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Lesson Study and Teacher's Dialogue About SMP 5

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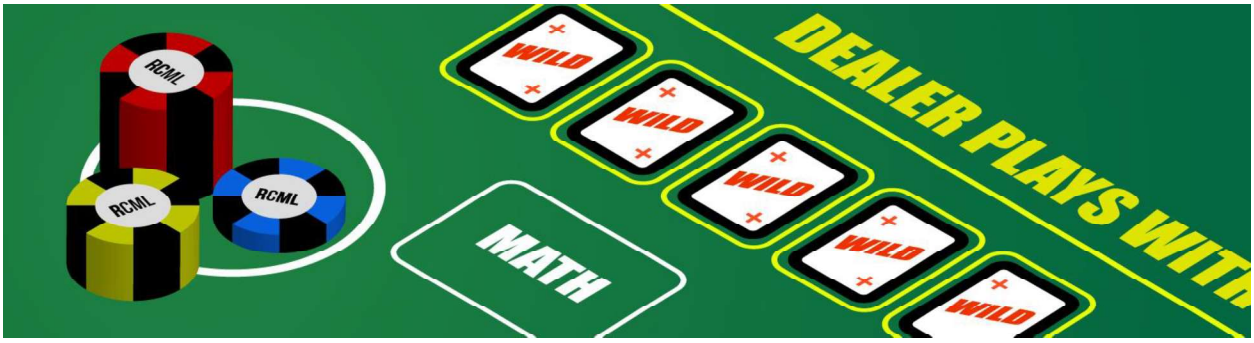
Increasing the Odds for All Mathematics Learners



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Please Note:

RCML History

The Research Council on Mathematics Learning, formerly The Research Council for Diagnostic and Prescriptive Mathematics, grew from a seed planted at a 1974 national conference held at Kent State University. A need for an informational sharing structure in diagnostic, prescriptive, and remedial mathematics was identified by James W. Heddens. A group of invited professional educators convened to explore, discuss, and exchange ideas especially in regard to pupils having difficulty in learning mathematics. It was noted that there was considerable fragmentation and repetition of effort in research on learning deficiencies at all levels of student mathematical development. The discussions centered on how individuals could pool their talents, resources, and research efforts to help develop a body of knowledge. The intent was for teams of researchers to work together in collaborative research focused on solving student difficulties encountered in learning mathematics.

Specific areas identified were:

1. Synthesize innovative approaches.
2. Create insightful diagnostic instruments.
3. Create diagnostic techniques.
4. Develop new and interesting materials.
5. Examine research reporting strategies.

As a professional organization, the **Research Council on Mathematics Learning (RCML)** may be thought of as a vehicle to be used by its membership to accomplish specific goals. There is opportunity for everyone to actively participate in **RCML**. Indeed, such participation is mandatory if **RCML** is to continue to provide a forum for exploration, examination, and professional growth for mathematics educators at all levels.

The Founding Members of the Council are those individuals that presented papers at one of the first three National Remedial Mathematics Conferences held at Kent State University in 1974, 1975, and 1976.

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LESSON STUDY AND TEACHER'S DIALOGUE ABOUT SMP 5

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The purpose of this paper is to share research on the dialogue of teachers related to the Standard for Mathematical Practice 5 during the post-lesson debrief of Lesson Study. Lesson Study debriefs were recorded and transcribed for teacher teams conducting Lesson Study to improve students' mathematical problem solving. Inductive analysis was used to find similarities and differences between teacher dialogues about the SMPs. Conclusions and implications about teachers' dialogue are shared.

Introduction

In 1999, Stigler and Hiebert's book titled, *The Teaching Gap*, called for lesson study to be tried and tested in the United States (p. 131). Since that time, several researchers have shown that when it is implemented well and for sufficient duration, similar positive results to Japanese lesson studies are found (Lewis & Hurd, 2011; Lewis, Perry, & Hurd, 2009). Teachers who enact lesson studies provide an authentic window through which researchers can understand teacher professional decisions and thinking. Of particular interest in this study are the conversations teachers have during the debriefing stage of a lesson that incorporated the promotion of at least one Standard for Mathematical Practice (SMP; CCSSI, 2010). Through the lens of teachers' authentic dialogue about students' learning and the lessons that develop students' learning abilities, we consider what is understood about SMP 5 and how teachers use those understandings to improve instruction. For the purpose of this proceeding, we focus on teachers' dialogue about SMP 5, "Use appropriate tools strategically" (CCSSI, 2010).

