A Qualitative Study of What Ideas New Graduate Teaching Associates Report from Student-Centered Instruction in Professional Development

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Masters of Arts in Mathematics

by
Christopher David Gibson
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Abstract

The landscape of professional development for graduate teaching assistants (GTAs) in university mathematics departments is changing. San Francisco State University has been shifting towards giving new GTAs more comprehensive preparation for teaching, including efforts to support GTAs in using student-centered instructional methods. The importance of student-centered approaches took on new importance when the COVID-19 pandemic caused a tectonic shift in college instruction in 2020. In the 2020-21 and 2021-22 academic years. My own first experiences in professional learning about college teaching began at San Francisco State University in Fall 2020. I learned, online, about how to teach online. While the ideas of student-centered instruction were not new to me, how they might be achieved with adults and how that might happen remotely, both were new. I wondered how others were faring. In Fall of 2021, I reached out to all 13 of the new GTAs in the department and asked them to participate in a series of surveys and interviews. Eight GTAs completed three rounds of survey and two rounds of interview. The goal of the surveys was to find out what they knew about student-centered instruction and how much that changed over time. The interviews helped bring context and meaning to their survey responses. From the surveys and interviews I learned that GTAs’ knowledge of student-centered instruction had indeed expanded. They spoke of the importance of supporting students in evaluating knowledge claims, learning how to learn, how to collaborate, and how to seek help. At the same time,
the GTAs had little experience, as mathematical learners, of student-centered methods. The GTAs still had a tough time applying their knowledge and de-centering themselves as instructors. Their greatest opportunities for professional growth were with three student-centered ideas: teaching that values and supports students to become capable of self-assessment, to be resilient (particularly in the face of cognitive challenges), and in building skills in what to do when they (students) do not know what to do.
I would first like to thank my advisor, Dr. Shandy Hauk, who kept me motivated when things got tough and would always provide me direction when I needed it. I would then like to thank my two other committee members, Dr. Hsu and Dr. Seashore, for providing me valuable input and guidance. Lastly, I would like to thank my fiancée, Kelsey, who has always supported me throughout my education.
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Chapter 1

Introduction

1.1 Statement of the Problem

Graduate teaching assistants (GTA) play an important role in university mathematics departments. Many departments rely on GTAs to teach introductory courses in order to give new GTAs teaching experience, provide financial assistance to the GTAs, and to reduce the workload of the rest of the faculty (Muzaka, 2009). Even beyond helping the department, there has been evidence that GTAs teaching undergraduates leads to increased student retention in STEM majors (Zehnder, 2016). For much of the past 50 years there was little professional development about teaching for GTAs, and graduate students experienced a sink or swim approach to learning how to teach (Deshler et al, 2015). In recent years there has been more of a push to create more effective support for GTAs to learn about teaching. Recent years have also seen a shift towards student-centered instruction within universities.
CHAPTER 1. INTRODUCTION

College level educational research has found that students learn more and have higher pass rates in classrooms that support student-centered instruction than in traditional lectures (Beisiegel, 2017; Freeman et al., 2014). The main problem facing college mathematics now is how to best support those who teach to do so in effective, evidence-based ways. This support includes the preparation of novices, graduate students, as they begin their teaching experiences.

Like many universities, at San Francisco State University mathematics GTAs are offered several forms of support for learning about teaching. In particular, they are strongly encouraged to take a course in teaching mathematics concurrently with their first time teaching undergraduates. This course, Math 700, focuses on developing and refining teaching skills for student-centered instruction. While taking this course most GTAs are also teaching an introductory mathematics course. As of this writing, the main courses taught by GTAs are Math 197 (the first semester of a two semester pre-calculus course), Math 198 (the second semester of a two semester pre-calculus course), Math 199 (a one semester pre-calculus course), Math 107 (the first semester of a two semester business calculus course), Math 108 (the second semester of a two semester business calculus course), Math 123 (a co-requisite course that accompanies elementary statistics) and various “fourth hour” courses intended to support three-hour Calculus courses taught by faculty. Each of the courses taught by GTAs have curricula (e.g. materials for activities, assignments, and exams). The aim of the lesson materials and course templates provided to new GTAs is to scaffold the transition into teaching because GTAs are graduate students who also need to focus on their own course
1.2 Purpose of the Study and Research Questions

This study aimed to discover what knowledge about student-centered instruction GTAs gain in their early experiences of teaching. At SFSU that includes what might be learned from Math 700 and related professional learning opportunities and what techniques for student-centered instruction GTAs were implementing in their first year of teaching. The study also explored the techniques GTAs planned to implement in the future. The research question driving the study was:

How does GTA knowledge about student-centered instruction develop over time when GTAs are in online professional development for online teaching?

In seeking to answer that question, I considered the sub questions:

- What do GTAs know about student-centered instruction before the professional development?
- What do GTAs know about student-centered instruction at the end of the semester?
- What do GTAs know about student-centered instruction the following semester?
1.3 Plan of Thesis

Chapter 2 contains a literature review which justifies the need for this study. The review includes many reports among the niche literature on GTAs, professional development for GTAs, student-centered instruction, and – as a consequence of the global pandemic during which the study occurred – the shift to teaching in a virtual environment. Chapter 3 describes the design and methods for this study. The results gathered from the analyses of survey and interview data are explained in chapter 4 and in chapter 5 I discuss the results and their implications for future work in research and development around GTAs and student-centered instruction.
Chapter 2

Literature Review

GTAs are important to the university ecosystem. In the context of recitation and lab sessions in the sciences, GTAs teaching undergraduates has been shown to lead to increased student confidence and retention in STEM majors (Zehnder, 2016). In mathematics, GTAs teach not only recitation/lab sessions, they are frequently instructor-of-record. Across STEM fields, GTAs have more face time with undergraduates and are often seen by undergraduates as more approachable and engaging than professors (Kendall & Schussler, 2012). At the same time, a persistent issue is that GTAs may have little access to training or preparation for teaching. This is particularly important when the GTA is the sole instructor of record (Deshler et al., 2015). By introducing or increasing the preparation a GTA recieves there can be an improvement on the experience for undergraduate majors and non-majors alike in introductory courses (Stes et al., 2010). Important aspects of GTA preparation that are more likely to increase GTA teaching confidence and the desire to teach in the future are
activities and discussions about teaching, teaching demonstrations, course-specific instructor interaction, and, more generally, working with graduate student teaching-peers (Ellis, 2015; Stes et al., 2010).

For the most part, graduate students have little preparation for teaching or prior experience with college instruction in mathematics that is student-interactive (except, perhaps, for their own experiences of recitation or problem-solving sessions linked to large lectures; Oleson & Hora, 2014). At the same time, due to changes in K-12 education over the last decade, those who are graduate students today are more likely to be teaching at least some undergraduates who do have experiences with student-interactive mathematics instruction (Yonezawa, 2015). An additional factor in the development of teaching skills for GTAs since 2020 has been the COVID–19 pandemic and the formidable challenges of synchronous online instruction.

2.1 Background on Professional Development in Teaching for Graduate Students

The last 30 years has seen a great deal of research and development on the topic of graduate student professional learning about teaching. Research to date informing this work includes information about the role and development of graduate teaching assistants (GTAs) and their professional identity, along with contextual information about the profes-
sional knowledge GTAs are learning (e.g., pedagogies such as student-centered instruction, understanding how people learn) and the environments in which they are learning and doing the teaching (e.g., master’s program, CoVid 19-related pivot to online instruction).

GTA professional development (PD) has changed a lot over the past 30 years. It used to be that GTAs were sent to sink or swim and were given no PD before they started teaching (Deshler et al, 2015). In recent years the common practice has changed to some type of PD/mentoring throughout the first semester/year. The more innovative of these methods include ongoing PD throughout the entire program for the GTA. Desher and colleagues reported that we know from college and K-12 research that active-learning practices lead to students learning more deeply, but GTAs are generally more comfortable with passive learning styles as that is how they were taught. Desher et al. also note that successful PD programs include an initial intensive experience with ongoing PD throughout the graduate school experience. Ideally, this ongoing PD has a format of an initial intensive experience followed by regular follow-up sessions that include two or more of the following components: examining student thinking/work, collaboration, engaging in plan-implement-assess-reflect cycles, analyzing/designing assessments, and working with a mentor with observations/feedback. It is also important for the department to self-evaluate its own PD: identify its goals and collect data from classes and GTAs, compare them semester to semester, and refine PD in response to the evaluation.

Universities have varying approaches to professional development for GTAs. Bragdon and colleagues (2017) categorized approaches in 120 different master’s and doctoral-granting
CHAPTER 2. LITERATURE REVIEW

departments into nine models. They described models based on the amount and type of interaction around teaching, activities for learning about teaching, and feedback offered to GTAs. The authors defined the intensity of “interaction” by frequency (pre-semester, course in first semester, continuing) and format of professional learning options (workshops of a few hours, day, or multiple days, seminar(s), course(s)); “amount of activities” came from a list of activities in their survey. Model 1 had the lowest variety and time and Model 9 had the highest amount for each. The middle levels have varying levels of interaction and activity. For each model there were different kinds of activities.

<table>
<thead>
<tr>
<th>Model Name</th>
<th>Interaction Level</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>Low</td>
<td>Low (0-1)</td>
</tr>
<tr>
<td>Model 2</td>
<td>Low</td>
<td>Medium (2)</td>
</tr>
<tr>
<td>Model 3</td>
<td>Low</td>
<td>Medium (3)</td>
</tr>
<tr>
<td>Model 4</td>
<td>Medium-Mixed</td>
<td>Low (0-1)</td>
</tr>
<tr>
<td>Model 5</td>
<td>Medium-One Semester</td>
<td>Low (0-1)</td>
</tr>
<tr>
<td>Model 6</td>
<td>Medium</td>
<td>Low (1-2)</td>
</tr>
<tr>
<td>Model 7</td>
<td>Medium</td>
<td>High (4-5)</td>
</tr>
<tr>
<td>Model 8</td>
<td>High</td>
<td>Medium (2-3)</td>
</tr>
<tr>
<td>Model 9</td>
<td>High</td>
<td>High (4-5)</td>
</tr>
</tbody>
</table>

Table 2.1: Interaction and Activity Levels for Nine Models of GTA PD (from Ellis, 2015, p. 4)

While GTAs have existed in US graduate programs since the mid-20th century, the UK did not start heavily using GTAs until the 1990s (Muzaka, 2009). Research about GTAs started recently in the UK. Surveys were conducted at the University of Sheffield in 2006 which was given out to undergraduates, GTAs, and the instructional staff. The surveys asked open-ended questions about the most beneficial and problematic aspects of GTAs
running small group seminars. One of the most problematic aspects, said undergraduates, was that GTAs lacked a sound overall knowledge of the subject matter. Another problem for students was that the small seminars appeared not to be consistent with the main course. Students reported the perception that there was a lack of communication between GTA and professor. Also, undergraduates thought GTAs were not familiar with the assessment criteria at the university. Some complained that GTAs allowed for too much student involvement, undergraduates would have preferred a traditional teacher-centered lecture-based format. Overall, students found the most beneficial aspects to be that GTAs were more casual, better at facilitating discussion, and more relatable. The benefits for the GTAs were work experience and improved teaching skills. The negatives were that teaching took time away from their own graduate education/research. The staff thought the most beneficial aspects for the GTA were that the GTA could learn management, people, and presentation skills, which was important as PD for working as a professor in academia.

2.2 Graduate Student Identity in Teaching

The role of GTAs and their learning about teaching varies greatly depending on location and is still changing. For example, while in the UK the role of the GTA is fairly new and is still being figured out, in the US the history of GTAs as teachers is longer. However, only in recent years has there been an increased focus in the US on improving the teaching skills of GTAs (Deshler et al., 2015). This has led to increased research on the GTA experience
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and their professional identity across a variety of instructional roles.

