

SCIENCE INTERNATIONAL TEACHING ASSISTANTS' DEVELOPMENT OF
CULTURAL COMPETENCE AND TEACHING SELF-EFFICACY

by

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DEDICATION

To my parents, Lixin Jia and Fanrong Meng,
who never had the opportunity to go to college, but they left their mark on this
dissertation.

我将此论文献给我的父母，贾立鑫和孟凡荣。

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ABSTRACT

A significant number of international graduate students teach undergraduates in science departments as teaching assistants, often as laboratory instructors. The compelling cultural differences between international teaching assistants (ITAs) and their students in the U.S. have led to profound communication problems, which was often referred to as the “ITA problem”. The findings from this dissertation provide insights into this persistent problem by examining science ITAs’ cross-cultural teaching experiences in U.S. classrooms from the lens of cultural competence and teaching self-efficacy.

Following a brief introduction of the problem (Chapter 1), this dissertation starts with a literature synthesis on ITAs’ development of cultural competence using a cultural competence framework from healthcare (Chapter 2). The result of this synthesis was an adaptive framework for ITAs’ cultural competence development, which was used to construct a STEM GTAs’ teaching self-efficacy model into science ITAs’ context (Chapter 3), and as analytical framework to examine science ITAs’ teaching-related experiences (Chapter 4).

Adopting a sequential explanatory mix-methods design, I conducted a cross-sectional survey and follow-up interviews to explore science ITAs’ development of teaching self-efficacy (Chapter 3). The results showed that science ITAs can develop their teaching self-efficacy with sufficient training for teaching and with ample teaching experiences. High-quality teaching professional development (TPD) in which ITAs can establish supportive teaching relationships with peers and supervisors is the key factor for science ITAs’ development of teaching self-efficacy.

A phenomenological study was conducted to gain insight into science ITAs' cross-cultural teaching experiences by conducting semi-structured interviews with ITAs with different cultural backgrounds (Chapter 4). The results provided validity evidence for the ITA cultural competence framework in Chapter 2 of this dissertation. Consistent to the findings in Chapter 3, cultural encounters, including ITAs' experiences in teaching and TPD, were also the central components and the driving force for science ITAs' development of cultural competence.

This study draws attention to science ITAs' unique, profound and variable challenges and conveys the urgency to support them in TPD that focuses on cultivating critical cultural skills such as English proficiency, pedagogy, and cross-cultural communication skills. This dissertation concludes with a brief summary of all the three studies and their collective implications for international graduate student instructional development (Chapter 5).

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CHAPTER ONE: INTRODUCTION

Problem Statement

Graduate students are critical for effective college science teaching for several reasons. First, American universities depend on graduate students to teach large numbers of undergraduate students (Rushin et al., 1997; Connolly et al., 2016), especially in introductory courses and science laboratories (Schussler et al., 2015). Because of this high amount of contact, Graduate Teaching Assistants (GTAs) can impact student learning and retention in sciences (Reeves et al., 2016; President's Council of Advisors on Science and Technology, 2012, Seymour and Hewitt, 1997). Second, GTAs are the source of future faculty, and they will have more teaching responsibilities when and if they take faculty positions at the post-secondary level. Their teaching experiences as graduate students could impact their teaching when they become faculty members, impacting even more students of sciences. Finally, GTAs may have a potential advantage for teaching undergraduate students as compared to faculty (Rushin et al., 1997) in that GTAs are closer in age undergraduate students, making it is easier for them establish rapport with students. Therefore, GTAs could be valuable asset in college science teaching to help increase student retention.

Even though GTAs are critical for college science teaching, the Teaching Professional Development (TPD) to support GTAs in teaching is often poor or non-existent and there is great variation in the length and types of GTA TPD offered across institutions and departments (Reeves et al., 2016; Schussler et al., 2015). Oftentimes the

initial orientation at the beginning of the instructional semester focuses on safety training and not teaching. Sometimes GTAs have weekly meetings, but the quality of training in instruction is poor (Garet et al., 2001; Desimone et al., 2002). Furthermore, GTAs' teaching roles are often discouraged by their mentors because GTAs have other obligations such as research and coursework (Nyquist et al., 1999; Gardner and Jones, 2011).

International graduate students comprise 21.2% of all first-year graduate students in the U.S. (data from 2016; Okahana & Zhou, 2017). From 2007 to 2018, the number of international graduate students across disciplines in the United States increased by 50.3%, with a total of 382,953 international graduate students enrolling in 2018 alone (IIE, 2019). Many of these students are international teaching assistants (ITAs): graduate students from other countries who are funded through teaching assistantships (LaRocco, 2011). Compared to their domestic U.S. counterparts, ITAs have additional challenges in graduate school including language, culture and pedagogy (Zhou, 2009), because English is their second language, and they grew up and were educated in a different culture. Without sufficient professional development, it is even more difficult for ITAs to teach American students effectively due to both pedagogical and cultural barriers. Therefore, it is no surprise that American students tend to have negative perceptions of ITAs, and some students even openly resist them (Bailey, 1983; Plakans, 1994). Despite these challenges, there is some evidence that ITAs do not negatively affect student outcomes compared to their American peers (Walsh, Jia & Vernon, 2020).

The data (IIE, 2019; Figure 1.1) indicates that most of the international graduate students are from Asia, making Asian international graduate students the major source of

ITAs in the United States. The significant cultural differences between Eastern and Western cultures have created profound intercultural communication problems between ITAs and their students, which was initially referred to in literature as the “foreign TA problem” (Bailey, 1983), and later revised to the “ITA problem” (Zhu & Bresnahan, 2020). Undergraduate students in the U.S have prevalent negative perceptions towards and resistance to ITAs because they have difficulty interacting with them both verbally and culturally (Kang, Rubin & Lindemann, 2015). From the ITAs’ perspective, they experience multiple challenges in teaching (Arshavskaya, 2015) and they need training in language, culture and pedagogy (Hoekje & Williams, 1992; Zhou, 2009) to teach students in the U.S. effectively. This study is structured to examine issues related to this ITA problem.

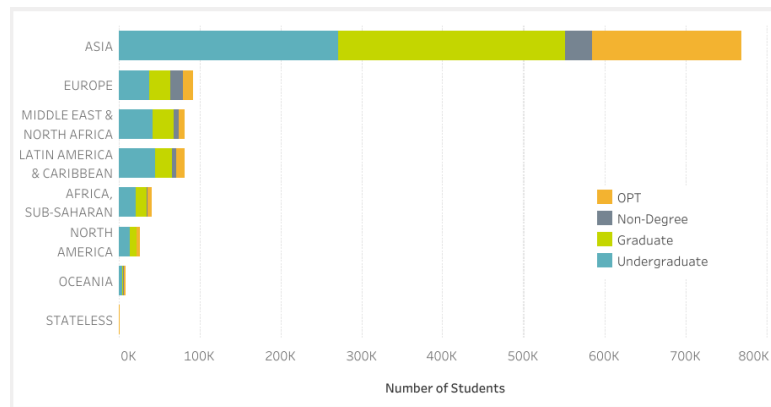


Figure 1. 1 The countries of origin of international students.

Purpose of the Study, Dissertation Organization and Research Questions

The purpose of the dissertation project is to identify the experiences and factors that might impact ITAs’ teaching practices so that ITAs can be better supported in GTA TPD. This dissertation is structured as an alternative format dissertation with general

introductory and conclusion chapters bookending three publication-ready manuscripts. The three manuscripts explore the ITA problem from three different angles.

The first manuscript is a critical literature synthesis that explores how ITAs develop the cultural competence to teach students in the U.S. The ITA literature between 2009 and 2020 was reviewed using a cultural competence framework from healthcare (Camphinha-Bacote, 2011; Figure 3), which was reconstructed to adapt to ITAs' development of cultural competence in teaching. The goal of the literature synthesis was to explore the following research question: How can the cultural competence framework be revised for use in the context of ITAs? Through the literature synthesis I intend to provide the rationale and theoretical foundation for the second and third manuscripts.

In the second manuscript, a mixed-method study with survey and in-depth interviews was conducted to understand how ITAs overcome the cultural and language barriers to develop the cultural competence that they need to teach students in the U.S. successfully. The adapted cultural competence framework for ITAs in the first manuscript will be used as the analytical framework to answer the research question: What is the process of science ITAs' development of cultural competence in teaching students in the U.S.? The aim of the second manuscript is to collect data about science ITAs' cross-cultural teaching experiences to backup and/or revise the adaptive cultural competence framework for ITAs.

For the third manuscript, a cross-sectional survey of international graduate students with experiences of teaching sciences (Biology, chemistry, physics, etc.) was conducted to measure science ITAs' teaching self-efficacy and explore the factors that could impact their teaching self-efficacy. The survey included items from DeChenne et

al. (2015; Figure 4) to measure STEM GTAs' teaching self-efficacy and the sources of teaching self-efficacy to answer the following research questions: 1) What is the level of teaching self-efficacy for science ITAs, compared to STEM GTAs in general? 2) What are the sources of teaching self-efficacy for science ITAs? The third manuscript intends to gather information about science ITAs' teaching experiences with a bigger sample size.

Theoretical Framework

Two major theoretical frameworks will be used to organize and contextualize the manuscripts in this dissertation: cultural competence and self-efficacy. In the next section, I provide only a brief overview of each framework, as they will be discussed in more detail throughout the dissertation. Cultural competence framed the work related to the critical literature synthesis (Chapter 2) and the mixed methods research study (Chapter 3). Teaching self-efficacy theory framed the work related to the cross-sectional survey study of ITAs (Chapter 4).

Cultural Competence

If ITAs' are conceptualized as people providing service to their students with different cultural backgrounds, the ITAs' situation is, in many ways, similar to healthcare providers who interact with patients with different cultural backgrounds on a daily basis. Cultural competence training is very common in the healthcare field and is well developed to support doctors and nurses to provide patients with culturally-sensitive services (Tanner & Allen, 2007; Shen, 2015). Cultural competence in healthcare was defined "as the ongoing process in which the healthcare professional (HCP) continuously strives to achieve the ability and availability to work effectively within the cultural

context of the patient (individual, family, community)” (Campinha-Bacote, 2011, p. 43). Therefore, one way to assist ITAs in conquering those challenges as a whole is by utilizing the theoretical lens of cultural competence to examine their instruction, perceiving language and pedagogy as cultural skills. A well-recognized cultural competence framework (Campinha-Bacote, 2011, Figure 1.2) was adopted in the critical literature synthesis in chapter 2 as an analytic framework to conceptualize ITAs’ teaching-related experiences.

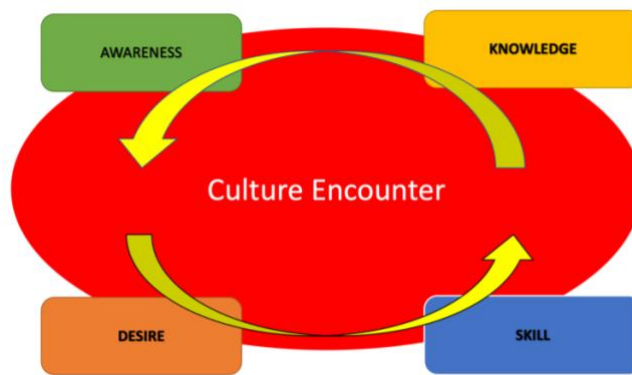


Figure 1. 2 Modified cultural competence framework based on Campinha-Bacote (2011).

STEM GTA teaching self-efficacy

Initially, the plan for this study was to observe STEM ITA teaching practices. Due to the complication of the COVID-19 pandemic, it was difficult to measure ITAs’ teaching practices by observing them in the classroom. Therefore, I decided to measure ITAs’ teaching self-efficacy instead, because evidence shows that there is strong relationship between teachers’ teaching self-efficacy and their teaching effectiveness (Bandura, 1997). Teaching self-efficacy has been defined as “a domain specific construct focusing on teacher perceptions of their own ability to ‘organize and execute courses of action required to successfully accomplish a specific teaching task in a particular context’

(Tschannen-Moran, Hoy & Hoy, 1998, p. 233)’” (DeChenne et al., 2012). Teaching self-efficacy can influence teachers’ motivation, performance, and the student outcome (Morris et al., 2017). I adopted DeChenne et al.’s (2015) proposed model of STEM GTAs’ teaching self-efficacy, because the participants in my study, science ITAs are a sub-population of the population for which the framework was intended. Furthermore, the framework is consistent with the results of literature review: GTA PD, teaching experiences, and systematic support from departments can impact ITAs’ ability to teach students in the U.S. Adaptation to American cultural and perceived English was added to DeChenne et.al’s (2015) original model, according to Kim (2009) and the literature synthesis in Chapter 2 of this dissertation. The proposed model for sources of ITAs’ teaching self-efficacy was shown in Figure 1.3.

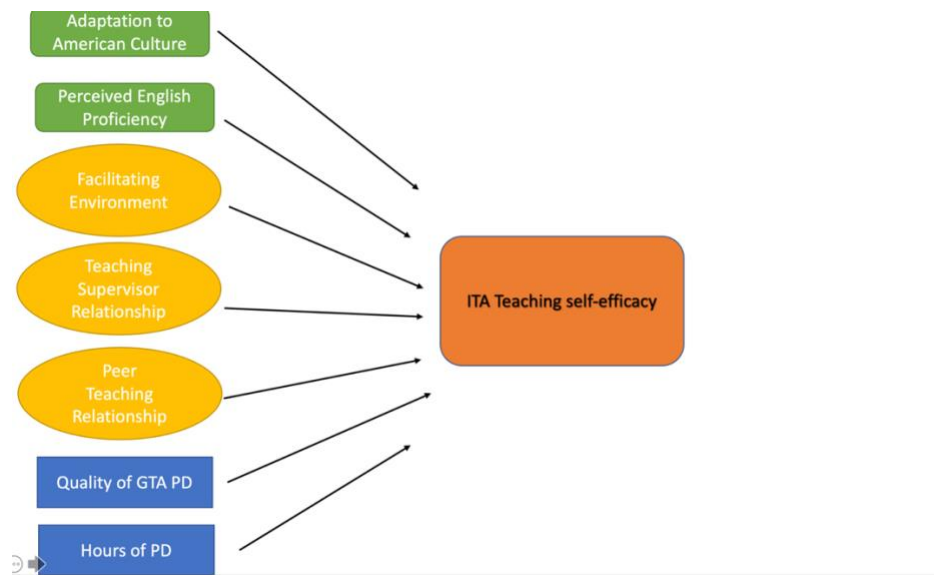


Figure 1. 3 Proposed model of Science ITAs’ sources of teaching self-efficacy

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CHAPTER TWO: SUPPORTING INTERNATIONAL TEACHING ASSISTANTS' DEVELOPMENT OF CULTURAL COMPETENCE: A LITERATURE SYNTHESIS

Introduction

Graduate students are critical for college science teaching, especially in introductory courses and science laboratories (Schussler et al., 2015). Graduate Teaching Assistants (GTAs) in the science department can impact student learning and retention in sciences (President's Council of Advisors on Science and Technology, 2012; Reeves et al., 2016) because they usually teach the lower division laboratory and recitation classes, which are often part of some gateway courses (Rushin et al., 1997; Seymour and Hewitt, 1997). Science GTAs have a potential advantage over traditional faculty when teaching undergraduate students because, oftentimes, GTAs have more interactions with undergraduate students than professors do (Rushin et al., 1997). Therefore, those GTAs could be a valuable asset in college science teaching to increase student retention in science.

Despite the potential high impact of GTAs on undergraduate student learning, there is significant variation in the length and types of GTA teaching professional development (TPD) provided by institutions of higher education (Reeves et al., 2016; Schussler et al., 2015) that GTAs receive during their professional training. Required participation in pre-semester TPD sessions for GTAs are common (Schussler et al., 2015). Still, those orientations tend to be singular events of short duration, which is often inadequate for GTAs to develop adequate teaching skills (Darling-Hammond &

Richardson, 2009). Despite the prevalent demand from GTAs for training in teaching techniques, learning theory, and lesson planning, oftentimes, those types of training are not offered (Schussler et al., 2015). GTAs often have to figure out how to be effective instructors for themselves. Furthermore, GTAs' teaching roles are often discouraged by their research mentors (Gardner and Jones, 2011; Nyquist et al., 1999).

Poor conditions related to teaching professional development can put international teaching assistants (ITAs) at an additional disadvantage. While facing many other challenges as international graduate students (Mori, 2000), they also have to deal with cultural and language barriers with students in teaching (Zhou, 2009).

Goals of the Literature Synthesis

According to the Institute of International Education (2019; Figure 2.1), a total of 377,943 international graduate students enrolled in U.S universities in 2019. The number of international graduate students has been increasing steadily since 2007/2008 term, only with a slight decrease from 2015/2016. International students comprise 21.2% of all first-year graduate students in the U.S in 2016 (Okahana & Zhou, 2017), which means for every five graduate students, approximately one is an international graduate student. The data (IIE, 2019; Figure 2.2) shows that the primary source of ITAs for American universities is Asian international graduate students, who are also the primary population for the ITA research. The significant cultural differences between Eastern and Western cultures pose many intercultural communication problems between ITAs and American students. This was initially referred to in scholarly literature as the “foreign TA problem”

(Bailey, 1983) and later revised to be called “ITA problem”. Undergraduate students have prevalent negative perceptions towards and resistance to ITAs serving as their instructors. Undergraduate student resistance is so prevalent it came to be known as the “Oh No! syndrome”, which was used to describe domestic students’ reactions when they find out that ITAs will be their instructors (Rao, 1995). From ITAs’ perspective, while all the GTAs, in general, need formal teaching professional development, as someone who grew up and was educated in a different culture, they need additional training in language, culture, and pedagogy in addition to TPD (Hoekje & Williams, 1992; Zhou, 2009).

