"There are other ways to answer this:" Development of Pedagogical Content Knowledge via Listening as a Benefit to Writing Fellows across Disciplines

Naitnaphit Limlamai, Colorado State University
Emily Wilson, Alfaisal University
Anne Ruggles Gere, University of Michigan

Abstract: While much research has been devoted to understanding how peer tutoring benefits tutors, less attention has been given to how peer tutors develop pedagogical content knowledge as an additional benefit of working with students as they write. In this qualitative study of 15 undergraduate Writing Fellows (writing-focused peer tutors who work in large undergraduate gateway courses at the University of Michigan), we explore how Fellows describe their interactions with students in order to understand how they developed more nuanced knowledge of content and honed their pedagogical skills. We use the framework of interpretive and hermeneutic listening in a novel way in order to understand how the Fellows' listening orientation towards students informed their pedagogical strategies. We found that Writing Fellows took students seriously as sense-makers and used their numerous interactions with students and their close proximity to novice perspectives to develop flexible thinking about the subject and to inform their teaching.

"Sometimes I think it takes a little bit more and sometimes you have to give [students] a different prompt or a different way to think about [course concepts] and just reword … what you've been looking at. Because sometimes I do agree, it is kind of confusing. So you have to break it down or just say it differently. A lot of times usually if you can say it in a variation or give them something more concrete, like something with them, maybe their own relevance or their own experiences, then they understand it more." —Taylor, Writing Fellow

Introduction

Taylor, an undergraduate student, served as an MWrite Writing Fellow. Writing Fellows are peer tutors: students who were highly successful in large-enrollment gateway courses who demonstrated good interpersonal skills and received a recommendation from their professor.[1] As a Writing Fellow, Taylor enrolled in a one-credit course that helped him learn about writing-to-learn pedagogies: how writing about course concepts increases student learning (Emig, 1977; Galbraith, 2015; Ivanič, 2004; Lemke, 2002) and how writing-to-learn has been useful in STEM fields (Arnold et al., 2017; Gere et al., 2019). As a Writing Fellow, Taylor drew on knowledge of students as he continued to develop

advanced knowledge of course content while honing pedagogical skills. Developing knowledge of content, students, and pedagogy as a Fellow is an understudied effect of peer tutoring on tutors.

Writing studies scholars have long written about the effects of peer tutoring on tutors like Taylor. Peer tutors learn how to work collaboratively with other students on campus (Falchikov, 2003; Goldschmid & Goldschmid, 1976), building social and intellectual engagement with tutees (Bruffee, 2008). The tutor can broaden their "understanding of [their] own and … fellow students' value and the importance of both … as human being[s]" (p. 6). Tutors develop a capacity for listening (Hughes et al., 2010; Seo et al., 2019). Tutors also report increasing their confidence and motivation in their learning (Falchikov, 2003; Goldschmid & Goldschmid, 1976; Srivastava & Rashid, 2018).

Another effect of peer tutoring on tutors is that tutors benefit academically from tutoring. They build content knowledge and reinforce their knowledge of the subject (Falchikov, 2003; Goldschmid & Goldschmid, 1976; Srivastava & Rashid, 2018). There is some evidence that tutoring has a positive effect on tutors' academic achievement (Leung, 2019). Tutors who work with writers learn how to write (Falchikov, 2003) and build new relationships with writing (Hughes et al., 2010). They also learn study skills (Falchikov, 2003), communication skills (Bruffee, 2008), analytical skills (Hughes et al., 2010), and build "skills, values, and abilities" for personal and professional relationships (p. 14).

While the studies above explore the many positive effects of tutoring on tutors, a less studied effect is how working with and responding to writing-to-learn pedagogies develops tutors' pedagogical content knowledge (PCK) (Shulman, 1986). PCK is a particular kind of knowledge for teaching that combines knowledge of content, students, and pedagogy to support student learning. In qualitative interviews with 15 Writing Fellows, we found that the strategies peer tutors report using represent PCK, even though they had no prior training in or knowledge of PCK. This study generates key insights into the ways that tutors describe their development of PCK, an additional positive effect of peer tutoring. This knowledge has the potential to shape how we prepare peer tutors, with implications for training that not only benefits peer tutors as individuals, but may also better prepare them to support student learning.

Pedagogical Content Knowledge (PCK)

Pedagogical content knowledge (PCK) (Shulman, 1986) is a kind of knowledge that can be leveraged by instructors, particularly peer tutors, to facilitate the teaching of course concepts. To teach novices concepts and ideas, peer tutors like Writing Fellows must be able to translate disciplinary concepts into comprehensible segments of content knowledge that a novice can access. This intersection of content knowledge and the pedagogies used to impart them, combined with knowledge of students, is pedagogical content knowledge (PCK) (see Figure 1) (Shulman, 1986; Smith & Kanuka, 2018; Streitwieser & Light, 2010). This kind of knowledge includes knowing which ideas to unpack, when, and how; how ideas fit together; how novices take in ideas; and which pedagogical strategies facilitate a novice's understanding of the concepts. While the domains of knowledge are disciplinarily specific, Smith & Kanuka (2018) argue that there are overlapping features of PCK that cross fields.

