Teachers' Instructional Vision and Practices around Promoting Productive Talk in Science Classrooms

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Abstract

To support students' learning, a wide body of research and instructional reforms emphasize students' engagement in productive talk with rigorous thinking in science classrooms. However, despite efforts, productive science talk is not yet prevalent in many classrooms. To gain more insight into the generation of productive talk in science classrooms, we explored a group of science teachers' instructional vision and practices with respect to promoting classroom discourse. Our analysis revealed variations in teachers' instructional visions and quality of instruction in their classrooms. In most cases, there was an alignment between teachers' instructional vision and practices. We observed high quality instruction in terms of facilitating productive discussions and rigorous students' thinking in the classroom of teachers with sophisticated instructional vision. Low instructional quality is observed in the classrooms of teachers with less articulate instructional vision of productive classroom discussion. We contend that exploring science teachers' instructional vision and their instructional practices together can provide a powerful lens to identify the areas of improvement for promoting high-quality instruction in many science classrooms. Moreover, working towards the development of a shared vision of instruction by stakeholders and teachers can support enactment of high-quality science instruction.

Topic Descriptors

Instructional vision, Instructional Practices, Facilitating Productive Classroom Talk, Instructional Quality

Purpose

A wide body of research in science education (e.g., Ford, 2008; Resnick et al., 2015) and instructional reforms (NRC, 2012; NGSS, 2013) emphasize students' engagement in productive science talk with rigorous thinking to support students' science proficiency and crucial skills such as critical thinking, reasoning, collaboration, and communication. Productive classroom talk involves students' discussions in service of making sense of scientific phenomena or solving problems as they reason about disciplinary core ideas and crosscutting concepts through their engagement in scientific practices such as argumentation, construction and critiquing of explanations in their learning community (e.g., NRC, 2012; Resnick et al., 2018). However, despite efforts to promote reformed-based teaching, productive science talk is not yet prevalent in many U.S. classrooms (Banilower et al., 2018; NASEM, 2015).

To promote productive talk, prior research primarily focused on curriculum and teachers' instructional practices and revealed teachers' critical roles in providing opportunities for students' engagement in productive talk (e.g., O'Connor & Michaels, 2019). Teachers' roles have been explored with a primary focus on teacher questioning (e.g., Chin, 2007; van Zee et al., 2001), talk moves (e.g., O'Connor & Michaels, 2017), teachers' responsiveness to students' thinking (e.g., Hutchison, & Hammer, 2010). These studies revealed that teachers' effective use of questioning and talk moves and attention to students' thinking could support students' engagement in productive classroom discussions. However, empirical studies revealed that many teachers find facilitating productive talk challenging although they attended professional development (PD) opportunities (e.g., Sandoval et al., 2018; O'Connor & Michaels, 2019). Science teachers' thinking regarding productive science talk and how to promote this talk remains an area that requires further exploration (e.g., Pimentel & McNeill, 2013).

In this study, by building on prior research around teachers' instructional vision (e.g., Hammerness, 2001, Munter, 2014; Tekkumru-Kisa et al., 2021a), we explored teachers' instructional vision and their instructional practices by framing teachers as thinkers who envision about teaching practices and doers who act teaching practices (e.g., Hammerness, 2006; Horn et al., 2017). The following questions guided our exploration: (1) How do science teachers, who attended a PD focusing on promoting productive talk, envision high-quality science instruction with respect to facilitating classroom discourse?, (2) How do the quality of science instruction differ in classrooms of teachers with different sophistication in their instructional vision of productive classroom discourse?

Conceptual Framework

The ambitious vision for science teaching and learning presented in the Framework for K-12 science education and the NGSS (NRC, 2012; NGSS, 2013) is at the core of reform efforts. While vision for instruction developed by stakeholders such as policy makers, school leaders, curriculum developers, teacher educators, and researchers are considered as essential for improving education, teachers' own instructional vision rarely gets attention. Teachers are mostly "expected or encouraged to 'buy into' an institutional vision" rather than develop and share their own vision of classroom practices (Hummerness, 2001, p.144). Prior research in mathematics and elementary education have emphasized surfacing and acknowledging teachers' instructional vision to better understand and promote their learning and instructional practices (e.g., Hammerness, 2001; Munter, 2014). However in science education, examining science teachers' instructional vision and their practices remains an area that needs exploration.