Research to date, mostly in doctoral-granting departments, has found that first year GTAs are largely in a “survival stage” and have a hard time implementing active learning in courses (Beisiegel, 2017, p. 2). The same authors have argued that GTAs are better able to implement what they encounter in PD in the 3rd or 4th year of a doctoral program, while they are in a “renewal” or “maturity stage.” In particular, Beisiegel and colleagues rely on Katz’ model of four developmental stages:

(1) survival of the first year of teaching, with particular focus on classroom management and the routines of classrooms and schools; (2) consolidation, in which teachers begin to understand which skills they have mastered, and what tasks they still need to master; (3) a period of renewal, when teachers become tired of their routines and start to think of how things might happen differently; and (4) reaching maturity, where teachers think more broadly about the contexts of schools and students’ learning. (p. 2)

Beisiegel and colleagues suggest professional development should extend beyond the first year and be a continuous process throughout the GTA experience. In related work, Beisiegel et al. (2012) explored identity development among GTAs, and noted that graduate studies causes the voice of the mathematician to emerge, but also causes the voice of the mathematics teacher to be silenced. The purpose of education is often to turn complex beings into predictable beings (von Foerster, 2003). Beisiegel and colleagues (2012) reported the main
purpose of many graduate studies in mathematics seemed to be to trivialize the teacher in favor of the mathematician, encouraging GTAs to focus on being a researcher. There were many different elements that led to this idea, but two main themes were teaching assistantships and standard mathematical textbooks. Absent regular support (e.g., from a weekly 3-hour course about how to teach college), teaching assistantships can be an unfulfilling teaching experience for GTAs with too many students to work with in a short period of time. When this is combined with a large amount of grading, to the GTA, teaching can become very impersonal which can lead to undermining the development of a resilient teaching identity. The standard mathematical textbook can also interfere with a positive teacher identity since most mathematics textbooks follow a very rigid convention that conceals the fact that the author or reader is a human being. This, reported Beisiegel et al., can cause GTAs to view mathematics as set in stone, which is then reflected in their teaching.

Throughout graduate school, GTAs, as teachers, progress through different stages of growth. The rate and path of this growth is different from GTA to GTA, but they all form their own identity.
2.3 Key Components of Professional Knowledge for Teaching for Novices

GTA identity is very much influenced by their graduate school’s culture, goals, and offers of professional development for teaching. The research to date has focused on what instructional expertise looks like and the role of GTA experiences and GTA thinking in professional learning about teaching. What the desired characteristics are in a college mathematics teacher is context dependent. Among the key components of professional knowledge for college teaching today are understanding how people learn and building skill in equitable student-centered instruction (Abell et al., 2018).

Students learn better when they are aware of and direct their own learning and when they engage in activities that pose a challenge (National Academies of Sciences, Engineering, and Medicine [NASEM], 2018). In fact, *How People Learn II*, indicated that teachers can guide students in developing sound academic habits by offering feedback. Summarizing, drawing, explaining their work, teaching others, and other effective learning strategies are important methods for retention (rather than just taking notes while listening to a lecture). These strategies encourage the learner to go beyond the explicit material which allows for more critical thinking. Fostering a student’s feelings of autonomy, competence, belonging, and academic achievement are all important to support student agency as learners. Self-regulation is important for a student’s learning but it is difficult for people to regulate their own learning and training is needed to improve this capacity. Teachers can assist students
in developing self-regulation by guiding students towards meaningful goals, monitoring their motivation, and providing useful feedback. Problem and project-based learning are strategies that promote learners’ engagement in learning challenges by focusing on long-term goals. Research has shown benefits in primary and secondary school, but it is still hard to draw conclusions on how the learning outcomes are affected. Collaborative learning is another strategy that leads to flexible knowledge growth. This is when peer members of a group each contribute their own thinking as the group completes a complex task. In collaborative groups, learners have their own authority to divide up the tasks as they see fit. This allows students to take responsibility for their learning and be encouraged by (and offer encouragement to) their peers in the process. The teacher is a facilitator for this. Research on collaborative learning has suggested that successful tasks are those that allow learners to take control, give support and multiple resources for making sense of complex ideas, and provide learners with the means to share multiple viewpoints (NASEM, 2018).

Ways of achieving the goals for today’s college instruction can be described by four common models of instruction: Transmission, Product, Process, and Praxis (Davis et al., 2009). The Transmission model is where the curriculum is the content of the syllabus and textbook. Standard lecture-based courses are a form of the Transmission model. The Product model is where the curriculum’s main goal is to produce students at an equivalent level where the course grade is meant to represent what they have learned, the degree to which the product (the students) have attained the instructor’s goals for their learning. The Process model is about developing thinking skills. Student growth is more important
than producing the same results for each student with the same letter grade. Though rare in most STEM fields below the graduate level, the Praxis model is a collective practice between teacher and student where mathematical knowledge is gained to address a concern or puzzlement of the teacher and students; grades are unimportant and grades are given depending on the context of the situation. While student-responsive instruction is possible in each of these models, Davis et al. (2009) assert that active student-centered instruction can be realized only in the Process and Praxis models.

2.4 Student-centered Instruction

Student-centered instruction is a form of active learning. In higher education it is characterized by students having a say, often through choices, about their own path in a course instead of the instructor asserting a path. In traditional Transmission and Product model classrooms students expect to be told exactly what to do, and when to do it, by the instructor, which is further reinforced when a rigid syllabus is provided (Wright, 2011). In such teacher-centered courses students tend to resort to memorization rather than conceptualization when faced with an unmanageable amount of content. Wright has suggested that this leads students in higher education to be anxious and tentative. When instructors give power to their students, the students can choose their own goals and determine what they need to learn in the course; which allows them to become confident and self-motivated. In student-centered instruction, the teacher is there as an expert resource and guide for how to use course con-
cepts to acquire skills of critical thinking and problem solving; student-centered instruction also shifts some responsibility from the teacher to the student. There are challenges in doing student-centered instruction. The main one is pushback, from both instructors and students, which largely stems from being comfortable with teacher-centered methods (Deslauriers, et al. 2019). Active-learning that includes students in decision-making is a bit of an unknown to many so it can take more and different effort than offering an engaging lecture (Freeman et al., 2014; Laursen, Hassi, Kogan, & Weston, 2014).

Goodyear and Dudley (2015) note that while student-centeredness varies through different contexts, student-centeredness does not mean that students are simply left alone by teachers. It also does not mean simply collaborative activity-based learning or that the student gets to decide to do whatever they want:

Instead, student-centered approaches entail developing students’ ability to become their own teachers and supporting them to know how to evaluate knowledge claims, how to learn, how to collaborate, how to seek help, how to become assessment capable, how to be resilient (particularly in the face of cognitive challenges), and aiding students to know what to do when they do not know what to do. (p. 275)

To many, the teacher in student-centered instruction is thought to be a facilitator, but little research has been done to actually understand what a teacher should be doing to facilitate student-centered instruction:
Hattie (2009) has argued that teachers have a greater effect on student learning when they are an activator; that is, when their teaching leads to a very active, direct involvement and there is a high sense of agency in the teaching and learning process. [as cited in Goodyear and Dudley, 2015]

Teachers who impact their students the most are able to introduce new content by understanding what their students know and can do. The agent of change in this situation is the teacher.

Deslauriers and colleagues (2019) examined the correlation between students’ actual learning and their perception of learning. The study, among introductory physics classes, found that students in active courses indeed learned more (as measured by traditional timed assessments). However, undergraduates in the study thought they had learned less than they would have if taught traditionally. The study’s authors suggested three main factors for this mismatch: 1) The fluency of lecturers can mislead students into thinking they are learning more than they actually are, 2) students who are new to a subject do not have sufficient knowledge to properly judge how much they have actually learned, and 3) students who are unfamiliar with active learning might not appreciate the benefits that come from struggling with a topic. To address this bias the authors suggested that instructors (early on in the course) should present students with data showing that active engagement promotes learning better than passive methods in most cases.

Traditionally, education in universities has been teacher-centered and lecture-based. Ret-
search has offered evidence that student-centered and activity/project based learning actually allows for students to learn more even when they do not think they are learning more. Universities all over the US are trying to implement various types of active instruction, including student-centered methods, and much of the new GTA PD has this focus. However, many new GTAs were taught in a more traditional system so this shift is often a struggle for them as it is outside of their comfort zone. In 2020 the COVID-19 pandemic brought education to mostly distance-learning formats, including GTA taught classes. This further increased the struggle as GTAs and those offering them professional development were trying to implement a teaching style that was unfamiliar and, for many, uncomfortable in a new environment.

2.5 Context and Consequences of the Pandemic Pivot to Remote Instruction

The shift to remote teaching was sudden for most mathematics teachers, including college instructors. In 2020, 91% of college mathematics and statistics instructors moved from face to face to online teaching (Lopez et al., 2021). Most of these instructors had little to no experience in remote teaching and little to no training related to remote teaching. This led to many having to put more work into teaching their courses as they learned new teaching strategies while also having to deal with unfamiliar technologies. Lopez and
colleagues reported on the challenges for mathematics and statistics faculty of working from home to support students who were also working from home. Many instructors spent more time answering emails and being there to support students than before the pivot to online teaching. There also were new challenges for instructors with remote teaching. A few of the main challenges were and continue to be student-teacher interactions and online exams. Many instructors have had struggles with connecting to the students as many students have their cameras off during online sessions, do not use email for communication in the ways expected in colleges, and do not join in online discussions in ways instructors expected them to. Teachers also have struggled with giving exams, reporting that it seemed many more students were cheating and having an increased distrust of what students turned in (Lopez, et al., 2021). Yet, reported Lopez and colleagues, by the end of the spring semester 2020 many instructors had more of a handle on the situation: At the beginning of the semester roughly one tenth of instructors said they would want to teach online over face to face and that had increased to roughly one third by the end of the pivot semester.

2.6 Connecting to the SFSU Study Context

The SFSU mathematics department provides the more common forms of professional development for new GTAs, with some pre-semester orientation and a first-semester course (Bragdon et al., 2017). The PD at SFSU falls somewhere in the middle of the models reported by Bragdon and colleagues (2017). Model 6 has GTAs participate in training
before the first course they teach with training continuing for one semester. This model has a medium level of interaction and two or three (of six) categories of activities that are incorporated into the training. The department also has made efforts in the direction of a more supportive approach of ongoing structured professional development through the whole graduate program. Since Fall 2018 at SFSU, there have been intensive orientation workshops that occur right before each semester starts (3 days in Fall, 1.5 days in Spring). During the Fall semester, new GTAs take a 3 unit Teaching Workshop course that includes big picture concepts and dedicated course-specific “pod” time on the day-to-day running of a class. The pod groups include both GTAs and others who are teaching the same course. The focus of pod time is lesson planning and learning how to implement specific instructional tasks (e.g., a Desmos activity). The pod groups have continued beyond the first semester/year to continue professional learning about teaching in self-selected and faculty-supported ways. As of spring 2022, the pod activity and related teaching squares (more on this in chapter 3) were the only mechanisms for sustained professional learning related to teaching.

GTAs at SFSU are encouraged to promote active learning environments which may be different for students taking courses from more experienced teachers. Though GTAs are more often an instructor of record, as in the recent research in the UK, GTAs at SFSU also teach small seminars. Like the report from the UK, these seminar/lab GTAs experience consistency issues due to sparse or absent communication between the professor and GTA. GTA professional learning in this context largely depends on how much guidance the professor gives the GTA.
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In the research for this thesis I explored what new GTAs know about active learning and what they aim for with active learning, in the context of the SFSU master’s degree (2-year) program. When you create or at least adapt materials for your own use, the “survival” stage may be shortened (Beisiegel, 2019). For master’s students, particularly those who are instructors of record, consolidation may happen sooner than for TAs who are not instructors of record. Partly because there are more contact hours with students, more control, and more responsibility for instruction in teaching a 3-hour/week course than two or three separate 1-hour per week sessions for different groups of students.