Developing PCK includes a focus on all three areas of knowledge rather than focusing on just two. Knowledge of content as it intersects with knowledge of students specifically refers to an instructor's ability to combine their knowledge of course concepts with knowledge of specific learners. Ball et al. (2008) offer specific examples of what it might look like to join knowledge of students and knowledge of content: anticipating what students will think and likely find confusing; predicting what students will find motivating; and hearing and interpreting student thinking. Because of the temporal distance of disciplinary experts from novices, developing knowledge of content and students also entails being able to imagine learning concepts from the point of view of a novice or non-expert. This kind of

knowledge centers the learner and their learning (Streitwieser & Light, 2010). Peer tutors, who are temporally closer to novices and their learning, "are knowledgeable responders, ...also colearners or collaborators with the student writer" (Alsup et al., 2008, p. 334). Combining content knowledge and knowledge of students is useful, but leaves out knowledge of teaching.
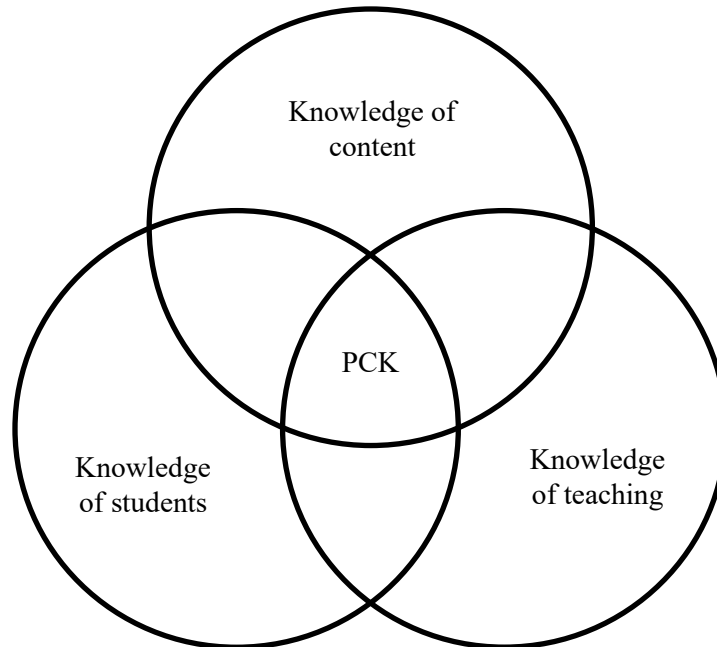
Figure 1: Pedagogical content knowledge as the intersection of knowledge of content, teaching, and students

Knowledge of content as it intersects with knowledge of teaching refers to ways instructors synthesize knowledge of subject matter to inform pedagogical choices. Instructors who can effectively tap into this kind of knowledge can "represent ... key ideas ... at once attuned to student learning and to the integrity of the subject matter" (Ball et al., 2008, p. 392). They know which questions about content to address now and which to address later. They know affordances and limitations of different ways of explaining concepts. They know how to combine what they know about concepts with what they know about pedagogy to maximize student learning.

Yet knowing content and teaching is not enough. Leveraging knowledge of specific students as they attend to content and pedagogical choices, instructors can convert their content expertise into strategies that facilitate the learning of course and disciplinary concepts for students (Ball et al., 2008; Shulman, 1986).

Developing pedagogical knowledge, even if it is not specifically focused on PCK, can enhance students' tutoring skills. In a study comparing peer tutors who were trained in content knowledge to peer tutors trained in tutoring skills, Hsiao et al. (2015) found that "TS [tutoring skills] tutors provided more appropriate explanations to the problems identified, gave more suggestions to improve the problems identified and used more affective language than CK [content knowledge] tutors" (p. 505). What Hsiao et al.'s study did not do was explore benefits to tutors of a kind of training that brings together all three elements listed above: knowledge of content, knowledge of students, and knowledge of teaching.

Listening

A potential way pedagogical content knowledge (PCK) is developed is through listening to learners and being able to interpret their thinking vis-à-vis content knowledge and by then making a pedagogical choice. Davis (1997) identifies three categories of instructor listening: evaluative, interpretive, and hermeneutic.

Evaluative listening occurs when the instructor appears to be listening for a particular answer, rather than listening to a particular speaker. The listener evaluates the talk "by judging it against a preconceived standard" (p. 359). When an instructor engages in evaluative listening and students do not respond in ways the instructor expects, the instructor tends to fill in the blank, ignoring student responses (Davies & Walker, 2007; Davis, 1997). Therefore, it is interpretive and hermeneutic listening that are of special importance in relationship to developing pedagogical content knowledge.

Interpretive listening occurs when learners respond in ways the instructor cannot completely anticipate; then, instructors use students' understandings of a concept to shape their teaching. When an instructor tailors an explanation based on the learners' understanding of a concept, interpretive listening occurs. Thus, when learners respond to a question, instructors are listening for information rather than for answers: what does the learner's response indicate about how they understand the question and concept? Because instructors do not know what learners will say, they hear the responses in ways that are different from evaluative listening, attending deliberately and "aware of the fallibility of [their] own sense-making" (Davis, 1997, p. 364). The listener recognizes that their own sense-making is limited and listens to how students make sense to tailor their instruction. This kind of listening tends to be more learner-centered.