The concept of teachers' personal vision is about how individuals envision ideal classroom practices (Hammerness, 2001; 2006). Hammerness (2001) highlights that teachers' personal vision can "serve as a starting point for reform because they represent 'reach' – a set of images of ideal classroom practice for which teachers strive." (p. 143). Teachers' thinking of ideal classroom practice can function as a "reach" which inspires and encourages them to shape their instructional practices. Also, teachers' vision can invite them to make reflections upon their teaching (Hammerness, 2001; 2006). The concept of teachers' instructional vision (Munter, 2014) builds on the notion of teachers' personal vision (Hammerness, 2001) and focuses more on understanding teachers' thinking for high-quality teaching. It refers to what aspects of instruction teachers highlight for quality instruction (Munter, 2014). Munter (2014) aims to assess the level of depth or sophistication of teachers' vision of high-quality instruction based on critical dimensions of classroom practices described in the literature. This line of work suggests further exploration of teachers' vision as a lens to explore and assess teachers' learning and development of their thinking about classroom practices. Munter and Correnti (2017) found that the improvement in their instructional practice could be predicted by teachers' vision of high-quality mathematics instruction.

By building on the prior research (e.g., Hammerness, 2001; 2006; Munter, 2014; Tekkumru-Kisa et al., 2021a), we contend that exploring science teachers' instructional vision and their instructional practices together provide a powerful lens to better understand teachers' thinking which shape their instructional decisions and identify the areas that need improvement in teachers' instructional vision and practices to facilitate reform-based science instruction.

Study Design and Context

This study was conducted as a part of a National Science Foundation-funded project focused on promoting science teachers' learning to facilitate productive discussions with their students within the context of a professional development (PD) program. The PD program included a summer workshop and cycles of meetings throughout the subsequent school year. Each PD cycle consisted of three parts: (a) co-designing a science lesson with another teacher or a research team member, (b) teaching the co-designed lessons, (c) reflecting on the lessons. In the second year of the project, nine teachers voluntarily attended the project. Eight of the nine teachers, who participated in the larger project volunteered to be interviewed for this study. The participants' teaching experiences varied, ranging from 1.5 years (Ms. Shelly) to more than 20 years of teaching experience (Ms. Kate and Ms. Renee). Two of these teachers (Ms. Kate and Mr. Jerry) taught at the middle school; the remaining seven were high school science teachers. Although there was a variation in teachers' certification, all the teachers, except Mr. Daniel, were certificated to teach biology across grades 6 through 12. Mr. Daniel was certificated to teach chemistry grades 6 through 12. Only, Ms. Tina and Ms. Renee worked in the same school. The seven schools came from two different school districts in the Southeastern United States.

Data Sources and Analysis

This study drew on three primary data sources: (i) interviews with teachers, (ii) teachers' lesson planning documents, and (iii) video recordings of implementation of the lessons, which were designed by the teachers during the PD to promote their students' engagement in productive classroom talk. Each participant attended two types of teacher interview: end of school year interview and instructional vision interview. At the end of the 2019-2020 academic year, teachers attended an interview, which focused on understanding their characterization of productive talk and their experiences about facilitating discussion in their classrooms. A few months later, each teacher participated in a semi-structured interview focused on instructional vision. Instructional vision interviews (Tekkumru-Kisa et al., 2021a) were structured by building on the existing literature on teachers' vision (Munter, 2014; Hammerness, 2006). During the instructional vision interviews, teachers were asked to talk about how they envision high-quality science instruction, how they envision teachers' roles, features of classroom discourse, classroom tasks in high-quality science instruction. The interview also involved questions about how teachers envision productive classroom discussion. The instruction data for this study was planning documents of lessons that the teachers designed and video recordings for the implementation of these lessons in their classroom. The data on teachers' instruction was collected towards the end of the academic year.

To address the first research question regarding teachers' instructional vision with respect to classroom discourse, we examined interviews by using instructional vision rubric set for classroom discourse (Tekkumru-Kisa et al., 2021a). The rubric set is designed to assess the sophistication in teachers' articulation of classroom discourse when instruction is high quality. The rubrics help to assess teachers' instructional vision of productive science talk in terms of two main dimensions: (1) Patterns & structure of talk, and (2) nature of talk, as well as three sub-dimensions regarding the nature of teacher questions, student questions, and student explanations. In total, 12 hours of interview recordings and their transcripts examined by using these rubrics.

To address the second research question, we juxtaposed the results of analysis for the teachers' instructional vision with their instructional quality. We explored instructional quality in terms of two dimensions: teachers' facilitation of students' engagement in rigorous thinking and productive classroom discussions by using rigor rubrics (Tekkumru-Kisa et al., 2021) and talk rubrics (Tekkumru-Kisa et al., 2020a, 2020b). The rigor rubrics are designed to assess opportunities for students' engagement in high-level thinking and sensemaking. They are used to examine: (1) rigor in potential of the task presented in the lesson planning materials, (2) rigor in task launch as the teacher frame of intellectual work for students, mostly in the beginning of the lesson, and (3) rigor in implementation of the task by the teacher and students (Tekkumru-Kisa et al., 2021b). In total, planning materials for 8 lessons and 21 hours of video recordings of these lessons were coded.