Related Literature

Lesson Study

Lesson Study is a "comprehensive and well-articulated process for examining practice" (Fernandez, Cannon, & Chokshi, 2003, p. 171) and a method of professional development that encourages teachers to reflect on their teaching practice through a cyclical process of collaborative lesson planning, lesson observation, and examination of student learning (Lenski, Caskey, & Anfara, 2009). Lesson study allows teachers to view teaching and learning as they occur in the classroom. There is not a singular approach to all lesson studies. For the research conducted here, the approach to lesson study is based on Lewis and Hurd's (2011, p. 2) cycle of

studying curriculum and formulating goals, planning the research lesson, conducting the research lesson, and reflecting. The first stage, studying curriculum and formulating goals, stems from the Japanese term kyozaikenkyu, in which teachers should take the time to study curriculum, materials, and standards to help develop the research lesson. Also in this stage, teachers should formulate short-term and long-term goals for what they hope students learn. The second stage, planning the research lesson, requires teachers to use a critical lens to determine what aspects should be incorporated into the research lesson and why those aspects are the best ways for students to reach the goal of the lesson. The third stage, conducting the research lesson, consists of one team member from the lesson study group teaching the research lesson to a group of students while the other team members observe the lesson. These team members typically follow an agreed upon observation protocol and do not interact directly with the students. The final stage of the lesson study cycle, the debriefing stage, is a time for teachers to reflect and discuss their observations, considering improvements that could be made to better student learning. Following the debriefing stage, the lesson study team has the option to re-teach the research lesson using the observations and modifications to learn from a new set of students.

Debriefing Phase of Lesson Study

During the debriefing phase of lesson study, also known as the post-lesson discussion, the team of teachers and any other outside experts who observed the lesson will engage in reflection about the lesson. While debriefing, the teachers are assessing student learning, what aspects of the lesson promote student learning, and what can be done better in the future to improve their practice (Lewis & Hurd, 2011; Takahashi & McDougal, 2016). Before beginning to debrief as a group, the lesson study group members should take time to reflect individually and gather their thoughts to ensure their discussion stays organized and focused; this debrief should not become a retelling of the lesson. Prior to starting, Lewis and Hurd (2011) recommend that the team create a set of norms to ensure the discussion is respectful of all participants and no one teacher feels singled out. All members should understand it is a group effort and they have shared responsibility for this lesson. Lastly, it is crucial that this phase focuses on student learning and data recorded, not personal feelings and judgements on the teacher (Lewis & Hurd, 2011).

Standards for Mathematical Practice (SMPs)

The SMPs were incorporated as part of the Common Core State Standards Initiative (CCSSI) in an attempt to promote consistent learning goals across states (CCSSI, 2010). These standards

were enacted to promote students' mathematical proficiency for readiness and preparation as they advanced toward their college and career paths. The SMPs provide specific processes and proficiencies that mathematics educators should be integrating throughout their instruction and facilitation of student learning (CCSSI, 2010). They place the focus of the learning on the students, and key components of mathematical knowledge are interwoven throughout these practices, which include problem solving, reasoning, representation, productive mathematical discourse, conceptual understanding, and procedural fluency. There are a total of eight SMPs. For the purposes of this proceeding the focus will be on SMP 5.

SMP 5: Use appropriate tools strategically. SMP 5 focuses on the importance of giving students opportunities to consider available tools and decide which tools would be helpful in various problem solving situations (Bostic, Matney & Sondergeld, 2019; CCSSI, 2010). Allowing students the space to select a tool that is appropriate and demonstrate the tool's use strategically is a fundamental component of this SMP. It would be a misconception of the intent of SMP 5 to assume that if students are using tools, for any reason, then they are necessarily engaging in SMP 5. Mathematically proficient students should become accustomed to making sound decisions about the situations in which specific tools might be most beneficial while also recognizing the limitations of each (CCSSI, 2010).

Methodology

The research here considers the authentic context of teacher dialogue that develops after teams of teachers plan and enact lessons together. The research question is: What does teacher dialogue in the debriefing phase of lesson study reveal about teachers' understanding of SMP 5?

Context

Participants and lesson study design. There were 52 teachers involved in the research, all residents of the same state in the mid-west. All teachers taught in K-5 classrooms and ranged in professional experience from two years to thirty-one years. The participants were solicited to join a one-year project focused on developing students' mathematical problem solving (Inprasitha, 2015). The 52 participants constituted 12 lesson study teams that elected to join the project. The teams consisted of teachers from across the grade levels of K-2 and 3-5. There were six K-2 teams and six 3-5 teams. All but one of the teams consisted of teachers from the same school. The participants had two days of professional learning about the process of lesson study and problem solving (Changsri, 2015; Isoda, 2015; Kadroon & Inprasitha, 2013).