Student-centered instruction is not the norm in the American university system. It requires more flexibility in-class to respond to what happens and more complex preparation compared to the traditional teacher-centered lecture based model. Given the research on GTA teacher identity development, I wondered how GTA’s teacher identity in the master’s context might develop and if they might lose flexibility and revert back to traditional lecture-based teaching style, in a medium (Model 6) type PD environment.

Instruction at SFSU appears to be a mixture of the approaches reported in Davis et al. (2009). The main goal at one point in the recent past was likely to produce consistent students with grades reflecting that (product model). There has been a shift towards more student-centered learning systems which is a bit more process/praxis model. As instructors, GTAs have some flexibility to choose their grading methods. Though there are definitely plenty of instructors that are still more closely in line with transmission or product models.

GTAs at SFSU are encouraged through workshops and pod meetings to use active-
learning methods with much of the curriculum designed to support group activity in-class. As
with other locations, many GTAs at SFSU have little to no experience with active methods,
much less student-centered instruction, as either learners or teachers.

The new GTAs who were a part of my study were also dealing with online struggles. While the nation was more than a year into the pandemic at the start of the study, as
novices to college teaching GTAs encountered the issues that came up for more experienced professors early on (as reported by Lopez et al., 2019). The GTAs were new to dealing with
low student interaction, potential cheating, and technology issues.
Chapter 3

Methods

3.1 Setting

3.1.1 Professional Development Context

This study was conducted at San Francisco State University (SFSU). This section describes the professional development for new graduate teaching associates (GTAs) in the SFSU math department in the Fall semester of the 2021-2022 academic year. Several options for professional learning about teaching were offered to GTAs before and during the school year.
3.1.1.1 Orientation

At the end of summer of 2021, prior to the new GTAs’ first semester of teaching in Fall 2021, they were invited to attend an online Orientation Workshop across four days. In this workshop, GTAs participated in information sessions and activities. Some sessions were about how to use iLearn (the online learning management platform used by SFSU), some were on how to use Zoom (the online class meeting platform), and others were about department policies and expectations about teaching and included time to plan for Fall teaching. GTAs were introduced to their peers through getting-to-know-you activities and worked together on lesson planning for their first few weeks of classes as they got to know the materials that were set up for the classes they would teach.

It was recommended for all new GTAs to participate in the orientation for Fall 2021 that ran August 16th to 19th. GTAs who participated received a stipend of $425. A scheduled collection of orientation sessions was hosted on Zoom from 9:30am to 3:30pm for the first three days with the fourth day open for GTAs to schedule their own sessions (e.g., in pod groups). All of the GTAs in my study were present for all days of the orientation. The first day started off with the GTAs getting to know each other. They were separated into groups of three in breakout rooms. In these breakout rooms they created a 3-way Venn Diagram in which they were supposed to show how each of them had similarities and differences. The Venn Diagrams were shown to each of the other groups so that they could see each other’s responses. After this “icebreaker” activity there was an introduction to iLearn (the
required online course site) in which GTAs did a scavenger hunt in order to get accustomed to the site. There was then an activity where GTAs asked questions and gave answers about various technologies that they would be using in their teaching. After the lunch period, there was a panel of experienced GTAs – they discussed their experiences the previous year and emphasized the importance of collaboration among teachers/GTAs. At the end of the day GTAs were introduced to their pod groups (pods discussed in more detail in an upcoming subsection).

On the second morning there was a session that focused on group-worthy activities. This was followed by a session with the payroll administrator who reviewed important paper-work related to their employment. The second half of the day opened up with another panel of experienced GTAs – they discussed their experiences with lesson development. At the end of the day there was more time for GTAs to work with their pod groups. The third morning started off with a discussion of different forms of assessment. One of the main discussion points was a question asking why do we give grades? After that, GTAs were introduced to the Center for Equity and Excellence in Teaching and Learning (CEETL) (discussed in more detail in the Teaching Square subsection). In the next session, GTAs were introduced to their union rep and, in a separate room from faculty, the GTAs and rep discussed important details about being in a union. GTAs spent the rest of the day in their pod groups.
CHAPTER 3. METHODS

3.1.1.2 Graduate Teaching Workshop

When hired, GTAs were encouraged to take a three unit class called the Graduate Teaching Workshop which met twice a week throughout the fall semester. Though not required, GTAs at SFSU are strongly encouraged to enroll in the course. All of the new GTAs in the department did take this course in Fall 2021. The course had GTAs do frequent readings about college mathematics teaching and learning, reflect on their own teaching, plan for instruction, and regularly discuss and write about these topics. The course also fulfilled a graduate level course requirements towards their degree.

The goal of the workshop course was for instructors to develop and refine their teaching. The course syllabus asserted three main goals for increasing skills for college teaching: mathematical knowledge for teaching, social and materials management, and commitment to essential professional processes. The course included individual and group assignments aimed at three related objectives:

1. to develop effective processes for teaching college mathematics

2. to develop effective teaching materials for remote instruction

3. to build understanding about the nature of human thinking and learning

The objectives were satisfied through discussions, readings, documentation, observations, in Zoom meetings and out of class activities.
3.1.1.3 Course Pods

As a part of the Graduate Teaching Associate position, GTAs were expected to participate in a “pod” group as a part of their instructional preparation time. In a pod, GTAs met with other GTAs and non-GTA instructors who were also teaching the same course (e.g., pre-calculus, statistics, business calculus). Each pod group was supported by a tenure-line faculty member of the mathematics department who provided direction and acted as consultant for weekly conversations about teaching the course. The faculty member did not provide instructions on what had to be done, but rather provided guidance and experience. These groups generally would discuss what went well for the week, what didn’t go well, what they were planning for the next week, and other class logistics. The pod group sizes ranged from three to ten instructors (most were GTAs). In these groups the main objective was to collaborate, but each group determined how to do this.

I participated in a pod group for three different semesters, so have some personal knowledge that is relevant. Generally in each of these groups we would start with discussing what went well and what didn’t go well for that week. We then talked about potential remedies for what didn’t go well. For things that did go well for someone we would discuss ways to implement these ideas into our own courses. After the discussion we would talk about what premade lessons/activities were coming next. We would then determine if these lessons and activities would work well for the given week and make any changes that were necessary – for example extending the time to spend on an activity or advising each other on how to
trim an activity. We would also occasionally create new activities if we felt that something was missing. From my own experience, pod groups were a great way to get perspective from other GTAs who were in a similar situation to me. When I was in my first semester teaching it was particularly helpful since it allowed me to not feel alone in my struggles. In subsequent semesters it was great being able to help new GTAs and it still helped me in my own lesson planning.

3.1.1.4 Teaching Squares

Towards the beginning of the semester of the Graduate Teaching Workshop, the GTAs were introduced to Teaching Squares, a program hosted by the Center for Equality and Excellence in Teaching and Learning (CEETL). It was not required for the GTAs to participate in the program but all who were a part of my study did so. A stipend of $220 was given to the GTAs who meet the requirements of the program.

To participate in a Teaching Square the GTAs had to notify CEETL of the membership in their group and confirm the intention of being a supportive and non-evaluative collaboration group. The goal of the Teaching Square was to share inclusive teaching practices so that members could learn from each other. The members of the group had the freedom to choose which activities they would do as a group to satisfy this goal. Based on their goals, Teaching Square members determined their activities. To receive the stipend the GTAs were to engage in a minimum of 10 hours of activity related to the Teaching Square. They submitted a short reflection on their individual process at the end of the semester. It was reviewed by a CEETL
Faculty Mentor before the stipend was awarded.

3.1.2 Participants

To recruit participants for this research, I sent an email to all of the 13 new GTAs in the mathematics program. Nine GTAs consented to participate and eight of the GTAs completed all three surveys and both interviews. One GTA decided not to participate in the study before the first survey due to a busy schedule.

In Table 3.1, the pseudonyms of participants encode some basic information. One syllable indicates a person with no previous experience teaching or tutoring nor with professional learning about teaching. A two-syllable name indicates a person with some experience as a tutor or teacher of groups of people. A three-syllable pseudonym is used for people with at least some experience in both professional learning for teaching and with tutoring or teaching groups of people.
### Table 3.1: Information on Interviewed GTAs

<table>
<thead>
<tr>
<th>Name</th>
<th>Career Goal</th>
<th>Teaching Experience</th>
<th>Previous PD</th>
<th>Spring 2022 PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mateo</td>
<td>Research</td>
<td>Tutoring</td>
<td>Course on peer tutoring</td>
<td>Pod meetings</td>
</tr>
<tr>
<td>Nicholas</td>
<td>College professor</td>
<td>Undergrad TA</td>
<td>TA training</td>
<td>Teaching square</td>
</tr>
<tr>
<td>Oliver</td>
<td>PhD, college professor</td>
<td>SI leader; instructional aide</td>
<td>Education courses</td>
<td>None</td>
</tr>
<tr>
<td>Patricia</td>
<td>PhD, research</td>
<td>Tutoring; SI leader</td>
<td>SI leader training</td>
<td>Teaching square, pod meetings</td>
</tr>
<tr>
<td>Queenie</td>
<td>PhD, college professor</td>
<td>Tutoring</td>
<td>None</td>
<td>Teaching square</td>
</tr>
<tr>
<td>Robert</td>
<td>PhD, college professor</td>
<td>Non-math teaching; tutoring</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Sandra</td>
<td>PhD, college professor</td>
<td>Tutoring</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Tom</td>
<td>PhD, research</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

#### 3.2 Instrumentation

The data gathering tools in this study were three surveys and two interviews. There was a survey at the beginning of the Fall 2021 semester with a follow-up interview mid semester. There then was another survey at the beginning of the Spring 2022 semester with a follow-up interview mid semester. Finally, there was one last survey at the end of the Spring 2022 semester.

#### 3.2.1 Surveys

I created three surveys with the goal of getting an understanding of GTAs’ thought processes and knowledge of student-centered teaching at three different points in time (see
Appendix for the full surveys). All three surveys were developed at the same time. They were submitted and approved by the IRB before they were put into the online survey program called Qualtrics. The first survey was intended to be completed early in the Fall semester 2021. The process of delivering the survey to the GTAs took a bit longer than expected and Survey 1 was completed in October.

The main goal I had in mind when creating the questions for Survey 1 was to get a baseline of what GTAs knew about student-centered teaching and what they expected to learn about it through the workshop course. The main survey item for this was repeated across all three surveys: In a few sentences, please explain what “student-centered instruction” means to you.

For Survey 2, the main goal was to get an understanding of how the GTAs thoughts and knowledge of student-centered teaching had changed by the end of the workshop course. Given GTA interview responses, shortly before administering Survey 2 I added (and got IRB approval) for a set of questions that asked respondents to answer from their own student’s perspective; the goal was to have GTAs take a different view in describing how they thought they were teaching:

On average, how do you think YOUR STUDENTS would respond to each of the following questions...? In the first column, answer for the Fall 2021 semester. In the second column, anticipate what students will answer for Spring 2022.

(The options: Never - Seldom - Sometimes - Often - Always)
1. The instructor helped me identify problem areas in my study.

2. The instructor gave me valuable feedback on my assignments.

3. The instructor encouraged my participation.

4. The feedback I got on assignments was useful.

5. I related my work to others’ work in this class.

6. I collaborated with other students during class.

7. I collaborated with other students outside of class.

8. Group work was a satisfying part of my activities in this class.

9. I made decisions about how I learned in this class.

10. I was in control of my learning in this class.

Survey 2 was completed by GTAs by the second month of the Spring semester.

