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Unveiling a Power Dynamic in a General Science Class through Positioning Theory

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Abstract

Positioning theory was used to identify interactions between an instructor and student in a general science class. Using Anderson's analysis categories and multiple forms of data provided space to look at typically unseen dynamics. One salient conversation between the instructor, Courtney and student, Matthew reveals power dynamics between them. Without this analysis, the instructor, Courtney, appears to hold all the authority. However, our analysis showed that Matthew held power to move the class forward. It is unclear if they shared this power at the epistemic level in addition to the logistical level.

Keywords

Positioning Theory, College Science Courses, Epistemology

1. Introduction

A cursory view of instructors in university classes might leave the impression that they hold much of the authority, which also determines the flow of instruction. As a student, an instructor, and a science education researcher, we have wondered about the role of authority and power dynamics in a science class. Stroupe et al. (2014) argue that when cognitive authority is shared with students, they are able to sensemake, make connections as to why and how a natural system works, the material more readily. However, there are few tools or methods that show how authority and power dynamics play out in a science classroom. In this paper, we use positioning theory and the theoretical lens of social constructivism and sociocultural theory, we show that unseen motivations between instructor and student altered the flow and power dynamics of a class.

2. Background

2.1. Social Constructivism

In the mid-20th century, several scholars contributed to the development of *social constructivist theory*. Piaget (1964) defined *constructivism*; Berger & Luckman (1966) described *social constructionism*; Vygotsky (1978) developed the *zone of proximal development* and through it identified *sociocultural theory*; and Bruner (1984) rediscovered Vygotsky's ideas and used them to support explanations of language development in children. Bruner was one of the first recognized to combine all the theories into social constructivism, which is a theoretical principle based on the premise that humans construct individual knowledge because of interactions between people (Vygotsky, 1978). Specifically, learning develops within cognitive structures due to social and cultural processes experienced by individuals (Lemke, 2001).

Based on these foundational works, social constructivists accept the following premises. First, internal discourse due to social and cultural interactions enhance cognitive change. Second, meaningful learning occurs with shared interactions between individuals. Third, teachers or more experienced others facilitate learning for less knowledgeable individuals.

2.2. Sociocultural Theory

Sociocultural theory grew out of Vygotsky (1963)'s early work and others. Cole (1996) took their ideas and added that culture constrains the social interactions in which learning occurs (Nasir & Hand, 2006). Based on this perspective learning is seen as a fluid process of interpretation situated in cultural-historic settings (Miller, 2011). There is an added emphasis that all human interactions function on multiple scales. This is found in the interaction of intrapersonal, interpersonal, organizational, developmental, historical, biographical, linguistic, political, and economic systems, which inform the culture and social components that shape an individual's learning (Lemke, 2001). Within this perspective, the boundaries between personal knowledge formation and group cultural knowledge formation are tenuous. This perspective also emphasizes the importance of group norms within learning.

Normative behaviors of an individual's culture contain the social process of learning (Tomasello, 2016). Humans evolved a suite of sociocognitive skills, which allow them to interact and survive in groups (Tomasello et al., 1993). In this way, groups are able to take advantage of amassed knowledge and skills. The accrual of group knowledge and skills leads to normative group behaviors; the expected actions within the context of the group, which in turn create the foundation of the group's culture. In a reciprocal relationship, the culture then presses individuals to behave in normative specified ways; humans have a tendency to accept and adapt to these pressures (Bruner, 1993).

Because normative behaviors are important to human learning, shared practices therefore define groups (Lemke, 2001; Nasir & Hand, 2006; Tomasello,

2016). Thus, cultural learning is distinct from social learning because cultural learning depends on a shared understanding of context from which the authority figure operates (Tomasello et al., 1993). For students to learn from an instructor, they need to understand the normative behavioral expectations of their teacher. These behaviors become the shared practices of the group; thus, it is important for students to understand how these shared practices of classrooms develop. Positioning theory allows for dynamic exploration of conversation and the meaning-made between two people (Davies & Harré, 1990). Thus, the use of positioning theory can reveal how shared culture of a classroom might develop.

