroom instruction (adapted from Kim et al., 2017, p. 346).



Kim et al.'s (2017) most important contribution to literature and practice was developing a model connecting teachers' noticing and responsive teaching strategy (see Figure 1). Based on previous studies (Blömeke et al., 2015; Jacobs et al., 2010; van Es &

Sherin, 2008), the teachers' noticing consists of attention, instructional reasoning, and decision making. Teachers attend important mathematical events where student thinking can be revealed (e.g., mathematical errors) and make instructional reasoning to understand and evaluate such events. Then, teachers decide how to respond to them to support student learning. Kim et al. (2017) assumed that these noticing processes affect the responsive teaching of teachers in mathematics classrooms.

Meaningful Example: Teacher Lee's Noticing and Responsive Teaching

As described above, it is hard to implement responsive teaching and connect it with teachers' noticing about student thinking. Therefore, I have provided Teacher Lee's classroom episodes selected from the study by Kim et al. (2017).

Teacher Lee designed mathematics instructions based on her understanding of student thinking, analyzed through before-class tasks and in-class questioning. Before the class, Teacher Lee implemented pre-tests and examined students' mathematical understanding. Then, Teacher Lee prepared mathematics tasks considering what the students knew and did not know. Based on her observations of student challenges, for example, Teacher Lee transformed complex problems in the textbook into simple ones and prepared tasks by which the misconceptions of students could be detected. Moreover, during the class, Teacher Lee frequently showed questions to attend to and reason student thinking (e.g., "what points are you not sure?" "how do you solve the problem?" and "can you explain your strategies?"). These questions helped students examine their understanding, and then Teacher Lee decided to perform the following activities.

The responsive teaching by Teacher Lee was not a one-time event. Teacher Lee continuously examined students whether the students develop their thinking. After a response of students to her question, Teacher Lee showed them supplementary questions to solidify the students' understanding, bridge concrete examples, apply new ideas, and compare various strategies. Moreover, students' responses to her questions were used as evidence for responsive teaching. For instance, Teacher Lee asked the students to explain the exercises to their peers. In this activity, the students rephrased mathematical concepts with their words and provided additional examples.

Moreover, she noticed student misconceptions and provided responsive feedback. Therefore, students could understand and examine the strategies of their peers during mathematical discussions and choose the most appropriate ideas. For example, Teacher Lee invited all students in responsive teaching practice using "Do you agree with these ideas?" and "Do you have other thoughts?" questions. Students attended and interpreted the strategies of their peers and decided how to respond to them as mathematics investigators. At the same time, Teacher Lee worked as a facilitator of student discussions. Consequently, the noticing of Teacher Lee led to her response teaching and the response learning of students in the mathematics learning community.

III. CLOSING REMARKS

Unlike previous studies conducted in Korea, the noticing framework of Kim et al. (2017) was explicitly connected to the teachers' noticing with responsive teaching, considering their instructions in classrooms. Teacher Lee implemented responsive teaching strategy by attending to students' current mathematical thinking, the possibility of developing students' mathematical thinking, and mathematics learning opportunities for all students. Particularly, examples of illustrating how teachers used discourse to attend to and interpret student thinking and respond to such thinking by the students were provided in this study through different examples.

The authors highlight the importance of two questioning strategies. One is related to examining the thinking of students (e.g., "how do you solve the problem?"), and another is related to encouraging student participation (e.g., "do you have other thoughts?"). These findings are aligned with supportive and extensive teaching moves suggested by Jacobs and Empson (2016). Jacobs and Empson explained that mathematics teachers should implement cohesively connected activities to support and extend students thinking, including (a) ensuring the child makes sense of the problem, (b) examining the child's strategy, (c) encouraging the child to consider other strategies, (d) connecting the child's strategies to other symbolic notations. However, the study by Kim et al. (2017) extended Jacobs and Empson's study in three ways. First, while Jacobs and Empson focused on one-on-one interaction between one teacher and individual students, Kim et al. focused on whole-class discussion and examined teacher-student and student-student interactions. Second, Jacobs and Empson examined elementary school students, while Kim et al. examined middle school students. Third, Kim et al. explicitly used noticing framework (Jacobs et al., 2010) to shed light on responsive teaching practices. Despite these differences, the results of the two studies are similar. Mathematics teachers are required to attend to and interpret student thinking, and provide appropriate questions to support students' learning.