For Survey 3 the goal was to gather GTAs’ reflections on student-centered teaching and what they had learned during their professional activities across the year (e.g., workshop, pod, Teaching Square, and from the activity of teaching itself). As a result of expert-checking with committee members, I amended Survey 3 to add a set of questions that asked the GTAs about their personal experiences as a learner with student-centered instruction. The amendment was approved by the IRB before Survey 3 was administered. Survey 3 was completed by the GTAs the last week of the Spring semester.
3.2.3 Interview Protocols

I created two interviews, one for Fall and one for Spring (see Appendix for complete protocols). When developing the interviews the goal in mind for both was to get extra context and details for the topics in the surveys. Both interview protocols were developed at the same time and were submitted and approved by the IRB before use. I conducted the interviews through the Zoom web conferencing tool. Each GTA consented to recording of each interview. The first interviews were completed by the end of October of the Fall semester and the second interviews were completed by the end of April of the Spring semester. No IRB amendments were made during the process.

3.3 Procedures for Data Collection

I collected survey and interview data in five stages (Figure 3.1). As mentioned previously, there were three surveys and two interviews with interviews occurring after the first and second survey, respectively. Each survey and interview was intended to take about 15 minutes.
3.3.1 Survey and Interview Data Collection

The first survey was a baseline which could be compared to responses in later surveys/interviews. The first survey occurred in the middle of participants’ first semester of teaching and asked questions related to their professional goals and background, what they considered an effective teacher, what they would like to learn in the Graduate Teaching Workshop, and what student-centered teaching meant to them (see Appendix A for surveys and interview protocols).

The first interview occurred a few weeks after the first survey. Mostly, I was looking for more information on what each GTA thought about student-centered instruction and what they would like to get out of their professional development as teachers.

The second survey occurred the first week of their second semester. The survey’s questions were similar to the first survey but with more focus on their own teaching and how the graduate teaching workshop (Math 700) had served their needs (or not).

The second interview occurred within a few weeks of the second survey. The goal of the second interview was similar to the first interview which was to follow-up on the preceding
survey. I was looking to get additional information on how teaching had gone for them in the Fall 2021 semester, what challenges had occurred, and if the professional development had met their expectations/goals.

The third survey was completed at the end of the Spring 2022 semester. The goal of the survey was largely to repeat the key questions, to gather information on how GTAs might feel differently about teaching than when they first started and to reflect on their professional development across the year.

### 3.3.2 Participant Communication

I communicated with the GTAs primarily through email. Before conducting surveys or emails I sent them each an informed consent form to get their consent for the research. I sent them emails for each survey and interview in which I let them know how and when to complete it. I also let them know how to contact me if needed. I sent follow up emails weekly if they had not completed a survey or scheduled an interview with me yet. I tracked communication through a google spreadsheet and online calendar.

### 3.3.3 Data Management

Survey data was first collected through Qualtrics. I then transferred the data to a google spreadsheet that was secured by invitation only (to my advisor) in my google drive. Interview videos and transcripts were stored in password protected files on the Zoom platform. I then
cleaned the transcripts, repairing the automatic transcription to better reflect what people actually said, and stored the transcriptions in google documents on my secure google drive. All data analysis and notes involving the data was also stored within my google drive.

### 3.4 Analysis

#### 3.4.1 Coding of Interviews

In the spreadsheets with transcriptions, I assigned a code to each row (an utterance) of the cleaned interview transcript. If the utterance was my own, the code represented the question in the IRB approved interview protocol. For example if I labeled one of my lines as “q2” that meant that was question 2 in the survey. For any utterance by a GTA the initial code would range anywhere from one word to a sentence. This code was intended to capture and summarize the essence of the utterance. For example, Queenie said:

I think that the class itself isn’t necessarily the stressful part, so I think so, to answer your question and was it better or worse than I expected, I think the class itself went better than I expected

and I coded it with a partial quote from her utterance: the class itself went better than expected.
After this initial coding of each interview, I then went through each interview a second time. The goal of the second coding was to consider each of the other interviews when generating new categories that grouped together initial codes that had something in common. In some cases, the commonality was the topic, like “first week expectations” (the focus of one of the interview questions was how the first week of classes had gone). For example, on the second pass, Queenie’s statement was categorized as first week expectations as were Mateo’s “I hadn’t expected anything. I hadn’t known what to expect.” and Robert’s “A bit of a slow pace... it was new for me, so I wasn’t sure about what to cover with the students... but overall I’m thinking it went well.” In other cases the category emerged as a new category code across initial codes.

The third pass through the interviews involved noticing larger categories or themes across the existing codes. I used pivot tables in the spreadsheet to organize and review utterances by categories (from the second pass). However, a person might offer seven comments made
up of 24 utterances about a topic. Often, a string of utterances (a comment) were coded with the same theme. All counts reported in the results in chapter 4 are counts of utterances. A higher number does not indicate a more important or powerful or valuable idea for an interviewee, though a higher number does indicate that more words were used to discuss that theme.

3.4.2 Descriptive Data from Surveys

First, I took the data from each survey and put them into a spreadsheet where each question was a column with each row being a different GTA’s responses. One of the goals of the surveys was to learn about what GTAs knew and learned about student-centered instruction. There were three questions directly about student-centered instruction in survey 1, two in survey 2, and 1 in survey 3. I took those questions and put them in a spreadsheet with each question assigned to a row and each column assigned an interviewee. I then used that data to write a summary of each GTA’s progress, as reported in the results section. The ideas from these summaries are supplemented by interview data to provide more context to GTAs progress. Another goal of the surveys was to see what GTAs got from Math 700 and what they thought was absent from it. I took the two questions on Math 700 from survey 1, three questions from survey 2, and two questions from survey 3 and put them in a new spreadsheet. The columns were assigned the questions and the rows the interviewees. I then used that data to summarize what the GTAs thought they would have liked to learn from
CHAPTER 3. METHODS

Math 700, what ideas from Math 700 were the most useful, what they wished Math 700 had covered that was absent, and if they were more prepared to teach their second semester because of their experiences in Math 700. This information is in the results chapter.

3.5 Criteria for Rigor

For works like this thesis that use qualitative research, various aspects are expected in a rigorous report. One standard set for quality in is the set: credibility, authenticity, transferability, dependability, and confirmability (Patton, 2014).

Credibility is about the trustworthiness of researcher portrayal of participants’ intentions, perceptions, and actions. The methods for conducting and reporting credible research include attention to multiple aspects: an audit trail, member checks, peer debriefing, expert checking, progressive subjectivity, negative case analysis, and persistent observation. The audit trail refers to the keeping of meticulous records of the process of the study. If the same steps were used by another researcher with the same data a similar result would be expected. This includes evidence of how the data were reduced, analyzed, synthesized. I included within the methods section how I collected and used the data from my participants. I also had a research timeline of what to complete which I updated when the schedule changed. Peer debriefing and expert checks included several threads. First, my advisor worked with me every step of the way reading and editing what I had written. Also, throughout my work I was part of a research group led by my advisor with other graduate students who also
CHAPTER 3. METHODS

provided feedback about my work. After completing a draft I sent it to my thesis committee who provided input and I made changes accordingly.

Authenticity is concerned with balance in the presentation of perspectives, addressing the question: Has the research been fair in presenting views? Avenues for addressing authenticity include interviews with participants and member checking. Authenticity also includes researcher position - what is the story of the researcher(s) (collectively and individually)? I was not able to have member checking due to the short timeline of the study, but I did have interviews with the participants and used their utterances to do the coding within my data analysis. I also have a research position statement to tell my story (see Appendix C).

Transferability means using rich descriptions and multiple informants or cases to make interpretation possible by the reader. Such details enable the reader to make connections to broader issues and interpret research in another context. The information given earlier in this chapter offers details of who, what, when, why, and how for the research. So someone in a different context can decide what is similar or not to this research which will help the reader determine transferability.

An assessment of dependability considers the quality of the processes of data collection, data analysis, and reporting, and an assessment of confirmability considers how well the reporting is supported by the data. Dependability is addressed in a description of the data collection that clearly states the conditions. Confirmability is addressed by a robust data pool (e.g., full transcripts of interviews, electronic files of notes made during observations and interviews, text of participant responses to open-ended items, quantitative data sets
available in electronic form) as well as through offering the manuscript for committee- or peer-review. Dependability is addressed by detailed descriptions of the research context and participants (with some limitations since I do not want the participants to be identifiable). Confirmability is addressed by the fact that I have written documentation of participant responses to surveys and interviews.

### 3.6 Limitations and Delimitations

The main findings are from a study of a particular set of GTAs in the specific context of teaching at SFSU. As indicated previously, the results are not intended to be generalizable. Rather, the goal is transferability: giving sufficient detail about this particular case to support the reader in interpreting the results for a situation similar to that presented here. This small study did not gather or analyze information about societal structures and systemic influences (and consequences) of student and instructor perceptions. The case was eight GTAs from a single Math 700 class. These eight represented only 60% of the enrollment in the class. Nonetheless, a useful example can anchor a lot of learning. At the same time, the interviews brought further context by letting GTAs share their stories about teaching for the first time in a university setting.
Chapter 4

Results

Before getting into the data collected from the survey and interviews, I give a definition of student-centered instruction to help bring context to the following results. I then share the themes that emerged from the interviews. The themes help illuminate GTAs’ thought-processes while they were trying to implement student-centered instruction as a first time instructor. Then I talk about what the GTAs experienced during their professional learning opportunities (largely Math 700). Their reported experiences indicate what they took away from the professional learning opportunities and what they felt was missing. After summarizing survey results on the GTAs’ perception of student-centered instruction, I connect those with the themes to directly address the research question: How does GTA knowledge about student-centered instruction develop over time when GTAs are in online professional development for online teaching? In particular:
• What do GTAs know about student-centered instruction before the professional development?

• What do GTAs know about student-centered instruction at the end of the semester?

• What do GTAs know about student-centered instruction the following semester?

4.1 Definition of Student-Centered Instruction

Student-centered instruction broadly refers to a variety of teaching practices, strategies, and styles that include students in decision-making about how teaching and learning happen (Froyd & Simpson, 2008; Goodyear & Dudley, 2015; Wright, 2011). Such a focus is a shift from the instructor/curriculum to the student. Addressing each student’s learning needs, cultural background, interests, and professional goals, student-centered instruction is about giving each student choice in how they want to learn (Jones, 2007). This is in contrast to the common approaches to K-12 education of the last century where the instructor chooses how the students will learn. Teacher-centered instruction includes lecture based teaching and also can – depending on design and implementation – include activity based instruction.

The teacher in the case of student-centered instruction is often more of a facilitator to each student’s learning, there to help give students options in their learning. The teacher is still an expert in the subject matter and is still a resource, but at the same time is not the only source of information to the students.
A student-centered classroom isn’t a place where the students decide what they want to learn and what they want to do. It’s a place where we consider the needs of the students, as a group and as individuals, and encourage them to participate in the learning process all the time (Jones, 2007, p. 2).

As noted in the literature review, Goodyear and Dudley (2015) describe specific types of engagement entailed by student-centered approaches. In addition to setting classroom environment and community expectations that are inviting, student-centered instruction supports students in learning:

1. how to learn,

2. how to collaborate,

3. how to evaluate knowledge claims,

4. how to seek help,

5. how to become (formative) assessment capable,

6. how to be resilient (particularly in the face of cognitive challenges), and

7. what to do when they do not know what to do
4.2 Note on Reporting

As noted in the Methods chapter, an “utterance” is the piece of speech distinguished by pauses. All counts reported are counts of utterances. A higher number does not indicate a more important or powerful or valuable idea for an interviewee, though a higher number does indicate that more words were used to discuss that theme. In each thematic section I summarize the baseline information from interview 1 and then offer the views expressed after the first semester of instruction at follow-up, from interview 2. Throughout, descriptives are consistently used as follows: “a few” means two to three, “several” mean three to four, “many” means at least five, “most” means six or more, and “all” means all who responded.