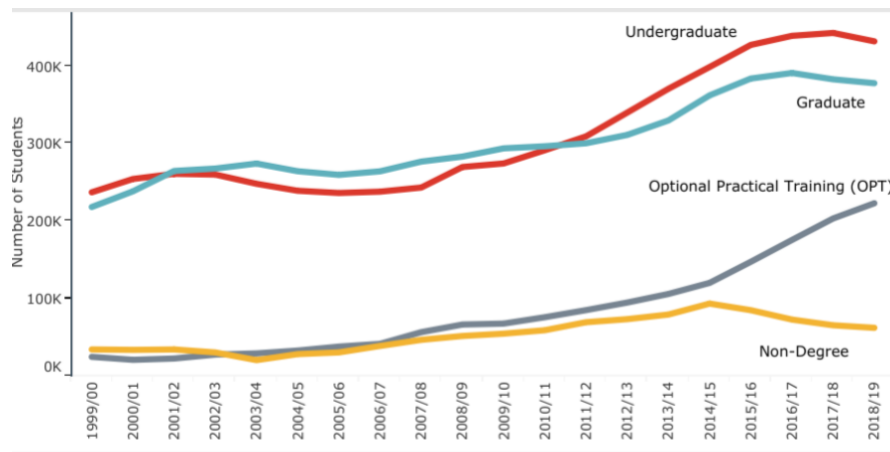


Figure 2. 1 The number of international students every year (IIE, 2019). All the numbers in Figures 2.1 & 2.2 are for international students. Optional practice training is for international students to temporarily work in the U.S. with an F-1 student visa.

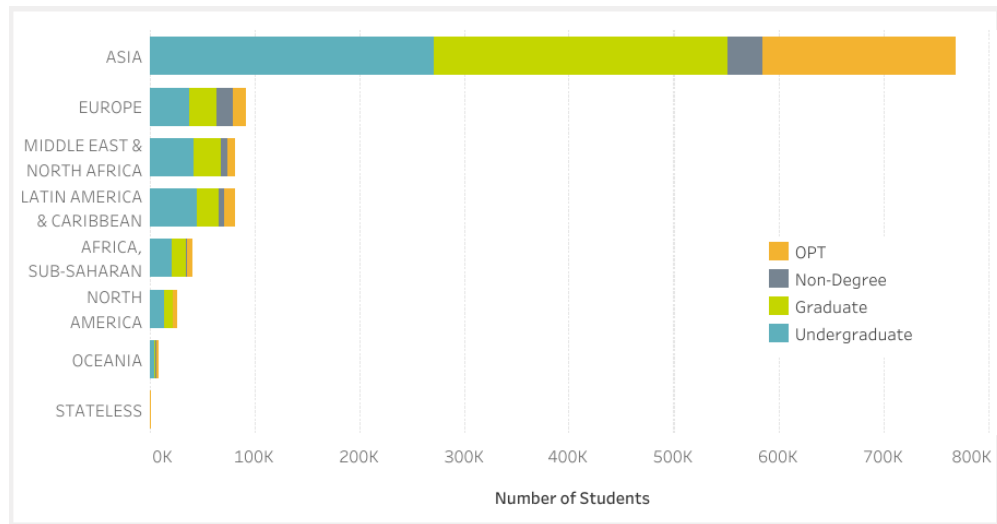


Figure 2. 2 The countries of origin of international students (IIE, 2019).

The goal of this particular literature synthesis is to examine the ITA problem through the lens of cultural competence. By examining how ITAs deal with cultural transitions related to their instructional roles in American Universities, we can better understand the challenges they are experiencing in teaching and the factors that impact their process of developing cultural competence in teaching students in the U.S. I hope this manuscript can provide insights into ITAs' teaching practices and inform GTA supervisors to design effective professional development activities and programs to address ITAs' specific needs.

Rationale

The majority of the manuscripts about ITAs have been published in journals of language, intercultural communication, international student, or education in general. Among all the manuscripts included in the present literature synthesis, only two articles were published in science education journals (Wheeler, Sturtevant & Mumba, 2019;

Walsh, Jia & Vernon, 2020). Therefore, the ITA literature may not be well-known to STEM educators, who need to know the information to better support ITAs in teaching many STEM classes. To draw more attention to ITAs, a population that has been largely neglected in STEM education, and to inform future research in this area, a literature review is needed to synthesize the findings from those studies that had been conducted recently. Therefore, the primary objectives of this study were to:

1. Identify and synthesize literature on ITA development of cultural competence for teaching.
2. Explore, adapt and develop the cultural competence framework in healthcare for ITAs, based on literature findings.
3. Provide implications for ITA TPD in terms of cultural competence for teaching.
4. Identify the gaps in the ITA TPD research literature and suggest future research directions for this field.

Methods

I conducted the literature search using the Educational Research Information Center (ERIC) and Scopus databases, with the search term “international teaching assistants”. This broad search aimed to capture all the literature regarding ITAs in a diversity of disciplines. The inclusion criteria below were used to reduce the initial sample.

Inclusion criteria

1. Studies published between January 2009 and July 2020 were included. I chose this particular selected period because there was an existing literature review

published in 2009 (Zhou, 2009) that related to ITA teaching professional development.

2. The studies had to be empirical, peer-reviewed, and must be related to ITAs' teaching experiences.
3. Only peer-reviewed journal articles were included. Dissertations and non-peer-reviewed publications were excluded, because only a portion of those manuscripts is empirical, and their quality is not consistent. In addition, dissertation were excluded to avoid redundancy of including both a dissertation and papers resulting from that dissertation.

Selection and Analysis Process

I conducted a comprehensive search using ERIC and Scopus databases for manuscripts related to ITAs' teaching experiences. I also wrote Annotated Bibliographies for all the studies that met the inclusion criteria, with the article title, publication year, publication name, methodological information, study context, and participants. I also summarized the findings from each study related to ITAs' teaching experiences. The original search returned a sample size of $n=393$ articles. First, all the articles that were duplicated from both ERIC and Scopus databases were removed, leaving $n = 106$ articles. Next, I removed all the articles that were not published in journals, including books, book chapters, and research reports leaving $n = 86$ articles. For each of the 28 articles, I wrote Annotated Bibliographies, with the article title, publication year, publication name, methodological information, study context, and participants. I also summarized the findings from each study related to ITAs' teaching experiences.

Analytical Framework

In order to better understand the literature related to the cultural challenges of ITAs in STEM classrooms, a cultural competency framework was selected.

Most previous research approached the ITA problem by focusing on only one of ITAs' three primary challenges in language, culture, and/or pedagogy (Hoekje & Williams, 1992; Zhou, 2009). It is difficult, however, to separate those three components in reality because they are so tightly intertwined. For example, research shows ITAs' cultural knowledge can impact their linguistic and pedagogical skills (Kim, 2009; Trentin, 2009). Therefore, cultural differences may be a factor that influences ITAs' challenges in language and pedagogy.

Suppose we conceptualize the ITAs' pedagogical context as people providing service to their students with different cultural backgrounds from them. In that case, the ITAs' situation is, in many ways, similar to healthcare providers who interact with patients with different cultural backgrounds daily. Cultural competence training is very common in healthcare field, and it is well studied to support doctors and nurses in providing patients with cultural-sensitive services (Tanner & Allen, 2007; Shen, 2015). Cultural competence in healthcare is defined “as *the ongoing process* in which the healthcare professional (HCP) continuously strives to achieve the ability and availability to work effectively within the cultural context of the patient (individual, family, community)” (Campinha-Bacote, 2007, p. 43).

Therefore, acquiring cultural competence can be defined as the ongoing process to achieve the ability to work effectively within other cultural groups' cultural contexts. Therefore, one way to assist ITAs in conquering those challenges related to instruction as

a whole is to utilize the theoretical lens of cultural competence to examine their instruction, perceiving language and pedagogy as cultural skills. A well-recognized cultural competence framework (Campinha-Bacote, 2007) was adopted in this study as an analytic framework to conceptualize ITAs' teaching-related experiences.

Most of the following definitions of the concepts in the cultural competence framework were adapted from Campinha-Bacote (2013), and applied to educational contexts.

Culture: The customary beliefs, social forms, and material traits of a racial, religious, or social group (Merriam-Webster, 2021).

Cultural awareness: This is the instructor's self-examination and in-depth exploration of one's biases, stereotypes, prejudices, and assumptions about students they teach who may differ from them.

Cultural knowledge: The process of an instructor seeking and obtaining a sound educational base about diverse cultural groups of students they teach and their level of information about diverse cultural groups.

Cultural skill: This refers to an instructor's ability to collect and interpret incoming cultural information about their students regarding their beliefs, values, and behaviors that are then leveraged for more effective instruction.

Cultural desire: This is the instructor's motivation of "wanting to", not "having to", engage in the process of becoming more culturally competent.

Cultural encounter: This is the continuous process of interacting with students from different cultural backgrounds to validate, refine, or modify existing values, beliefs,

and practices about a cultural group and to develop the other four components of cultural competence.

Cultural competence in education:

Put most simply, it (cultural competence) is the ability to successfully teach students who come from different cultures other than your own. It entails mastering certain personal and interpersonal *awareness* and sensitivities, learning specific bodies of *cultural knowledge* and mastering a set of *skills* that, taken together, underlie *effective cross-cultural teaching*” (Diller & Moule, 2005, cited in Tanner and Allen, 2007, p. 252).

As Campinha-Bacote (2013) pointed out, “The foundational construct and beginning point of the process of becoming culturally competent is cultural encounter” (p. 43). In the context of this literature review, the primary cultural encounter is the interactions between ITAs and students in the U.S. However, this study's cultural encounters also include the interactions between ITAs with other graduate students, GTA supervisors, faculty, and administrators.

I choose this specific cultural competence model as the analytic framework for this study for several reasons. First, the framework was well-recognized in the healthcare field, and it is well developed time, with the first version of the model proposed in 1991. It has been revised several times, with the latest version released in 2013. Second, a series of instruments to measure cultural competency based on the framework for which there is validity evidence have been developed recently (Shen, 2015). Finally, the framework was very consistent with the definition of cultural competence in educational settings, with four of the five components included: cultural awareness, cultural knowledge, cultural

skill, and cultural encounter. Cultural desire is the component that can add to the definition of cultural competence in education.

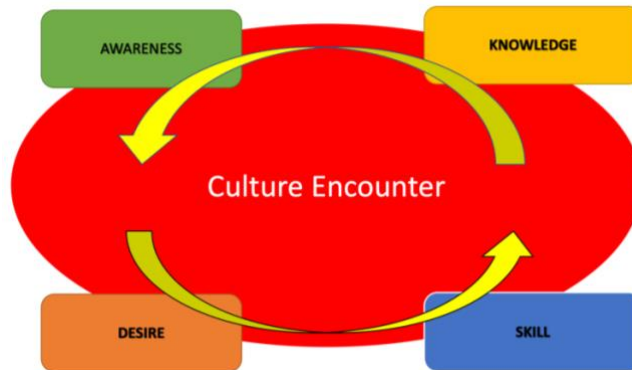


Figure 2. 3 Modified cultural competence framework based on Campinha-Bacote (2013).

Results

For this review, we have modified the healthcare cultural competence framework (Campinha-Bacote, 2013; Figure 2.3) and will use it as an analytic lens to frame the organization and content of this review. The five components from the cultural competence framework in healthcare (Figure 2.3) will be kept in the proposed framework for ITAs' development of cultural competence, with the cultural encounter between ITAs and students in the U.S. at the center (Figure 2.4). The review begins with a discussion the types of cultural encounters that ITAs experience while teaching (the center portion of the framework in Figure 2.4). Cultural encounters are experienced between ITAs and the students they teach. When different cultures are involved, these encounters often manifest as challenging interactions, and as such, this first section will review the literature on challenges ITAs, and students face when encountering one another in instructional settings. As cultural challenges are discussed, linkages between the

peripheral cultural competence aspects will also be brought to light (desire, awareness, skill, and knowledge). The review then used evidence from the literature to propose a dynamic and mechanistic cultural competence framework for ITA cultural competence development.

Phase 1: ITAs Experience Challenges in Teaching

ITAs experience multiple challenges in teaching students in the U.S. (This phase was represented by the number 1, including the two arrows between ITAs and students in Figure 2.4), because of their personal limitations in teaching students in the U.S., especially when teaching for the first semester (e.g., Arshavaskaya, 2015 & 2016). For purposes of organization, this paper categorized ITAs' challenges into three domains: Linguistic challenges, instructional challenges, cultural challenges (Table 2.1). *Linguistic challenges* are when ITAs experience difficulties interacting with students for lacking English proficiency (Zhou, 2009), which is a critical cultural skill with which ITAs often struggle. *Instructional challenges* are difficulties that ITAs experience due to lack of cultural skills related to teaching practices. *Cultural challenges* are when ITAs experience difficulties because they do not possess sufficient cultural knowledge and cultural awareness, and they lack cultural skills to deal with culture-related problems in the classroom.

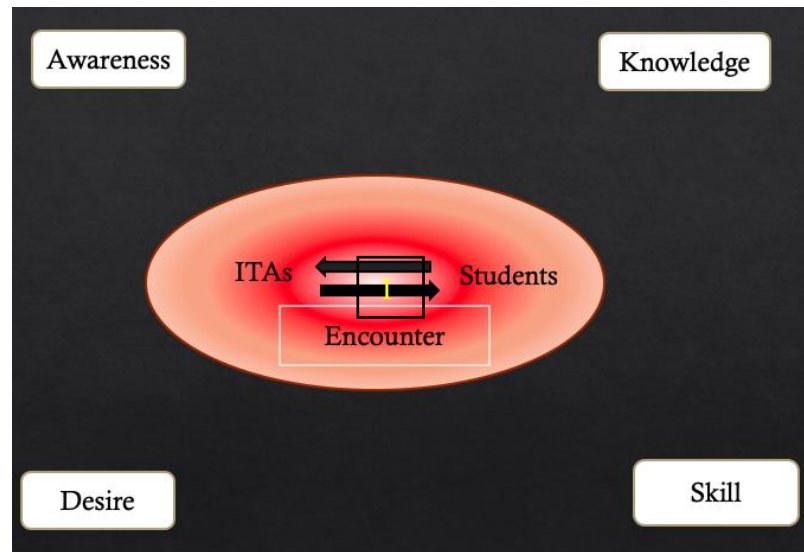


Figure 2. 4 ITAs experienced multiple challenges when teaching students in the U.S. The two arrows represent the interactions between ITAs and students, which is the major cultural encounter for the ITA problem. The number 1 represents phase 1 during which period ITAs experience challenges in Table 2.1.

Table 2. 1

ITAs' Challenges in Teaching

| Category | | Specific challenges | | | |
|--------------------------|---------------------------|----------------------|-------------------------|-----------------|---------|
| Linguistic challenges | Listening | Accent | Fluency | Humor | Jargon |
| Cultural challenges | Student Negative attitude | Physical contact | Power dynamics | Humor | Rapport |
| Instructional challenges | Student prior knowledge | Classroom management | Facilitating discussion | Teaching method | Grading |

Note. The table includes the common challenges when teaching students in the U.S. that were reported in the literature.

Linguistic challenges. Arshavskaya (2015) conducted interviews with six ITAs in computer science (4) and chemistry (2) from India (3), China (1), Russia (1), and Nepal (1) about their teaching experiences in the U.S. at the beginning, middle, and end of their first semester of teaching. Arshavskaya (2015) found that most of the ITAs struggled to understand students because “students speak fast, use short sentences, and informal language” (p. 61), among other linguistic challenges. In general, ITAs may have sufficient language training for standardized tests like TOEFL or IELTS. However, ITAs did not have enough practice for the everyday use of English because those tests focused only on academic English. Adebayo and Allen (2020) conducted interviews with 15 ITAs (3 Africans, 3 Middle-easterners, and 9 Asians) from multiple disciplines about their linguistic challenges in the classroom using the lens of cultural competence. They found that students have difficulty understanding ITAs because the students, who are mostly Americans, have “limited exposure to ‘foreign accents’” (p. 76).

Moreover, ITAs’ awareness of their accents can be a source of worry and increase in anxiety about students’ perceptions of them as effective instructors. According to Adebayo and Allen (2020), fluency is another challenge: even though many ITAs have a sound foundation of English grammar, they struggled to express their ideas by choosing words fluently and effectively, especially in semiformal and informal contexts. Additional challenges in the U.S. context include the fact that many ITAs were training in British English, and they have to overcome the differences between American English and British English.

One particular example of a language challenge is that ITAs often have difficulty understanding and producing humor in U.S. classrooms (Arshavskaya, 2016; Williams,

Case, & Reinhart, 2018). Williams et al. (2018) conducted interviews and observed the teaching videotapes of 20 ITAs (10 males and 10 females) from 13 disciplines and 14 countries. The ITAs had an average of three years of teaching experiences in U.S. colleges and had lived in America for five years on average. It was reported that ITAs felt isolated when they could not understand humor (Arshavaskaya, 2016). They felt that the use of humor was a cultural expectation in the U. S.: an expectation they struggled to meet (Williams et al., 2018).

