Mathematics Tutors’ Perceptions of their Role
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In this study, we investigate the beliefs of undergraduate mathematics tutors. Thirty-three tutors completed surveys and twenty-five participated in interviews to assess their attitudes towards mathematics and their beliefs about the roles of a tutor and instructor. Our analysis provides examples of orientations, goals, and resources that were expressed by tutors in surveys and interviews. Tutors in this study viewed their role as distinct and supplementary to that of a teacher. The orientations, goals, and resources identified in this study provide a foundation for future studies that explain and predict tutor decision making. Although tutors are not content experts, they offer a valuable perspective that is different than that of the instructor.

Keywords: mathematics tutors, beliefs, orientations, goals, resources

Introduction and Literature Review
In a recent study, 97% of universities surveyed offered mathematics tutoring to Calculus students (Bressoud, Mesa, & Rasmussen, 2015), therefore tutoring is a common resource for undergraduate student learning outside of the classroom. Tutoring has been linked to improved pass rates (Cuthbert & MacGillivray, 2007; Patel & Little, 2006) and an increase in grades (Byerley, Campbell & Rickard, 2018; Lee, Harrison, Pell, & Robinson, 2008; Rickard & Mills, 2018), and has been shown to have a positive impact on student attitudes towards mathematics (Bressoud et al., 2015; Croft, Grove, & Bright, 2008; Topping, 1998).

Some studies related to tutoring have emphasized that tutors are not experts in either pedagogy or content (Grasser, D’Mello, & Cade, 2011), but nevertheless, tutoring seems to improve student learning. Grasser et al. (2011) describe several different effective teaching methods and then, by analyzing a corpus of tutoring observation data, they conclude that tutors do not utilize these methods. This deficit perspective of tutoring does not help us to understand what it is that tutors are doing to help students. Also, the context of a one-on-one drop in tutoring session is so different from a classroom setting, it may not be reasonable to expect that an effective tutor would make similar moves to an effective teacher. Defining the differences between a tutor and a teacher can help us to unpack the specialized knowledge that tutors have that may be distinct from teachers’ knowledge.

This study will report on undergraduate mathematics tutors’ views of mathematics and their perceptions of their role as a tutor, as well as how they perceive their role compares to the role of a mathematics instructor. Our analysis will focus on the orientations, goals, and resources that the tutors mention in their interviews. This foundational understanding of tutors’ views of mathematics and their perceived roles is a first step to understanding how these factors influence their practice.

Theoretical Perspective
Schoenfeld (2011) suggests that decision making in an academic setting (and many other settings for that matter) is influenced heavily by a person’s orientations, goals, and resources. In this theory, Schoenfeld describes how a person has some set of orientations, goals, and resources which all act on each other during the decision-making process. These factors can be used to construct a model of their decision making process that has explanatory and predictive power.
Through their experiences in education, both as students and tutors helping students, tutors may develop their own perceptions of their role. Because we do not have direct access to a tutor’s thoughts and because a tutor may not be aware of them, we cannot say explicitly whether they have specific orientations, goals, or resources. Schoenfeld (2011) skirts this issue by stating that we can attribute goals, orientations, and resources to a person in a manner that explains and predicts their behavior and our model can be adjusted or replaced if the tutor’s actions are not in line with the model.

Here, we discuss briefly what is meant by orientations, goals, and resources as given by Schoenfeld (2011). A person’s orientations are the set of that person’s beliefs, preferences, and values among other things. They are the different meanings and understandings created by the person from their experiences. Orientations play a big role in a person’s perceptions of a given situation and can trigger certain behaviors. Therefore, it is important to describe the specific situations as well as the person’s orientation.

A goal is “something that an individual wants to achieve, even if simply in the service of other goals” (Schoenfeld, 2011). Goals may be immediate or long-term, and they may have sub-goals. Goals may work together in a given situation or they may work against each other, and the person making the decision may not be consciously aware of their goals at any given time. Goals are prioritized by what the person with those goals believes is more important for the given situation. For this reason orientations play an important role in the prioritization of goals. This set can be adjusted and prioritized multiple times in the process of achieving a goal (or set of goals).

Resources are defined to be everything that is available to use by a specific person. Each individual has their own set of resources, which contain intellectual resources, material resources, and social resources. Some examples of resources include the knowledge somebody has about a certain topic, physical objects or tools that can help a person achieve a goal, or ways of communication that can identify new information.