4.3 Overview

From the interviews there were a total 537 utterances across 19 different themes. Table 4.1 below shows the number of utterances per theme. The bold face text is the section the theme falls into which is discussed in section 4.4.
<table>
<thead>
<tr>
<th>Theme and categories</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>The challenges of implementing student-centeredness</td>
<td>47</td>
</tr>
<tr>
<td>student centeredness - student focused</td>
<td>12</td>
</tr>
<tr>
<td>student centeredness - teacher focused</td>
<td>35</td>
</tr>
<tr>
<td>I don’t know what I need to know</td>
<td>67</td>
</tr>
<tr>
<td>how do I do what I have never experienced myself?</td>
<td>21</td>
</tr>
<tr>
<td>I don’t know what I need to know</td>
<td>46</td>
</tr>
<tr>
<td>Student participation and engagement</td>
<td>80</td>
</tr>
<tr>
<td>student participation / engagement</td>
<td>60</td>
</tr>
<tr>
<td>communicating with students</td>
<td>20</td>
</tr>
<tr>
<td>Peer support</td>
<td>33</td>
</tr>
<tr>
<td>peer support</td>
<td>33</td>
</tr>
<tr>
<td>Planning and logistics</td>
<td>67</td>
</tr>
<tr>
<td>planning</td>
<td>50</td>
</tr>
<tr>
<td>logistics</td>
<td>17</td>
</tr>
<tr>
<td>Pacing</td>
<td>31</td>
</tr>
<tr>
<td>pacing</td>
<td>31</td>
</tr>
<tr>
<td>Less frequent themes</td>
<td>67</td>
</tr>
<tr>
<td>grades and grading</td>
<td>24</td>
</tr>
<tr>
<td>first week expectations</td>
<td>22</td>
</tr>
<tr>
<td>balancing teacher and learner roles</td>
<td>3</td>
</tr>
<tr>
<td>stress</td>
<td>18</td>
</tr>
<tr>
<td>career goals</td>
<td>7</td>
</tr>
<tr>
<td>class management</td>
<td>9</td>
</tr>
<tr>
<td>Math 700 expectations vs reality</td>
<td>34</td>
</tr>
<tr>
<td>math 700 expectations vs reality</td>
<td>31</td>
</tr>
</tbody>
</table>

Table 4.1: Cross-Interview Themes and Utterance Counts
4.4 Knowing and Doing Student-Centered Instruction

4.4.1 The Challenges of Implementing Student Centeredness

In interview 1, there were 30 utterances from the GTAs about the challenges of implementing student centeredness. A few of the interviewees had a similar statement to Patricia who said “I’d like to know where the line crosses from student centered teaching to like babysitting and hand-holding.” Many reported struggling with a different teaching style than they were used to themselves. Robert found student-centered instruction challenging to implement due to a stronger need for it “to be engaging,” saying that:

To be student centered they (the instructor) need to put a lot of effort into the way they lecture or design the class because you need to have enough activities that need to be engaging enough, it can’t be too difficult, but it needs to drive the point (of the lesson).

Patricia also voiced the belief that SFSU mathematics courses had a higher pass rate than first-year mathematics courses at other universities because student-centered instruction makes the course too easy for the students.

The following semester, in interview 2, there were 17 utterances about these challenges. A few of the interviewees discussed their dealings with student push-back against student-centered instruction, saying they would get “strong requests for lecture.” Queenie said, “I felt like every time I tried to implement anything student-centered or group worthy my
CHAPTER 4. RESULTS

students would kind of riot a little bit.” Also, several of the GTAs had a tough time letting
the students take the lead with Nicholas saying:

It was very difficult because I tried to go away from lecturing to the students
taking over. So you kind of have to lead them so they aren’t teaching the wrong
stuff, but not so much that it then just becomes you teaching.

Oliver had a similar sentiment saying that:

I might be intervening too early in group work and telling them the answers
before they can figure it out. But I want to keep things on a certain track since
we only have so much time.

4.4.2 I Don’t What I Need To Know / How Do I Do What I
Never Experienced Myself

In the first interview there were 30 utterances about how to know what was needed
and trying to implement student-centered instruction without having experienced it. When
referencing the struggles of implementing student-centered instruction Queenie said, “En-
couraging students to do math in a student centered way . . . I think it’s very difficult for me.
I never even experienced it; I don’t know how I can implement it.” Many of the interviewees
weren’t sure what they would like to learn from Math 700 about student-centered instruc-
tion, with Oliver saying, “There are things (from Math 700) that I don’t need to know and
I can point to those easily, but the thing is I don’t know what I need to know.”
CHAPTER 4. RESULTS

In interview 2 there were 37 utterances from the GTAs about not knowing what they need to know. A few of the GTAs felt it was hard to implement some of the ideas from Math 700, with Tom saying:

I can’t say that I always saw the point of what we were talking about in Math 700. Some contextualization of what we were talking about would have maybe helped. We were being taught about a bunch of things without really being told how to actually go and use that knowledge to improve our own teaching.

A few of the female interviewees had uncomfortable experiences with male students that they did not know how to deal with one of them saying (in reference to an uncomfortable situation they dealt with):

I find myself constantly trying to make sure that I’m keeping up a very professional demeanor and the right level of respect and professionalism. I haven’t heard any of my male peers speak about that ... I think it would have been helpful to have a discussion (in Math 700) about how to handle something like that [uncomfortable situations].

4.4.3 Learning to Be A Teacher & Feeling Like a Teacher

In the first interview there were 15 utterances about learning to be a teacher and 27 utterances about feeling like a teacher. Many of the interviewees made statements about how they struggled with teaching the first few weeks of the semester, but they understood
they were first time teachers and that it would get better with experience. Oliver said, about learning to be a teacher:

It’s kind of like on the job training. I’m training to become a professor. I don’t expect to in my first day at work to know exactly what I need to be good at.

Several of the interviewees felt like a teacher during the first interview. Tom felt like a “peer who just kind of is in a leadership position.” And Queenie responded she felt like a teacher because students emailed her with their requests to add the class:

I had a lot of students emailing me before the first week, just asking to get into the class, I think that probably got me a little bit more [feeling] like I’m in charge of these students.

In the second interview, there were 51 utterances related to feeling like a teacher. A few GTAs still reported they did not feel like a teacher at the end of the first semester. Yet, all reported an increase, feeling more like a teacher for a variety of reasons, such as increased confidence, giving grades to students, and receiving emails from students about their grades. Patricia’s comment captured these apparently conflicting feelings when she said:

I felt like I was an imposter, like somebody gave me the wrong responsibility right now, [it] was so scary . . . I think that by the end of the semester, I felt a lot more confident in my decisions about how to handle the material and so, in that way, I think it went better.
Nicholas noted a similar experience, “Being the teacher figure at the beginning was kind of weird, but I guess you just get more comfortable in the role of [the teacher].”

4.4.4 Student Participation/Engagement and Communicating with Students

There were 37 utterances related to student participation / engagement and communicating with students in interview 1. There were many comments about black screens and frustration at trying to get students engaged and not being sure how to change that. Robert said:

I was expecting college students to want to get a good grade and be sort of motivated ... So, on the first day of class, everything [cameras and microphone] was turned off. No people are really talking. Had to overcome that.

Some of the GTAs wanted to be able to reach out to students who were falling behind. Math 700 helped Patricia figure this out, “[Math 700 helped me with] knowing how and when to reach out to students who are not staying caught up on work or showing up to class all the time.”

In Interview 2, there were 45 utterances related to student participation / engagement and communicating with students. Comments focused on disappointingly low attendance and disengagement by students in Zoom class meetings. GTAs noted “fluctuations” and “students seeming lost,” “getting participation was a constant struggle” and “I had to bring
them into the conversation.” For all the GTAs, arriving in a silent breakout room and eliciting any response was a recurring challenge in their first semester of teaching. Several GTAs echoed Queenie who said “online it was like pulling teeth to get them to share their screen.” Sandra had challenges trying to communicate with students who weren’t doing the work saying:

Students who wouldn’t show up to class and put in effort, they still wanted to pass, but they weren’t doing any work. So having to reach out to them and figure out what was going on was challenging.

Patricia stated, “I couldn’t really tell if anyone was behind the computer, whereas if they were with me in person, I would know immediately.” This sentiment was shared by most of the interviewees as they all struggled with connecting with students online. All of the interviewees that were teaching in person the following semester said there was an improvement in being able to communicate with the students and student engagement. Oliver did note that in person “some people [students] get lost and are not doing much, so I have to bring them into the conversation”.

4.4.5 Peer Support

From interview 2, there were 33 utterances about the peer support that the interviewees received during Math 700 and other professional development (e.g., Teaching Squares). While some of the interviewees did not like the course format of Math 700, all of them found the
peer support to be useful. In particular the “Pod Time” and “Teaching Square” groups were found to be one of the most useful collaborative experiences. Tom said, “The teaching square, I wouldn’t have known about it if not for Math 700. In my teaching square our whole focus was wanting to improve our time management in the classroom”. With Queenie saying about collaboration in Math 700, “It provided a space for me to like bounce ideas off of [others]”. A few of the GTAs said they wished that they had more people teaching the same course as them so that they could collaborate. Sandra was the only first-year GTA for the course she was teaching. The other people teaching the course rarely came to pod meetings, leaving Sandra isolated. She said:

I think the most challenging part for me was that there wasn’t anyone else in the class that was teaching [the course I was teaching]. So it was hard to ask any specific questions about how to explain a specific topic in a different way or where other people were at in the syllabus [curriculum schedule].

4.4.6 Planning & Logistics

There were 29 utterances about planning and logistics from the first interview. Half of the interviewees wanted there to be more time before the semester to plan for their course. Queenie said, “I wish that there was more prep time…. If [the orientation workshop] was maybe two weeks before school, at least, that would have been nice”. Oliver had a similar sentiment where he thought that teaching would have gone smoother if he had known in
the beginning how to give them the structure of the class that he learned later. A few of
the interviewees also wished they had learned about some logistics involved in teaching in
more detail before the semester had started. For example Nicholas said, “It would have been
nice [to have learned] that iLearn can merge your classes, I have three sections where I’m
teaching the same exact material.” On the other hand, Sandra thought that orientation had
prepared her well, “it did a good job, I felt comfortable with web-assign, how to do zoom
and breakout rooms, assign quizzes, accessing course materials, and how to do my course on
iLearn.”

There were 28 utterances about planning and logistics from interview 2. Many of the
statements were about managing the time preparing for teaching class each day. GTAs said
it generally got easier for them by the end of the semester. Nicholas said, “The class part
wasn’t that bad. The prep was the hardest. For every hour of class, I did probably four
hours of prep, but that was kind of too much.” A few of the GTAs found the logistics of
dealing with the online grading system to be difficult since it was a fairly clunky system to
them. Mateo said that, “One challenge was to learn the iLearn grading system and keep
the students up to date in their grades.” Patricia thought as the semester went on that the
time she spent on prep went down. She said, “My preparation went smoother and I felt like
I understood more of what I needed to prep and so that made me more efficient.”
4.4.8 Less Frequent Themes

Grades & Grading

Across both interviews, there were 24 total utterances about grades and grading (only two were from interview 1). A few interviewees said grading was a challenge to them due to the responsibility of a grade affecting a student in the long-term. Regarding his challenges with teaching, Nicholas said, “Grading is the hardest part for me, being able to say whether a student understood the material this much or not.” Robert had to deal with a student, who didn’t complete assignments and exams, who appealed their course grade and remarked on it being an increased pressure on him as a first time teacher.