2.3. Positioning Theory

To understand the reality of social experience, Davies & Harré (1990) proposed positioning theory. Positions are defined as the relative place one takes against another in conversation (van Langenhove & Harré, 1999) and positioning theory operates under the ontology that speech acts, which are any discursive practices where meaning is communicated, including words, gestures, and written communication, form the reality of human existence (e.g., Vygotsky, Wittgenstein). Van Langenhove & Harré conceptualized positioning theory as a triangle with positions, speech acts, and storylines, the meaning given to the social episode, at each corner of the triangle. Positions, speech acts, and storylines are interactive with each other on all levels.

As a way to use positioning theory, Anderson (2009) argues that positions are constructed through scales of interactions described as synchronic, intertextual, intercontextual, and diachronic. The synchronic scale looks at "moments of interactions" (p. 298) and are the actual words and gestures being given. This level falls into the speech acts of the positioning triangle. The intertextual level links moments of interaction and normative practices. The third level is intercontextual and happens when participants make meaning in relation to past, present, or future. The intertextual and intercontextual inform the meaning or storyline associated with the position. The final category is diachronic. Here the synchronic, intertextual and intercontetual levels are synthesized to form a position.

3. Purpose and Research Question

This study explored how to elucidate power dynamics between the instructor and a student in an undergraduate science class. To do this we used the assumption from social constructivism that learning is a socially dynamic process, the assumption from sociocultural theory that our interactions are caged within in normative cultural behaviors, and positioning theory as a tool to understand an in-class social interaction. The research question was: What does the interaction between a student and an instructor in an undergraduate science class reveal about power dynamics and the flow of the class?

4. Methods

This study was part of a larger study that looked at the epistemological frames of

an undergraduate science classroom. Participant recruitment and data collection occurred in early 2020. Data included: video recordings of the undergraduate class from two perspectives, surveys, interviews, and class artifacts such as notes and power-point presentations. This portion of the larger study is a qualitative case study, with one student Matthew, and one instructor, Courtney at a mid-size intermountain west university bound within one lecture and lab period of a general science class. The analyzed conversation was chosen because of the impact it had on Courtney and Matthew. The participants were interviewed separately, they watched video recordings of the teaching sessions and talked through their thoughts. This conversation stood out to Matthew and Courtney as an impactful moment. Therefore, it was selected for further analysis.

4.1. Participants

Matthew. Matthew was the only student, from the group of students in the larger study, who demonstrated consistent behavioral engagement and reaction to the instructor. Additionally, he demonstrated by his engagement and behaviors that he understood how science works more robustly than the other students in the class and was often focused on sensemaking scientific phenomenon. Matthew was 18 at the time of the survey and 19 at the time of the interview. He was a computer science major and selected this major based on the potential of a steady income and the challenge of programming home devices. His parents both hold PhDs in psychology PhD's and he is the oldest of their six children.

Courtney. Courtney was a soft-spoken graduate student in her 20's. Her eyes sparkled when she talked about science. Her background was in physics and she had a keen interest in improving her own teaching. Her overall goal for teaching science is to increase accessibility of science for all but with a particular focus on women. This class was her first time acting as a primary instructor for a university class. She had previously worked as a teaching assistant for physics classes with an "active learning" instructional emphasis. At the time of this study, she was enrolled in a university program to improve her instruction.

4.2. Interviews

The purpose of the interviews was two-fold. First, we wanted to understand the backgrounds that might influence how Courtney and Matthew reacted. Second, to get their thoughts about the interactions between them in class. To do this, they watched video clips of the actual class and commented on what they were thinking during those moments in class. They were also able to explicate their thinking and reasonings behind their behavior. For Matthew we watched the video clips focused on the students. Because of this, he was able to see his behavior and hear the instructor. This allowed him to focus on and think through why he might be reacting the way that he did. Similar for Courtney, we watched the video clips of the same time period as Matthew but with the camera angle that focused on her. The interviews were semi-structured. An interview guide

served to prompt discussions around the two-fold purpose of the interviews. They were conducted separately starting with Courtney in early March and Matthew in May. Each interview lasted about one hour.