Williams et al. (2018) further identified four sources of challenges for ITAs to produce humor: cultural, linguistic, social, and authoritative challenges. The use of humor is a cultural skill that ITAs may possess in their own culture. However, they struggle to use humor in U.S. culture. Humor, as a kind of cultural skill, is built on cultural knowledge and other cultural skills such as linguistic competence.

Cultural challenges. Arshavskaya (2015) reported ITAs' multiple sources of cultural challenges, such as students' negative perceptions of ITAs and lack of cultural knowledge about the physical contact rules between teachers and students. Adebayo and Allen (2020) also found that ITAs' cultural challenge in lack of sufficient knowledge of the U.S. higher educational system and U.S. classroom practices such as the boundaries between teachers and students, when to report students' inappropriate behaviors, their responsibilities to help students deal with social problems.

Chae, Lim & Fisher (2009) conducted semi-structured interviews with 14 mathematics ITAs from the department of mathematics and statistics about their past and current teaching experiences. They found that ITAs were expecting more respect from students, but they noticed that they did not possess the same authority level over their

students as American faculty or the teachers from their own country (Chae et al., 2009). Moreover, as mentioned in ITAs' linguistic challenge, ITAs felt that producing humor was a cultural expectation in the U.S. However, they struggled with it because they were not familiar with the U.S. pop culture (Williams et al., 2018).

Instructional challenges. Arshavskaya (2015) reported that ITAs were not satisfied with certain student behaviors that did not meet their expectations (e.g., students not being well prepared for the class; not cleaning up after a laboratory session; not paying attention to the lesson; not taking notes). ITAs found it painful to go through students' use of bad language and other disrespectful behaviors that could have a racist basis (Gomez, Khurshid, Freitag & Lachuk, 2011). Zhou (2014) conducted interviews and classroom observations with a female Chinese ITA from the anthropology department. The ITA was struggling to lead the discussion session because of her limited discussion-facilitation skills, which posed an interaction barrier between her and her students. Walsh, Jia, Vernon (2020) surveyed 1,065 undergraduate students and their 31 GTAs, 8 of whom are international graduate students. They found that those ITAs had difficulty grading the two writing assignments. The authors suggest that this is possible because ITAs need a longer time to grade a single paper than native GTAs when there is a limitation of hours that ITAs can work for every week.

The Other Side of the “ITA problem”: Students’ Negative Perceptions of ITAs.

Even though the ITA literature has focused on training ITAs to fix the “ITA problem”, there is abundant evidence showing that students’ negative perceptions, attitudes, and microaggressions *create problems and challenges for ITAs*. ITAs’ negative

experiences interacting with students in the U.S. include experiencing microaggression from students (Gomez et al., 2011) and experience of stigma (Zhu & Bresnahan, 2020).

ITAs' experience of microaggression. Gomez et al. (2011) explored the microaggression experiences of three ITAs from Chile, India, and South Korea from a highly ranked Elementary Education program, using life history methods.

“Microaggressions are subtle displays of racism that are more difficult to recognize or analyze than overt displays of racism (p. 1189)”. Through semi-structured interviews, the study revealed that those ITAs shared the experience that students in the U.S (primarily Americans) subtly challenged their teaching. Those students perceived ITAs, who are often from Asia, Africa, and South America, to be different from themselves in race, ethnicity, language, religious, and cultural backgrounds (Gomez et al., 2011). Those differences make some American students believe that ITAs could not understand their beliefs, experiences, and pedagogical choices. Therefore, those American pre-service teachers challenged ITAs' instructional choices with subtle techniques.

An ITA from Chile revealed that white prospective teachers invalidated his knowledge of U.S. schools, made racist comments on course evaluation forms, and complained to his faculty advisor rather than speaking to the instructor himself. The ITA from India found that her students avoided talking about social justice, equity, and differentiation of instruction with her because of her different ethnic and national background. The ITA from South Korea also felt students invalidated her professional knowledge in subtle ways.

The study did not interview those domestic students to explore their explanations for those behaviors, but data from the study demonstrated that those ITAs interpreted

those students' behaviors as microaggressions. After the ITAs failed to change students' microaggressions by making instructional changes, one of the ITAs felt that she was a total failure in her instruction. Ashavskaya (2015) also reported that some students used bad language with a racist undertone and were being disrespectful towards an ITA.

ITAs' experience of stigma. Zhu & Bresnahan (2020) conducted in-depth semi-structured interviews with 14 ITAs to study their stigma experiences. Most of those ITAs were from East Asia, major in social sciences, sciences, or engineering. "Stigma involves marking and marginalizing a particular group of people based on some feature of their identity, behavior, or experiences" (p. 16). This study adopted Link and Phelan's (2001) model of the stigma that labeling, stereotyping, separation, and losing status-suffering discrimination can result in ITAs' stigma experiences. The results revealed that "some ITAs experienced stigma from domestic students, their supervisors, their departments, and even themselves. Such stigma experiences result in English-proficiency determinism that overgeneralizes ITAs' expertise and learning-teaching experiences based on English proficiency levels alone" (p. 1).

When ITAs encounter microaggression and stigma experiences, their cultural desire was repressed; they are reluctant to seek more cultural encounters. When ITAs' efforts to make instructional changes failed because of a lack of support from students, some ITAs felt like total failures in relation to their teaching ability.

Phase 2: ITAs Codevelop Cultural Awareness and Cultural knowledge

ITAs experience the aforementioned challenges in cultural encounters with students in U.S classrooms (Arrow 1 in Figure 2.5). The literature suggests that in response to those challenges, reflection by ITAs can lead to co-development of cultural awareness and cultural knowledge about instruction (Arrow 2 in Figure 2.5) (e.g., Arshaskaya, 2015 & 2016; Chae et al., 2009; Kim, 2014). ITAs attempt to make sense of those challenges by reflecting on their own culture, their teaching practices and get to know more about the students in the U.S (cultural knowledge). As a result, they have increased their cultural awareness and knowledge of the differences between their own and the U.S. culture.

The ITAs developed their “awareness of cross-cultural differences and similarities” by actively participating in cultural encounters such as Halloween parties and Thanksgiving dinners (Arshavaskaya, 2016, p. 348). Some of those ITAs reported that they “experienced a significant gap between their initial expectations for students and the actual level of students’ mathematical competency” (Chae et al., 2009, p. 250). Those ITAs, however, gradually accumulated knowledge about the primary differences between their own mathematics learning experiences and those of their students in the U.S. Another common cultural awareness that ITA had gained through teaching was about the differences in power dynamics in ITAs’ home country and the U.S. They noticed that instructors and students have a more equal power relationship with students in the U.S. than those in the ITAs’ home country (Chae et al., 2009; Dimitrov, Dowson, Olsen & Meadows, 2014).

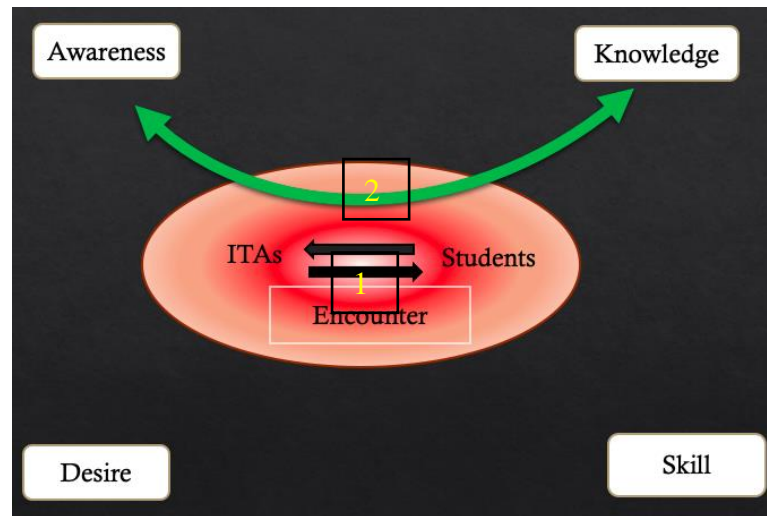


Figure 2. 5 ITAs codevelop cultural awareness and cultural knowledge through teaching.

Phase 3: Experiencing Pedagogical Challenges: ITAs Struggle to Make Culturally Competent Instructional Changes Without Formal TPD Training

In response to the co-development of cultural awareness and cultural knowledge, ITAs may develop the cultural desire (Arshavaskaya, 2015 & 2018; Zhang, 2019; Arrow 3 in Figure 2.6) to make instructional changes in their classroom practice (Figure 2.6) (Arshavaskaya, 2015 & 2016; Chae et al., 2009). ITAs, however, could not transfer their cultural awareness and knowledge into cultural skills (Arrow 4 in Figure 2.6), and many of them expressed that they are struggling with making instructional changes, and those changes are often not culturally competent without external support (e.g., Chae et al., 2009; Zhou, 2014; Li, Mazer & Ju, 2011; Gomez et al., 2011). In this case, a cultural desire to be a more culturally competent instructor was limited by their ability to access support and teaching professional development to develop cultural skills (Arrow 5 in Figure 2.6).

Some ITAs attempted to modify their traditional, teacher-centered instructional methods into a more student-friendly way. Without the support of TPD, however, those instructional changes were based on their personal learning and teaching experiences, and “their instructional modification remained within the boundary of traditional ways of teaching mathematics-presenting themselves as an ‘arbiter of the true’” (Chae et al., 2009, p. 252). Arshavaskaya (2015) found that ITAs developed strategies to overcome the challenges. However, “some of their instructional decisions seem arguable (e.g., being lenient in grading). Therefore, developing and implementing the mechanism of ongoing support and assistance (e.g., mentoring by more expert peers or professors) from the ITAs’ respective departments is necessary” (p. 61). What this implies is that skills in culturally competent instruction are difficult to obtain in informal ways.

Likewise, an ITA resorted to adopting disengaging strategies to overcome anxiety when interacting with students (Zhou, 2014). Even worse, another ITA tried to resolve the language inadequacy problem by engaging in a dialogue with students. However, the results indicate that her efforts negatively affect student perceptions of her classroom clarity (Li et al., 2011). Without formal pedagogical training such as participating in a teaching professional development, ITAs often struggled to craft some specific cultural skills that related to teaching practices, such as rapport management (Zhang, 2019), use of humor (Williams et al., 2018), grading writing assignments (Walsh et al., 2020). Those cultural skills are built on cultural knowledge (Williams et al., 2018; Dimitrov et al., 2014), but it usually takes a long time to implement the knowledge into practical skill beyond just being passively aware of it without formal training and ongoing support (Arshavaskaya, 2015). Unlike cultural awareness, knowledge, and desire (Green arrows 2

& 3 in Figure 2.6), ITAs often could not develop cultural skills sufficiently through teaching without TPD support (Red arrows 4 & 5 in Figure 6).

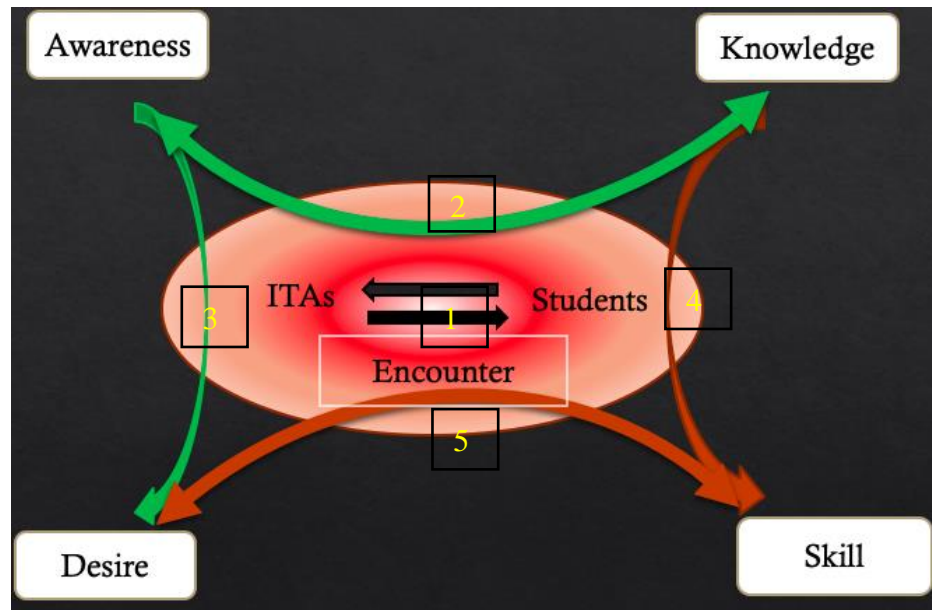


Figure 2. 6 ITAs are struggling to make culturally competent instructional changes without TPD. Green arrows represent processes that ITA can often accomplish only through teaching experiences. Red arrows represent that in phase 3, ITAs cannot develop cultural skills effectively without TPD support.

Phase 4: ITAs Make Culturally Competent Instructional Changes with TPD

Training

As argued in the previous section, facilitating culturally competent ITAs requires they develop a skillset. This skillset for instruction is difficult to develop informally and is likely best supported by formal TPD programs. In other words, the best way to promote the development of culturally competent instructional skills in ITAs might be to harness their cultural desire as well as their informally gathered knowledge during formal

TPD (Green arrows in Figure 2.7). There are two types of TPD to help ITAs improve cultural competence by overcoming personal limitations discussed in the literature: TPD with components of cultural competence and those without. As will be discussed below, however, no significant differences in ITA or student outcomes were found between those two types of TPD, which will be discussed independently below. Future research can explore the different impacts of those two types of TPDs to help design TPDs for ITAs. I will discuss the types of TPD intervention and relevant outcomes for those TPDs that ITAs have participated in in the empirical literature selected for this review.

TPD Not Explicitly Addressing Cultural Competence

Noticing during a videotaped classroom observation. Williams and Case (2015) conducted interviews with 20 ITAs from 13 different fields and 14 nationalities with an average of three years of teaching experience before and after each of the participants' one entire class period. The results showed that the observation provided ITAs the opportunity to observe their teaching in the context of the cultural norms of universities in the U.S. and to explain their pedagogical choices to the interviewer. This observation experience promoted noticing in their teacher development and evaluating their teaching, which served as an *impetus* to make instructional changes (culture desire) (Williams & Case, 2015). Furthermore, ITAs were able to get *cultural clarification* of the events in teaching from the interviewer; ITAs became *aware* of their lack of *cultural knowledge* to understand some cultural inference instantly (cultural awareness and cultural knowledge).

After watching their classroom videos with the researcher, those ITAs were ready to make instructional changes based on their observation and the feedback from the

researcher. The study did not report what instructional changes they made or how effective they were. With the researcher's support and the noticing activity, however, the ITAs did make instructional changes based on observation of their teaching and advice from an expert, rather than merely personal experiences.

One-on-one mentoring. Two doctoral students from China and Jordan in engineering education met one-on-one with the mentor before and after teaching each of the three lessons with their teaching videotapes (Arshavskaya, 2018). In the meantime, both ITAs also actively sought feedback from their advisors and students to improve teaching. The results indicated that both ITAs became *aware* of their personal limitations (e.g., talking too fast). They had developed effective strategies (*cultural skills*); therefore, they achieved a greater student engagement level by the end of the semester. ITAs in the focus group expressed their (*cultural*) *desire* to participate in TPD activities. However, the institutional constraints seemed to repress ITAs' willingness to participate in TPD, as some ITAs were assigned to grade student work rather than teaching, and some did not even get teaching assistantships at all (Arshavskaya, 2018).

Taking a Teaching Methods course. In Wheeler et al. (2019), ITAs taught project-based guided inquiry (PBGI) chemistry laboratory and took a semester-long Teaching Method course with all department TAs. The results showed that students perceived ITAs who took the Teaching Methods course more positively in terms of instructional practices and learning outcomes than ITAs who did not. Specifically, students perceived ITAs who took the Teaching Methods course to be significantly more supportive, interactive, and effective, with an increased understanding of their role as facilitators of student learning.

The study revealed that the Teaching Methods course and teaching experience improved ITAs' confidence in teaching PBGI laboratories and creating a supportive learning environment for students. This study reported student evaluations of ITAs' instructions, but they did not measure ITAs' teaching practices. Therefore, no claims can be made regarding ITAs' development of cultural knowledge, cultural awareness, and cultural desire. The students' positive evaluations, however, were strong evidence that those ITAs who took the teaching method course had become more culturally competent instructors.

TPDs explicitly addressing cultural competence

This study found three manuscripts analyzing how ITAs develop cultural competence with TPD support that explicitly addressed cultural competence. These studies were all conducted in Canada (Dimitrov et al., 2014; Meadows, Olsen, Dimitrov & Dowson, 2015; LeGros & Faez, 2012.). Dimitrov et al. (2014) and Meadows et al. (2015) researched the same TPDs, and their manuscripts were published in the same journal. Therefore, I will discuss them together.

Dimitrov et al. (2014) conducted focus group interviews with 20 international graduate students (from Iran, China, Pakistan, and Latin American and Eastern European cultures) and 4 Canadian graduate students. The aim was to study the opportunities that two GTA teaching professional development programs have provided for ITAs' development of cultural competence. All ITAs participated in both Teaching Assistant Training Program (TATP) and the Teaching in the Canadian Classroom program (TCC). TATP was designed for all GTAs, to introduce graduate students to teach at the university level; TATP included an intercultural training session with a two-hour video

case study about teaching in an intercultural classroom. TCC was a workshop designed specifically for ITAs, focusing on discussing cultural differences in terms of “communication styles, feedback styles, expectations for teachers and students behavior” (Dimitrov et al., 2014, p. 92).

