

A CASE OF SHARED AUTHORITY DURING A STUDENT DEMONSTRATION IN A MATHEMATICS CLASSROOM

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By applying a conversation analytic approach to analyze the fine-grained manifestation of authority in classroom interaction, we examine the interaction between a teacher and a student while the student presented a solution at the whiteboard. This case highlights the complexity of shared authority and the ways that authority is construed by discourse practices and negotiations over the ownership of knowledge. We offer a nuanced interpretation of how the teacher and student shared epistemic authority through their joint activity. Further, we argue for the importance of distinguishing teachers' epistemic authority and deontic authority to further our understanding of how a teacher can share authority with students during instruction.

Keywords: Classroom Discourse, Authority, Student Demonstration, Conversation Analysis

The flow and concentration of authority in mathematics classrooms can impact students' identities as knowers and doers of mathematics (Boaler & Greeno, 2000; Esmonde & Langer-Osuna, 2013, Langer-Osuna, 2017). In our view, authority is not static but rather is relational (e.g., a teacher is presumed to have more authority than a student) and interactional (e.g., a student sharing a solution may imbue the student with authority). Moreover, our analysis focuses on the relative nature of authority, meaning participants may have greater or less authority, but this may shift over the course of interaction. In this paper, we explore a case of one mathematics teacher's attempts to share authority when a student (i.e., a *demonstrator*) shared a solution at the front of the room. This case study of a teacher negotiating authority with students during a common classroom activity (i.e., presenting a solution at the board) offers an opportunity to examine the complexity of shared authority in mathematics classrooms. Our analysis highlights the ways that authority is construed by discourse practices and negotiations over the ownership of knowledge.

This paper uses data from a partnership with mathematics teachers designed to support teachers to do action research on their discourse practices. Here, we build on that research using a conversation analytic (CA) approach to foreground the role of language and knowledge in the sharing of authority in mathematics classrooms. We approach our analysis under the assumption that knowledge is public and interactionally managed and occurs within and is constituted as a situated discursive practice (Barwell, 2013; Edwards, 1993). By attending to how teachers and students *perform* knowledge rather than what knowledge they *have* (Byun, 2019), our analysis centers the knowledge displays and negotiation that are an integral part of the process of sharing authority in classroom interactions. In this paper, we argue that the physical arrangement and position of a student alone—such as the physical location of a student at the front of the room—may not be enough to account for how authority is shared in the classroom. Instead, authority can be shared through discursive moves that orient classroom members to the knowledge domains in which one or more students are the primary authorities.

Authority in Mathematics Classrooms

Teachers exercise tremendous authority in their classrooms (Amit & Fried, 2005; Oyler, 1996; Wagner & Herbel-Eisenmann, 2014b). In mathematics classrooms, teacher authority is also influenced by the institution of schools and common discourses of mathematics. As a student in an

interview stated, “[mathematics] is not like literature where someone can say this way, and someone can say this way” (Amit & Fried, 2005, p. 158). This commonly held belief reflects the common practice of mathematics teachers determining what is correct or incorrect as arbiters of truth. As mathematics educators try to move from teacher-centered to student-centered ways of teaching, sharing authority has been a central theme in the discussion (e.g., Ball, 1993; Cobb, Wood, Yackel, & McNeal, 1992; Cohen, 1990; Hamm & Perry, 2002; Lampert, 1990).

Scholars have examined authority and authority relations in mathematics classrooms from multiple perspectives. Amit and Fried (2005) found that students portray parents, teachers, and peers as authority figures while placing teachers at the center of authority. Wagner and Herbel-Eisenmann (2014b) found that teachers attributed authority to not only people but also institutions (e.g., school board) and tools and artifacts (e.g., textbooks, manipulatives). Authority in mathematics classrooms thus has complex origins and relations that manifest in overt and covert ways (Wagner & Herbel-Eisenmann, 2014a).

Authority can also have different discursive functions in unfolding classroom interactions. Oyler (1996) distinguished two dimensions of teacher authority: teacher being *an* authority and being *in* authority. These two kinds of authority, respectively, represent a content dimension of mathematical knowledge and a process dimension of organizing and orchestrating learning activities. Similarly, Langer-Osuna (2016) examined both intellectual authority and directive authority in student-to-student interactions. Although these two kinds of authority are interdependent (Langer-Osuna, 2016), it is important not to conflate these two. As we argue in this paper, process authority can be a resource for teachers to share content authority in the unfolding classroom interactions. To further examine teacher authority in the context of classroom interaction, we draw on two major discussions on authority in social interaction: epistemic authority and deontic authority.