Putting these three concepts together gives us a way to model a person’s decision-making process. Before decisions are made, a person starts with their own resources, goals, and orientations. They will then collect information about the situation. Goals will be either established or reinforced. Then the person will make decisions about how to direct an interaction or a situation that stay consistent with their goals. All of these steps are repeated as many times as necessary as a situation progresses and reevaluation is needed.

Since decision making is influenced by a person’s resources, orientations, and goals, we may begin to construct models of tutors’ decision making processes to explain or predict their behavior. Thus, we aim to identify what a tutor believes his or her role is in a student’s learning process.

**Methods**

The participants in this study were undergraduate tutors from drop-in mathematics tutoring centers at two institutions: a large research university in the Midwestern United States and a small private university in the Northwestern United States. Thirty-three tutors were given surveys prior to the start of the Fall 2017 semester addressing their beliefs about mathematics, beliefs about mathematics instructors, and beliefs about mathematics tutors. The survey consisted of items that were modified from the CSPCC math attitudes survey (Bressoud, et al., 2015) and the NCTM Teaching and Learning Beliefs Survey (NCTM, 2014).

Twenty-five of the tutors were interviewed to allow them to elaborate on their responses. The interviews were conducted throughout the entire semester as the tutors completed a particular
part of their training. At one of the universities, the first semester tutors were not required to complete this portion of the training and thus not all of the tutors who completed surveys participated in the interviews. This study focuses on tutor responses when asked to compare and contrast their perceptions of their roles and instructors’ roles. The themes that emerged are presented with representative quotes from tutors.

The surveys gave us some indication that the tutors viewed their role as a tutor slightly differently than that of an instructor. These results gave us a lens through which to look at our interview data. We analyzed the interview data using thematic analysis (Braun & Clarke, 2006). The first phase of our analysis involved transcribing the data and reading through all of the transcripts. Then we generated initial codes and searched for themes among the codes. Lastly we defined and named some orientations, goals, and resources that emerged from the interview data. This theoretical framework was helpful for organizing our analysis of their responses. Note that the tutors were not directly asked to talk about their perceived orientations, goals, and resources. In addition, we should note that the results that we present here are formed from a combination of all of the tutors’ responses, and may not reflect the perspective of each individual tutor.

Results

We interviewed the tutors in this study to address any gaps in information given, as well as to elaborate on anything from the surveys. For the purpose of this paper, we only analyzed the portion of each interview in which the tutors expressed how they conceptualize their role as a tutor and how that compares to the role of an instructor.

Since we did not specifically ask the tutors to list their orientations, goals, and resources, the results found are not exhaustive. Instead, we provide an example of each category that the tutors in this study mentioned to help explain what tutors could think or do during a tutoring interaction. Furthermore, a tutor is not limited to only one orientation, goal, or resource.

Orientations

Instructors lay the foundation and tutors fill in the gaps. In the interviews, 82% of the tutors made statements that indicated that the instructor is the one who presents the theoretical material and “lays the foundation” while the tutor’s role is to work with individual students on the application of the theory and “fill in the gaps” in their understanding.

…and I think a tutor is only there to reinforce it, and I think of it like building a bridge, so like the teacher lays the foundation, maybe puts the rough parts of the bridge on there, and the tutor comes around and puts the, you know, the pavement on it. Smooth and easy to travel over. Just to make it just a little bit better. – Anthony

Many of the tutors in this study believe that like instructors, their goal is to enhance students’ knowledge of specific mathematics content. However, some tutors expressed that the instructor’s role is to present new mathematical ideas while the tutors’ role is to reinforce students’ understandings and address any gaps in the students’ knowledge. The tutors mentioned that instructors are constrained by class size and time, which are not constraints that tutors typically have in the drop-in environment.

Tutors guide students, tutors do not teach students. It is a safe assumption that students who seek help from a tutor are enrolled in a math class. Also, those students usually ask
questions about something that was mentioned in class. One belief that these tutors expressed is that the tutors should not be responsible for teaching new material to the students, rather that they should assist the student in understanding new ideas and concepts. Tutors who expressed this belief focused more on what is not part of their role, whereas the tutors who expressed beliefs from the preceding section were focused more on what is part of their role.

**Tutors are not experts, but they offer a different perspective than instructors.** Although tutors are not mathematics content experts, they do have a different kind of specialized knowledge than instructors have. Because not all tutors are math majors, they can often help students to understand how the mathematics that they are learning can apply in their subsequent engineering or physics courses.