The Results showed that both ITAs and Canadian GTAs increased cultural awareness about their own cultural identity and cultural assumptions. ITAs had learned to expect cultural differences in new situations and “with-held judgment until they understood the intentions of those with whom they were interacting” (p. 93). Moreover, the ITAs showed the “ability to reflect on intercultural interactions with their students and choose *culturally appropriate* communication strategies during challenging interpersonal situations” (p. 93). They also transferred cultural competence with students to the interactions with faculty, peers, and staff, which was not found among ITAs who participated in TPD that did not address cultural competence explicitly (Williams & Case, 2015; Arshavskaya, 2018; Wheeler et al., 2019).

Within the same context of TATP and TCC programs, Meadows et al. (2015) conducted a survey study using the Teaching Assistant Self-Efficacy Scale, analyzed two 10-minute microteaching segments using Teacher Behavior Inventory, and conducted interviews of six focus groups. The study aimed to explore how TA training programs impact ITAs’ and Canadian TAs’ teaching self-efficacy and effectiveness in two TA training programs: TATP and TCC. The participants were n=64 ITAs and n=85 Canadian TAs who participated in TATP, while n=55 ITAs participated in TCC.

The results showed that participants' self-efficacy from both programs increased, with no significant differences between ITAs and Canadian GTAs. A substantial increase

in observed teaching effectiveness among ITAs in both TCC and TATP was found, but not among Canadian TAs. All TAs' effectiveness in their interactions has increased during their teaching: they also improved in teaching organization, from pre- to post-program. Data from the focus group supported the hypothesis that TAs' teaching self-efficacy from both groups would increase. Furthermore, all TAs showed a shift towards student-centered learning. However, "TCC participants showed a greater ability to engage in critical, student-centered reflection related to their teaching practices and to adapt their teaching approaches to new situations" (p. 45).

Intercultural communication course. LeGros et al. (2012) conducted a study to measure the outcomes of ITAs' participation in an intercultural communication course: Communication in the Canadian Classroom (CCC). CCC was aimed to support ITAs to become familiar with the expectations of Canadian students and academia. "The CCC course introduces students to the field of intercultural communication, strategies for overcoming culture shock, cultural differences in classroom norms, and the language of teaching" (p. 15). CCC also included a microteaching component when ITAs taught their classmates and observed their teaching behaviors by watching teaching recordings.

The results show that ITAs "developed interculturally competent teaching behaviors and improved their overall teaching performances" (p. 7) after participating in a course on intercultural communication. The most significant improvements include being generally effective as an instructor, providing positive feedback to student questions and comments, and using everyday examples to explain concepts and principles. The results also showed that ITAs "overrated their teaching performance at the beginning of the course but underrated it at the end" (p. 20), suggesting ITAs "had

become more aware of and critical of their teaching behaviors” (p. 20) in the Canadian educational, cultural context. Besides improving student learning, ITAs’ cultural competence development also impacted their career aspirations: One ITA won a Teaching Assistant award; Another won an award for the best research presentation in the program.

Table 2. 2

Components of Cultural Competence Impacted by TPD

| Intervention | Awareness | Knowledge | Desire | Skill | Encounter |
|------------------------------------|--------------|--------------|--------------|-------|-----------|
| Noticing | X | X | X | X | X |
| Mentoring | X | X | X | X | X |
| Teaching method course | X | X | X | X | X |
| Intercultural communication course | Not reported | Not reported | Not reported | X | X |
| ITA program | X | X | X | X | X |

Note. The table reported the components of cultural competence that were impacted and reported by each study that provided ITAs with TPD support. X means that that component was reported to be impacted by the TPD

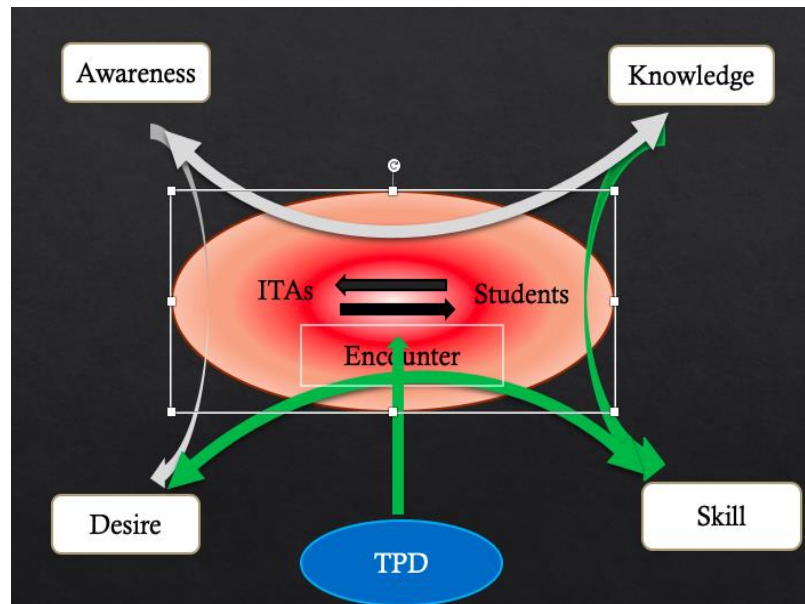


Figure 2. 7 ITAs can make culturally competent instructional changes with TPD.

The previous section discussed how formal TPD might be able to provide ITAs with the knowledge and skills to promote effective interactions with their students in classroom contexts. Researchers, however, have also explored ways to change undergraduate students' negative perceptions of ITAs. The results show that the interventions in those studies were effective, and the following section discusses interventions for developing cultural competence in students towards their international instructors.

Interventions to change students' negative perceptions of ITAs

Intercultural interventions can effectively change students' negative perceptions of and attitudes towards ITAs (Figure 2.8). There are two types of interventions: perspective-taking (Manohar & Appiah, 2016) and structured contact: including one-hour

structured contact (Kang, Rubin & Lindemann, 2015), and one-semester-long structured contact program (Staples, Kang & Wittner, 2014).

According to Galinsky, Ku, and Wang (2005), perspective-taking is “the process of imagining the world from another’s vantage point or imagining oneself in another’s shoes” (p. 110). There are two types of perspective-taking: self-focused and target-focused (Batson, Early & Salvarani, 1997). Self-focused perspective-taking is when participants imagine their feelings if they were in the other person’s situation. In contrast, target-focused perspective-taking happens when participants try to imagine the other person’s feelings in that person’s situation.

For structured contact, two frameworks were adopted for each of the two ITA articles' interventions to help set up conditions for effective cultural encounters for people from different cultural backgrounds. In Kang et al. (2015), the “structured intergroup contact” framework was used to design structure contact activity. “In general, efficacious intergroup contact must provide for (1) equal status between the groups in the situation, (2) common goals, (3) cooperation but no competition between the groups, (4) authority sanction for the contact”, and “contact which (5) allows participants to personalize outgroup members, to attain some intimacy with them, is especially potent” (p.687). Staples et al. (2014) adopted another similar framework to design an intercultural contact program, with seven ideal conditions for successful encounters between groups (1) Equal status of group members; (2) negotiated decision making; (3) common goals (4) collaboration; (5) ample time for the interaction and lack confounding stress (6) potential for developing interpersonal relationships; (7) institutional support (Rubin and Lannutti, 2001).

The results from those intervention studies show that students' perceptions of ITAs are subjective and arbitrary, and they often do not match ITAs' abilities in reality. For instance, there is evidence that biology ITAs do not negatively affect student retention (Walsh et al., 2020). Students can and should take their share of responsibility by improving their attitudes towards ITAs and supporting ITAs.

Perspective-taking intervention. Manohar and Appiah (2016) conducted a post-test only, between-groups experiment where 143 undergraduate students were randomly assigned to two kinds of interventions: self-focused and target-focused. Then they were randomly assigned to watch one of three ITAs teaching videos and completed a questionnaire about their willingness to support ITAs. The results showed that students in the target-focused perspective-taking group were more willing to support ITAs than those in the self-focused perspective-taking group (Manohar & Appiah, 2016). However, perspective-taking interventions were not effective for students who had higher levels of national identity. Furthermore, students with higher negative attitudes toward ITAs prior to the study were less willing to support ITAs. Therefore, to some degree, these perspective-taking interventions can change students' perceptions, but with some limitations.

One-hour structure contact activity. Kang et al. (2015) asked 68 English-speaking undergraduates to evaluate ITAs' audio-recording speech samples with instruments (Background questionnaire, comprehensibility scale, English proficiency rating scale, instructional competence scale, and accent standardness ratings) before and after the intergroup contact intervention. The intervention was to engage undergraduate students in puzzle-solving activities with ITAs in the experimental group. The results

showed that the contact intervention could improve undergraduates' perceptions of ITAs' instructional competence. The contact group's undergraduate students found the ITAs easier to understand at post-test, but no such change was found in the noncontact group. The interviews with the undergraduate students revealed that the intercultural intervention promoted "a more mindful and less prejudiced mindset among at least some of the participants" (Kang et al., 2015, p. 695). This study provided strong evidence for the outcomes of cultural encounters that even a short, one-time, low-stakes intercultural contact experience can affect undergraduates' perceptions of ITAs (Kang et al., 2015), which promote students' cultural awareness and knowledge. This is similar to ITAs' experiences to develop cultural awareness and knowledge just through interactions with students.

Intercultural Contact Program. Staples et al.'s (2014) tested 94 undergraduate students' perceptions of ITAs accent, comprehensibility, and teaching quality before and after a contact program. The contact program met once a week for eight weeks for one hour each time. The program was designed based on Rubin and Lanutti's (2001) principles for intergroup contact. The results indicated that domestic U.S. undergraduates who interacted with international partners rated ITAs significantly higher on accent measure, comprehensibility measure, and teaching ability measure. That means that undergraduates found ITAs less accented, more comprehensible, and more competent at teaching after the intercultural interactions (Staples et al., 2014).

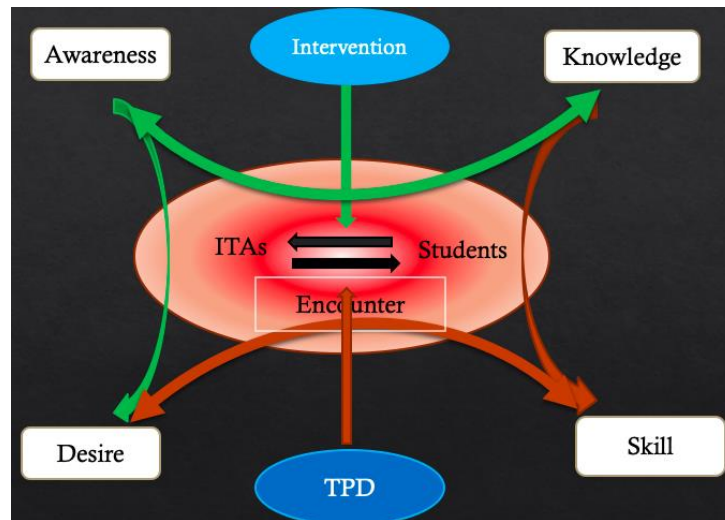


Figure 2. 8 Interventions can change students' negative perceptions of ITAs. The intervention can help students to develop cultural awareness and knowledge through cultural encounters.

Discussion and Conclusion

Both ITAs and undergraduate students should play pivotal roles and share the responsibility of creating a culturally inclusive classroom environment. To achieve this, they both need training from TPD or intercultural interventions (Manohar & Appiah, 2016; Kang et al., 2015; Staples et al., 2014). Moreover, ITA and students have different responsibilities in the classroom related to inclusivity and cultural competence because of their different roles. ITAs should focus on improving cultural skills (especially linguistic and pedagogical competence) with systematic support from faculty and peers in the form of formal teaching professional development (Dimitrov et al., 2014).

However, ITAs also need students' support to become culturally competent instructors because students' negative attitudes can discourage ITAs' motivation to engage in cultural encounters to craft cultural skills (Gomez et al., 2011). Students can

improve their cultural awareness and cultural knowledge through specific cultural encounters (e.g., structured contact program; buddy program; cultural encounters in informal settings) so that they can change their negative attitude towards ITAs; otherwise, their negative attitude itself impose ITAs as a challenge (Arshavaskaya, 2015; Kang et al., 2015; Staples et al., 2014). Students may not be expected to be trained to develop cultural skills. However, they should be provided with the opportunities to interact with ITAs in structure-contacts that can serve as a venue to improve their perceptions of ITAs (Kang et al., 2015; Staples et al., 2014).

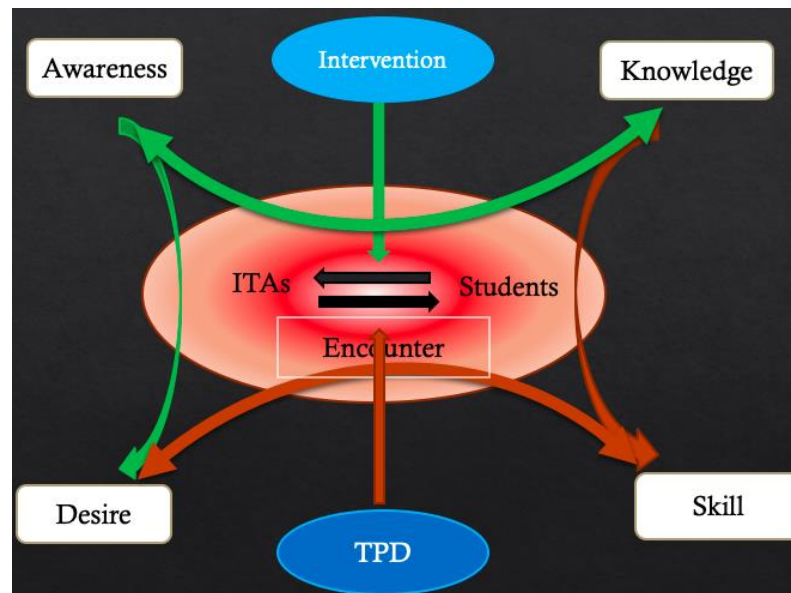


Figure 2. 9 Proposed Framework for cultural competence in teaching

Summary of Major Points of the Proposed Framework

Figure 2.9 shows cultural encounters between ITAs and students are at the center of cultural competence development. Thus, both share responsibility for creating a culturally inclusive learning and teaching environment. As for ITAs, they first encounter challenges in the classroom (Phase 1; Figure 2.10), and then their cultural awareness and

cultural knowledge codevelop through teaching (and they develop the cultural desire to make instructional changes to overcome those challenges (Phase 2). Phase 1 and 2 were represented in green arrows in the framework (Figure 2.9) because ITAs can accomplish the development of cultural knowledge, awareness, and desire through teaching experiences. However, without proper TPD and systematic support, those instructional changes are often not effective in dealing with their teaching challenges (Phase 3). Teaching professional development, especially those which address cultural competence explicitly, can support ITAs to transform their cultural desire into cultural skills, making culturally competent and effective instructional changes (Phase 4). Phase 3 and 4 were represented in red in the framework (Figure 9) because those two phases are when ITAs need support in teaching to develop cultural skills efficiently. Cultural knowledge and cultural desire are foundations for developing cultural skills, with cultural knowledge as the knowledge base and cultural desire as the driving force.

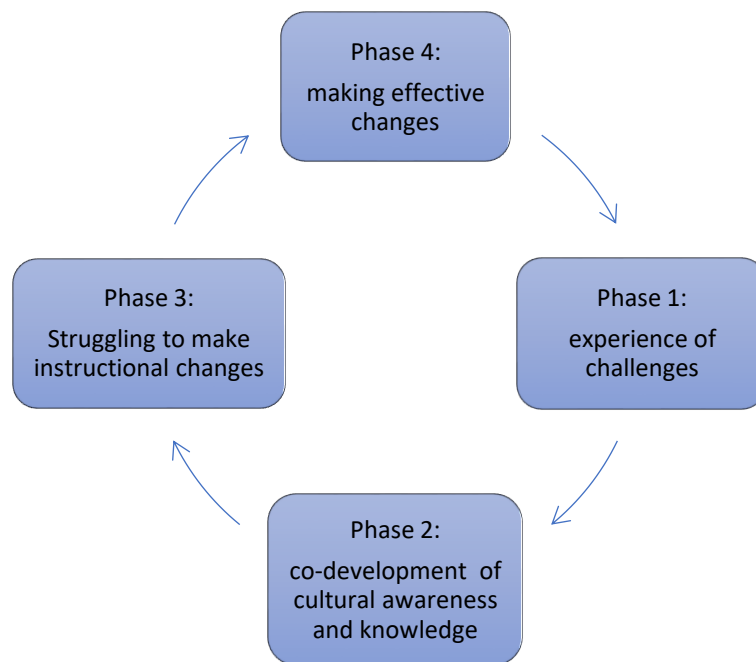


Figure 2. 10 The four phases that ITAs go through to develop cultural competence

However, lack of cultural skills and students' negative attitudes can suppress ITAs' cultural desire. Students without intercultural interventions may have negative perceptions of and attitudes toward ITAs, leading to behaviors that ITAs perceive as microaggressions. Therefore, students are creating challenges and problems for ITAs. However, students' negative perceptions and attitudes can be changed by participating in intercultural activities, in which they can develop the cultural awareness, knowledge, and desire to support ITAs.

Above all, cultural encounters in the classroom, cross-cultural teaching is at the center of the cultural competence development framework. Participating in teaching professional development and intercultural activities are the two kinds of cultural encounters that ITAs and students need most, respectively, to develop their cultural competence at phase 2 for ITAs and phase 1 for students.