This study has several limitations. First, this study examined one teacher only. Second, the study did not examine the student data. Instead, the study generally focused on classroom discourses only. Thus, although it would be safe to say that teachers' responsive teaching affected student learning positively, we could not ensure that Teacher Lee accurately noticed student thinking. Given these limitations, future studies can be conducted to examine the issue by collecting more evidence for teachers' noticing and responsive teaching. The questing strategies suggested by Kim et al. (2017) could be used at every stage in classrooms to help teachers notice student thinking, design responsive teaching, and support the mathematical understanding of students.

In summary, in the study by Kim et al. (2017), a new model was presented with specific examples to help teachers design mathematics lessons. These examples will also be helpful for mathematics researchers in assessing teachers' instructional practices and their ability to notice student thinking.

References

Blömeke, S., Gustafsson, J. E., & Shavelson, R. (2015). Beyond dichotomies: Competence viewed as a continuum. *Zeitschrift für Psychologie, 223*(1), 3-13.

Coffey, J. E., Hammer, D., Levin, D. M., & Grant, T. (2011). The missing disciplinary substance of formative assessment. *Journal of Research in Science Teaching, 48*(10), 1109-1136.

Dyer, E. B., & Sherin, M. G. (2016). Instructional reasoning about interpretations of student thinking that supports responsive teaching in secondary mathematics. *ZDM: The International Journal on Mathematics Education, 48*(1), 69-82.

Hammer, D., Goldberg, F., & Fargason, S. (2012). Responsive teaching and the beginnings of energy in a third grade classroom. *Review of Science, Mathematics and ICT Education, 6*(1), 51-72.

Jacobs, V. R., & Empson, S. B. (2016). Responding to children's mathematical thinking in the moment: An emerging framework of teaching moves. *ZDM: The International Journal on Mathematics Education, 48*(1), 185-197.

Jacobs, V. R., Lamb, L. L., & Philipp, R. A. (2010). Professional noticing of children's mathematical thinking. *Journal for Research in Mathematics Education, 41*(2), 169-202.

Kang, S. K., & Hong, J. K. (2021). Exploring central beliefs through noticing analysis of mathematics teachers. *Communications of Mathematical Education, 35*(4), 377-411.

Kim, H. J., Han, C. L., Bae, M. S., & Kwon, O. N. (2017). The relationship between mathematics teachers' noticing and responsive teaching: In the context of teaching for all students' mathematical thinking. *The Mathematical Education, 56*(3), 341-363.

Lampert, M. (2001). *Teaching problems and the problems of teaching*. Yale University Press.

Lampert, M., Franke, M. L., Kazemi, E., Ghousseini, H., Turrou, A. C., Beasley, H., Cunard, A., & Crowe, K. (2013). Keeping it complex: Using rehearsals to support novice teacher learning of ambitious teaching. *Journal of Teacher Education, 64*(3), 226-243.

National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all*. Author.

Pang, J. S., Sunwoo, J., Kim, L. N., Lim, G. H., & Kang, E. J. (2020). Teachers' perception and noticing of mathematics classroom culture. *School Mathematics, 22*(4), 945-965.

Sherin, M. G., Jacobs, V. R., & Philipp, R. A. (2010). Situating the study of teacher noticing. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 3-13). Routledge.

Star, J. R., & Strickland, S. K. (2008). Learning to observe: Using video to improve preservice mathematics teachers' ability to notice. *Journal of Mathematics Teacher*

Education, 11(2), 107-125.

Stockero, S. L., Van Zoest, L. R., Freeburn, B., Peterson, B. E., & Leatham, K. R. (2020). Teachers' responses to instances of student mathematical thinking with varied potential to support student learning. *Mathematics Education Research Journal*, 1-23. https://doi.org/10.1007/s13394-020-00334-x

van Es, E. A., & Sherin, M. G. (2008). Mathematics teachers' "learning to notice" in the context of a video club. *Teaching and Teacher Education, 24*, 244-276.