The interview data were analyzed and included the video of the lecture and the interview of the instructor's intentions and responses to the teaching. We thematically coded these data for instructor intentions and understanding of epistemic science principles. Based on the instructor results, student data were compared with the themes from the instructor data. Process coding was used to look at the dynamic of time within the learning experiences comparing student data with instructor data. The results section provides the scene of their interactions pulled from one learning segment in which the class was discussing the nature of light.

We used a salient conversation between Matthew and Courtney in the learning segment as the focus for this case study. This conversation was chosen because they both had a lot to say about this particular interaction during the interview indicating that this particular social episode was impactful for them. The data from this conversation was applied to the Anderson (2009) matrix. This matrix was chosen after the semi-structured interviews and was applied because of the known ability to bring clarity to unspoken positions as described by Anderson.

5. Results

5.1. Synchronic, Intertextual, and Intercontextual Levels

The synchronic level was the actual words spoken and actions between Matthew and Courtney and the intertextual were the normative practices that occurred during the conversation. In this instance, Courtney posed a question as the instructor. Matthew, as the student, listened and watched her. This represents the expected behavior between instructor and student at a university in the US. The intercontextual level links from their past events that influenced their interactions. I was able to report on these influences based on the interviews from Courtney and Matthew. Both Courtney and Matthew indicated that they pulled from past experiences and influenced their thinking and behavior in this moment. The synchronic and intercontextual levels are both described in the following narrative.

Social episode narrative. Courtney, the instructor of the undergraduate Astronomy course, stood in the front of a lecture hall. Although she had never been a primary instructor, Courtney had experience working as a teaching assistant. They were 26 minutes into a 90-minute lecture, and Courtney had already used a series of instructional strategies: pair-share, whole-group question, and a demonstration. Her purpose was to get the students participatorily involved in the content she was presenting.

So, my goal here is to have them actually go through the scientific process. [I want them to] predict what they would see if it was a particle versus if it was a

wave. *And then when they go and they actually see what it looks like, they can say* "*Oh, it's definitely not a particle, because if it was particle, we already know it would look like this. And so, because it looks like this. It looks like a wave.*" *So, I was trying to get them to do that whole hypothesis part before we did the actual demo. That was the goal behind that.*

Courtney hoped that the instruction she designed would allow students to first predict through the use of pair-share and whole group question strategies and then use evidence from a demonstration to draw a conclusion on the nature of light. Thus, she hoped the students would not only see the content but learn that science works through gathering evidence to support a testable hypothesis.

To support Courtney's intentions for this instructional segment, there was a power-point on two screens at the front of the lecture hall. Twenty-five students sat in tiered seating arrangement and looked down at Courtney. She provided content background on whether or not light is a particle or a wave and then instructed the students to talk with their neighbors.

And there still is [*debate about this*] *today. I am going to end the suspense. It is both a particle and a wave, which is very cool* [*and*] *also a little confusing. So, the way that we figured out it was a wave was with what we call the double slit experiment. So, what I want you guys to do real-quick is just turn to someone next to you, and ask, talk about* "*if you had,*" *and we'll do this together as a class* "*if you had a little slit right here.*" *I know this is probably hard to see. But there's a little slit in the metal right here.*

Courtney pointed towards a small piece of metal with a slit cut through the center.

And if you shine a laser through it. What's it going to look like if your light is a particle versus if your light is a wave? So, talk to each other real-quick and come up with an idea.

In response to this prompt, Matthew, wearing glasses and a blue t-shirt, leaned forward over his computer, looking intently either at the computer or at Courtney. When given the prompt to talk with their neighbor, Matthew turned to his neighbor and began talking animatedly using his hands. His neighbor looked at him nodded but did not speak. Matthew later explained what he was thinking during this conversation.

I was going over the experiments I've seen before [in videos]. *And thinking about how I would explain it to the other student…What the results are going to be…I was using an example used in the videos, they would put the two boards and they would slash it and so that way to make the inference pattern.*

After two minutes, Courtney aimed another question at the whole group. "What would it look like if it was (sic) just a particle?" Quietly Matthew said "two lines." Later, Matthew explained his thinking for this interaction.