Future research directions

First, the ITA literature has been primarily focused on training ITAs to overcome their personal limitations. Based on this literature synthesis, however, students also play a critical role in the "ITA problem" (Gomez et al., 2011). Therefore, more research should explore the activities that can change students' perceptions of ITAs and other minority groups. More empirical studies are needed to explore how to incorporate those activities into classroom settings based on the frameworks adopted in structure contact programs (Meadows et al., 2015; Staples et al., 2014).

Second, the majority of the manuscripts were published in the journals related to communications, linguistic, international students, etc., with only two articles published in STEM education journals; thus, more discipline-based educational research should be conducted in the future, as the research shows that ITAs experienced specific challenges related to their disciplines (Chae et al., 2009; Chiang, 2009). Third, all three studies that report the outcomes of ITA TPD programs addressing cultural competence explicitly were conducted in Canada (LeGros et al., 2012; Dimitrov et al., 2014; Meadows et al., 2015). More research on this type of ITA TPD should be conducted in the U.S. and measure the differences in ITA outcomes between TPD with and without cultural competence components. Finally, more empirical studies are needed to provide evidence to support or revise the proposed framework of ITAs' development of cultural competence in this literature synthesis.

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CHAPTER THREE: EXPLORING THE SOURCES OF TEACHING SELF-EFFICACY FOR INTERNATIONAL GRADUATE STUDENTS IN SCIENCE: A MIXED METHODS STUDY

Introduction

Graduate students are critical for effective college science teaching. This is especially true in introductory courses and science laboratories because they disproportionately teach the gateway courses, especially at larger universities (Schussler et al., 2015). In addition, Graduate Teaching Assistants (GTAs) can impact student learning and retention in science (Reeves et al., 2016; President's Council of Advisors on Science and Technology, 2012). There is significant variation, however, in the length and types of GTA teaching professional development (TPD) (Reeves et al., 2016; Schussler et al., 2015) that graduate students receive during their professional training to provide them with the tools to impact student learning and retention in a positive way.

Pre-semester TPDs have been widely mandatory for GTAs (Schussler, Read, Marbach-Ad, Kristen & Ferzli, 2015). Unfortunately, those pre-semester orientations rarely incorporate pedagogical theory and are difficult for new GTAs to apply because they have not yet started teaching the course (Schussler et al., 2015). Sometimes GTAs have weekly meetings during the semester they are teaching, but the quality of training in teaching is often poor (Garet et al., 2001; Desimone et al., 2002). Despite the prevalent demand from GTAs for training in teaching techniques, learning theory, and lesson planning, oftentimes, those types of training are not offered in a significant amount (Schussler et al., 2015), and sometimes there is no training offered at all. Furthermore,

GTAs' teaching roles are often discouraged in their work as researchers (Nyquist et al., 1999; Gardner and Jones, 2011). Some faculty perceived the relationship between research and teaching as antagonistic (Reid & Gardner, 2020), as teaching and research sometimes are competing for more time investment from faculty and graduate students (Gottlieb & Keith, 1997).

The insufficiency of quality TPD for GTAs and discouragement from their professors can significantly impact GTAs' teaching self-efficacy, as GTA PD and department teaching climate (including peer and supervisor teaching relationship) can be the sources of STEM GTAs' teaching self-efficacy (DeChenne et al., 2015). GTAs' TPD experiences were found to be positively correlated with their teaching self-efficacy (Prieto & Altmaier, 1994), and ongoing support, especially in the form of mentoring, is critical for GTAs to regain self-efficacy in their later stage of teaching (Chiu & Corrigan, 2019).

International teaching assistants (ITAs) are a subgroup of GTAs who are non-native graduate students relying on teaching assistantships as funding to complete their degree and pay for living expenses in the U.S. (LaRocco, 2011). For international graduate students, teaching responsibilities can be more time-consuming (Walsh et al., 2021), and they often experience stress and anxiety interacting with students due to language barriers (Mori, 2000; Zhou, 2014). International teaching assistants have to deal with cultural and language barriers with students in teaching without sufficient support for teaching (Zhou, 2009), while facing many other challenges as international graduate students (Mori, 2000). Therefore, due to compounded challenges for ITAs', their

development of teaching self-efficacy can be an even more unique challenge. It is critical to explore the specific sources of teaching self-efficacy for ITAs to inform GTA TPDs.

International graduate students have been a large group in U.S. higher education. The Institute of International Education (IIE) reported (2019; Figure 3.1) that a total of 377,943 international graduate students in U.S universities in 2019. For every five graduate students, approximately one is an international graduate student, as they comprise 21.2% of all first-year graduate students in the U.S in 2016 (Okahana & Zhou, 2017).

According to IIE (2019; Figure 3.2), the primary source of ITAs is Asian international graduate students. The significant linguistic and cultural differences between students from Eastern and Western countries lead to many intercultural communication problems in ITAs' classroom in the U.S. Those communication problems between ITAs and their students in the U.S. were referred to as the "foreign TA problem" (Bailey, 1983) and later rephrased as the "ITA problem". Many undergraduate students have profound negative perceptions and resistance against ITAs (Finder, 2005). The "Oh No! syndrome" was used to describe domestic students' resistant reactions when they find out that ITAs will be their instructors (Rao, 1995). From ITAs' perspective, while all the GTAs, in general, need formal teaching professional development, as someone who grew up and was educated in a different culture, they need additional training in the intersection of language, culture, and pedagogy (Hoekje & Williams, 1992; Zhou, 2009). One indicator for effective PD training is that GTAs have increased their teaching self-efficacy after participating in those professional development activities (Smith & Delgado, 2021).

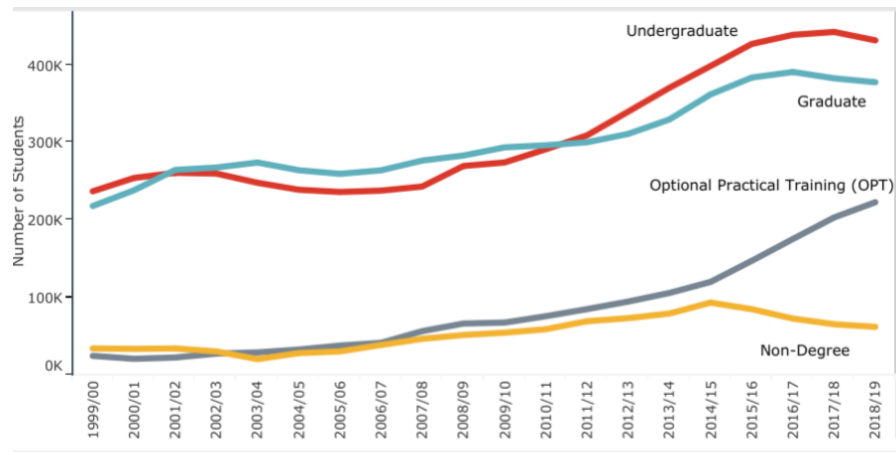


Figure 3. 1 The number of new enrollments of international students every year (IIE, 2019).

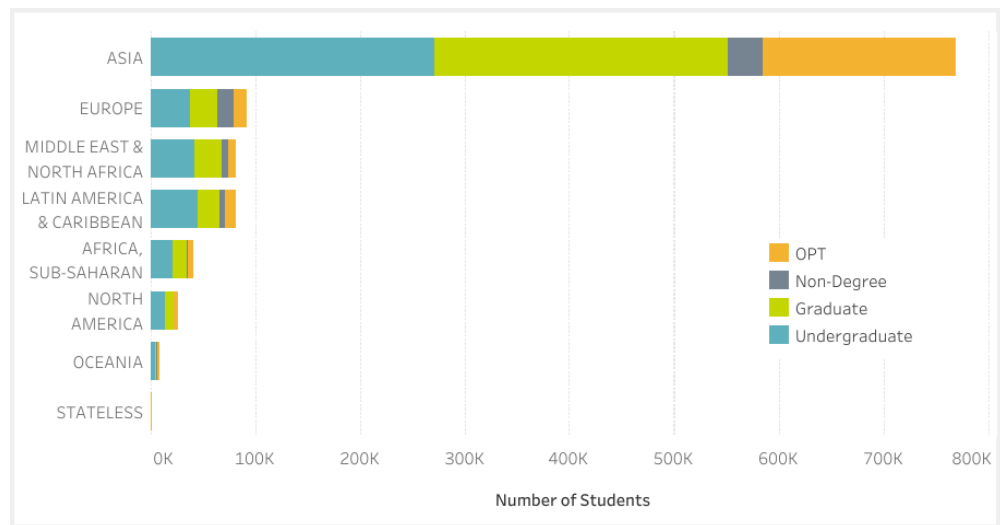


Figure 3. 2 The countries of origin of international students.

Teaching self-efficacy can influence teachers' motivation, performance, and student outcomes (Morris, Usher, and Chen, 2017). Therefore, gathering information on ITAs' self-efficacy and the factors that could influence their self-efficacy can inform how to provide systemic support for ITAs in overcoming their challenges in cross-cultural teaching, such as linguistic and cultural barriers, students' negative perceptions, and microaggression experiences (Zhou, 2009; Gomez et al., 2011). Many ITAs are not

confident in their ability to teach effectively in U.S. classrooms, especially when teaching for the first time (Arshavskaya, 2016). ITAs' level of teaching self-efficacy can increase significantly, however, with more teaching-related experiences in the U.S. (Kim, 2009; Smith & Delgado, 2021). Therefore, it would be meaningful and insightful to explore what factors that contribute to this improvement of self-efficacy and what factors could delay the progress of this development in ITAs.

Literature Review of GTA Teaching Self-Efficacy

Bandura (1997) defined self-efficacy as “beliefs in one’s capability to organize and execute the courses of action required to produce given attainments” (p. 3). Teachers’ self-efficacy beliefs are defined as “the beliefs teachers hold about their capability to carry out their professional task” (Morris et al., 2017, p. 796). Teaching self-efficacy was defined as a domain-specific construct that describes how teachers perceive their ability to achieve particular teaching objectives by organizing and executing necessary courses of action in a particular context (DeChenne, Enochs & Needham, 2012).

Based on previous research on GTAs’ teaching self-efficacy, prior teaching experiences and participation in PD were two primary categories of sources of teaching self-efficacy for GTAs. For example, Prieto & Altmaier (1994) conducted a survey study among 112 GTAs from various departments, and they found significant positive relationships between prior training and previous teaching experience with higher levels of teaching self-efficacy. For STEM GTAs specifically, Connolly, Lee & Savoy (2018) found a positive relationship between participation in Teaching Development (TD) and teaching self-efficacy among doctoral students in STEM departments in a survey study of 1445 participants.

DeChenne et al. (2015) explored the sources of teaching self-efficacy for STEM GTAs by surveying 128 GTAs from nine STEM departments at a research university. They found that K-12 teaching experience, hours and perceived quality of GTA PD, and perception of the department facilitating environment were significant predictors of STEM GTAs' teaching self-efficacy. STEM ITAs were part of the sample, with 33% in the college of science and 50% in the college of engineering, but no results were reported regarding how this subgroup differed from the other disciplines. Recently, Smith and Delgalo (2021) measured the teaching self-efficacy of 104 STEM GTAs with the same instrument used in DeChenne et al. (2015). They found GTAs with high teaching self-efficacy rely on mastery experiences, vicarious experiences, and verbal and social persuasions from reliable sources (e.g., professors and peers) as sources of teaching self-efficacy; GTAs with low teaching self-efficacy “draw from student feedback associated with their experiences in class and vicarious experience and mastery experiences pertaining to self-oriented teaching skills such as class management, grading, and public speaking” (p.7).

Furthermore, GTAs' development of teaching self-efficacy can be an iterative process. Chiu & Corrigan (2019) conducted a quasi-experimental study with a follow-up cross-sectional study to explore whether GTAs' perceived self-efficacy towards teaching change in their first three years as GTA. They found that GTAs gained self-efficacy through training, but self-efficacy decreased in their second year in graduate school, and they regained self-efficacy in their third year of teaching. The authors suggested that a formal mentoring scheme should be provided for GTAs as continuous support for GTAs'

self-efficacy to reduce the tendency for it to increase and decrease across a GTA's teaching career.

There is little research that measures ITAs' teaching self-efficacy in STEM. Through a systemic literature review on the topic of ITA, I only found one study that measures the ITAs' teaching self-efficacy (Kim, 2009). In addition, this study reported no information regarding their disciplinary departmental membership was reported. Kim (2009) used a survey of a nationally collected sample to measure East Asian international teaching assistants' ($N=119$) teaching self-efficacy at a U.S. university. The study explored how perceived English fluency and sociocultural adaptation difficulty were associated with teaching self-efficacy. The results showed that a positive relationship between perceived English fluency and teaching self-efficacy was not apparent only when sociocultural adaptation difficulty was included in the analysis.

Science ITAs are a group GTAs with unique challenges in developing teaching self-efficacy. Therefore, the focus of the current study is how science ITA's level of teaching self-efficacy changes over time and what factors contribute to science ITAs' development of teaching self-efficacy.

Conceptual Framework

DeChenne et al. (2015) proposed a model with factors that influence GTAs' development of self-efficacy based on social cognitive theory (Bandura, 1977, 1986, 1997, 2001). The factors include ITAs' experience of quality and hours of GTA PD, department teaching climate, and prior teaching experiences. The goal of the survey study is to explore whether the sources of teaching self-efficacy for STEM GTAs

(DeChenne et al., 2015) are also significantly correlated with science ITAs. In addition, I want to explore other sources of teaching self-efficacy for science ITAs.

As noted above, DeChenne et al. (2015) found that department teaching climate (including facilitating environment, teaching supervisor relationship, peer teaching relationship), quality, and hours of PD positively correlated to STEM GTAs' teaching self-efficacy. For ITAs, Kim (2009) found that English proficiency and adaptation to American culture correlated with ITAs' teaching self-efficacy. Therefore, I proposed a framework for factors that impact science ITAs' teaching self-efficacy, which includes all those factors (Figure 3.3). The goal of this study is to measure science ITAs' current level of teaching self-efficacy, explore whether those factors are correlated with science ITAs' teaching self-efficacy, and what factors science ITAs perceived to be the most important factors for their development of teaching self-efficacy.

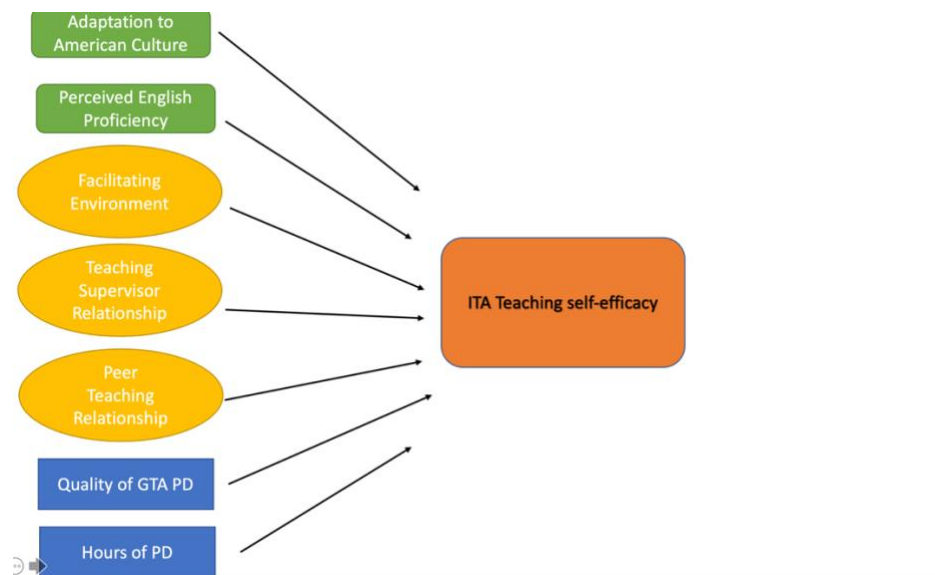


Figure 3. 3 Proposed model for sources of ITAs' teaching self-efficacy. Adaptation to American cultural and perceived English was added to DeChenne et.al's (2015) original

model according to Kim (2009) and the literature synthesis in Chapter 2 of this dissertation.

Research questions:

1. What is the level of teaching self-efficacy for science ITAs?

Sub question 1) (Survey) What is the current level of science ITAs' teaching self-efficacy?

Sub question 2) (Interview) How do science ITAs perceive changes to their teaching self-efficacy over time?

2. What are the factors that impact science ITAs' teaching self-efficacy?

Sub question 1) (Survey): How do perceived English proficiency, department teaching environment, hours, and quality of teaching professional development associate with science ITAs' teaching self-efficacy?

Sub question 2) (Interview): How do science ITAs perceive the factors the impact their teaching self-efficacy?

Methods

Research design.

I adopted a sequential explanatory design (Gay, Mills & Airasian, 2014) to collect both quantitative and qualitative data to answer research questions 1 and 2.

Aligned with the QUAN-qual research design, quantitative data was collected first (Gay, Mills & Airasian, 2014) by conducting a national, cross-sectional survey (See Appendix 3A). The survey included items measuring STEM GTAs' teaching self-efficacy,

departmental teaching environment (from DeChenne et al., 2015), perceived English Fluency (from Kim, 2009), ITAs' prior education and teaching experiences, and demographic information (designed for this study). Sufficient validity and reliability evidence was provided in DeChenne et al.'s (2015) to ensure that GTA PD, department teaching climate and GTA teaching self-efficacy was adequately measured.

