Teacher Reflective Noticing and Scaffolding for Student-Driven Knowledge-Building Inquiry

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Abstract: This study investigates a teacher’s noticing and scaffolding in two Grade 5 science classrooms based on knowledge building pedagogy. The teacher observed students’ inquiry and collaboration in the classrooms and online and kept weekly reflective journals to write about her noticing, reflection, and planning to scaffold deeper knowledge work. Qualitative analysis of the teacher’s journal entries in connection with classroom data generated a detailed temporal view of the teacher’s ongoing noticing, envisioning, and classroom actions, which responded to and further reshaped student-driven inquiry efforts. Through engaging in reflective noticing and envisioning of students’ knowledge building progress, the teacher can devise responsive support to scaffold ever-deepening inquiry processes in which students enact epistemic agency.

Introduction
Reforms in education prioritize the need for students to develop deep knowledge and authentic practices by which knowledge is constructed (National Research Council, 2012). To cultivate authentic practices for knowledge building in science classrooms, teachers face the challenge of how to scaffold expansive inquiry processes in a way that enhances student epistemic agency for charting and reshaping the course of improvisational inquiry in a collaborative community (Scardamalia & Bereiter, 2006; Zhang et al., 2022). Existing studies have documented a wide range of scaffolding moves teachers take to facilitate students’ knowledge building conversations (e.g., Hmelo-Silver & Barrows, 2008). Further research needs to better understand their ongoing pedagogical judgment and decision-making underlying their classroom moves (Horn, 2020; Watkins & Manz, 2022). Thus, the current study investigates a teacher’s noticing and scaffolding in two parallel Grade 5 classrooms that implement Knowledge Building (KB) pedagogy with technology (Scardamalia & Bereiter, 2006). This study aims to produce a comprehensive and temporal account of the teacher’s reflective noticing that informs her scaffolding of student collaborative inquiry. Our research questions ask: (a) What aspects of students’ knowledge building work did the teacher attend to in her reflective journals? (b) In what ways did the teacher interpret the changes in student knowledge building and envision responsive classroom moves? And (c) how did the teacher scaffold student knowledge building based on her ongoing noticing and envisioning?

Conceptual and design framework
We propose a framework to guide our design and analysis of teacher noticing and scaffolding for student-driven knowledge building. Based on this framework, investigating teachers’ reflective noticing and envisioning for knowledge building may demystify how teachers navigate the emergent changes and opportunities in students’ inquiry work and make strategic choices to catalyze deeper conversations and sustain iterative idea improvement. The key elements of the framework are elaborated on below.

First, teachers’ reflective noticing and scaffolding revolve around student-driven knowledge building processes, treating students’ authentic problems and evolving interests and ideas as the center of classroom dynamics (Scardamalia & Bereiter, 2006). Teachers use an open-ended approach to classroom planning: identifying big ideas and challenging issues in a curriculum area, sketching an overarching picture of how the collective inquiry may get started and evolve while leaving the detailed actions and processes open to be co-improvised with students as they step in the scene (Zhang et al., 2022; Zhang & Messina, 2010). Second, our framework highlights three interconnected elements of reflective noticing and scaffolding: Attending, Interpreting, and making pedagogical Moves (A-I-M). While these elements have been identified in the literature on teacher noticing (Barnhart & van Es, 2015), our framework further aligns such teacher efforts with student-driven action and agency for deepening collaborative inquiry and discourse. Specifically, in a knowledge building community, teachers need to (a) attend to students’ evolving ideas and inquiry practices to detect dynamic information about what is going on and what is new and emerging; (b) interpret the classroom information to understand how students are thinking now, in relation to their work in the past and potential idea development in the future; and (c) in response to the evolving landscape of ideas, envision strategic pedagogical moves (choices), which catalyze or leverage student-driven efforts to further their collaboration and inquiry. Third, teachers’ attention, interpretation, and pedagogical moves are guided by the core principles of knowledge building. For example, guided by the principles of authentic problems, real ideas, and continual idea improvement, teachers are attentive to students’ evolving problems and ideas generated in personal and collaborative works. Capturing
such information helps teachers make timely and intentional moves to advance students’ knowledge building efforts.

**Classroom context**

This study was part of a larger project to explore classroom designs and technology for student-driven knowledge building in science at a public elementary school in the Northeastern U.S. The participants included one teacher, Mrs. G, who taught science in two Grade 5 classrooms, including her homeroom class (classroom G) and Mrs. W’s class (classroom W). Mrs. G taught for over 20 years and was in her third year of teaching science based on KB pedagogy. There were 21 students in each classroom (20 boys and 22 girls), who were 10- to 11-year-olds and came from diverse ethnic backgrounds. In the school year of this study (2015-2016), Mrs. G worked with the students to study human body systems over eight months as part of their science curriculum. There were two science lessons every week, each lasting for 40 minutes.