Additionally, participants read and discussed Lewis and Hurd's (2011) *Lesson Study: Step by Step*. Participants developed norms to keep their lesson study focused and professionally respectful throughout the planning and debriefing phase discussions (Lewis & Hurd, 2011). Next, the 12 teams of participants enacted two full lesson study cycles during the one-year project; one lesson study took place in the fall semester and one in the spring semester for a total of 24 lesson studies. Each team spent between six and eight hours researching ideas involving student learning in the content domain Operations and Algebraic Thinking and consisting of at least one SMP (CCSSI, 2010). The teams constructed their collaborative research lesson toward the end of this research and development time. Each team taught and observed students' mathematical thinking and problem solving during the lesson and then met immediately afterward to reflect and revise. Then, the team taught, observed, reflected, and revised a second time with a new group of students in the same day. At the end of these two teaching cycles the teams reflected on their own professional learning.

Background and incorporation of the SMPs in the project. The SMPs had been part of the state standards for seven years prior to the start of the research, and all participants indicated that they were aware of the state's expectations for promoting the SMPs during instruction. The participants were asked to use their knowledge of the SMPs in two ways: focus on the promotion of at least one SMP during the collaborative research lesson planning phase and discuss, during the debriefing stage, whether or not there was any evidence of the SMPs being enacted by students. In preparation for the post-lesson discussion, a debriefing protocol was developed during the project based on teachers' reading of Lewis and Hurd (2011, p. 57-64). Though questions and focuses varied by team during these discussions, each debriefing protocol had the question "What evidence is there that the lesson provided an opportunity for student engagement in mathematical proficiencies (SMP's)?" for each participant to reflect on and discuss with their team.

Data and Analysis

Each of the written and revised collaborative research lesson plans were collected, as well as videos of each post-lesson debrief session. The videos totaled more than 19 hours of teacher discussion about the enacted lesson and revisions that needed to be made to improve students' mathematical learning. To answer the research question, videos were transcribed and an

inductive analysis (Hatch, 2002) was performed on the resulting text. Figure 1 shows the step-by-step process taken when analyzing the debrief sessions.

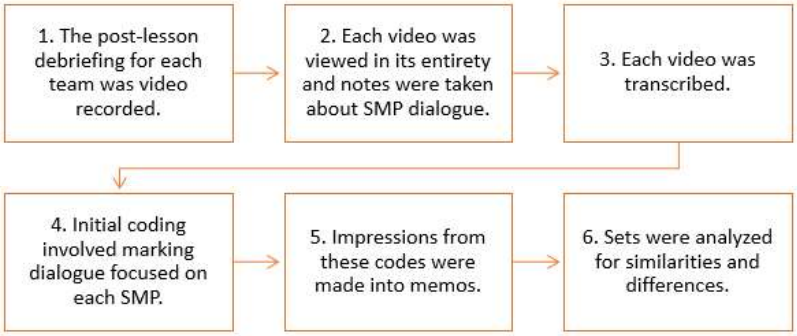

Figure 1. Steps taken in the analysis of debriefing sessions.

Findings

The inductive analysis reveals three themes from the dialogue of participants. Teams made very few connections to SMP 5 despite the structural opportunity to discuss such things through the Lesson Study process. Teams lacked an SMP 5 mindset when thinking about the use of tools in their lessons. Teams who focused directly on SMP 5 revealed misunderstandings about its expectations. These themes are explicated below.

Few Connections to SMP 5

Overall, data revealed that the majority of teams missed opportunities to discuss and implement direct connections from SMP 5 into their lessons to foster student sense making during problem solving. Throughout each debriefing session, the teams suggested changes to their research lesson. Each team was asked to have a focus SMP for their research lesson and had a debriefing protocol which included *discussing evidence of student engagement in any of the SMPs*. Seven of the 24 lessons stated SMP 5 as the focus. However, tools could have been used by students to makes sense of the problems in each of the 24 lessons. Dialogue occurring among 21 of the 24 lessons missed connections about how using tools could have strategically benefited students in solving the problems. During the 24 debriefing sessions only one group used language from SMP 5 in their discussions about tools. Although seven teams directed their focus toward SMP 5, less than half had dialogue that discussed tools in ways related to SMP 5, including: the need to provide manipulatives for students to select and use (Team 4; Team 8) and give students time to learn the manipulatives before the research lesson is conducted (Team 1;

Team 8). These two changes relate to the appropriate use of tools and opportunity to understand a tool as a strategic choice.