Hermeneutic listening occurs when the instructor becomes a participant in the exploration of the inquiry. The listener develops a new kind of thinking about the subject based on their interactions with the learner. When a learner shows the instructor a new way to think about the course concept, grounded in their own experiences as learners, hermeneutic listening occurs. This kind of listening "demands the willingness to interrogate the taken for granted and the prejudices that frame our perceptions and action" (Davis, 1997, p. 369-70). This is the most complex kind of listening because of the dispersion of authority from the instructor to instructor *and* learner; it is rare to find this kind of listener (Davies & Walker, 2007). In hermeneutic listening, learner and teacher co-construct knowledge and develop their understanding of course concepts together.

In summary, interpretive listening develops the instructor's view of teaching. Hermeneutic listening develops the instructor's view of the content. In our interviews with peer tutors we heard their accounts of how listening to their students' talk facilitated the development of their pedagogical content knowledge (see Figure 2
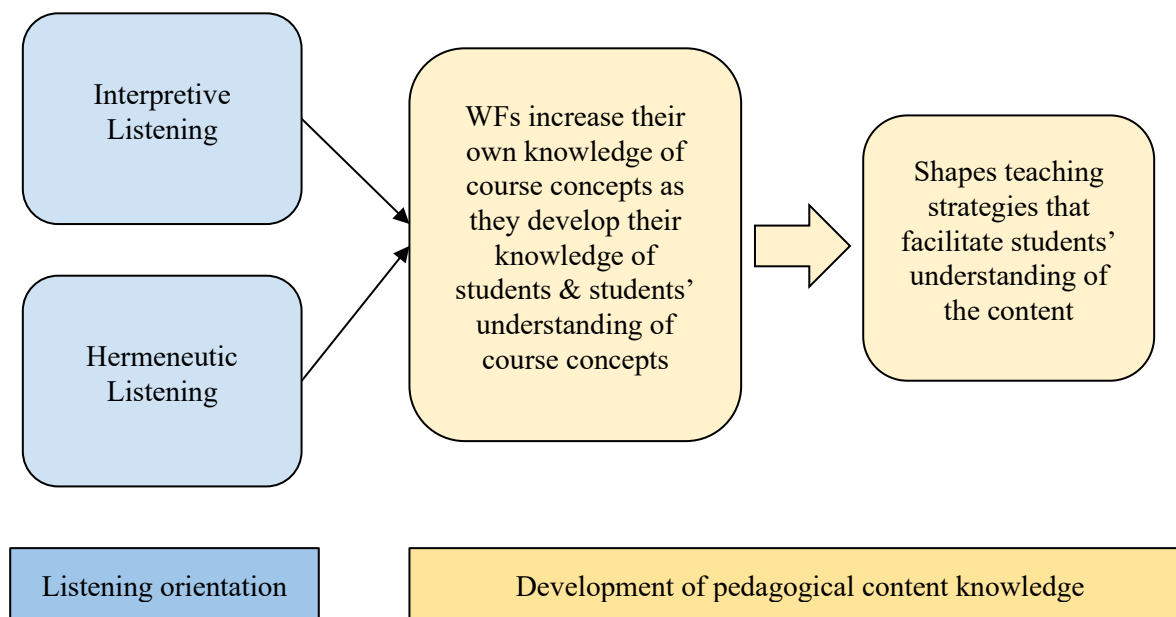
*Figure 2: Writing Fellows' (WF) listening orientation helps develop their knowledge of students,
which shapes their teaching strategies to facilitate student learning*

Methods

The data in this study was originally collected to examine how Writing Fellows' knowledge of content shifted in their work as Writing Fellows. After initial analysis, however, their discussions of developing content knowledge reminded us of how teachers develop pedagogical content knowledge and the role of listening in that development. Thus, in order to investigate the role of listening in how Writing Fellows develop pedagogical content knowledge, we developed the following research questions:

1. How did Writing Fellows develop their pedagogical content knowledge?

2. To what extent was that pedagogical content knowledge developed in interactions with students in the course?

The following sections offer detail on Writing Fellows, data collection, and data analysis.

MWrite & Writing Fellows

Study participants were current Writing Fellows, students who facilitated MWrite, a writing-to-learn program at the University of Michigan, which focuses on implementing writing-to-learn pedagogies in large-enrollment courses in multiple departments in the College of Engineering; the College of Literature, Science, and the Arts; the School of Kinesiology; the School of Nursing; and the School of Public Health. MWrite staff work with faculty members to develop three to five writing prompts that require students to write about key course concepts that are traditionally challenging for students and to develop disciplinary thinking; Fellows frequently contribute to the development or revision of these prompts.

Because Fellows are undergraduate students who received high grades and showed an outstanding capacity to work well with others in the specific MWrite course the previous year (or term) and/or

who were nominated by the faculty member who taught the course, they bring subject matter knowledge to conversations about writing.

Students who are nominated and apply are selected as Writing Fellows if their application shows appropriate interest and a schedule that can accommodate that of MWrite. They enroll in a one-credit course offered by the Sweetland Center for Writing which includes learning about processes of writing and writing-to-learn pedagogies, training in the automated peer review tool, and examination of the prompts. This training prepares them to administer the prompts, review student work and provide feedback, facilitate peer review, and assist students in office hours.