The same video recordings were also examined in terms of facilitation of classroom discussions by using the productive talk rubrics, which helped to uncover the extent to which discussion in the classroom is accountable to the learning community and the knowledge and reasoning in service of sensemaking (Boston, 2012; Resnick et al., 2010; Tekkumru-Kisa et al., 2020a;b). These four talk rubrics (see Table 1) were used to examine students' and teachers' contributions to classroom talk. Although we examined the talk from students' and teacher's contributions, we especially focused on two rubrics: Teacher linking and teacher press for knowledge and reasoning to examine teachers' instructional practices for facilitating classroom talk. Half of the data sources were analyzed first individually by two coders by using the rubrics. They, then, came together to discuss their ratings by showing evidence and justification from the data and rubrics until reaching a consensus. After having an interrater reliability over 80 percent, the first author coded the rest of the teacher interview data, lesson planning materials, and classroom recordings.

Findings

Our analysis revealed that science teachers, who attended the PD focusing on promoting productive talk, envisioned high-quality science instruction with respect to classroom discourse at various levels of sophistication (see Table 2). Majority of the teachers' characterization of productive classroom discourse when instruction was of high-quality was classified at the moderate sophistication level. This means, teachers mention both whole-class and small group discussions by referring to the teacher's and students' talk around science content or investigations but they did not discuss aspects of discussion in service of doing science. Only Ms. Kate and Mr. Daniel clearly articulated what makes classroom discourse productive by referring to critical aspects of facilitating science talk. For example, they clearly discussed the features of teacher questions in terms of supporting students' scientific thinking, and helping students to explain and elaborate on their thinking and discussing alternative ideas as they are working towards developing explanations and arguments. They also described students' questions as driving instruction and leading further thinking and students' explanation with the focus on how and why things work.

All teachers emphasized discussion among students as an important component of productive talk, but many of them could not describe the substance of classroom talk, the nature of student questions, and explanations. In addition, Mr. Jerry, Ms. Shelly, Ms. Karly, did not talk about student questions and Ms. Monica did not talk about student explanations while describing their vision of classroom discourse. These findings show that the teachers could not articulate in detail what they see as critical for classroom talk to be productive in science classrooms, especially in terms of the nature of students' questions and explanations for facilitating classroom discussions.

When we juxtaposed teachers' instructional vision with their instructional practices (see Table 3), the analyses revealed that in most cases, except Ms. Tina and Ms. Renee, there was an alignment between how teachers' envision high-quality science instruction with respect to classroom discourse and quality of instruction in their classrooms. For instance, Ms. Kate and Mr. Daniel with a sophisticated instructional vision had high quality instructional practices in facilitating classroom discussion and rigorous student thinking. Consistent with how they envision the nature of teacher and student talk, they regularly asked students to support their contributions with evidence and explain their reasoning as they worked towards explaining a phenomenon. They also showed consistent effort in connecting students' contributions to each other and providing opportunities for students to build on each other's ideas. However, Ms. Tina and Ms. Renee, whose instructional vision was coded as less sophisticated, had low instructional quality in facilitating productive discussions in their classrooms. Although they envisioned teachers asking questions around students' claims, evidence, and reasoning, in their classroom they rarely asked for students' reasoning for their claims, sometimes asked for their evidence regarding their claims, and did not show effort to make connections among students' ideas.

Conclusions and Scholarly Significance

Our study findings show that there was an alignment between teachers' instructional vision and their instructional practices. Teachers who have highly sophisticated instructional vision were more likely to facilitate high-quality science instruction in comparison to the teachers with less sophisticated instructional vision. However, some teachers might not have yet translated their vision to their current instructional practices. These teachers might need more learning opportunities to improve their teaching practices. By building on prior research (Hammerness, 2001; 2006; Munter & Correnti, 2017) and the findings of this study, we argue that exploring teachers' instructional vision can help to understand what shapes teachers' instructional practices, and the development of teachers' instructional vision can promote their use of reform-based instructional practices. Teachers' instruction vision could act as a guide for their instructional practices so that teachers can use their vision as a model which informs their learning and their current and future instructional decisions and practices.

Also, our study findings suggest that exploring teachers' instructional vision, and their vision and practices together provide useful lenses to identify the areas that need improvement in teachers' instructional vision and practices and contribute to development of means to support instructional improvement in science classrooms. As the field is seeking ways to support teachers' learning and their enactment of science instruction aligned with current ambitious instructional reforms, the analytical lens used in this study and our findings can inform professional development efforts for science teachers. Working towards the development of a shared vision of high-quality instruction by researchers, policy makers, teacher educators, school leaders, and teachers can support enactment of high-quality science instruction.

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