Epistemic and Deontic Authority: A Conversation Analytic View

CA scholars found that participants orient to relative authority in two broad ways during interactions. First, epistemic authority concerns the relative difference in participants' depth of knowledge at hand. To be clear, the concern is not with the depth of knowledge in participants' minds, but rather how the participants treat themselves and others as more or less knowledgeable in the interaction. As we discussed earlier, institutional roles such as being a teacher or a student, in part, shape the epistemic authority. CA approaches can uncover how such authority manifests in a local, interactional context. For instance, Heritage and Raymond (2005) illustrated how, when a person assesses and describes something before others share, they are often ascribed with more epistemic authority than doing so after someone else. They observed when a participant with less authority makes a claim first, the participant mitigates the associated epistemic authority by downgrading their assertion (e.g., pre-facing with "I think," adding a tag question, seeking confirmation). Thus, epistemic authority can originate from not only being *a teacher* but also from a local, interactional role such as being a *teller of news* or *teller of trouble*. In our case, a student being someone who shares a solution at the board afforded her with epistemic authority, though limited.

Second, deontic authority concerns someone's "right to determine others' future actions" (Stevanovic & Peräkylä, 2012, p. 298). Although epistemic authority is about "description," deontic authority is about "prescription" (p. 298). In a classroom setting, process-authority aligns with deontic authority, with which a teacher directs the future actions of the class, such as selecting who will speak next and choosing a topic for the class to discuss (Mehan, 1979). Directives and proposals are often associated with deontic authority, but the recipients of these actions may resist the speaker's deontic authority by refusing to comply or framing their compliance as their autonomous action (Kent, 2012). As Stevanovic and Peräkylä (2012) stated, "[d]eontic authority is an interactional

achievement, claimed, displayed, and negotiated at the level of the turn-by-turn sequential unfolding of the interaction" (p. 315).

A CA approach fits our investigation on teacher authority in classroom interactions for at least two reasons. First, teacher authority is "created and maintained through interactions" (Oyler, 1996, p. 23). A CA approach brings our attention to teacher authority situated in interactions, thereby allowing us to see how authority is instantiated and shifts as the interaction unfolds. Second, a CA approach offers a systematic way to formulate empirically grounded interpretations of authority in social interaction. Based on its root in ethnomethodology, a CA approach attends to how participants orient to authority based on the subtle details of moment-to-moment interactions. Based on this theoretical grounding, we investigated the following research question: *How do epistemic and deontic authority instantiate and interact with each other when a student is a demonstrator?*

Data and Methods

This study was part of a larger partnership focused on supporting secondary mathematics teachers to use action research to examine their classroom discourse by focusing on, for example, issues of status, and positioning in mathematics classrooms. Data came from classroom videos of participating teachers that they collected to examine changes in their discourse patterns. Among multiple cases of student demonstrations, this case of Ms. Reed was selected for this report because on the surface, her case illustrated evidence of overt teacher authority. She regularly used directives (e.g., "stop," "continue," "ask"), and the length of the student demonstration was approximately 13 minutes, which was longer than many of the other observed student demonstrations. This was intriguing for us because we anticipated that the greater the authority that a teacher exercises, the less knowledge can be shared from demonstrating students, thus resulting in a shorter demonstration length. This led to a more fine-grained analysis of this selected case to understand how teacher authority manifested during this relatively longer student demonstration.

Following the tradition of conversation analysis, we adopted the Jefferson Transcription System (Jefferson, 2004) to capture a range of speech features (e.g., delays in response, elongated pronunciation, intonation changes) that may be significant to examine authority in interaction. Here, we only report the following features: silence in 1/10 sec, (.x); silence shorter than 0.3 sec, (.); overlapping talk, []; vowel elongation, : ; emphasis, _ ; unrecoverable speech, (), as we referred to them in our findings section. By examining both what the teacher does and how students respond, we examined how the teacher and students are orienting to both epistemic and deontic authority. Based on the participants' orientation, we made an empirically grounded interpretation of authority.

Findings

In this section, we analyze transcript extracts from a demonstration by Anika, an 8th grade student. Before the demonstration, students were engaged in two warm-up problems, each of which asked them to create an equation of a line passing through two given points. After the students solved the problems individually, Ms. Reed called on students to share their answers. Anika volunteered to share her solution. Ms. Reed asked Anika to share her method at the front of the room on a digital interactive whiteboard. Our analysis highlights the nuanced ways that authority was shared through the joint discursive activity of members in the class. This analysis also points to the importance of distinguishing teachers' deontic and epistemic authority.