I’m a physics undergrad, but one of the things that might help them is like more tactile, you know, an example of how stuff works, that’s all I run into in my classes. . . I don’t try to get into that too much because if I try to start talking modern physics to someone in trig, they immediately glaze over. It’s just, it’s comforting to them to say, this is real, it’s not worthless to learn, there is an application for it. – John

**Goals**

**Help students become independent learners.** Part of this goal entails that tutors should help a student towards a correct solution rather than showing them how it is done. Furthermore, a person with this goal in mind may believe that tutors should help students with their problems in such a way that allows the student to succeed at similar tasks on their own.

So they can kind of go through it themselves and if they get stuck, they can know what to do. Rather than having to go for help every time. – Molly

**Determine the needs of the student.** Because the tutors in this study work in a drop-in setting, they may not know the needs of the students that come in to get help on any given day. So when a tutor approaches a student who has a question, the tutor has to assess what kind of help the student needs. The tutors in this study talked about four common ways in which they help students: 1. Checking student work for errors, 2. Showing students how to do an example, 3. Leading students through an example by questioning, 4. Helping students understand a specific concept. Tutors do not believe that it is their responsibility to teach a student who has not been coming to class.

Some tutors prefer a more direct approach to figuring out how much a student knows. By probing the student to describe their situation as much as possible, some tutors feel they can better understand what the student needs and then be able to help fill in what a student is missing.

**Help students stay on the right path.** Tutors can be a valuable resource for students in that they can determine when the student is starting to go in a direction that will not be beneficial for them. It is worth noting here that the phrase “right path” means the path that the tutor believes will lead to a solution to a given problem. In previous research, physics tutors tended to focus on the next step toward a solution on a path dictated by the tutor and did not allow the student to stray too far from the path (VanLehn, Siler, & Murray, 2003). Tutors have different resources at
their disposal to address these kind of issues, for example asking questions to direct the students or providing their own explanations of certain problems.

Ideally, I would just be able to sit there, and they would ask a question, and I would be able to ask a question back that would be able to guide them into the right answer. That would be ideal. – Jonah

And try to... we can't process it for them. Just try to help them, stay on the right path, I guess. – Ashton

Resources
Tutors have a variety of resources available to them based on their own experiences with mathematics and with tutoring. Since they are undergraduate students, the tutors have taken math courses already. So they have built their own knowledge of problem-solving strategies which may be different from the teachers’ methods of problem-solving.

I mean, the teacher may have one approach that they use in class, and then the tutor may have a different approach that the student can understand better, and that just may not have been mentioned by the professor before. – Veronica

Conclusion
The survey results showed us that undergraduate mathematics tutors view their role as different from an instructor in the sense that they elicit more student thinking and understanding than instructors do, and that they walk students through problems step-by-step more than instructors do. The one-on-one nature of tutoring may account for these differences.

With the interview results, we were able to define a few possible orientations that a tutor might have regarding their role in a tutor-student interaction. From the information provided to us by the tutors that were interviewed, some possible orientations that a tutor may have include the following: 1) Instructors lay the foundation and tutors fill in the gaps. 2) Tutors guide students, they do not teach students. 3) Tutors are not experts, but they offer a different perspective than instructors. The tutors also mentioned some goals they have when helping a student including: 1) Help students become independent learners. 2) Determine the needs of the student. 3) Help students stay on the right path. Lastly, a few resources were named, for example the tutors can use their prior knowledge of mathematics and problem-solving techniques. Some expected resources, such as using the internet and asking a fellow tutor, were not mentioned by any of the tutors that were interviewed. This may be because tutors were not asked directly to name the resources they had or used when they were interviewed.

During this research, tutors self-reported their own thoughts and beliefs about their roles as a tutor. Not having observed the tutors during live tutoring interactions where they may apply their beliefs makes it more difficult to say that a certain tutor’s behavior follows a certain orientation or goal. Future research can investigate how the identification of these resources, goals, and orientations work to explain or predict a tutor’s in-the-moment decision making while tutoring. Another line of research could investigate how students’ resources, goals, and orientations align or are different from the tutor’s resources, goals and orientations. Schoenfeld (2011) points out that in an interaction between two individuals, the two parties may have common or conflicting goals. Thus, it may be interesting to see how the student’s goals affect the interaction.
References