Based on the findings from the survey data, I conducted interviews with a sub-sample of the participants to collect qualitative data to help explain or elaborate the results from the survey study (Gay, Mills & Airasian, 2014). The mixed-methods allowed me to measure science ITAs' current level of teaching self-efficacy and explore how their level of teaching self-efficacy changed over time. Furthermore, the interviews not only revealed the association between those factors and ITAs' teaching self-efficacy, but ITAs' narratives help us understand how and why those factors impact ITAs' teaching self-efficacy. Moreover, how those factors relate to each other and how they work together to affect ITAs' teaching self-efficacy.



Figure 3. 4 Sequential explanatory design. The flow chart was adapted from Warfa (2016).

Table 3. 1

Description of the Survey Items.

| Construct | Descriptions | Number of items | Item example | Response options |
|---|---|-----------------|---|---|
| Teaching self-efficacy (DeChenne et al., 2015) | ITAs' perceptions of their confidence to complete some specific teaching tasks. | 18 | Specify the learning goals that I expect my students to attain. | No confidence (1)-Complete confidence (5) |
| Department Teaching Climate (DeChenne et al., 2015) | It includes three factors (facilitating environment, supervisor-teaching relationship, and peer-teaching relationship), which have been found to significantly impact GTA teaching self-efficacy. | 18 | The department is supportive of innovations that TAs wish to try in their teaching. | Strongly disagree (1)-Strongly agree (5) |
| ITAs' perceived English fluency (Kim, 2009) | How ITAs perceive their level of English fluency, including three questions, rated on a 4-point, Liker-type scale. | 3 | What is your current level of fluency in English? | Poor (1)-Very good (4) |
| Hours of PD (DeChenne et al., 2015) | The total number of hours of university-wide and departmental GTA PD and the hours of college course work in teaching. | 3 | Please estimate the number of hours you have spent in the following types of TA training in all institutions you have attended. Overall, how effective has the TA training you have received been preparing you to teach. | Hours university-wide training |
| Quality of PD (DeChenne et al., 2015) | ITAs' perceptions of how well they have learned 15 specific teaching skills and the overall effectiveness of PD. | 17 | | Not effective (1)- Very effective (5) |
| Adaptation to American culture | The degree of ITAs' being comfortable with American culture and interacting with American people. | 10 | I attend social functions with American people | False (1)-True (5) |

The participants for this study are former and current international graduate students who teach in the sciences (Biology, physics, chemistry, space science, earth science, etc.) in the U.S. A total of $n = 69$ ITAs finished the whole survey for the study: 55.1% female, 42% male, 2.9% other/did not report; 78.3 % Asian, 10.1% Africa, and 11.6% from other continents. The survey was disseminated to multiple U.S. universities using the Qualtrics survey system to collect responses. The dissemination venues include DBER research conference listservs (SABER, NARST, BioTAP, etc.), ITA program coordinators, science departments (Department chairs, Professors, lab coordinators), and the author's personal connections.

The results of three case participants (Antonio, Tao & Ming) were selected to present in this paper. These case participants were chosen for the following reasons. First, they all were non-native English-speaking teachers (NNESTs) who experienced profound challenges in teaching students in the U.S. at their early stage of being ITAs, with low teaching self-efficacy to start with. Second, Antonio and Ming improved their teaching self-efficacy significantly over three semesters, and their current teaching self-efficacy is very high. Therefore, their experiences are very valuable for exploring the factors that impact ITAs' teaching self-efficacy. Third, Tao and Ming were the only pair of participants who were classmates in their home country and came to the U.S. at the same time. Therefore, Ming and Tao started teaching as ITAs with very similar prior experiences. However, their teaching self-efficacy reached different levels as they

progressed through their programs, so they can serve as comparative cases to understand ITAs' development of teaching self-efficacy in similar contexts might differ. In the survey study, two participants reported a perfect teaching self-efficacy score, and only Antonio agreed to be interviewed. Therefore, Antonio's case will be discussed first as an outlier case of an ITA with comparatively high self-efficacy. Then the results for Tao and Ming will be presented as comparative cases.

Data Analysis Procedure

Descriptive statistical analysis of the survey items that measure teaching self-efficacy was conducted in Microsoft Excel to measure the level of science ITAs' teaching self-efficacy. Then it was compared to STEM GTAs in general ($M=4.15$, $SD=0.53$; DeChenne et al., 2015). Matrix correlation statistical analysis was run in R studio to determine the variables that are significantly correlated with science ITAs' teaching self-efficacy. My hypothesis is that ITAs' perception of English proficiency, department teaching climate, hours, and quality of GTA PD will be significantly correlated with science ITAs' teaching self-efficacy (e.g., DeChenne et al., 2015; Wheeler et al., 2019; Arshavskaya, 2015).

In addition, I conducted in-depth semi-structured interviews to explore the factors that impact science ITAs' development of teaching self-efficacy. During the interview, I asked the participants: 1) How did your confidence in teaching change over time? 2) What factors have contributed to this change? The interviews were part of a research project about ITAs' teaching-related experiences. The interviews took about 45-60 minutes and were audio-recorded. The recordings were transcribed. The transcriptions were analyzed using the qualitative data analysis software Dedoose.

I derived the themes based on the proposed framework for science ITAs' teaching self-efficacy (Figure 3.3). Most of the themes (Table 3.3 & 3.4) were consistent with the framework, and I will continue discussing how those themes connect to the factors in the proposed framework later in the results. The themes have also been compared to the other participants' interviews, and only themes that were backed up by other ITAs' experiences were selected and presented in the results. New emerging themes must also be grounded in literature and compared to other participants' interviews to make sure it is valid. In addition, I asked another graduate student to read the excerpts and the coding to ensure inter-rater reliability.

Results

Research question 1: What is the current level of teaching self-efficacy for science ITAs on this sample?

Sub question 1) (Survey) What is the current level of science ITAs' teaching self-efficacy?

The results (Table 3.2) show that science ITAs' teaching self-efficacy ($M= 4.15$, $SD= 0.60$) was relatively high, on the same level as STEM GTAs in similar studies ($M= 4.15$, $SD= 0.53$; DeChenne et al., 2015), but with a slightly bigger statistical variation. The average time for ITAs' participation in PD was 40.9 hours in total, and the median was 13.8 hours. GTAs perceived the quality of their PD ($M=3.37$; $SD=1.00$) as moderately good and the departmental teaching climate as relatively high: supervisor-teaching relationship ($M= 4.21$, $SD= 0.73$, on a scale 1-5), and peer-teaching relationship ($M= 3.98$, $SD= 0.61$), and facilitated environment ($M=3.50$, $SD=0.88$).

Table 3. 2

Descriptive Results of Science ITAs' Teaching Self-efficacy and Relevant Factors.

| | Mean | SD |
|----------------------------------|------|-------|
| Hours of PD | 40.9 | 64.88 |
| Quality of PD | 3.37 | 1.00 |
| Facilitating environment | 3.50 | 0.88 |
| Teaching-supervisor relationship | 4.21 | 0.73 |
| Peer teaching relationship | 3.98 | 0.61 |
| Teaching self-efficacy | 4.15 | 0.60 |

Sub question 2) (Interview) How do science ITAs perceive changes to their teaching self-efficacy over time?

All three participants reported that their teaching self-efficacy increased over time (Antonio, Ming & Tao). For example, Antonio described how his confidence in using teaching methods increased from the first semester to the third semester, which was “the breaking point” for him:

It was like the first time, the first semester I teach, I was very nervous, like I said. *The second time, I decided, OK, I will try to apply this kind of method, but still many things didn't go OK. I made a lot of mistakes. I think that the third semester, it would be my second year, I started to feel that confidence about teaching because, like, the third semester, the reviews that I hear from my students, the one*

that the university give you, yes, I have had like 100% of the comments were positive. “Great TA”, “He is an amazing TA” sometimes, “You should pay him more”, or something like that, *something that makes you feel good about teaching*. So yeah, *that was like the breaking point for me, hearing those things for the students*. Because the first two semesters, I had positive feedback, but I also had some students, were like, “he's not able to inform me well,” “I didn't understand any of the classes,” “too long the lectures”. So, some things like that. “OK, I need to fix this”. But the semester that actually I received, like all my students gave me good reviews. *“OK, I'm doing a good job, now I can continue with these methods”*. *And it has been working since then*. (Interview, January 30, 2021)

Antonio's teaching self-efficacy increased significantly in only three semesters. Ming experienced a similar change in teaching self-efficacy. Antonio was one of two participants who reported a perfect score for teaching self-efficacy ($M=5.00$ on a scale of 1-5). Ming's current teaching self-efficacy was well above average ($M=4.46$). However, not every ITAs experienced such swift improvement in their teaching self-efficacy. Tao's current teaching self-efficacy was far below average ($M=2.79$). In the next section, I will discuss the results that can illuminate the factors that impact science ITAs' development of teaching self-efficacy. That will help explain the different changes in teaching self-efficacy among Antonio, Ming, and Tao.

Research question 2: What are the factors that impact science ITAs' teaching self-efficacy?

Sub question 1) (Survey): How do perceived English proficiency, department teaching environment, hours, and quality of teaching professional development associate with science ITAs' teaching self-efficacy?

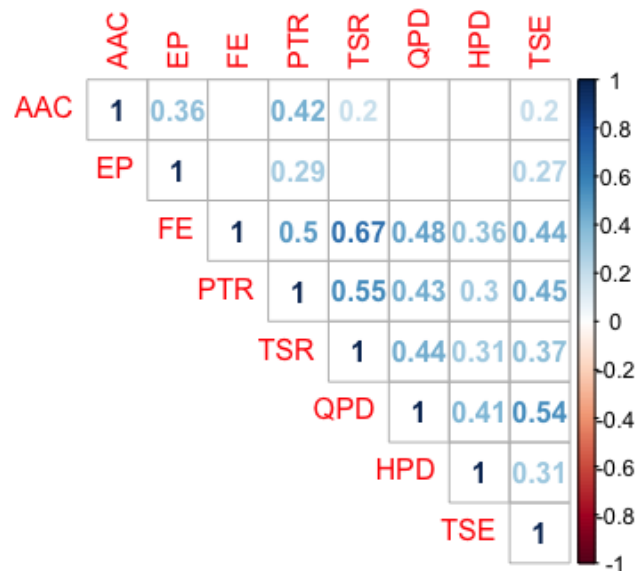


Figure 3. 5 Correlation results for sources of STEM ITAs' teaching self-efficacy (AAC: Adaptation to American culture; EP: ITAs' perceived English proficiency; FE: Facilitating Environment; PTR: Peer Teaching Relationship; TSR: Teaching Supervisor relationship; QPD: Quality of PD; HPD: Hours of PD; TSE: Teaching Self-efficacy; Only the coefficients for significant correlations ($p < 0.5$) are shown in the figure.)

The correlation results (Figure 3.5) show that adaption to American culture, perceived English proficiency, facilitating environment, peer teaching relationship, teaching supervisor relationship, quality of PD, and hours of PD were all positively correlated with ITAs' teaching self-efficacy. That means ITAs' teaching self-efficacy is

higher when ITAs are better adapted to American culture ($r=0.2$), with higher perceived English proficiency ($r=0.27$), stronger facilitating environment ($r=0.44$), stronger peer teaching relationship ($r=0.45$), and stronger teaching supervisor relationship ($r=0.37$), higher quality of PD($r=0.54$) and more hours of PD ($r=0.31$).

Sub question 2) (Interview): How do science ITAs perceive the factors the impact their teaching self-efficacy?

In the follow-up interviews, the three participants were asked to describe how their teaching self-efficacy changed over time and what factors contributed to the change. As noted before, those science ITAs' teaching self-efficacy improved with the increase of their experiences as GTAs. In both DeChenne's (2015) proposed model of teaching self-efficacy and their model of teaching self-efficacy for STEM GTAs based on survey results, teaching experience, department teaching climate, and professional development were three types of factors that could impact GTAs' teaching self-efficacy. Instead of asking each participant how each factor in the framework impacted their teaching self-efficacy, the open-ended questions allowed the participants to talk about the factors and relevant experiences that they believe were most important. Antonio's case will be discussed first as an outlier case as Antonio had a perfect teaching self-efficacy score. Then I will present the interview results about Ming and Tao as a comparative case. For each case, I will provide a brief description of each participant first before I discuss the results.

Case 1: Biology ITA Antonio (Perfect TSE score)

Antonio was selected because he was one of the only two participants ($N=69$) in the survey with a perfect score in teaching self-efficacy ($Mean=5.00$ on a scale of 1-5). Four themes emerged as I analyzed his data as to why his teaching self-efficacy may have been so high: he received consistent positive student feedback, he increased his content knowledge, he was recognized by faculty for teaching, and he had several years of teaching experience (Table 3.3). The next session is a brief description of Antonio's background and highlights of his case before I presents the four themes from his case.

Biology ITA from Bolivia-Antonio (pseudonym)

Antonio is from Bolivia. He was very confident and very fluent in English. He was in his fifth year as TA, and he had been teaching the same lab for ten semesters. The GTA supervisor, who had retired now, would observe his class, help him with pronunciations, and make a suggestion on how to interact with students. He also participated in an ESL course, which helped him a lot with his English and cultural awareness. He had gained a lot of confidence in teaching, partly because of the positive feedback he got from students. And he got to teach more advanced students. He also thought that his increase in content knowledge, becoming an expert in the course, helped improve his confidence. He believed that his teaching experiences help him to become more confident in giving a lecture. He wanted to pursue a career that involved teaching biology. (Interview notes, January 30, 2021)

Table 3. 3

Four Themes Emerged from Antonio's Case.

| Themes | Descriptions |
|--|---|
| Student feedback | Getting more positive student evaluations was a “breaking point” for Antonio’s teaching self-efficacy |
| Content knowledge | Increased content knowledge about the topics he was teaching made him feel more confident to answer students’ questions. |
| Faculty recognition | One professor selected him to teach honor classes and medical students, which increased his belief in his ability to teach the course well. |
| Teaching experience with the same course | Antonio mentioned several times that teaching the same lab ten times increased his confidence to teach the course. |

Positive Student Feedback Improved Antonio’s Teaching Self-efficacy

Antonio’s teaching self-efficacy improved over time. The third semester was the "breaking point" of reaching high teaching self-efficacy when he got 100% positive reviews from students. Students' positive feedback is a strong factor that impacted his confidence in teaching. Student feedback was not a theme included in the proposed framework (Figure 3.3). However, students’ attitudes towards ITAs that were reflected in their behaviors in the classroom and their evaluations have been frequently reported as a critical factor to influence ITAs’ perceptions of their ability to teach (Zhou, 2014; Gomez et al. 2011; Ashavskaya, 2015). In addition, students’ attitudes and perceptions of ITAs are at the heart of the ITA problem. Therefore, student feedback is a valid potential variable impacting ITAs’ teaching self-efficacy and should be further explored in future research. The following excerpt was the same one that was used in research question 1:

It was like the first semester I teach. I was very nervous, like I said. The second time, OK, I decided OK, I will try to apply this kind of method, but still many

things didn't go OK. I made a lot of mistakes. I think that the third semester, it would be my second year I started to feel that confidence about teaching because, like yeah, the third Semester, the reviews that I hear from my students, the one that the university give you, yes, I have had like 100% of the comments were positive. "Great TA". "He is an amazing TA" sometimes, "you should pay him more" or something like that, something that makes you feel good about teaching. So yeah, *that was like the breaking point for me, hearing those things for the students*. Because the first two semesters, I had positive feedback, but I also had some students, were like, "he's not able to inform me well,"; "I didn't understand any of the classes,"; "too long the lectures". So, some things like that. "OK, I need to fix this". *But the Semester that actually I received, like all my students gave me good reviews. "OK, I'm doing a good job, now I can continue with these methods". And it has been working since then.* (Interview, January 30, 2021)

Increased Content Knowledge was a Factor for Teaching Self-efficacy

Antonio explained how the increase in content knowledge of the topics in his class was a key reason for his improvement in teaching self-efficacy. This can partly explain why department TPDs that address a specific course are directly associated with ITAs' teaching self-efficacy. Those TPDs are directly related to the course, with the content knowledge ITAs are going to use. Antonio took extra efforts to increase his knowledge that helped him to address students' questions, which improved his teaching self-efficacy. Antonio was gradually increasing his content knowledge over the years of teaching the same course. Therefore, content knowledge is related to ITAs' teaching experience of a specific course and their prior teaching and learning experience:

It's specifically the knowledge that you can gain on the topics that we are going to be teaching. Because the first semester, we're going to talk about climate change. There are always the students that "I thought about this", "what about that". And you don't know about it. That's when you started feeling nervous, and it's like, "OK, I'm not that prepared." The second semester, instead of worrying about preparing for tests, preparing for your class, you're focusing on getting more knowledge into that topic because you already know how the class is going to go. The third semester even more. Now, this is going to be my 10th time, five years, teaching a class. I just worry about putting that information, and obviously, I know I'm going to teach you very well, *and I have increased my knowledge of other topics. Obviously, if you feel confident about that, you know everything.* So, I think that's the main, the key ingredient, in relation to teaching it, if you know what you're going to teach you feel comfortable. So, if they ask, I know that I know the information. So, it's very hard that they can, even from time to time, one genius student that ask you something challenging. I would say: "I'm sorry. I don't know this, but I'm sure I'm going to find it out. And I just go to the library, spend time reading papers reading books, so you get more and more and more. Next time you can, OK, here's your answer. But *like the knowledge for the class is what makes you confident about what you're teaching.* (I have become an expert in teaching this lab) In those things. Ten times is a long time. (Interview, January 30, 2021)

Positive Feedback from Faculty Increased Antonio's Teaching self-efficacy

Antonio mentioned that one professor selected him to teach major students, which demonstrated the professor's recognition for his teaching quality. The professor who was teaching the medical students requested Antonio to be the lab instructor because he knew Antonio got positive student evaluations and he had observed his teaching before. The professor chose him because he thought highly of the quality of Antonio's teaching. This kind of feedback and recognition from a professor is another factor that contributed to Antonio's development of teaching self-efficacy. This factor is related to the variable "teaching-supervisor relationship" in the proposed framework (Figure 3.3). When the GTA supervisor recognized Antonio's efforts to improve his teaching quality, that encouraged Antonio to continue to grow as a GTA, and his teaching self-efficacy increased:

Another important thing maybe might be relevant to what you are doing is here in Texas, usually, the teachers may be responsible for the class, they request TAs. So, usually, that class is one of the most challenging ones because we receive like 1000 students each semester, because it's the first one that every single student needs to take if they want to go to the medical field. So, that teacher gets the priority is usually the teacher used to pick the best teachers, according to him. I'm going to be asking for the teacher. I will prepare because that this is an important class for future majors. And the time on that class, the way that teacher grades that class. It's like half of the time, most of the students were failing or struggling because they thought going to the scientific field is going to be easy, and it's not. So, it's you gotta be able to transmit that information so "OK, are you ready to be in the science field or not?". And luckily, that's why I've been teaching that class

a lot because *that teacher will read their students' reviews. And he was in my class. (That teacher said to Antonio) "You are a good teacher for this class every single semester," he asked for me.* And right now, for example, I increase, and I am teaching the honor sections so students that have like higher grade, so it's like OK. *I feel proud that I'm doing a good job. But this is my 10th time teaching the lab, and the other TAs just taught this class like three times. So, the difference is huge... That specific teacher always elected me for teaching this class. So, I'm very grateful.* (Interview, January 30, 2021)

Years of Teaching Experiences with the Same Course Associates with Antonio's Teaching Self-efficacy.