Study Participants

We interviewed 15 Writing Fellows across six science, technology, engineering, and mathematics (STEM) subjects: Chemistry 216, Climate 102, Economics 101, Math 216, Physics 140, Statistics 250. Information regarding the Fellows who were interviewed, including their number of terms as a Fellow, the subject for which they served, and their undergraduate course of study can be found in Table 1.

To recruit study participants, the instructor of their one-credit training course sent the Fellows an email. One of the researchers also visited the class so Fellows could see who would be interviewing them and to respond to any questions.

Table 1: Information on 15 Writing Fellows interviewed for this study. All names are pseudonyms.

Name	Number of terms as WF	Subject	Major
Tamra	1	Stats250	premed
Rosey	1	Chem216	
Einstein	1	Math216	
Collin	1	Econ101	Economics
Vivaan	1	Chem216	Biopsychology
Ashley	1	Math216	Nuclear engineering
Stephen	1	Chem216	Chemistry
Kenny	2	Chem216	Biomolecular science, pre-dental
Clea	3	Climate102	Communications major; fine arts minor
Aydin	3	Physics140	Biomedical engineering
Taylor	4	Stats250	Biology and business
Dana	5	Stats250	premed

Stephanie	5	Stats250	
Lucas	7	Stats250	Industrial and operations engineering
Denver	unsure	Econ101	

Data Collection

Each Fellow agreed to an hour-long, semi-structured interview that asked about their learning and teaching of course concepts. The interview entailed three sets of questions to understand Fellows' interaction with course concepts as students, as Fellows, and what shaped those understandings.

The first set of questions inquired about their experiences as students in the course and asked questions such as, What were useful ways you learned stats/chemistry/etc in your time as a student in the course? What concepts did you struggle with? How did you overcome these challenges? The second set of questions asked about experiences as Fellows in the course, and included questions such as, Is there a stats/chemistry/etc concept you feel more confident in or understand better as a Writing Fellow? If responded to affirmatively, Fellows were asked the follow-up question, Can you explain to me how you developed that greater understanding? Another question was, What kinds of activities did you participate in to prepare you to be a Writing Fellow? The third set of questions asked Fellows to what extent interactions with students, course material, other Fellows, the professor, and their writing-to-learn training developed their understanding of course concepts. These questions included, Has working with students in office hours changed how you are thinking or have thought about learning stats/chemistry/etc? If Fellows respond affirmatively, they are asked the follow-up question, how so? Each interview was recorded and transcribed.

Data Analysis

Engaging in grounded theory coding (Chun Tie et al., 2019) of Fellows' responses to the semi-structured interview questions allowed us to see how Fellows took up ideas of the course as students and whether/how their work as Writing Fellows affected or shaped—if at all— those understandings.

We conducted an initial round of open coding (Saldaña, 2016) to investigate in what ways Fellows thought about course concepts differently than they had as students in the course. We noticed that Fellows seemed to move between their emerging expertise of course concepts and their memory of their experiences as novices learning about these concepts. We examined how Fellows relayed their interactions between students, other Fellows, and professors to investigate how their interactions with each group potentially changed the ways Fellows discussed their understanding of key ideas of the course. We noticed that the ways Fellows described their interactions with students sounded reminiscent of ways instructors develop pedagogical content knowledge (PCK).

In the second round of coding, we turned to the literature on PCK and reexamined the data through the lens of Fellows' potential development of specialized content knowledge and pedagogical content knowledge (Ball et al., 2008; Shulman, 1986; Smith & Kanuka, 2018; Streitwieser & Light, 2010; van Driel & Berry, 2017). The examples they offered of their efforts to understand student thinking in order to help students understand course concepts and successfully complete MWrite writing assignments led us to consider how Fellows listened to students, and what effect, if any, different kinds of listening had on their development of pedagogical content knowledge.

To prepare for our third round of coding we consulted literature on the different kinds of listening that instructors engage in with learners (Davies & Walker, 2007; Davis, 1997) and investigated how

different kinds of listening might affect the trajectory of how Fellows might move the conversation to help students understand course concepts. Recordings of interviews also helped us examine and code the extent to which Fellows communicated that they were engaging in different kinds of listening with students.

Multiple rounds of coding allowed us to develop a grounded theory to pursue an understanding of how Writing Fellows' listening in very specific ways helped them develop pedagogical content knowledge (Chun Tie et al., 2019).

Results

What emerged across all interviews with Writing Fellows were descriptions of how they listened to students in what we evaluated as interpretive and hermeneutic ways (Davies & Walker, 2007). Engaging in these two types of listening seemed to help Fellows build from their existing and evolving content toward new pedagogical content knowledge. We found moments in the interviews where Fellows recalled their own recent struggles with difficult concepts, and this led us to hypothesize that the Fellows' temporal proximity to the novice perspective might be allowing them to better listen to students as sense-makers. The Fellows discussed how they used what they learned from students to inform their thinking about teaching and about content. This is not to say that the Fellows never engaged in (or described engaging in) evaluative listening. Since our primary research interest was in the development of pedagogical content knowledge, and since it is interpretive and hermeneutic listening that are of special importance in relationship to developing pedagogical content knowledge, we focused our analysis on the Fellows' interpretive and hermeneutic listening.