First Week

The interviewees had 22 utterances (all from interview 1) related to how their first week went. Most mentioned realizing it had gone better than anticipated. Tom said, “I think it had went better than I expected. I think, with the materials that we were given, it went pretty smoothly.” Though a few of them also said their pace was maybe too slow early on with Robert stating, “[The first week was] a bit of a slow pace, it was new for me, so I wasn’t sure what to cover with the students.”
Balancing Roles and Stress

There were 21 utterances about dealing with stress and balancing roles as a teacher and a graduate student. Patricia said,

I didn’t really realize how much was going to be expected of us as a GTA. I was sort of under the impression that all of the materials and everything were just going to be set up and handed to us, it was overwhelming at first.

She, like a few of the other interviewees felt they hadn’t had enough preparation before the semester started. Mateo had to reduce his course load as a student and commented, “Personally I’ve been overbooked, I think I don’t have the capacity to do everything I started out doing this semester”.

4.4.9 Math 700 Expectations and Reality

There were 33 utterances about Math 700 expectations, all of which were a part of interview 2. When asked about what they expected of Math 700, most of the GTAs did not identify expectations of Math 700. Nicholas said, “the pedagogy stuff was not necessarily what I expected” as he was expecting it to be a bit more focused on collaboration and lesson planning with peers. Most of the interviewees would recommend that new GTAs take Math 700. Robert said, “If you have no idea what you are doing at the beginning [of teaching], it gives you a place to start”.


4.5 Professional Learning About Teaching

The GTAs had participated in multiple professional learning experiences that included the pre-semester orientation, teaching squares, pod groups, and Math 700. The interview themes touch on all four of these and the additional survey questions asked about Math 700 specifically. On all three surveys GTAs responded to questions asking them about what they would like to learn from Math 700, what ideas from Math 700 were the most useful, what they wished Math 700 had covered that was absent, and if they were more prepared to teach their second semester because of their experiences in Math 700.

4.5.1 What the GTAs hoped to learn in Math 700

All of the GTAs included in their response that they hoped Math 700 would help them improve their teaching. The two most common hopes beyond becoming a better teacher were: learning to effectively lesson plan and how to get students to participate. Tom mentioned that he wanted “to get an insight on how to teach well online and alternatives to normal lecture based classes” while Queenie said she wanted to learn how to “run a class that optimizes students’ learning and experience.”

4.5.2 What ideas from Math 700 were the most useful

The most common idea that was considered useful was learning how to setup/encourage group work. Mateo stated that “the idea of assigning the various roles to the members of each
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group of students for completion of group activities” was a useful idea to get group work to be more effective. Another commonly useful idea was learning to collaborate with other GTAs. Tom mentioned “that the collaboration with other instructors in the form of pod time and teaching squares was helpful to me and something I would not have organized on my own.” Patricia found that learning to consider the level of a question to be useful saying, “the types of questions we ask as instructors can impact the depth of our students’ conversations.” A few of the GTAs also talked about how learning to consider the perspectives of students when lesson planning was useful. Nicholas mentioned that one of the most useful ideas to him was learning to “be aware of different students’ backgrounds” and Tom said that a useful idea to him was “intercultural communication, which I often considered when presenting new ideas to my class.”

4.5.3 What was absent from Math 700

GTAs wished that there were more “practical examples of student-centered learning.” Robert said he wished there was “more of an opportunity to learn from peers and from the instructors about teaching.” Some GTAs said Math 700 was too theory-based rather than focused on practical teaching applications. Queenie said, “I wish it was more like a workshop, rather than a think-tank.” She also said that Math 700 was a great example of a class that used student-centered instruction, but it was not great at teaching how to implement student-centered instruction. Tom mentioned that it was difficult to implement
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ideas from Math 700 saying that “often we would be introduced to an idea without fully having a grasp on what it meant.” Sandra thought that Math 700 was not supportive of “making online lectures more engaging.”

4.5.4 Did Math 700 help prepare the GTAs for teaching?

The answers to this question were mixed. The GTAs who felt more prepared said that Math 700 helped them to become “more aware of what it means to teach in a student-centered way,” how to make “group-worthy activities,” and how to “encourage students to participate.” The GTAs who said that they did not feel prepared said that Math 700 did not provide them enough practical application. Patricia said that “we did not discuss specific situations” and differed from others in saying “the instructor did not do a good job modeling student-centered learning.” Oliver said he gained more from “the experience I had teaching last semester.” Queenie said that Math 700 was focused on developing curriculum which did not help her when she was using the pre-made curriculum for her course.

The GTAs also had responses to what Math 700 did not prepare them for as a new teacher. Half of the GTAs noted that Math 700 had not helped them anticipate or have a response for low attendance rates. Mateo said that Math 700 “did not prepare me for significant levels of student absence throughout the semester.” Patricia said that it did not prepare her for “students who do not or will not participate in class activities.” She also mentioned that she had issues with cheating and harassment that it did not prepare her for.
Queenie mentioned that she had a tough time keeping control of the classroom when “letting the students lead” which Math 700 did not help her with.

4.6 How GTA Knowledge on Student-Centered Instruction Changed Over Time

This section draws on survey and interview data to tell the story for each GTA of how their knowledge on student-centered instruction changed over time. The primary value of the surveys was the snapshots of GTA knowledge at different points in time. Open-ended items in surveys 1, 2, and 3 asked directly about respondents’ personal experiences with, and definitions of, student-centered instruction.

As noted in section 4.1, Goodyear and Dudley (2015) describe specific types of engagement entailed by student-centered approaches, student-centered instruction supports students in learning:

1. how to learn,

2. how to collaborate,

3. how to evaluate knowledge claims,

4. how to seek help,

5. how to become (formative) assessment capable,
6. how to be resilient (particularly in the face of cognitive challenges), and

7. what to do when they do not know what to do

In this section, I use the seven touchstones from Goodyear and Dudley (2015) to organize the comparison of the open-ended survey responses across time and link that information to the interview themes. For each GTA, I report on the evidence from the survey items and the previously discussed themes to characterize the change in that person’s knowledge about student-centered instruction.

### 4.6.1 Mateo

Mateo’s first definition of student-centered instruction stated that “it is more about what the student is doing rather than the instructor.” He also mentioned how student-centered instruction “is about conceptual change as opposed to information transmission” and that it “related content to what the student already knows” with a focus on the “development of learning skills.” His definition showed evidence of his knowledge including supporting students in learning how to learn (#1). In survey 2, Mateo’s definition said that student-centered instruction “means giving up most of the control of what happens in the classroom to the students,” which suggests evidence of attention to supporting students in decisions about how to learn (#1). Mateo noted that he felt that he was effective at providing feedback to students, evidence of a teacher-centered approach to formative assessment. He had a focus on his job of assessing students rather than supporting students to assess themselves. His third
CHAPTER 4. RESULTS

Nicholas’s definition of student-centered instruction in the first survey showed little evidence of any of the seven types of engagement. He said student-centered instruction was, “teaching meant for students” without further explanation. By survey 2 his definition had expanded a bit showing evidence of supporting students in learning how to learn (#1), noting that the teacher needs to adjust teaching to meet the learning habits of the students. He also reported supporting participation in his own classes because he felt “the best way to learn is to get involved.” In survey 3 his definition included evidence of how to collaborate (#2). Nicholas’ new definition included group work as a core part of student-centered instruction. In interview 1 he said he had used limnu boards and asked students to write their names next to their work on the board which “really increased engagement with the activity.” This also provided evidence of him supporting his students learning to collaborate (#2). In interview 2, Nicholas said that Math 700 encouraged him to create questions “that have more open ended thinking” instead of just looking for “yes or no” answers. He hoped
this would “encourage discussion.” This may indicate he was working to support his students in evaluating knowledge claims (#3) and collaborating (#2).

4.6.3 Oliver

Oliver’s first definition of student-centered instruction stated that a “student-centered approach to instruction focuses on how students learn rather than the material.” He also mentioned a need to “give space for students” and to allow for “a hands-on approach to learning” to accomplish this. This showed evidence of knowledge for supporting students in learning how to learn (#1). His definition of student-centered instruction in survey 3 (he did not respond to the prompt on survey 2) included that “student-centered teaching puts more weight on the will of those who lack knowledge [the students].” Meaning that “students create the focus of the course, rather than the teacher.” This definition also suggests evidence of knowledge related to students learning how to learn (#1). In interview 1 Oliver noted the value of student-centered instruction saying that “in order to understand something you should be working with your hands.” This suggests further evidence related to students learning how to learn (#1). In interview 2 he said he was maybe “intervening too early in group work [and] telling them the answers before they can figure it out.” This awareness about giving more time for struggle, supporting students to persist in problem solving provides some evidence of his knowledge in supporting his students to evaluate knowledge claims (#3).
4.6.4 Patricia

Patricia did not provide a definition in the first survey, saying she could not because she had never experienced student-centered instruction herself. She did say that she thought student-centered instruction was “focused on student interests and needs” and that it included “getting students involved in the direction” of the course. This showed evidence of knowledge of the role of supporting students in how to learn (#1). In survey 2, Patricia’s definition of student-centered instruction included “creating a classroom environment in which students have an equal voice with their professor” and “actively doing work rather than passively listening to a lecture.” This gave evidence of her growing knowledge about supporting students in how to learn (#1). She said she was effective at “giving helpful feedback” and encouraging “students to ask myself and each other questions”. This showed evidence of her knowledge expanding to include supporting students in how to seek help (#4) and how to collaborate (#2). Her final definition of student-centered instruction in survey 3 stated that “the focus is on getting the student actively participating in their own learning.” This showed evidence of deeper knowledge about supporting students in how to learn (#1). Patricia also said that she used group activities instead of lecturing when teaching so that “students can explore concepts and learn from each other.” This showed more evidence of supporting her students in how to collaborate (#2). In interview 1 Patricia said that the orientation helped her be more supportive of students who needed various disability resources, suggesting knowledge growth related to supporting students to seek help (#4). In
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interview 2 she said that Math 700 helped her “to ask better questions that would lead to more discussion, rather than just like a yes or no answer.” This encouragement of critical thinking in her students provides evidence that her knowledge included supporting students in evaluating knowledge claims (#3).