Antonio mentioned several times in his interview (see the excerpt above) how teaching the same laboratory course over and over again increased his confidence in teaching. After teaching the same course for five years, he had become very comfortable with teaching and more ambitious in his methods. He made extra efforts to do reading about biology to address student questions and was able to relate to students based on those readings. Teaching the same course over and over again clearly improved his teaching self-efficacy. The other participant with the perfect teaching self-efficacy (Salah) also had taught the same laboratory for more than five years by the time he took the survey.

Case study 2: Ming and Tao, two physics ITAs

Ming and Tao were classmates when they were undergraduate students in Asia. Both of them came to the U.S. to pursue a Ph.D. degree in physics in the same year after getting bachelor's degree in physics. Both of them started teaching in their first semester in the U.S. Therefore, they had a lot in common at the beginning of their graduate program in terms of English proficiency, teaching experiences, and teaching self-efficacy. However, after teaching physics in different universities, their teaching self-efficacy had diverged significantly. Ming's teaching self-efficacy ($TSE=4.46$) was well above average level ($TSE=4.15$) in the survey study. However, Tao's teaching self-efficacy was far below average ($TSE=2.79$). In the interview, I explored the factors that contribute to this profound diverging after only teaching for three semesters in the U.S. I will present the four themes emerged from their cases after a brief description of those two participants.

Physics ITA from China-Ming

Ming was a fourth-year Ph.D. student in physics from China. He started to teach labs when he first came to the U.S. He had no teaching experiences before coming to the U.S. after just getting his bachelor's degree in China. He had sufficient support for teaching (weekly lab meetings, teaching method courses, English courses, university orientation, etc.). He even considered the support "too much." He was always teaching the lab with a partner, who could be an American TA or another international TA. In the first semester, he preferred to let the other TA lead the discussion as he was not confident in doing that. But later, he developed the confidence and the skill to do that and would offer to lead the discussion. He mentioned how much he appreciated the teaching experiences. He felt satisfied, and he also improved his English significantly through

teaching. After changing to RA and not teaching for a couple of years, he missed teaching and felt that his English was not as fluent as before. (Interview notes, January 07, 2021)

Physics ITA from China -Tao

Tao and Ming were classmates in college in China before they came to the U.S. to get Ph.D. in physics. However, they have had very different experiences of teaching physics in the U.S., Like Ming, he taught the first three semesters right after he came to the U.S. Tao did not like teaching at all, and he considered it a very painful and sometimes embarrassing experience. He was struggling with English, jargon and the students were not learning effectively. Unlike Ming, Tao was teaching the physics lab all by himself, without another TA. To make it worse, he had to teach four lab sessions nonstop in a single day, eight hours total. He also mentioned that his English was not good enough for him to enjoy a conversation with students at the time. He just wanted to get his teaching done and move on to do other assignments, research, and coursework. Tao rejected the assignment to teach physics again in his fourth year. When talking about the instructional training, he did not think the training was helpful. He could not think of any support that can help him overcome his challenges in language, and he never asked. Tao mentioned students' complaints about his teaching. Students considered his introduction of the experiment procedures a waste of time because they couldn't understand him, and they can find the instructions in the learning materials. (Interview notes, January 12, 2021)

Table 3. 4

Four Themes Emerged from Ming and Tao's Case

| Themes | Descriptions |
|--|--|
| Formal teaching professional development | TPDs in the form of Co-teaching with another TA and weekly lab meetings |
| English proficiency | Their familiarity with science terminology and conversational English increased over time. |
| Increased pedagogical skills | Ming's ability to lead discussions improved significantly |
| Role model | Ming's partners and Tao's professor served as positive and negative role models |

Co-teaching with a Peer GTA Increased Ming's Teaching Self-efficacy

Ming found the weekly lab meeting helped him to get familiar with the science terms, which was a challenge for him. He did not have to lead the discussion because he was co-teaching with another TA. He was not confident in leading the discussions at the beginning. However, observing the other TA lead discussions increased his desire to be capable of doing the same. In Ming's case, a peer teaching relationship proved to be a critical factor that impacted his teaching self-efficacy. Co-teaching as a type of TPD provided opportunities for Ming to develop teaching skills and thus improved his teaching self-efficacy. In Ming's case, co-teaching proved to be a high-quality PD with sufficient hours of training. The availability and quality of TPD are obviously associated with Ming's peer teaching relationship, and those factors are all related to Ming's teaching self-efficacy development:

First, every week, we have different labs, and before the lab really starts, we will have TA training. *And during that training, especially in the beginning, I don't know lots of expressions or words that I actually use when I teach. So, during that TA training session, I will kind of get familiar with all the words or jargon that I will use during the class.* So that is really helpful, especially in the beginning to get me familiar with the thing I need to do and the words I need to say. But for the lab I was teaching, we have two teaching assistants for each section. So normally, we will have, you know, overall discussion during the lab. Or maybe more than one like maybe, in the beginning, we will have a discussion like, what are we going to do and what's the overall structure of this lab or in the end, or in the middle, we will, if we consider most of the students are encountering some difficulties, we'll all just stress that by overall discussion. And after that, in the end of the lab will have a conclusion like seeing what do we get or what do we learn during this lab. *So, in the first year, especially in the first semester, I'm really nervous when doing that kind of stuff. So, normally I would just ask the other TA to do that.* So most of the time the job I do is go over table to table and solve their problem personally. And the overall discussion will be done by the other TA, which may be a native-speaker or some senior TA compared with me. *That feels good, but I have just escaping something and just not able or not willing to do overall discussion in front of other people...that is good but sometimes it's missing something, you know....Sometimes I feel I should have done that but I just don't dare.* (Interview, January 7, 2021)

Observing another TA leading whole class discussion had intrigued Ming's desire to lead the discussion himself. He did not do it because of his lack of confidence for leading discussions at the beginning of his GTA career. However, with more teaching experience and an increased English proficiency, Ming's teaching efficacy improved later on.

Increased English Proficiency Improved Ming's Teaching Self-efficacy

Ming improved his English significantly with more teaching experiences and participation in PD, which increased his teaching self-efficacy, especially in leading discussions. Ming's teaching self-efficacy improved over time as he improved his English, and like Antonio, he started to be more ambitious and wanted to take more teaching responsibilities on such as leading discussions. Ming and Tao had one major difference in their perception of teaching. Ming considered teaching as an opportunity to improve his English skills, while Tao merely perceived teaching as a way of getting funding for his graduate program. Tao even turned down one opportunity to teach and chose to be a grader instead.

English proficiency is significantly related to ITAs' teaching experiences, no matter whether they perceived teaching as opportunity to improve English or not. With more teaching experiences, their English proficiency improved, which helped them to become more willing to talk to undergraduate students in class. As a result, their classes became more interactive, and they were more likely to get positive feedback from students and supervisors. All those factors help ITAs increase their teaching self-efficacy:

So, after the first semester, especially after the first year, I started to like, I am the guy who is a little senior. *And I am the guy who are more familiar with no matter English or the jargon that (I) will use. So, I started to do that more actively. I started to be willing to talk to students in front of all the classes.* And (I was) more relaxing when I do that. So that's a great experience. Having that kind of improvement, progress and being able to see myself improving and on getting students to be ready to learn more is a really amusing thing on the other hand. And also actually in the meanwhile, I feel that, personally, my speaking English best is when I was a teaching assistant. Especially in the second year, you know, when I speak a lot of every week. I have to speak, speak to different students for about eight or 10 hours each week, which was a huge practice compare with what I am now (being a Research Assistant). (Interview, January 7, 2021)

Increased Pedagogical Skills Increased Ming's Teaching Self-efficacy

With more experience co-teaching with other TAs, Ming's pedagogical skills, especially leading student discussions, improved significantly. In the interview, Ming talked about he was "satisfying and amusing" to lead the whole class discussion. He beautifully described the feeling of leading the students to discovery. English language skill and leading discussions are two closely connected skills that were critical for Ming's teaching self-efficacy. Instead of escaping and worrying that he did not have the ability to lead discussion, Ming started to enjoy the process of leading the discussion and taking the students on a journey of discovery. Having the ability to engage students in this kind of discussion gave him a great sense of satisfaction. Therefore, TPD that support ITAs in

developing pedagogical skills can improve ITAs' teaching self-efficacy when ITAs' can implement them in teaching practices:

Also in the meanwhile, it is satisfying and amusing when you see students really understand something that you explain. So, I actually, I kind of enjoy having a whole class discussion in a later time, because I kind of feel, when you talk about something. It's like some mysterious to the student in the beginning, and then you talk about like peeling an onion, you know, you just push a thing a little step forward. And they feel kind of: "Oh, there might be something behind it". And then you do a little push more. And then they just got more sense. And after that, in the end, they just go: "Oh, that's it!". That's the whole thing and that's the physics. That's kind of like you guide them through the maze, and they finally found the result by themselves or under your guide, no matter what. It's kind of amusing that they are really willing to listen to you and think about it. And you are already getting them through the whole process so that kind of gives me a good feel. (Interview, January 7, 2021)

Comparative Cases: Tao's failing to increase teaching self-efficacy significantly was more evidence for the association between ITAs' formal TPD support, English proficiency, pedagogical skills, and their teaching self-efficacy.

For East Asian ITAs whose first language is not English, linguistic barriers were usually the primary challenge to instruction, especially for the first few semesters. Both Tao and Ming were struggling with spoken English, especially with using physics

terminology. However, their perception of teaching was very different. Tao did not believe there was anything he could do to overcome his language barriers and even TPD would not help. Tao started teaching a lab the first semester in the U.S., and his teaching self-efficacy was very low as he did not expect his students could learn anything from him. He noted that it is just a "process" that both the TA and the students have to go through. He mentioned he did make some progress in English proficiency by the time he had taught three semesters. Tao did not have the opportunity to co-teach with another TA. I mentioned to Tao about Ming's co-teaching experiences and how that had helped Ming to improve pedagogical skills and gained confidence. Even though he had just said that any TPD would not help his language skills, he thought co-teaching with another TA would have helped him:

I guess, *due to my English, the first year, they didn't get too much information out of my class. So, it was painful. And we also have an instruction for a laboratory. So, no matter whether they've learned something from my explanation or not, they can follow the instruction, do the lab without understand anything. Just do the math, as long as the result is correct. So that's basically the lab. My experience of undergraduate life, I didn't learn anything. So, I wasn't expecting them to learn anything. It's just a process.* (Interview, January 12, 2021)

From Tao and Ming's case, there is no doubt that English proficiency was a critical factor for their teaching self-efficacy. For example, Tao felt it "painful" when he did not have the basic level of English communication skill to teach students in the U.S. However, with more teaching experiences and support of TPD, they can gradually improve English skills. English proficiency may not be as a significant barrier to their

development of teaching self-efficacy after they teach for several semesters. That could help explain the result in the survey study, that perceived English proficiency was not as strongly correlated with ITAs' teaching self-efficacy as other variables that related to TPD and department teaching climate.

In the conversation below, Tao pointed out two factors that could be helpful to overcoming his stated challenges: English skills and experience living in the U.S. This is evidence for the two variables in the survey study: Perceived English proficiency and Adaptation to American Culture. However, he did not believe that he can compensate his lack of English proficiency and experiences living in the U.S. by participating TPDs:

Interviewer: So why do you think that's a painful experience and what could have made it less painful?

Tao: I don't know what can make it less painful. I mean, it's just a process. It's a fact. That non-native English speaker have those problems. *Unless you are really good with English, and you have experienced living in the United States. I guess there's no way to avoid that problem. And I don't think it can solve that problem by setting up extra training or English class. I mean, it's just unavoidable.*

Tao: *But at the end of the third semester, it was better. I was better English, and it was better prepared.* And the lab was easier than the first one. I was lucky. There was a TA wrote down a very clear step by step instruction for the lab. Even though I don't explain anything, the students was able to follow the instruction... *I was having trouble with really basic terminology.* Other than the terms like electric field that I know I was having trouble to describe certain equations.

Because I just don't know the word to represent the thing I want to say. But I mean you have to guess for them. (Interview, January 12, 2021)

Tao did not want to invest time in teaching. It's just a job for him, not something important for his career. He is not interested in a teaching career:

Tao: I don't think I should just spend a lot of time preparing those things (for teaching). I mean, it's like a job to me. It's not like something important in my career. So, I was not treating that as something important. If they can learn something, there's something. If they can't... there's the instruction.

Interviewer: You said teaching the lab is not something very important for your career. What do you want to do with your career?

Tao: Well, *not teaching*. (Interview, January 12, 2021)

Tao lacked the basic linguistic skill to communicate with his students and function as TA, which harmed his teaching self-efficacy. Tao had some peer support for teaching in that he would ask other graduate students for help with his language difficulty. He was more relaxed and willing to talk to his peers, which showed the importance of peer teaching relationship to his own sense of self as a teacher. Tao did not have the opportunity to co-teach with another GTA. Instead, he had to teach eight hours straight in one day by himself in his very first semester in the U.S.:

Interviewer: It seems you don't talk to the students.

Tao: I talked to my friends. I don't talk to my students

Interviewer: Why not?

Tao: I was, I mean, I was teaching right? So I just wanted to finish that and finish the class and leave. I wasn't thinking it as an opportunity (to practice English).

There are people surrounding me that I can speak English with...*I have no problem speaking my terrible English around them (peer graduate students) ... If I don't know something, I just asked them "how do you describe this thing?". I'm not afraid of making mistakes or be embarrassed around my friends.* But if you're teaching, then, I will feel embarrassed if I said something wrong or stupid. Maybe because when you are teaching you have higher expectation of yourself. You're supposed to deliver certain information to your students. And when you fail to do that, you feel like you're not live up to your expectations. So, I feel embarrassed. But I have no such pressure or stress when I'm speaking with my friends.

(Interview, January 12, 2021)

Role models for Teaching Impact ITAs' Teaching Self-efficacy

Ming increased his teaching self-efficacy by working closely to other TAs.

However, Tao did not have a good role model of teaching. He had professors in China and U.S. that were not good at teaching, according to him. He described their teaching as "bad "or "terrible". He did show high expectation for his teaching, but he lacked relevant skills and support to fulfill his expectations. While Ming increased his confidence and skill to lead discussions, improved his English proficiency from working with a peer TA, Tao did not had such opportunities. Ming had the opportunity to observe professors teach because those professors failed to serve as good role models for him. This connects to the variable of peer and supervisor teaching relationship in the teaching self-efficacy framework. Tao did not access to peer and supervisors' support for like Ming and

Antonio, which was two factors strongly correlated to ITAs' teaching self-efficacy in the survey results (Figure 3.5):

Tao: I mean, all the class are pretty much the same. They're talking what they're thinking. We're just sitting in a classroom and after the class we read the lecture notes, no matter what you were saying the class. It doesn't matter.

Interviewer: OK, so you're saying like your experience with American classroom as a physics student is not that different from your experience in China.