Interpretive Listening Shapes an Understandings of Teaching

Listening interpretively to learners in ways that can develop PCK entails going beyond evaluative listening that asks whether students are right or wrong (although it may begin with evaluative listening); it involves diagnosing where exactly students have missed connecting with the material and then selecting new strategies that might allow them to connect.

Interpretive listening usually involves three activities, which may occur simultaneously:

1. The Fellow listens to how students make sense of course material when students respond in unanticipated ways to Fellows' questions.

2. The Fellow uses that response to shape their understanding of how to respond to students.

3. The Fellow crafts an explanation that is accessible to students. In interpretive listening, the encounter shapes the Fellow's understanding of teaching.

It is likely that the sheer number of students Writing Fellows interacted with may have enriched the development of their pedagogical content knowledge as they listened interpretively to many students across the semester.

Writing Fellows discussed listening to students in ways that fit the description of interpretive listening. Specifically they talked about students who approached the subject from different backgrounds and starting points. Fellows described how they, after listening to students' points of entry into the content, synthesized knowledge of learners with knowledge of concepts in order to choose appropriate pedagogical strategies. In the following quote, Tamra contrasted her own journey toward conceptual understanding with that of the many students with whom she interacted:

> I had to find a lot of ways to explain things to myself that made sense for me, but it was especially solidified when I had to interact with 90 students [who] were all at different points in their academic career, at different points in the course, and understanding their level of understanding was completely different from each other … I didn't really have to think about how to give them that feedback until I was a Writing Fellow and until we were in 305 [the 1-credit writing-to-learn pedagogies course] and we had to think of different ways to give them that information.

Tamra's interpretive listening facilitated the formation of her pedagogical strategies ("ways to give them that information"). Her understanding of how to give feedback was formed by a demand for new ways of thinking about her subject. She learned to think more flexibly about course content and realized that the explanations she had developed for herself would not always work for students whose understanding of content differed from hers.

Some Fellows described being able to tell which type of learner they were working with and being able to then choose a suitable explanation. Lucas explained the flexible approach he developed through "listen[ing] to [each] student's ideas with the primary purpose of assessing" (Davies and Walker, p. 218, 2007):

> I think you've got to feel out like what is the best, it's what the best way to approach any person in a conversation. You'll have some students who are much more just hardcore the numeric side and it was easier to maybe go with less of an analogy or metaphor. I go ahead and just cut straight to these … then just tailoring maybe the example that you use to a person if there's something that you can sense might work better with them.

Lucas, who worked as a Fellow for seven terms, had so many interactions with students that he felt he could classify them according to their approaches: those who prefer a strictly numeric approach and those who benefit from analogies or metaphors. In describing "tailoring" the examples according to his sense of what might "work better" with a given student, Lucas implies that his explanations are responsive. "Feeling out" what is best for a student is one way we might describe the process of interpretive listening. He does not know what response the learner will give to his questions, so he must listen and adjust his teaching strategy.

Lucas's responsiveness to the learner suggests a path from interpretive listening to the development of PCK: as Lucas listened interpretively and figured out what kind of learner he was working with, he accessed or added to his set of patterned responses to different kinds of learners. The development of these patterned responses suggests what the simultaneous development of knowledge of students and teaching looks like.

Taylor's account of his work as a Fellow demonstrated this kind of learner-responsiveness and corresponding flexibility in teaching practice characteristic of interpretive listening:

> Sometimes when I was going through examples with students, there were times where they would get it right away and sometimes they would notice the patterns, but then sometimes they keep asking questions. And you realize, okay there's something … It's just not connecting as well. So then that's kind of when I started realizing, okay, maybe I need to come up with a different example really quick. Or I'll just try to use some … previous examples that I'd heard of from my lecture. So I would just kind of try to use those.

Taylor understood that there are certain patterns that students must discern for full conceptual understanding and that students who continue to ask questions signal a lack of understanding the

content. As he listened interpretively to students to ascertain where precisely they missed the connection, he was also simultaneously developing PCK as he brainstormed "a different example really quick" or "previous examples … from my lecture." Taylor's back and forth movement between listening to the learner and then tailoring examples to the learner showed how listening develops PCK.

Having robust pedagogical content knowledge also involves an instructor differentiating between their approach and students' approaches to learning concepts. As Taylor described listening interpretively to students to identify their gaps in knowledge, Denver recounted listening interpretively to figure out where students are starting from. He also recognized that although he could closely identify with students' perspectives, he couldn't flatten their perspectives into his own. It was his responsibility to figure out where students were and to guide them toward full understanding:

> You can't just attack this like how you'd want to be helped because it's just, it's not the same. And so I think I've become just a lot better at kind of asking those probing questions to get exactly what's, where are you struggling with this? Where's kind of the root of the cause? Because I think making sure not to just give away the end product is important to me. And so, kind of having that back and forth and not just being the answer of questions but also asking some of myself has been really important.