Exclusive Deontic Authority

Extract 1: Use of Directives

083 ANIKA: .hh so then I would (.) set up my equation lik:e
084 () over (2.5)
085 so: this would be x two: and then this would x one
086 so then it would be negative two: (1.0)
087 Ms.R: okay sto:p (.) question.
088 JOHN: u[:m] why is the uh seven uh y two and the fi- and
089 Ms.R: [John]
090 JOHN: the uh negative two x two.

Throughout the demonstration, Ms. Reed acts with deontic authority in at least two ways. First, she stops the speaker to direct the class to another activity (line 87). Ms. Reed's falling intonation when she says "question." indicates that this is a directive rather than seeking a question. Second, Ms. Reed selects the next speaker (line 89). Note that John starts his speech with "um" (line 88) occupying the conversational floor with his speech and vying for his right to speak. As soon as Ms. Reed names John as the next speaker, John starts his question. In both accounts, students orient to Ms. Reed's deontic authority with immediate compliance. That is, Anika stops her demonstration and John initiates and begins his question with full compliance with Ms. Reed's directives.

Sharing Epistemic Authority

Contrary to Ms. Reed's deontic authority, we found that Ms. Reed orients to Anika's epistemic authority, thereby sharing epistemic authority with Anika. Ms. Reed does so with particular kinds of actions (e.g., highlighting Anika's epistemic access, seeking confirmation). Some of these actions occur even before Anika walks to the front of the room. We illustrate this pre-work with Extract 2 below.

Extract 2: Constructing Anika as an Expert

023 ANIKA: so I found the slope and then I (substituted it)
024 into it. ()
025 Ms.R: okay so (1.0) we are gonna look at (.) your method.
026 (0.5)
027 Tanner? as you listen to Anika is that- does that
028 sound similar to (.) what approach you took?
029 (.)
030 she said y two minus y one::, (1.0) she did some
031 subtracting over x two minus x one,
032 (1.0)
033 TANNER: ()
034 Ms.R: so can I- can I ask you?:
035 (0.5)
036 what is tha:t formula= where did you get that.
037 (1.0)
038 ANIKA: u:m I learned it ()=
039 Ms.R: =okay
040 ANIKA: during the summer.

After Anika described her approach to the problem, Ms. Reed says "we are gonna look at your method" (line 25). With her lexical choice of the possessive pronoun, "your", Ms. Reed orients to Anika's ownership of the method. This lexical pattern continues. As Ms. Reed asks Tanner to compare his ideas with Anika's (lines 27-28), she indicates that the method originated from Anika by pre-facing her clauses with "she said" and "she did" (line 30).

Another salient point in this extract is the way Ms. Reed makes Anika's exclusive epistemic access public by asking Anika about the source of her method (line 36). Although what Anika names as the

source of knowledge is unrecoverable for the analysis (line 38), we can see, in contrast to deontic authority, Anika takes up her epistemic authority. Anika expands her turn by adding “during the summer” (line 40) despite Ms. Reed’s earlier acknowledgment token, “okay” (line 39). Anika’s expansion of her turn shows Anika’s orientation to her exclusive epistemic access to the method since “the summer” refers to a time beyond the school year, which lies outside of the class’s shared experience.

In these interactions Anika is constructed as a person with knowledge that the rest of class may not have. In the following extracts, we discuss instantiations of Ms. Reed’s orientation to Anika’s epistemic authority. Notably, some of the orientation is displayed with Ms. Reed’s deontic authority.

Extract 3: Treating Anika with Epistemic Authority

088 JOHN: u[:m] why is the uh seven uh y two and the fi- and
089 Ms.R: [John]
090 JOHN: the uh negative two x two.
091 (1.5)
092 ANIKA: u:m I guess it’s just the way it’s placed? so if this
093 was the: first two coordinates and this was second
094 two coordinates that-
095 JOHN: () closer to the x two uh (0.5) closer to
096 y intercept is: (1.0) for (0.5)
097 Ms.R: I think she mea:ns that’s the first point?
098 (0.5)
099 JOHN: a[::h]
100 Ms.R: [and that]’s the second point=
101 JOHN: =okay
102 Ms.R: that’s the x from the first one, and the y from the
103 first one so that’s how she said x one y one and
104 that’s the x: and y from the second one.
105 (.)
106 is that what you mean?
107 ANIKA: yeah

When Ms. Reed has students ask questions, John poses a question (line 88). Anika, thus not Ms. Reed, answers John’s question. The source of knowledge is Anika in this question and answer sequence. This contrasts with the deontic authority that Ms. Reed exercises by selecting John as the next speaker, as discussed earlier. Ms. Reed exercises her deontic authority to coordinate the activity of others and get the work of teaching done (Oyler, 1996). However, Ms. Reed tacitly acknowledges that Anika is the person from whom the flow of knowledge originates. For instance, Ms. Reed downgrades her epistemic stance as she explains Anika’s method. In line 97, she pre-faces her statement with “I think” and finishes her turn with a rising intonation (noted as “?”) despite her statement’s declarative syntax.