4.6.5 Queenie

Queenie’s definition of student-centered instruction in the first survey mentioned “allowing students the space to form their own understanding and ask questions”. This shows evidence of knowledge related to supporting students in learning how to learn (#1) and how to seek help (#4). She also said that student-centered instruction “requires group work and students discussing what they are learning” while giving “the tools to explain back what they are figuring out.” These show evidence of knowing to support students in how to collaborate (#2) and how to become formative assessment capable (#5). By survey 2 Queenie was less sure about a definition for student-centered instruction, saying that “all teaching has to be student-centered” since teaching students is the focus. She also said that “teaching becomes motivational.” In survey 3 her definition of student-centered instruction was mostly the same as her first definition saying that it included “giving space” and for students to “come to me with their own ideas.” In both interviews, Queenie mentioned implementing group worthy activities which provides evidence of her knowledge including support for students to learn to collaborate (#2).
4.6.6 Robert

In the first survey Robert stated that student-centered instruction was "when students are in charge of their own learning" and that the instructor is a "supportive coach". He also mentioned that the information given is meant to help the students "discover" the answer instead of them receiving the answer directly. This showed evidence of his knowledge including support for students in learning how to learn (#1). His definition in survey 3 had not changed much. His response described the instructor as the "co-pilot" giving guidance while the student was the "driver". This again showed evidence of supporting students in how to learn (#1). Robert said he felt that he was effective at creating a variety of channels of communication with his students, suggesting that his knowledge included a view of student-centered learning in which the instructor supports students in learning how to seek help (#4). In interview 1 he mentioned that in future semesters he would be able to "think about activities from the student-centered perspective" in order to make them more impactful. This could be evidence of him supporting his students in learning to learn (#1) and potentially (if the activities promote critical thinking) learning to evaluate knowledge claims (#3). In interview 2 Robert said he tried to make "a safe environment" where his students "feel comfortable" so that they participate and collaborate. This shows evidence of knowledge of the need for supporting students in learning to collaborate (#2). It also could be evidence of knowledge related to supporting students to seek help (#4) because a "safe environment" might make it more likely for the students to do so.
4.6.7 Sandra

Sandra’s definition of student-centered instruction in the first survey stated “students actively participate” and “the instructor facilitates while adjusting to student needs” which might suggest evidence of supporting students in how to learn (#1). Sandra also mentioned that student-centered instruction includes more time with peers in breakout rooms, evidence of attention to students learning how to collaborate (#2). Her definition of student-centered instruction in the second survey did not change much. She did mention that she was effective at “inviting questions from students” and communicating to them that she was available through office hours and email – suggesting evidence of supporting students to learn how to seek help (#4). Sandra’s definition in the third survey also mostly stayed the same, saying that the “instructor seeks out student feedback and creates an environment where student voices and ideas are heard” which is some evidence of supporting students in learning how to learn (#1). In interview 1 she said she wanted to learn how to communicate with her students better so that she could learn what they need help with. This was additional evidence of her knowing to support students in seeking help (#4). In interview 2 she said by the end of the first semester she was “more responsive to student feedback” and had “students contribute and take more of an active role in the lessons.” This suggests a deepening of her knowledge of the importance of students learning how to learn (#1).
4.6.8 Tom

Tom’s definition in survey 1 stated that student-centered instruction “describes an approach to teaching where each student’s needs and background are considered.” This showed evidence of knowing to support students in a variety of ways in learning how to learn (#1). He also mentioned that it “involves a high level of student feedback and interaction.” This statement provides some evidence of knowledge about supporting students in how to collaborate (#2) and how to become formative assessment capable (#5). In the second survey Tom stated that student-centered instruction puts “students in the driver seat” and makes students “active members in the classroom and in their own learning.” This is more evidence related to knowing about supporting students in learning how to learn (#1). In interview 1 Tom said:

"I’ve tried to be more careful in how I handle student questions... trying to move them towards that kind of level two thinking of understanding why something happened, not just what happened."

This showed evidence of him supporting his students in evaluating knowledge claims (#3). In interview 2 Tom said he would like to learn to create activities that will help students discover knowledge on their own. This showed evidence of him supporting his students in learning how to learn (#1).
Chapter 5

Discussion

5.1 Contributions of this study

The question driving the study was: How does GTA knowledge about student-centered instruction develop over time when GTAs are in online professional development for online teaching? The short answer: Slowly. The surveys indicate that the majority of the new GTAs to SFSU in the 2021-2022 academic school year built their knowledge about student-centered instruction. At the same time, the stories in section 4.6 illustrate the differences in the nature and timing of those changes. The results summarized here provide some insight into the details. At the beginning, in survey 1, most GTAs shared some ideas about what student-centered instruction was that seemed to be based on the literal meaning of the phrase “student-centered.” In interview 1 GTAs reflected on the Fall ‘21 semester so far and discussed what they would like to learn about student-centered instruction so that they could
improve their teaching. By survey 2, GTAs had a formal definition that talked about what the goals were for the students in student-centered instruction but said little about what the instructor did. As time progressed, GTAs talked more about what the teacher does to achieve those goals, using examples from their own instruction in survey 3, some expanding on ideas in Interview 2 with additional classroom examples.

Not only GTA knowledge changed. The GTAs perceptions of themselves and students changed in many ways. They were not just learning about student-centered instruction for teaching, many were experiencing it as a student for the first time in their own graduate courses at SFSU. Most of the GTAs had not experienced student-centered instruction as a learner before teaching. Moreover, no one reported they had been a college student in the class they were teaching. For most, their sole experience of online learning was under the extreme conditions of the pandemic.

Table 5.1 summarizes which of the seven specific types of engagement entailed by student-centered approaches that each GTA described in their definition of student-centered learning which is shown by the X. X1 is from survey 1, X2 is from survey 2, and X3 is from survey 3. For each Y labeled in the table, in the interviews the GTA talked about using this type of engagement with their students. Y1 is from interview 1 and Y2 is from interview 2.
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Table 5.1: Summary of GTA reporting on aspects of student-centered instruction
In the surveys and interviews all of the GTAs mentioned supporting students to learn how to learn as a goal, but did not offer specifics about what instructional moves or approaches might achieve that goal. GTA focus was on "getting students engaged" – a teacher-centered view about how to get students to look at and do the things the teacher and/or curriculum wanted/expected. Therefore, for #1 in table 5.1, all of the GTAs appeared to include learning how to learn as an important component in student-centered instruction, but they were still working on how to accomplish it.

Throughout the surveys and interviews all but one GTA mentioned the use of group work as an important part of student-centered instruction and an effective tool to support collaboration in their own classes. They all seemed to understand that working with others could be an effective form of learning in addition to or instead of lecturing only. The one GTA, Oliver, who did not mention it was using a curriculum that had activities that require group work, but he did not directly mention using group work throughout the surveys and interviews (he did not offer answers to the related questions in survey two). Thus, for #2 in table 5.1, the GTAs in this study were unlike the GTAs in Besiegel’s studies (2012, 2017, 2019). This is discussed below in the Connecting to Existing Literature section.

While GTAs mentioned ideas related to critical thinking in interviews, in the surveys none of the GTAs mentioned supporting critical thinking or other ways students might evaluate knowledge claims as a core part of student-centered learning. This may be because to them supporting critical thinking is a core part of their experience of the university system in general (Oleson & Hora, 2014). In the interviews many of the GTAs mentioned giving more
open-ended questions to their students in hopes of creating better discussion and deeper thought. So, for #3 in table 5.1, while the GTAs did not consider it a part of student-centered instruction directly, they were still supporting their students to evaluate knowledge claims.

Most of the GTAs, in the surveys, mentioned supporting their students to seek help as an important element of student-centered learning. This was supported by a few of them in their interviews saying they provided a welcoming space and tried to be available for students so that the students would know to come to them when in need of assistance. So GTA statements indicated a teacher-centered approach to seeking help. Only one GTA, Patricia, included students as a resource for each other by encouraging “students to ask myself and each other questions.” Overall, for #4 in table 5.1, many of the GTAs spoke of supporting their students to seek help in teacher-reliant rather than self-reliant ways.

Throughout the surveys, only two of the GTAs included some form of formative assessment as an element of student-centered instruction. These two did not seem to directly realize it as something that was important, but they did mention assisting their students in having the capability of judging their own learning. In the interviews the GTAs did not talk about encouraging their students to be more formative assessment capable. However, they talked about trying to get feedback for themselves about their teaching frequently in order to improve their own formative assessment skills. Thus, for #5 in table 5.1, developing the students’ formative assessment skills did not appear to be a significant component in GTAs definitions of student-centered instruction.
For #6 in table 5.1, the GTAs had much to say about their own learning to be resilient, but no specific comments related to supporting students to learn how to do that. Like resilience, learning what to do when they do not know what to do (#7 in table 5.1) was a personal challenge, what they were learning to do themselves in their efforts to be teachers. This category goes beyond the individual ”ask the teacher” idea of #4.

5.1.1 Shedding new light on experiences of GTAs in master’s degree programs

As noted in the review of literature, a current framework for examining GTA experiences in learning about teaching relies on four developmental stages (Beisiegel, 2017):

(1) survival of the first year of teaching, focused on classroom management;

(2) consolidation, as teachers begin to understand which skills are and are not mastered;

(3) renewal, when teachers question routines and think of how things might happen differently;

(4) maturity, where teachers think more broadly about the contexts of students’ learning.

This framework provides the foundation for describing the similarities and differences between existing work and the research reported here.

Beisiegel’s study (2019) and my study used GTAs who were teaching for the first time. Beisiegel found that GTAs started in the (1) survival stage due to them trying to learn how
to manage a classroom as first time instructors. The GTAs in my study also all appeared to be in the survival stage immediately for the same reason.

Beisiegel’s study used GTAs from doctorate programs while the GTAs in this study were all part of a masters program. The length and intensity of teaching experience in the programs differed. The GTAs in my study had different short-term and long-term professional goals. Several of the GTAs in my study wanted to become teachers at either a community college or high school while GTAs in a doctorate program potentially would want to teach at a university, focus on research or work in industry. GTAs might have different ideas of what they want to get out of and put into teaching while in their program. The GTAs in my study, and more generally at SFSU and in master’s programs, are instructors of record of various entry level math courses such as pre-calculus or business calculus. The GTAs in Beisiegel’s study taught weekly one hour recitations in support of a course taught by a faculty member (like the 4th hour calculus sections at SFSU). The recitations also can be in support of a higher level math class such as linear algebra or differential equations. Teaching as an instructor of record has different pressures and expectations than someone who is a recitation leader. While an instructor of record requires mathematics knowledge and basic skills in planning and classroom management (like a recitation leader), an instructor also needs additional skills related to responsibilities and power in the classroom they have (e.g., for structure, assessment, and assigning of grades at the end of the term) and obligations to teaching colleagues (e.g., if someone gets a C in my Math 101 course which is a prerequisite for Math 102, are they ready enough to succeed in Math 102). Beisiegel’s study also followed
GTAs for four years of their doctoral program while I only followed the GTAs in my study for one school year. Beisiegel’s study also had a total of 27 participants while my study had 8. Thus, more caution is warranted in interpreting the results.

Beisiegel observed that first year GTAs appeared to be in the (1) survival stage. The GTAs in this study also focused on classroom management since they were new teachers and were still trying to get the hang of things, which is a main part of the (1) survival stage. However, the GTAs in my study appeared also to be in the (3) renewal stage at the same time since they were often looking for new teaching strategies to increase engagement among their students. A possible explanation for this difference is that the GTAs at SFSU were encouraged to teach with a focus on student-centered instruction which is different from the lecturing style of teaching common for Beisiegel’s GTAs. Thus, moreso than in the recitation setting, GTAs in my study had to constantly change their routines to figure out what approaches would work best for them. Changing routines is a main part of the (3) renewal stage.

Some of the GTAs in Beisiegel’s study had progressed into the (2) consolidation stage in their second year. The GTAs in my study, by the beginning of the second semester, were showing signs of understanding what parts of teaching they were good at and what they needed to work on which suggests they were also progressing into the (2) consolidation stage. However, at SFSU the GTAs’ opportunities to learn about student-centered instruction had also encouraged the GTAs to think about intercultural communication and the different experiences of students with and of learning. These ideas came up many times throughout
the interviews and surveys, indicating the GTAs were also progressing into the (4) maturity stage at the same time as their development into (2) consolidation.

Thus, a main difference from Beisiegel and colleagues’ studies is that the GTAs in the SFSU master’s program who participated in this study appeared to be in more than one stage at a time and progressed through them nonlinearly.

5.2 Implications for Future Work

There are many ways the work reported here could be expanded. In particular I discuss in this section ideas for future research, address the context needs [if you take my suggestion for revising the title of section 5.2.2] of student-centered instruction in teaching mathematics, and implications for future development of professional learning opportunities for new GTAs and the providers who support them.