If I don't raise my hand and nobody else does either. She ends up sort of like pausing and so I didn't want that happen. I never really like the long pauses that

happen when my instructors are trying to drag things out of you. The other thing was I don't really get bothered by raising my hand in class and talking as much as I think some other people do. So, if it's something I understand, I don't really mind raising a hand.

Courtney responded to Matthew's "two-lines" answer. She said "So" then paused for several seconds. She explained what she was thinking in this moment.

I think it's [student unwillingness to speak in front of the class] because they're scared of getting it wrong, which I think is interesting. Because in science, it's okay to get it wrong as long as you kind of figure out why you get it wrong. I think that is the whole process of learning.

She then continued speaking to the whole class but addressed Matthew specifically. "If it was just a particle, I mean it would be just like uh, it would shoot through the slit and it would be like a dot on the wall. Right?" Matthew nods slightly and says "ya" quietly. Later he explained his thinking.

I don't like being wrong in front a whole group of people. If I'm not fairly certain about what the answer is, I think, in that case actually I wasn't exactly correct. I was used to lines instead of the dots that laser makes. So, I think I said a line and she was like, "Well it's a dot." And I thought "nobody's perfect.

Later, Courtney explained her intentions for this segment of her lesson, the pair-share activity.

She said, *"I like to try to get them to talk to each other as much as I can. Because I feel like the more you talk to your neighbor than more invested in it you almost are and the more willing you are to participate. Especially if you're talking to the person next to you and they agree with you. Then you're more likely to share what you're thinking, because you have an opinion that someone else says "Oh yeah, I think you're right." So, you're more confident in it. [At this point] I'm thinking about whether they're thinking about it correctly, and that if a laser beam goes through a slit and it comes out the other end and it's just a particle, it's just going to be a dot on wall, right?"*

Courtney intended for the students to collaboratively sensemake and then hypothesize what they thought would happen during the demonstration.

5.2. Diachronic Level

The diachronic are the positions that are assigned and taken up by Courtney and Matthew that can be seen because of these other levels. Courtney positions self as authority figure based on normative practices of university classes, but also as dependent because of the need for students to participate and as powerful because she held the power to move the class forward. Matthew positioned himself as a student and as powerful base on his ability to move the class forward through reducing the wait time. Table 1 gives a summary of the synchronic, intertextual, intercontextual and diachronic levels.

The categories from Anderson gave space to look at the unseen influences on the interpretation of the learning experiences. Without this analysis the instructor,

Table 1. Data matrix of interactions between Courtney and Matthew.

Category from Anderson (2009)	Relevant data
Synchronic	The spoken words and actions provided in the narrative
Intertextual (Normative practices from synchronic)	Courtney posing question, Matthew listening and responding, Matthew looking at Courtney as she speaks and remaining quiet. These practices are normative because they are the expected behavior between students and instructors in university classes in the US.
Intercontextual (Links from past, present, or future events determined through interviews)	Courtney: *Here I'm thinking "Please someone." Because I do this a lot where I'll ask people to share and I have a couple of select students that are usually willing to. But I really would like more. I recognize that it's hard to get that.* Matthew: *If I don't raise my hand and nobody else does either. She ends up sort of like pausing and so I didn't want that happen... The other thing was I don't really get bothered by raising my hand in class and talking as much as I think some other people do. So, if it's something I understand and I don't really mind raising a hand.* Cara: *You said that you wanted to raise your hand, so she wouldn't pause. So, were you motivated by keeping the class moving forward?* Matthew: *Yes, that's it. I never really like the long pauses that happen when my instructors are trying to drag things out of you.* Both Courtney and Matthew are linking past events in class to their action in the moment.
Diachronic (Positions determined by considering the synchronic, intertextual, and intercontextual)	Courtney ● Positions self as authority figure based on normative practices of university classes. ● Positions self as helpless based on need for students to participate ● Positions students as powerful because they hold the power to move the class forward Matthew ● Positions self as student based on normative practices of university classes ● Positions self as powerful based on ability to move the class forward through answering a question and reducing wait time ● Positions self as helpful to class based on ability to raise hand in contrast to other students

Courtney, appears to hold all the authority and influence over the learning experience. However, the matrix shows that Matthew, the student, held power given to him by himself and Courtney to move the class forward. Courtney expressed she just wanted someone to share their ideas because she has experienced those students were hesitant to share in the past. She was motivated to get students involved. Matthew was willing to share because he didn't want a long pause and wanted to keep the class moving.