Most notably, after revoicing Anika’s method (lines 100-104), Ms. Reed seeks Anika’s confirmation (line 106), to which Anika responds with a positive confirmation, “yeah” (line 107). This interaction marks a significant shift in how Ms. Reed overtly shares authority with Anika. By seeking confirmation, Ms. Reed once again downgrades her epistemic stance and signals to the class that she is not the expert over the information being clarified. With both Ms. Reed’s confirmation-seeking and Anika’s response, both of them treat Anika with epistemic authority.

Extract 4: Centering on What Anika Does

151 ANIKA: so then (.) y is equal to negative two fifths
152 ((Anika writes on the board))
153 times (1.8) three (1.0) plus ()
154 Ms.R: k (.) stop (.) questions so far?
155 (.)
156 what is she doing?
157 (2.0)
158 we talked about how she found her slo:pe and that was
159 similar to just the change in y over change in x that
160 we done (0.7) Azad (.) what is she doing?
161 AZAD: exploiting the x y coordinates: to (.) find b.
162 (1.7)
163 Ms.R: Molly?
164 MOLLY: what's the three in parentheses?
165 Ms.R: ask (0.7) Anika
166 MOLLY: what's [the th-]
167 ANIKA: [it's x.]

Ms. Reed continues to exercise deontic authority throughout the student demonstration. Once again, Ms. Reed uses a directive, “ask” (line 165). Prior to this, Molly poses a question (line 164). From the extract, it is not clear who the recipient of the question is. Nonetheless, Ms. Reed treats Molly's question as not directed to Anika, and she uses a directive to direct her question toward Anika (line 165). Molly, in turn, starts to repeat the same question (line 166), but Anika answers Molly's question even before Molly finishes her repetition (line 167). In other words, Anika projects Molly's question to be identical to the question Molly asked earlier, and she acts as if the recipient of the original question was herself. This is another illustration of how Ms. Reed's deontic authority manifests overtly. Ms. Reed suspends the ongoing questioning and answering activity and makes the recipient of the question relevant to the degree that the identical question has to be repeated.

Although Ms. Reed's use of deontic authority may seem pedantic, it plays an important role in the lens of epistemic authority. By having Molly direct her question to Anika, Ms. Reed orients to Anika with epistemic authority over the information being presented (i.e., Anika's method). In a similar vein, Ms. Reed stops Anika's demonstration and prompts the class to ask questions (line 154). Because no student responds (line 155), Ms. Reed asks, “what is she doing?” (line 156). Note Ms. Reed's use of the pronoun “she”, which indicates Anika as the agent of the activity. This utterance implicitly orients to Anika's epistemic authority since Anika has the primary right to describe what she is doing.

Ms. Reed then selects Azad as the next speaker. The interesting feature of this question and answer sequence is the absence of evaluation or feedback after Azad's response. This contrasts with the common Initiate-Response-Evaluate (IRE) pattern (Mehan, 1969) and reinforces how Ms. Reed is sharing epistemic authority with Anika because Ms. Reed is tacitly deferring her epistemic authority that otherwise would have been used to confirm the correctness of Azad's response.

We initially hypothesized Ms. Reed's exclusive deontic authority and her deferring epistemic authority throughout Anika's demonstration. Our fine-grained examination, however, revealed deviant cases of such a claim (i.e., moments of Ms. Reed's asserting epistemic authority). In ethnomethodological studies, considering deviant cases is crucial to develop a more nuanced interpretation of the phenomena (Heritage, 1984). In the following, we present one of these deviant cases and further explore how Ms. Reed does, and does not, share epistemic authority.

Deviant Case: Not Sharing Epistemic Authority

Extract 5: Choral Chant

232 Ms.R: two divided by five (.) is what
 233 (1.2)
 234 S?: (point) (.) four
 235 Ms.R: point four. (0.5) negative point four. (0.5)
 236 negative two divided by five is,
 237 (0.9)
 238 STs: (negative point four). ((Choral Chant))
 239 Ms.R: negative two point four because (.) negative divided
 240 by a positive (.) is negative (0.8) two divided by a
 241 negative five is,
 242 STs: negative - [WOO]
 243 Ms.R: negative [point four] because a positive
 244 divided by a negative is
 245 (1.1)
 246 STs: a negative
 247 Ms.R: so: (.) as long as you have one negative (0.8) you
 248 can place it (.) wherever you like in your fraction
 249 (.) because it has the very same value. (.) okay?