Denver's questions reveal a stance that could be influenced by students' perspectives. Like Taylor, Denver used interpretive listening to form his knowledge of students—developing his PCK—to separate other learners' perspectives from his own, and to adjust his pedagogical approach appropriately. Over time, and through interactions with many novices, he changed his approach to questioning. He was keen to not simply give students answers, and he sought to understand the "root cause" of students' struggles and integrate that knowledge into his teaching approach.

What the above comments demonstrate is that close and careful interpretive listening, in which the instructor attempts to learn not only whether or not the student understands the concept, but also how they do or do not understand it, is one vital piece in the development of PCK. What matters is not just the interpretive listening, but what the Fellows do with the knowledge they gain through listening. They recognize patterned approaches from learners, like Lucas did. They come up with examples on the fly, like Taylor did. They figure out the root cause of students' misunderstanding and adjust accordingly, like Denver did. Fellows' development of these understandings of learners, students, and how they engage in the content suggest development of their sense of PCK.

What also emerged from the interviews were hints as to why the Writing Fellows were able to engage in interpretive listening, despite being peer tutors and therefore new to pedagogy. The Fellows partially attributed their perceived success with students to the fact that the Fellows recently took these courses themselves. Writing Fellow Stephanie discussed her perceived proximity to students:

> And I do think it's probably very beneficial for the students to learn stats, kind of having that peer guidance, like someone on the same level helping them and someone who has very recently gone through the course and understands what they're doing.

Stephanie's assessment of why peer guidance was helpful for students had to do with how recently the material was new for her—she had a more personal understanding of the novice's path and a clear memory of the content as difficult to grasp.

One important consequence that proceeds from the Writing Fellows' identification with students and that informs their PCK is how seriously they listen to student perspectives, even when students are

in error. Below, Tamra explains her proximity to (and close identification with) the novices she was helping. Explaining one of her pedagogical moves, Tamra said

> I also just had to put myself in the students' shoes. Again, it's not that far off. I was only a semester out … so it was really just thinking about reflecting on what I would've wanted to hear … and so really just reflecting on that helped me find words to get to them.

Tamra drew on her own experience to try and find the words that would "get to them," the explanations that would bridge the gap between learner and content. Having recently walked across that bridge herself, Tamra used her own experience as a guide. Later in the interview Tamra explained how proximity to learners influenced how she offered feedback:

> I could understand a lot of why they would interpret something in a given way, even if it wasn't correct. And so my train of thought was "Okay, explain why you understand that this would be their interpretation, but then also explain how … it's supposed to be interpreted."

While there are elements of evaluative listening in Tamra's response, there is also a traceable path from her interpretive listening to her PCK: she allowed her proximity to students to serve as a source of understanding, she made an effort to understand why they interpreted content in a particular way (even incorrectly), and then she allowed that information to shape her approach to building understanding. Tamra later asserted that such a move was better than "tearing down all their ideas and telling them they're wrong all the time." Davies & Walker (2007) argue that "Teachers who do not listen or do not understand their students' thinking, tend to minimize or dismiss it, by imposing their own understandings" (p. 217-218), the opposite of Tamra's approach. Likewise, Ball et al. (2008) assert that "Skillful teaching requires being able to size up the source of a[n] … error," (p. 397). Tamra's listening orientation gave her a learner-centered pedagogical stance that invited progress.

Across almost all the interviews, Fellows described leveraging their proximity to student perspectives as an asset, a phenomenon that shaped their approaches to teaching. Clea stated the importance of "reading [the prompt] and being able to see it from the student perspective." Taylor asserted that when he was helping the professor revise the writing prompt, he said things like "the way we're wording this is a little tricky. Even I would struggle with this." For these Fellows, recognizing students as novice learners, taking their thinking seriously and listening interpretively to their understandings of content, and using these ideas to shape their pedagogy describe the development of PCK.

Hermeneutic Listening Shapes an Understandings of Content

The Writing Fellows' interactions with students not only profoundly shaped the Fellows' understanding of teaching, but also shaped their understanding of the content. Dana explained how her interactions with students have made her hyper-aware of the language she used to describe concepts in statistics:

> I think that … [conversations] that center around … P-values and hypothesis testing has made me much more cognizant of language and statistics, and how the inclusion or exclusion of a word here or there means so much in terms of what you're saying, which has also made me more aware of how I'm explaining concepts to students and making sure that they're also not falling into those traps.

Dana described the evolution of her specialized content knowledge, a fine-grained understanding of how "inclusion or exclusion" of specific words can alter a concept's meaning. She developed this "distinct disciplinary ... discourse" (Smith & Kanuka, 2018) through many interactions with different learners. She has observed how students misunderstand concepts ("falling into ... traps"). Understanding why a certain explanation prompted student error led to a new understanding of the concept itself, which describes hermeneutic listening. She was "continually and interactively listen[ing] to [each] student's ideas" and engaging in the "messy process of negotiation of meaning and understanding" as a result of her interactions with students (Davies & Walker, 2007, p. 218). In this excerpt, we see her sensitivity to the novice perspective, and the development of new thinking about her subject: she came away with a better understanding of precision of language in articulating concepts. We see this as demonstrating the path from hermeneutic listening to pedagogical content knowledge.

Part of the reason Writing Fellows were able to engage in hermeneutic listening was that they described approaching interactions with students from a stance of curiosity and openness. From this stance, Fellows were able to partner with students in subject matter inquiry and negotiate meaning together, allowing for robust development of PCK.