In mid-September, students participated in the kick-off activities, each of which required them to complete a challenging task about various body parts. In the following science lesson, students from each classroom participated in a reflective conversation called a metacognitive meeting (MM), in which they shared a wide range of questions and, as a whole class, built shared interests in understanding the functions of the human body. Then, students with interrelated interests and questions worked together to formulate an overarching question to guide their inquiry in a shared “wondering area.” As their discussion proceeded, they formed a spontaneous group with those having similar interests and conducted personal and collaborative inquiry activities. Major questions, ideas, and findings generated through the face-to-face activities were contributed to Knowledge Forum for online discourse. In the classrooms and online, Mrs. G worked as an attentive listener to understand students’ interactive questions and ideas while offering support to help students further their inquiry and refine their collaboration. She kept a weekly reflection journal designed based on our conceptual framework to record her observation (“I notice…”), interpretation (“I think…”), and responsive planning (“In the following week(s)…”).

**Data source and analysis**

The core data source was Mrs. G’s weekly reflective journals. The teacher recorded 27 reflective journals to reflect on student inquiry in the two classrooms. Her journals contained 172 journal entries, including 92 entries reflecting on the inquiry work in her home class (classroom G) and 80 for classroom W. We analyzed Mrs. G’s journals in connection with several other data sources, including classroom observations of students’ inquiry activities and the archive of student online discourse in Knowledge Forum. We observed each science lesson during the human body inquiry and video/audio-recorded the major classroom activities, such as whole class metacognitive meetings.

To address the first two research questions, we analyzed Mrs. G’s reflective journals using a grounded theory approach to understand what aspects of student inquiry the teacher attended to, how she interpreted, and the classroom moves she envisioned in response. Each entry (row) of reflection (i.e., an A-I-M set) was considered a unit of analysis. The first author read the journals multiple times to develop a general sense of Mrs. G’s reflection. Then, she worked with the second author to develop initial open codes (raw codes) using a subset of reflection journals as applying open codes to characterize Mrs. G’s reflection. The two co-authors then discussed the open codes and the related examples, reflected on the meaning and consistency of the codes, and refined the labels and definitions better to capture the teacher’s points of observation and thinking. Through multiple rounds of discussions, the authors compiled an initial codebook and then reviewed all the open codes and examples to formulate salient themes that characterized Mrs. G’s attention, interpretation, and planning of classroom moves. In the final analysis phase, the authors searched for connections across the themes of A-I-M sets, identifying how Mrs. G interpreted the observed knowledge work and considered various pedagogical moves. To address the third research question, we further examined Mrs. G’s noticing points and scaffolding moves in the temporal context of student knowledge building processes in the actual classroom events, discovering patterns of teacher scaffolding that built on and further shaped student inquiry actions.

**Results**

**What aspects of students’ knowledge building work did the teacher attend to?**

Through coding Mrs. G’s writing in the column of “I notice…”, we identified six salient categories (themes) representing what the teacher attended to when observing and monitoring student knowledge work as individuals, groups, or a whole class. As the most salient points of noticing, Mrs. G observed students’ individual and
collective efforts of ongoing idea improvement in existing lines of inquiry (A-2, 37.21%) while paying attention to the emergence of new inquiry interests and directions (A-1, 23.26%) and monitoring gaps in inquiry and contribution (A-6, 2.33%). She was also attentive to students’ specific inquiry activities, emotions, and needs (A-3, 16.28%), their use and generation of resources and tools to support inquiry (A-4, 6.98%), and the meta-talk among students about knowledge building practices and norms (A-5, 2.91%).

In what ways did the teacher interpret new changes in student knowledge work and envision responsive moves?

The teacher’s interpretation and sense-making of what was going on
Nine themes emerged from the coding of the teacher’s journal writing in the “I think…” section, which recorded her interpretation and analysis of what was going on in student knowledge work. Mrs. G’s pedagogical analysis and sense-making centered on understanding students’ personal intent, needs, and emotions (I-6, 30.23%) while comprehending and appreciating their progressive ideas (I-1, 25%) to discern emergent opportunities and needs for further idea improvement and collaboration. As the related considerations, Mrs. G also reflected on specific gaps in student inquiry and idea contributions (I-9, 5.81%), analyzed potential opportunities for deepening ideas (I-2, 2.33%), expanded collective inquiry (I-3, 0.58%), and assessed the clarity of student ideas (I-5, 1.16%). She examined potential connections between different concepts and areas of inquiry (I-4, 3.49%), reflected on how students used and created resources/tools in their knowledge work, including their needs for support (I-7, 3.49%), and analyzed student knowledge building practices and norms reflected in the classrooms and online discourse for possible improvement (I-8, 2.91%). In her pedagogical sense-making, Mrs. G often positioned the specific events she had observed in the larger context of the core disciplinary ideas in the curriculum area, the past and future of the human body inquiry of the whole classroom community, and the knowledge building principles and norms.