Ms. Reed facilitates choral chants through which she rhetorically constructs common knowledge within the classroom (Edwards & Mercer, 1987). The choral chant occurs after a student asks a question relating to the equivalence of the fractions $(-2)/5$, $-2/5$, and $2/(-5)$. In contrast to Extract 4, in which Ms. Reed did not evaluate Azad's response, Ms. Reed confirms each response during the choral chant with her repetition (lines 239, 243, and 247 through 249). This indicates that Ms. Reed, not Anika, had epistemic authority during this interaction despite the fact that Anika is still at the front of the room. Further, in these IRE sequences, Ms. Reed justifies each response as indicated by her use of "because" (lines 239, 243, and 249). Her consistent justifications can be explained as her efforts to orient to the authority of mathematics as a discipline; yet, Ms. Reed remains to be the person who confirms the correctness.

Although we do not include the corresponding transcripts here, we also note other moments when Ms. Reed asserted her epistemic authority during Anika's demonstration. For instance, when one student asked if Anika's method is similar to what they have learned before, Ms. Reed offered confirmation, "exactly what it is," again with her account of how Anika's method relates to their prior learning. These deviant cases lead to a more nuanced understanding of how epistemic authority was shared during Anika's demonstration. Within the knowledge domain of Anika's method, Ms. Reed orients to Anika's epistemic authority. However, when the topic of discussion deviates from Anika's method (e.g., how her method connects to the class's prior learning, equivalence of fractions), Ms. Reed retains her epistemic authority to confirm the necessary knowledge for students to meaningfully engage with Anika's method.

Discussions and Implications

The push to develop student-centered classrooms should not imply the abdication of teacher authority (Oyler, 1996). This case demonstrates that teachers' deontic authority can aid in designating students' epistemic authority. Discussions about student-centered classrooms that misconstrue the role of teacher authority can paralyze teachers' efforts to facilitate productive mathematical discussions. Rather, there is a need to further examine how teachers can utilize deontic authority to share epistemic authority with students so that students can share and co-construct knowledge productively against a backdrop of institutional constraints such as curricular requirements and time limits. In professional development settings, this distinction can be helpful in designing a range of teacher moves that can be used to share epistemic authority (Herbel-Eisenmann et al., 2017).

This case also highlights the importance of how mathematics knowledge is introduced and framed by the teacher. Anika's method is quite conventional and is based on procedures that are often introduced in textbooks. However, Ms. Reed and the class treated her method as novel and, more interestingly, as a knowledge domain over which Anika had primary authority. This shows the situated nature of mathematical knowledge within a community in terms of authority. Although Ms. Reed might have known the conventional nature of Anika's method, Ms. Reed performed knowledge in ways that imbued Anika with primary epistemic authority. This had the effect of reconfiguring Anika's knowledge, converting it from a conventional method learned during the summer into an owned resource lying within Anika's epistemic domain. This was made possible through Ms. Reed's deontic authority, the exercise of which enabled her to demarcate lines along a terrain of mathematical knowledge. By setting boundaries around who owns what knowledge, Ms. Reed was able to portray Anika as someone who was not merely repeating a textbook method.

We also see potential for this study to contribute to discussions of equity in mathematics education research. As Byun (2019) discussed, teachers need authority to control the topic of classroom discussion so that students are steered toward different knowledge domains that can position minoritized students in more powerful positions. Without this deliberate reshaping of the epistemic terrain, participation patterns would likely continue to marginalize groups of students with particular social markers (e.g., race or gender). Although we did not attend to the racialized and gendered aspects of authority in classroom interactions in this study, we suggest further investigating the question of who teachers share epistemic authority with and its consequences for equity in mathematics classrooms. For instance, this case could be seen as an example of a female student of color who re-authors a conventional mathematical method through joint activity with her teacher, thereby challenging dominant conceptions about the authorship of mathematical ideas. Further work along these lines may offer valuable insights into equity issues in mathematics classrooms.

Acknowledgments

We thank the teachers, students, and parents for the partnership. We also thank NSF (Award #0918117) and the MSU Graduate School for their financial support. Any opinions, findings, and conclusions or recommendations expressed in this paper are those of the authors and do not necessarily reflect the views of the granting agencies.

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