In the following exchange, Aydin described how interacting with students has shaped his perspective on course concepts:

> Aydin: Sometimes you realize that you learn from the questions that the students would ask you in office hours. Because you realize you've never thought about that aspect of the scenario or the physical concept, then it pushes you to think about that, which kind of makes you think more and more deeply about the concepts. So you learn from questions that you get from office hours. Pretty much most of the time. Because students can come up with very different questions.

> Interviewer: Yeah. And being able to see where they are.

> Aydin: Exactly, like gauging where they are and gauging how they think about the concept, because that's totally different than how we talk about the concept because we know the answer, right? ... We're really focused on that answer and we know that that's 100% what we're expecting, but we ignore all the other possibilities when we're answering those questions, right? So sometimes we end up changing the rubric so that, "Oh actually the way that student thought about it is actually right too, so we can add that to the rubric too because that's not wrong." We just never thought about it that way.

Here, Aydin notices the limitations of evaluative listening that "ignore(s) all the other possibilities." Because of the way he listened to them, Aydin was able to "learn from the questions that the students ... ask ... in office hours." He viewed students as sense-makers and understood that his knowledge of the "right answer" can render him unable to see other ways of approaching the subject. Aydin described a level of openness, choosing not to "ignore all the other possibilities when ... answering ... questions." This is a description of developing flexible thinking about the content, which means a more robust PCK. Because of his open stance, he allowed learners to "push" him, not only to think "more" about the concepts—to return to that conceptual framework again and again with many different learners—but also to think "more deeply" about the concepts, considering them from previously unconsidered angles.

Thinking more deeply about concepts is what teachers must do, and what Aydin described is the development of his pedagogical content knowledge. He described returning to content repeatedly and knowing it in a way that could be explainable to different kinds of learners, which entails a different kind of learning than mastering the content for oneself. With his newfound knowledge Aydin returned to the rubric. He returned to his pedagogy. He was open to letting his interactions with students change his (highly flexible) thinking, and his pedagogical content knowledge was directly shaped by his hermeneutic listening.

Part of hermeneutic listening also involves trusting students and the knowledge that they bring, which includes learning about content from the student. Vivaan described how she viewed student approaches and the way that engaging with student perspectives shaped her thinking about the content:

> Students have the freedom to kind of design what they understand best, and that might not be what I understand best. And so that might be the first thing that comes to their mind when they see the prompt and attempt to answer it. Whereas my mind might go somewhere else. And it's kind of interesting to be able to see that oh, there are other ways to answer this … and just kind of see how many different ways you can get to the same result is kind of cool.

Vivaan expressed trust in students to "design what they understand best" or to show their teachers how they should be taught. She engaged in hermeneutic listening by discovering what "comes to [students'] mind when they see the prompt." Vivaan was not only differentiating her understanding from students' understanding, but also seeing the multiplicity of student approaches as something that illuminates the content, further developing her own PCK. She did not insist that students rigidly follow the same path she followed in responding to the writing prompt, but interpreted different approaches as "interesting" and "cool," evidence of "how many different ways you can get to the same result." This deep hermeneutic listening, which results in a greater understanding of students as well as a greater understanding of content, then directly informed the strategies Fellows used to instruct students; this is how PCK is developed.

In addition to trust, another aspect of the hermeneutic listening orientation can also be valuing students' contributions. Tamra responded with surprise and wonder at the ways that novices synthesized ideas: "Looking at different concepts students would throw together, it was really super interesting because it was just like, 'Oh, my gosh, like I would've never thought to correlate those two things together.'" Even when students were not fully accurate in articulating course concepts, Tamra still learned from the connections they forged, something she referred to as "making like webs between the concepts of stats." Her encounters with different learners' perspectives and her open orientation toward those perspectives facilitated the development of her PCK.

For Aydin, Vivaan, and Tamra, hermeneutic listening shaped how they understood course concepts, which in turn influenced the development of their pedagogical content knowledge. The ways that the Fellows in our study discussed listening to students suggest that the development of pedagogical content knowledge requires being as diligent about studying students and what they say as about studying content.

Discussion and Conclusion

This study provides new insight into the effects of peer tutoring on the tutors and offers a framework for understanding how that effect might take shape: via the development of pedagogical content knowledge (PCK) as peer tutors listen to learners. As Writing Fellows talked about listening to

students and described movements among the domains of knowledge of students, knowledge of content, and knowledge of teaching, they were describing how their PCK (and thus knowledge of course content, knowledge of students, and knowledge of teaching) was developed. They explained how their knowledge of students changed how they thought about course concepts; they explained how they were able to break down concepts for novices; and they explained how their emerging knowledges informed their selection of teaching strategies. The Fellows thus described building a pedagogical repertoire, more nuanced content knowledge, and a deeper understanding of the students they supported. One key limitation of our study is that we do not know how much pedagogical content knowledge these Fellows were bringing to their roles prior to their participation in the MWrite program. Future studies could perhaps conduct pre- and post-service interviews that explore with more precision the effect that peer tutoring itself has on the development of PCK.