The teacher’s planning of responsive classroom moves
In light of what was going on in student work, Mrs. G envisioned ways to enhance student knowledge building in the coming week(s). Nine categories of classroom moves that the teacher envisioned. The most salient moves focused on (a) supporting students’ needs to improve their learning experiences and enhance their knowledge building practices (M-6, 19.19%), such as by offering suggestions to individual students on note writing or meeting with a small group to address their needs, and (b) facilitating idea connection and collaboration among students (M-4, 12.79%), such as by highlighting a student’s Knowledge Forum note during a metacognitive meeting for further discussion or pairing students who had posted interconnected questions to work as a group. As the relative classroom moves, she envisioned specific ways to continually trace students’ inquiry progress and contributions and explore the further directions of the community’s inquiry (M-9, 8.72%); to foster students’ deeper understanding of concepts through continual inquiry efforts (M-2, 8.14%); to form new inquiry directions with students (M-1, 6.98%); to broaden the sharing and spread of inquiry progress (M-3, 4.65%), while supporting student use of resources/tools (M-7, 4.65%), knowledge building practices and norms (M-8, 4.07%), and misunderstanding (M-5, 2.33%) as needed.

How did the teacher scaffold student knowledge building based on her ongoing noticing and envisioning?
Our analysis investigated the dynamic links between what the teacher captured from student work, her envisioning/planning of responsive teacher moves, and the actual classroom processes that followed. For a temporal view, this analysis zoomed in two time periods: (a) from October to November 2015, when students were initiating their inquiry works on the various human body topics and establishing their knowledge building practices as a whole community; and (b) in December, when the classroom members continually reflected on their ongoing inquiry and worked on new opportunities to deepen and expand their knowledge. For each period, we identified and traced the co-occurrence of various themes of A-I-M associated with each row (entry) in Mrs. G’s reflection journal.

For instance, we unpack one of the patterns: tracing ongoing student efforts in the unfolding lines of inquiry to enhance idea improvement, build connections, and address knowledge gaps. Students in each classroom co-formulated an initial set of wondering areas at the beginning of the human body inquiry, which guided students’ personal and collaborative knowledge building. Mrs. G continued observing how student thinking deepened in each inquiry area (A-2), attending to student-generated inquiry interests, ideas, and activities. Anchored in what she had observed, Mrs. G engaged in pedagogical sense-making to understand students’ progressive ideas and questions (I-1) and analyze potential opportunities/needs for students to further deepen their thinking (I-2). Based
on that, she (a) facilitated deeper inquiry and understanding of concepts (M-2); (b) facilitated student collaboration and idea connection (M-4); (c) spotlighted the inquiry progress and ideas of an individual or a group of students to facilitate broader sharing and discussion (M-3); and (d) addressed misunderstandings reflected in students’ work (M-5). From December, the teacher continued to observe students’ ongoing efforts in the existing lines of inquiry to understand students’ evolving ideas (I-1) while pondering their intentions of inquiry and needs for support (I-6). Such pedagogical analysis and sense-making helped the teacher to envision responsive moves to support student idea improvement and build connections across the various lines of inquiry (M-2, M-3, M-4) while addressing students’ specific needs (M-6). As Mrs. G monitored students’ ongoing progress, she also detected missing concepts yet to be incorporated in student discourse (A-6) and reflected on possible ways to bring such concepts to student attention (I-9), building on the questions and ideas they had generated online or in classroom-based activities. Instead of redirecting students to teacher-specified directions, the teacher built on student ideas and inquiry practices to introduce her responsive input. Students’ inquiry works and artifacts were used as examples to facilitate meta-talks about how they should carry out their knowledge building as a community, leading to more elaborate inquiry practices, tools, and classroom norms.

Conclusion and implications

This study suggests that principle-informed reflective noticing and envisioning may function as a dynamic process that teachers can leverage to support student-driven knowledge building practices in science and potentially other content areas. Ongoing reflective noticing of student knowledge work, guided by the core principles of knowledge building pedagogy, reveals ever-emerging opportunities for further advancing students’ inquiry and collaboration. Teachers then interpret and respond to such opportunities by devising possible classroom moves, which help catalyze students’ epistemic efforts to develop deeper inquiry and discourse on an ongoing basis. Following each major classroom effort to reshape the community’s inquiry works in specific ways, teachers co-engage in the subsequent knowledge building activities and discourse with students to observe how student inquiry efforts further evolve. Thus, teachers’ reflective noticing and responsive scaffolding unfold as an iterative and recursive process over time as students’ knowledge building proceeds (cf. Watkins & Manz, 2022). Given the challenging nature of teacher noticing in a constantly changing classroom environment, it is important to design classroom-oriented analytical support that can enhance teachers’ ongoing noticing of students’ dynamic inquiry in a collaborative community (van Leeuwen et al., 2019). The conceptual framework and empirical of this research may inform designs of the support and professional development resources aimed at helping teachers master the art of reflective noticing and scaffolding for collaborative knowledge building.

References