5.2.1 Research

Recommendations for further work:

- Clear next steps include replicating this study for another, larger, cohort of GTAs, exploring experiences of second-year GTAs (possibly following this study’s cohort) to examine the extent to which Katz’ (Beisiegel, 2019) model is useful in describing their experiences.
CHAPTER 5. DISCUSSION

- Following GTAs into their professional work, post degree, and capturing the ways their knowledge of student-centered instruction continues to develop.

- Following GTAs who start in a master’s program and continue on to a PhD program; capturing what ways their PD in their master’s program may have influenced their knowledge about teaching and how that compares to their peers who went directly into doctoral programs.

- Purposefully examine the future graduate experience and teaching development of today’s undergraduates, who are experiencing student-centered instruction (unlike the GTAs in this study).

- Explore the benefits and potential pitfalls of extended PD for master’s program GTAs who are instructor-of-record in terms of Katz’ framework.

5.2.2 Context for Teaching Mathematics

Several structural issues related to mathematics teaching emerged from this study as important to address:

- The curriculum and its readiness for supporting student-centered approaches is important. A curriculum being activity-based is not a guarantee of student-centered instruction (though it can be a structural scaffold for it). Additional structures are needed. Some were found by graduate students in this study in their own mathe-
matics graduate courses, where instruction was more student centered than they had previously experienced.

- GTAs had differing timelines for coming to a realization of the ways they had power to determine how their class went and for their sense of the responsibilities they had to students (e.g., related to grading/assessing). The timeline was consequential for the teaching they did and for the classroom cultures they created.

- Student pushback on student-centered approaches is real and people need to learn how to manage it (Deslauriers et al., 2019)

- Status is given to grades in teaching mathematics. Many GTAs were worried about the grading obligation and some felt it conflicted with what they were learning about student-centered instruction. Student-centered instruction is rooted in liberatory education, and away from traditional assessments and traditional goals of producing a worker-cog for society. At the same time, the structures in the department demand that a “C” in the first course in a two-course sequence needs to indicate something about students’ readiness for the next course.

### 5.2.3 Professional Development

Implications for GTA professional learning about teaching:

- Many GTAs said they wanted more time to prepare for teaching BEFORE they began
to teach, yet contracts (which begin a week before the first day of class) have meant models for PD are often structured with little support for advanced learning about teaching.  

- The study findings indicated GTAs would benefit from tools for self-assessment related to knowledge growth about student-centered instruction – for example, GTAs might have found it useful to have a checklist of “if you are doing this” or “if these things are apparent in your classroom” then you know you are succeeding in student-centered instruction. Having a sense of how to see success would be helpful. Most GTAs seemed to have a better sense of what student-centered instruction was NOT (i.e., all their previous experiences) but not what it DID look like.  

- Related to realizing power, explicit PD in course coordination about what is/is not in the purview of instructors could be especially useful for novices. For example, using a video case activity about processing student feedback (Hauk et al., 2013).  

- One level up is the need for support for providers of PD, in how to teach GTAs with learner-centered (i.e., GTA-centered) methods while teaching them about student-centered approaches.
Appendix A: Instruments

Interview 1 [early in Fall 2021]

1. What class(es) are you teaching? Are the classes online or in person?

2. How did your first day of class go?

3. Did you feel like a teacher?
   a. If yes, what made you feel like a teacher?
   b. If no, what needed to happen that didn’t happen to make you feel like a teacher?

4. What, if anything, did you use in your first day of teaching that you learned in the last few weeks? Where did you learn it?

5. Is there something you wish that the orientation (pre-semester) or workshop (Math 700) had prepared you for that it did not?

6. Now that you have had a day of teaching, what do you hope to learn in Math 700? (is it different from what was put in the survey?)

7. What would you like to learn about when it comes to student-centered teaching? What makes that student-centered?
Interview 2 [end of Fall 2021]

1. How did your last few weeks of class go?

2. Did you feel like a teacher at the end of the semester?
   a. If yes, what made you feel like a teacher?
   b. If no, what needed to happen that didn’t happen to make you feel like a teacher?

3. Did teaching get easier as the semester went on?
   a. If yes, why do you think it became easier?
   b. If no, what was preventing it from becoming easier?

4. What was the most challenging part about teaching? Also for my clarification what does challenging mean to you? What is the opposite of challenging?

5. Think back on Math 700 (look at ilearn). Recall that at the end of the semester we worked on: Did Math 700 help you with that challenge?
   a. If yes, give an example of something you learned from Math 700 that helped you with that challenge.
   b. If no, what could Math 700 have done to help prepare you for that challenge?

6. Are there people that have helped you? Do you consider them mentors?

7. Were you able to make use of any student-centered techniques learned in Math 700?
a. If yes, what and how?

b. If no, what got in the way?

8. Do you recommend that every new GTA takes Math 700?

a. If yes, why?

b. If no, why not?

9. Did Math 700 meet your expectations?

a. If yes, say more about the expectations that were met.

b. If no, tell me something about the expectations that were not met.

**Survey 1 [first week Fall 2021]**

The survey asks you about your views and experiences with different types of instruction.

1. Bring to mind someone you think of as an effective teacher, what is effective about their teaching? Give at least 3 examples.

   a. Would you consider the instruction you described as “student-centered”?

2. Bring to mind someone you think of as not an effective teacher, what is not effective about their teaching? Give at least 3 examples.

   a. Would you consider the instruction you described as “student-centered”?

3. In a few sentences, please explain what “student-centered instruction” means to you.
4. For you, how is student-centered instruction similar to or different from lecture?

5. For you, how is student-centered instruction similar to or different from activity-based instruction?

The next two questions ask you about the Math 700 Graduate Student Workshop that you will be a part of in Fall 2021.

6. What do you hope to learn about in Math 700?

7. What do you expect you will actually learn in Math 700?

The last few questions are about details needed to compare results of this work to existing research. Thank you, in advance, for sharing the information requested.

8. What graduate program are you enrolled in at SFSU?

9. What are your future career plans?

10. What previous teaching or tutoring experiences did you have prior to attending San Francisco State University for graduate studies?

11. What professional development (e.g., courses, seminars, workshops) related to teaching have you done?

12. What is your gender identity?

13. Are you an international student?
14. What is the highest degree you have obtained? [DROP DOWN: bachelor, master, doctorate]
   
a. What was your major area of study for that degree?

**Survey 2 [end of Fall 2021]**

The survey asks you about your views and experiences with different types of instruction.

1. Did you take any other professional development courses, training, or workshops during the semester other than Math 700? Elaborate if so.

2. On average, how do you think YOUR STUDENTS would respond to each of the following questions...? In the first column, answer for the Fall 2021 semester. In the second column, anticipate what students will answer for Spring 2022.

   (The options for a-j will be: Never - Seldom - Sometimes - Often - Always)

   a. The instructor helped me identify problem areas in my study.

   b. The instructor gave me valuable feedback on my assignments.

   c. The instructor encouraged my participation.

   d. The feedback I got on assignments was useful.

   e. I related my work to others’ work in this class.

   f. I collaborated with other students during class.

   g. I collaborated with other students outside of class.
h. Group work was a satisfying part of my activities in this class.

i. I made decisions about how I learned in this class.

j. I was in control of my learning in this class.

3. What does student-centered teaching mean to you? Explain in a few sentences.

4. What were you effective at as a teacher and why were you effective at it? Give at least 3 examples.

5. What were you not effective at as a teacher and why were you not effective at it? Give at least 3 examples.

6. What were the three most useful ideas that you learned in Math 700 that you used in teaching your class(es) throughout the semester?

7. Was Math 700 effective at improving your knowledge of student-centered teaching? Explain why or why not in a few sentences.

8. Now that you are finishing up the semester, is there something that you wish Math 700 covered?

9. The last two questions are needed for comparison to the previous survey you participated in.

10. What graduate program are you enrolled in?

11. What are your future career plans?
**Survey 3 [early in Spring 2022]**

This survey asks you about your views and experiences with teaching so far this school year.

1. What classes are you teaching this semester?

2. How is teaching this semester going compared to Fall?

3. What sort of professional learning about teaching are you involved in this semester (e.g., pods, seminars, CEETL activities / teaching squares)?

4. What does student-centered teaching mean to you? Please explain in a few sentences.

5. Before attending San Francisco State, what kind of exposure did you have to student-centered instruction as a learner of math yourself?

6. Since becoming a graduate student at San Francisco State, what kind of exposure have you had to student-centered instruction as a learner of math?

7. Do you feel your own prior experience with student-centered instruction is relevant to your teaching with student-centered methods?

8. Is your teaching style more student-centered than last semester? Please give an example to illustrate your answer.

9. Did you feel more confident about teaching this semester? Why or why not?
10. Were you more prepared to teach this semester because of Math 700? Explain why or why not in a few sentences.

11. What did Math 700 not prepare you for as a new teacher?
Appendix B: Researcher Position Statement

Before working on my thesis my opinion on student-centered instruction was fairly neutral. I had taken a few courses on education while working towards my bachelor’s degree and had learned about some of the early influences on student-centered instruction (e.g., John Dewey and Maria Montessori). The classes did not particularly influence me to think positively or negatively about student-centered learning at the time. Also, at the time I did think that many of the teaching practices were applicable at the college level, but these classes were about teaching K-12 so college was not the focus. It was not until I took Math 700 with Dr. Shandy Hauk (my thesis advisor) that I had really started to think about student-centered instruction. During Math 700 what I learned about student-centered instruction made sense and I thought it was probably the future of teaching in university mathematics, but I also was “just” a GTA and thought it was a bit too daunting of a task for me to implement in my courses. I also did not think it would really work well while teaching online during the pandemic – virtual learning made it even harder to encourage participation and engagement from new undergraduate students. I tried various student-centered techniques that I learned in Math 700, but many of them did not work as well as I hoped. As a result, I mostly reverted back to lecturing mixed with activity-based learning. When teaching, about one third of my class time was lecturing and the other two thirds was having the students work
on pre-made activities. I usually would save some time at the end of each class to go over homework. While activities are a part of student-centered instruction, my implementation was very teacher-centered: I did not really give my students choice in the direction of their learning. So, in my first year, in a lot of ways, I was like the novice GTAs in this study. I wanted to like student-centered methods, but it was just too difficult for me to get it right.

Though, if I do end up teaching more in the future (I hope to teach community college), I would definitely try to make my classes student-centered and ideally lecture very little or not at all.

Given my own experience, I would like to mention some of my biases in this study. As mentioned before, I think student-centered instruction is the future of mathematics instruction and that traditional lecturing is a poor way to teach. Traditional lecturing does not allow for students to make choices within their own learning and does not leave room for other learning styles. While some students may learn well by listening and taking notes, many others do not learn that way. Which is why it is important for instruction to allow students to learn by using the method that works best for them. I learn best by “working with my hands” or in the case of mathematics, just doing as many practice problems as possible, which is why I do not like classes with lecturing as the primary form of instruction.

Going into the study and at its end I also assumed that the GTAs were like me: approving of student-centered instruction, but not particularly capable of implementing it. This may not have been the case of every GTA. Some of them may have liked lecturing more than I did, we all have our own preferences. I also continue to think that teaching in a student-centered way
is very difficult to do online. I do realize there may be a way to do it. At the same time, I do not think SFSU and Math 700 provided the scaffolds for new GTAs to do student-centered instruction online. I also assumed that most undergraduate students taking mathematics do not want to be there and are not interested in learning mathematics, which may not truly be the case. With that said, I am relatively new to being the instructor-of-record for college mathematics and have taught only a handful of classes, all online. My ideas about what does and does not work about instruction change frequently. The GTAs in this study were very similar to me in this way and we were all trying to do our best to implement student-centered instruction during the pandemic, a tough task for even the most experienced.
References


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