Lack of SMP 5 Mindset

Teams also made several suggested changes involving tools that did not necessarily promote SMP 5 but held potential if the teams shifted their mindset toward improving students' mathematical proficiencies. Five out of 12 teams suggested changes that were potentially related to SMP 5. These changes include: take away manipulatives that were offered in the first teaching (Team 1; Team 10), change the manipulative being offered (Team 5; Team 10), and give a specific manipulative directly to each group (Team 6; Team 7). In each of these cases, discussion by the teams were focused on classroom management and not on students' strategic and appropriate use of tools to improve their mathematics proficiency.

Participants struggled to engage their students in SMP 5. More often than not, participants gave students specific tools to use for specific purposes, and this caused the students to focus on what should be done with the tool instead of making sense of mathematics. Additionally, some students made sense of the mathematics but became confused at how the tool was supposed to help. One example of this comes from Team 8 in speaking about observation of a student who "knew that there was supposed to be eight bears, she didn't understand" how to use them to help her. Other students tended to use the tools inappropriately, as a game for making patterns, which participants said inhibited learning. This was challenging for participants because they had not thought to look into this issue during research and planning. Having given the tools to students for a specific purpose, without enough time for students to make sense of the tool itself and ideas it may be connected to, the participants observed, "what it [tools] became was a game to make designs" (Team 2).

Misunderstanding SMP 5

Analysis of dialogue from the debriefing sessions revealed that the participants focusing on SMP 5 held the belief that if the students were using manipulatives, this represented a convincing argument for evidence of SMP 5 during the lesson. For example, the only group who used SMP 5 language in their dialogue began the discussion by stating, "And you [T1] provided opportunity…for appropriate tools," which another teacher responded to by stating, "Right. They might not have necessarily all used them correctly, but you used them" (Team 10). Conversations like this one revealed that participants may not view the appropriate and strategic

use of tools as an imperative aspect of the lesson. In the statements made by the participants, the perceived importance of the lesson giving students opportunities to use tools, whether or not they were using them appropriately and strategically, demonstrates a lack of participant understanding of the expectations of SMP 5.

Discussion

Teachers need time to more fully understand and implement pedagogical strategies that promote SMP 5. This would include giving students time to become familiar with new manipulatives before using them in the classroom to understand how they can be used appropriately and strategically. Teaching professionals should think carefully about the introduction of manipulatives, as tools for problem solving and making sense of mathematics, and not simple objects of manipulation. The understanding of tools in the former sense opens students up to thinking about the tool as appropriate or not and for what strategic purpose they are using the tool. In our findings, teachers did not discuss the idea of giving the students the opportunity to decide which tools they felt would be of most benefit to them. The teams demonstrated the belief that as long as tools were provided for the students, they were encouraging student engagement in SMP 5. However, we contend that evidence of a students' mathematical proficiency, in the essence of SMP 5, means that students astutely consider the tools' appropriateness for themselves and choose the tools in connection with their own strategic trajectory for solving the problem. This must be done with tools appropriate to the context, such as using a protractor to measure a needed angle rather than a ruler.

Conclusion

In this study we consider teachers' dialogue about lessons in which at least one SMP was their focus and all teams could have provided access to tools for their students' problem solving. Although seven teams directly focused on SMP 5 and the SMPs were part of the teachers' standards for seven years, our findings revealed that implementing and promoting SMP 5 during instruction was professionally challenging. The one team that used language directly from SMP 5 showed a lack of understanding of what constitutes evidence of student engagement in SMP 5, in that, the teachers believed simply using the given tools as directed by the teacher constituted evidence for SMP 5. Furthermore, the teams who used tools encouraged the students to use the tools as a form of manipulation or representation but not as a means to make mathematical sense of the problem. Teachers need time to reflect more deeply upon SMP 5 and acquire a thorough

understanding of how to best promote it among students. Following these lessons, we recommended to the participants that they consider conducting lesson studies focused on researching and understanding SMP 5. The implementation of tools in the classroom should supplement effective pedagogy, and to accomplish this, teachers need to work together to find effective ways to utilize tools to promote understanding and success for students' problem solving.

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