Our findings suggest that an important way these Writing Fellows developed pedagogical content knowledge was through interpretive and hermeneutic listening. As they listened interpretively to students, they described changing how they thought about communicating the content, which informed their PCK. As they listened hermeneutically to students, they described changing how they thought about course concepts, which also informed their PCK. We wonder whether part of the reason these Fellows were able to engage in interpretive and hermeneutic listening was their proximity to the novice perspective and their stance of openness—a hypothesis to explore in future studies. The way the Writing Fellows described their open listening orientation seemed to enable them to view students as sense-makers and to allow students' questions and explanations to shape their thinking about teaching and course concepts. Rather than using students' responses to merely check for error, they discussed using student responses to form new knowledge. The Fellows' interpretive listening seemed to help them become better at explaining concepts to students, because they worked to understand the root cause of students' misunderstanding and to recognize patterns in student approaches. But what was truly remarkable was evidence of Fellows' descriptions of hermeneutic listening. In these situations, Fellows appeared to become co-inquirers with the student. Having re-shaped how they viewed the content, the Fellows were demonstrating deep pedagogical content knowledge.

Further research might be able to determine whether the peer tutors' meta-awareness of these mechanisms might enhance the development of their PCK. That is, what would happen if Writing Fellows became more aware of and more reflective in their interpretive and hermeneutic listening? What if they consciously engaged in these types of listening? Would it have any measurable effect on the speed or quality of development of PCK? The development of meta-awareness regarding listening is one of the most promising practical implications of our study. If instruction in different types of listening were to be included in the Fellows' training, it may not only improve the quality of Fellow-student interactions, but it may also impact the development of different kinds of knowledge for both Fellows and students. Observational studies of peer tutoring sessions aligned with interviews of the Writing Fellows reflecting on those sessions may provide deeper insight into the development of PCK in practice.

There is also more research to be done regarding the effect of different kinds of listening and the development of PCK on learners. Our data provide rich insights into the perspectives of the tutors, but what about the perspectives of the students? Did they feel they were being taken seriously as sense-makers? Did they perceive the Fellows adjusting their strategies to make the content more accessible? Did they notice the Fellows reshaping their understandings of course content through interactions with students? Did they feel that they were co-inquirers with the Fellows? And perhaps most importantly: what is the effect, if any, of this kind of development of pedagogical content knowledge on student achievement in these courses? This last question is especially important, as large-enrollment gateway courses of the kind where peer tutors are utilized are often seen as

gatekeeper courses for continued study in the field, leaving behind women, students of color, students from low-income families, first-generation college students, and students who hold other marginalized intersectional identities. To what extent can offering students roles as peer tutors who continue to develop robust knowledge of content and teaching in their interactions with novice learners encourage their retention in the field and their support of other students? How might the Fellows' selection process support inclusionary practices, such as faculty mentorship of historically marginalized and underserved students? Can the community of Writing Fellows create a sense of belonging that strengthens the cohort's disciplinary identity and mitigates stereotype threat?

While we do not yet know the answers to these questions, we do know that the Writing Fellows were able to provide interactions with students that were more sustained and personalized than the instructors were able to provide. The deeper kinds of listening that Fellows described engaging in with students were likely facilitated by interacting with many learners and identifying closely with them. In a large undergraduate course, which is true of all the courses in which we have implemented the MWrite program, the possibility for 1:1 professor/student interaction is low; it is likely that a Writing Fellow or TA in one of these courses would have more interaction with students than the instructor. Additionally, the proximity to (and identification with) learners may have been another factor that facilitated the Fellows' open orientation to listening. Because Fellows had so recently been learners themselves, they remembered novice thinking. They described a willingness to take students' attempts seriously and to learn from students' attempts—about the students, about teaching, and even about the content. Therefore, this study has implications even for experienced professors of large courses. Those professors who work with Writing Fellows, peer tutors, and/or teaching assistants might learn more about their students from these groups. By listening to how Fellows talk about interactions with students, it is possible that experienced instructors can continue to develop their own pedagogical content knowledge.

The primary takeaway from this study is how peer tutors described ways of interacting that we have labeled as interpretive and hermeneutic listening to develop their own pedagogical content knowledge. We were able to track crucial links between the Fellows' careful listening to students and development of their PCK. Peer tutors' different types of listening appeared to shape a pedagogical approach that was deeply learner-sensitive and student-centered, and continued the development of their own knowledge of the content.

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Notes

1 Together with the lead professor of the course and MWrite staff, Writing Fellows help to develop three to five writing prompts that students in the course will respond to over the course of the semester. These prompts are designed to increase student learning and address some of the course's most crucial concepts. The Fellows respond to the prompts, provide feedback on their development, work with students in the course in office hours, review student work, and facilitate peer review of student responses.

Contact

Naitnaphit Limlamai
Assistant Professor of English Education

Department of English
Colorado State University
Email: N.Limlamai@colostate.edu

Emily Wilson
Assistant Professor of English
Director, Academic Success Center
Alfaisal University
Email: ewilson@alfaisal.edu

Anne Ruggles Gere
Arthur F. Thurnau Professor of English
Gertrude Buck Collegiate Professor, Marsal Family School of Education
University of Michigan, Ann Arbor
Email: argere@umich.edu

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