Additionally, I see those negative emotions both from Courtney and Matthew influenced the learning experience. Courtney was uncomfortable with no student participating and Matthew wanted to avoid boredom. This data shows that Matthew was responding to Courtney moment to moment, but he was doing so on a procedural level. He was not responding to her on an epistemic level. On an epistemic level, he was still concentrated on sensemaking.

Matthew's notes further show this point. His notes (see **Figure 1**) were very sparse, not identical copies of the power point. Rather, they were composed of equations he was using to try and understand the phenomenon of study as he sought opportunities to strengthen his understanding of phenomena as opposed to taking notes to complete a particular activity and achieve a grade. This
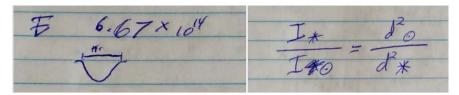
Figure 1. Matthew's notes from clip two.

matches Braaten & Windschitl (2011) explanation that in sensemaking a person does not just explain what is happening, but they want to know how and why a phenomenon is happening.

6. Discussion

The purpose of this study was to explore how to see power dynamics between the instructor and a student in an undergraduate science class. To do this, we used assumptions that learning is a socially dynamic process and our interactions are caged within normative cultural behaviors, with Positioning theory as our framework. The research question explored interactions between a student and an instructor in an undergraduate science class and how they might reveal power dynamics and shape the flow of the class. Results were valuable because they showed that power dynamics can be subtle but have the possibility of altering the class flow.

In this case, those power dynamics showed that the student aided the instructor in the logistical flow of the class. However, this logistical emphasis was likely at the expense of sensemaking the content. While both Matthew and Courtney expressed an interest in just moving the class forward Matthew's background showed that he was interested in making sense of science. It is interesting that he prioritized moving the classroom forward as opposed to taking the opportunity to understand why he was incorrect. He seemed to be looking for an opportunity to negate the feelings of boredom while at the same time indulging in a feeling of control over some flow of the lesson. For her part, Courtney just wanted to move forward to get onto the demonstration portion of the class. But she felt obligated to engage with the students and chose to ask a question, hoping someone would answer. She focused on this obligation as opposed to helping the students sensemake.

The central contribution of this research is to add to the works of McVee et al. (2019) and further demonstrate that positioning theory is an effective research approach and tool for understanding nuanced power dynamics in a classroom including the power dynamics in a general science university class. When using positioning theory, McVee et al. (2019) called for multimodal analysis of speech acts. We used a different analysis than McVee et al. who applied Branburg's three tiers along with the positioning diamond to their data. Instead, we used Anderson (2009). We see both McVee and our approach as effective because both allowed for elucidation of nuanced power dynamics. While McVee et al.'s multimodal analysis is effective for showing an array of relationships across

time, the analysis tool in this study lacked that ability. However, it was able instead to show a nuanced interaction in one small space of time. Future research could use a multimodal approach with positioning theory and look at examples between sensemaking and student/instructor authority in the classroom.

Additionally, teaching methods strategies in undergraduate science classes are often limited to lecture and active learning, with lectures being predominant (Fairweather, 2008). In this method, an instructor provides direct instruction to students and because this method is teacher-centered, it rarely considers social constructivism.

This illustrative case study of Courtney and Matthew showed that positioning theory can be used as a framework for analyzing power dynamics in a classroom. It provides an example of how a student Matthew could exert some control over the logistic flow of the classroom and by so doing satisfy some of his emotions. But Matthew was only given this control because Courtney was more concerned, at that moment, with the logistic movement of the class and less concerned with sensemaking. If Courtney would have been more focused on sensemaking perhaps the power dynamics would have shifted more to the epistemic level and Courtney could have influenced Matthew's learning in a more substantial way.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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