Tao: Well, it is different. *Most of my professors know the subject matter well enough and they're terrible at teaching...I think most people don't know how to teach effectively.* That's like a very common problem. I mean, teaching is a very difficult thing to do. I mean, to teach a class well, you need practice. And you need to prepare well. I mean, *there's one of my professors, who is doing really advanced physics research, and his classes are terrible....* terrible in a way that when there is something easy, he expected students to know. When there's something difficult, to save time. He would just say "you don't need to know this". So, students is like, if you're not explaining the difficult stuff to students, why would I need you? I know you're good at your research. But if I'm only asking you to teach the easy stuff, I don't need you. I only need a lecture note because everything easy is there. I can do it myself. I think there's this is a common problem for professors like to focus on the introduction, focus on the interesting stuff to keep students engaged. When you have something difficult, something like really important, something useful, they escape it....But also,

you're not supposed to teach me easy stuff in the class. I mean, it is a physics professor, we are physics major. If you don't give us the lecture notes and we're sitting in the classroom, at least in two years, explain something that we can get from textbook. And when you run into something important something related to advanced stuff you skip it. So, I'm not learning anything from you. (Interview, January 12, 2021)

DISCUSSION

Adopting a sequential explanatory mixed-methods design, I conducted a cross-sectional survey study on $N=69$ international graduate students who taught science as GTAs in universities across U.S. to measure their current level of teaching self-efficacy and explore the factors that could impact their development of teaching self-efficacy. I conducted follow-up interviews and selected three participants' interview data as a case study to explore their perceptions of their development of teaching self-efficacy and gain deeper understanding of the survey results.

Finding 1 (Research Question 1): Science ITAs' level of teaching self-efficacy can reach as high as STEM GTAs' in general with sufficient TPD support and ample teaching experiences.

The results show that science ITAs and STEM GTAs ($M=4.15$; $SD=0.53$; DeChenne et al., 2015) have the similar level of teaching self-efficacy as demonstrated by previous studies. Science ITAs reported significantly more hours of PD than STEM GTAs ($M=20.16$; $SD=32.49$; DeChenne et al., 2015). Science ITAs perceived their quality of PD slightly higher than STEM GTAs ($M=3.11$; $SD=0.99$; DeChenne et al.,

2015). Science ITAs reported slightly more positive department teaching climate than STEM GTAs in all three relevant variables, including facilitating environment ($M=3.39$; $SD=0.74$; DeChenne et al., 2015), teaching-supervisor relationships ($M=3.89$; $SD=0.75$; DeChenne et al., 2015) and peer teaching relationships ($M=3.77$; $SD=0.72$; DeChenne et al., 2015).

Sixty-one percent of the participants in this study had more than one year's teaching experience as GTAs in the U.S. Therefore, the ITAs who participated in the survey were ITAs with relatively more teaching experiences. Therefore, the results indicated that ITAs can improve their teaching self-efficacy to the same level as native GTAs when sufficient support in teaching is available, and they have ample teaching experiences. That is also supported by the interview data with the three ITAs in the case study. All those three participants reported that their teaching self-efficacy increased over time. Results from the survey and interview are consistent with Chiu & Corrigan's (2019) study that GTAs' teaching self-efficacy increased over time and they gained self-efficacy through training. However, the current study was not able to measure science ITAs' level of self-efficacy at different stages, which could be a future research direction. Future research should also examine science ITAs' level of teaching self-efficacy with a random sampling method to compare with STEM GTAs in general.

Finding 2 (Research Question 2): All the factors in the proposed model including perceived English proficiency, adaptation to American culture, department teaching climate, quality and hours of PD are significantly correlated with science ITAs' teaching self-efficacy.

Among all the variables in the proposed framework, quality of TPD and the three variables of department teaching climate show the strongest correlations with ITAs' teaching self-efficacy (Figure 3.6). The results are consistent with prior research about STEM GTAs' teaching self-efficacy (Smith & Delgado, 2021) that GTAs with higher teaching self-efficacy rely more on verbal and social persuasions from reliable sources (e.g., professors and peers) as the results show that peer teaching relationship and supervisor teaching relationship are strongly correlated with ITAs' teaching self-efficacy. However, different from the model of teaching self-efficacy in STEM (DeChenne et al., 2015), ITAs' perceived English proficiency, adaptation to American culture, peer and supervisor teaching relationships show significantly correlations with teaching self-efficacy.

The results of the case study supported those findings from the survey. For example, in Ming and Tao's case, the major reason for their diversion of teaching self-efficacy development is the availability of quality PD, as Ming had the opportunity of co-teaching with another TA, but Tao did not have such peer support. Antonio had the support from a GTA instructor who observed his teaching and provided feedback, which demonstrated strong supervisor teaching relationship. Future research with random sampling methods can run regression analysis to determine whether those variables can predict ITAs' teaching self-efficacy and whether those variables should be added to the model.

The data seem to imply that the factors that are more relevant to ITAs' teaching practice such as quality and hours of professional development have stronger correlations with ITAs' teaching self-efficacy. Factors related to ITAs' supporting networks, such as

peer and supervisor relationships, are also strongly correlated with teaching self-efficacy. The data also reveals strong correlations between hours and quality of PD and department teaching climate. My interpretation is that the quality and availability of PD for ITAs within the department is essential to creating a supportive teaching climate. ITA PD within the department is a critical venue to for ITAs to establish support networks for teaching.

However, ITAs' personal skills (perceived English proficiency and adaption to American culture) are not as strongly correlated with teaching self-efficacy as variables related to PD and department teaching climate. However, the interviews revealed a strong association between science ITAs' perceived English proficiency and their teaching self-efficacy, especially for novice ITAs who are non-native English speakers. That could explain the reason for the weak correlation between perceived English proficiency and teaching self-efficacy, as English is the first language of many of the participants.

Besides, I also explored the correlation between whether ITAs got their undergraduate degree in the U.S. with ITAs' teaching self-efficacy. However, the results ($p = 0.7218$) show that they are not significantly correlated, which was contradictory to my hypothesis. My assumption was that ITAs' experience of studying in U.S. universities as undergraduate students can improve their linguistic skill and cultural competence significantly. However, the majority of the participants in this study are experienced ITAs, with 39.1% of them teaching for the first semester. However, the true percentage could be less, because through follow-up interviews, I found out some participants misunderstood this survey item as whether they had taught as TA during their first semester in the U.S. Those experienced ITAs might have improved their teaching self-

efficacy through teaching and participating in PDs, and those experiences could have compensated for their lack of learning experiences in the U.S. institutions as undergraduate students. Besides, the linguistic skills and cultural competence that international students acquired from learning experiences in the U.S. still need to be transferred into the context teaching a specific science course.

The results provide important implications for supporting ITAs' development of teaching self-efficacy in professional development. First, designing and implementing high quality teaching professional development program in which ITAs can establish supporting network with peer and faculty should be at the core of building a supportive department teaching climate. Second, science ITAs should also be provided with sufficient opportunities to improve their English proficiency and get familiar with the educational culture in the U.S. through ITAs' teaching career as GTAs.

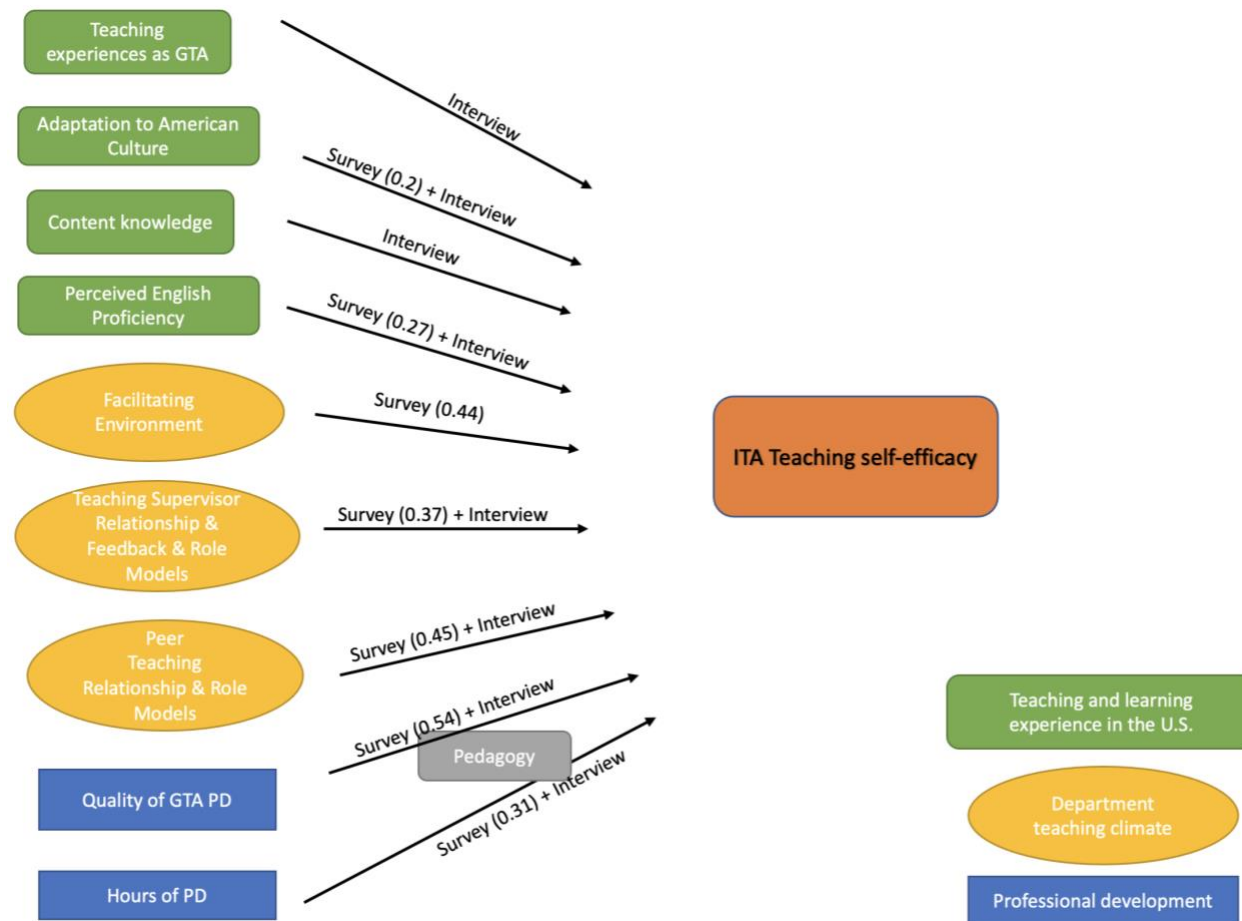


Figure 3. 6 An integrated model for ITAs' teaching self-efficacy

Limitations

The survey was disseminated during the covid-19 pandemic and the final exam period and winter break, which proved to be barriers to getting the expected number of responses (N=100). The majority of participants were ITAs with more teaching experiences in the U.S., maybe because experienced ITAs, with higher teaching self-efficacy are more likely to be interested in filling out the survey and participated in follow-up interviews to support other graduate students. The majority of the participants are not native English speakers. Therefore, they may have difficulty understanding some of the survey items, which could threaten the validity of the survey.

Conclusion

The results from this study added to the growing body of literature on STEM GTAs' development of teaching self-efficacy by measuring the level of science ITAs' teaching self-efficacy and exploring the factors that impact their teaching self-efficacy with survey and interview data. Science ITAs can improve their teaching self-efficacy with ample teaching experiences in a positive department teaching climate that provides sufficient support in teaching, especially in the form of formal teaching professional development. This study is the first endeavor to focus on science ITAs' teaching self-efficacy development and the results provide important implications for supporting ITAs in teaching. Future work should continue to explore the factors that impact ITAs' teaching self-efficacy with different cultural backgrounds and prior teaching and learning experiences.

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APPENDICES

APPENDIX 3A: ITAs' teaching self-efficacy survey

Q0 Are you an international graduate student who are/were teaching sciences (Biology, chemistry, physics, etc.) as teaching assistant (TA) in the U.S.?

- ☐ Yes
- ☐ No

Q1 Would you like to be entered into a drawing of \$25 Amazon gift card? If you select yes, your contact information will be collected at the end of the survey.

- ☐ Yes
- ☐ No

Q2 What is your country of citizenship?

Q3 I identify as a...

- ☐ Male
- ☐ Female
- ☐ Non-binary
- ☐ Other (Please write in below)

-
- ☐ I prefer not to answer

Q5 Please select your appropriate age range.

- ☐ 18-20 years old
- ☐ 21-30 years old
- ☐ 31-40 years old
- ☐ 41-50 years old

- 51-60 years old
- 61-70 years old
- Prefer not to answer

Q6 Where did you get your **undergraduate** degree?

- U.S.
- My home country
- Others (Please specify) _____

Q7 What is the name of the university you are/were teaching as a graduate student in the U.S.?_____

Q8 What is the name of the department(s) you are/were teaching as a graduate student in the U.S.?

- Biology
- Chemistry
- Physics
- Earth science
- Space Science
- Other (Please specify)_____

Q9 How many years of teaching experience did you have in your home country **before** you came to the U.S.?

- ☐ 0
- ☐ 0-1
- ☐ 1-3
- ☐ >3 (Please specify) _____

Q10 Are you teaching as a graduate student in the U.S. for the first semester/quarter?

- ☐ Yes
- ☐ No

Q11 Including this quarter/semester, how long have you been served in a teaching role as a graduate student in the U.S.?

- ☐ Less than one year
- ☐ 1-2 years
- ☐ 2-3 years
- ☐ 3-4 years
- ☐ 4-5 year
- ☐ More than 5 years. (Please specify)

Q12 Is English your first/native language?

- ☐ Yes
- ☐ No Please specify_____

Q13 What is your current level of fluency in English?

- Poor
- Fair
- Good
- Very good

Q15 How often do you communicate in English?

- Never
- Seldom
- Some of the time
- Most of the time

Q16. On a scale of 1-5 (1, rarely occurs; 5, very frequently occurs), please rate the frequency of the events listed below as they occurred during your time as a graduate student. GTA refers to graduate teaching assistant. TA refers to teaching assistant. Supervisor refers to the person who is directly involved in supervising the teaching assistants. (DeChenne et al., 2015)

- 1) GTAs help and support each other.
- 2) During meetings the supervisor explores all sides of a topic.
- 3) The supervisor treats all GTAs equitably.
- 4) GTAs respect the teaching competence of the other GTAs.
- 5) The supervisor puts suggestions made by the GTAs into operation.
- 6) GTAs in this school exercise professional judgment.
- 7) GTAs accomplish their jobs with enthusiasm.
- 8) The supervisor is friendly and approachable.
- 9) The interactions between the GTAs are cooperative.
- 10) The supervisor is willing to make changes.
- 11) GTAs provide strong social support for other TAs.
- 12) The supervisor lets GTAs know what is expected of them.
- 13) The supervisor maintains definite standards of performance for the GTA.
- 14) GTAs “go the extra mile” (make more efforts than expected) with their students.

Q17 On a scale of 1-5 (1, strongly disagree; 5, strongly agree), please rate your agreement with the statements below related to your experience with your department while you are/were teaching. Department refers to the department in which you are a

GTA. Supervisor refers to the person who is directly involved in supervising the GTAs.

(DeChenne et al., 2015)

- (1) The department is supportive of innovations that GTAs wish to try in their teaching.
- (2) In the department, when a GTA suggests an idea/procedure to enhance teaching, they are discouraged from pursuing them.
- (3) The department encourages GTAs to experiment with newly learned teaching methods.
- (4) The department provides sufficient resources for me to be successful in carrying out my job (e.g. equipment, secretarial help, mentors, etc.)
- (5) The department constantly changing teaching policies/procedures make it difficult for me to implement ideas learned in GTA training.
- (6) In the department, GTAs have freedom to conduct their teaching as they wish.
- (7) The department prefers that GTAs use teaching strategies with which the department is familiar.
- (8) GTA work in the department is often postponed until the last minute.
- (9) The department provides sufficient time to use newly learned teaching skills.
- (10) In the department, rules/administrative details make it difficult for new teaching ideas of GTAs to receive consideration.

Q18 On a scale of 1-5 (1, no confidence; 5, complete confidence), please indicate how confident you are in your ability to accomplish the stated teaching activities. (DeChenne et al., 2015)

- 1) Specify the learning goals that I expect my students to attain?

- 2) Actively engage my students in the learning activities that are included in the teaching plan/syllabus?
- 3) Create a positive classroom climate for student learning?
- 4) Encourage student participation in my classes?
- 5) Prepare the teaching materials I will use in class?
- 6) Promote a positive attitude towards learning in my students?
- 7) Accurately evaluate my students' academic capabilities?
- 8) Ensure that my students consider themselves capable of learning the material in the course?
- 9) Clearly identify the course objectives?
- 10) Maintain high academic expectations of students?
- 11) Appropriately grade my students' exams/assignments?
- 12) Think of my students as active learners, which is to say knowledge builders rather than information receivers?
- 13) Provide support/encouragement to students who are having difficulty learning?
- 14) Stay current in my knowledge of the subject I am teaching?
- 15) Provide my students with detailed feedback about their academic progress?
- 16) Calmly handle any problems that may arise in the classroom?
- 17) Develop my teaching skills using various means (attending conferences, reading about teaching/learning, talking to other teaching assistants...)?
- 18) Encourage my students to ask questions during class?
- 19) Make students aware that I have a personal investment in them and in their learning?

- 20) Evaluate the degree to which the course objectives have been met?
- 21) Let students take initiative for their own learning?
- 22) Show my students respect through my actions?
- 23) Be flexible in my teaching even if I must alter my plans?
- 24) Make students aware of the relevance of what they are learning?
- 25) Promote my students' confidence in themselves?
- 26) Spend the time necessary to plan my classes?
- 27) Select the appropriate materials for class activities?
- 28) Encourage the students to interact with each other?

Q19 On a scale of 1-5 (1, never; 5, every time), how often have you had the following experiences while teaching a class?

- 1) Students use disrespectful languages toward me.
- 2) Students insult me personally.
- 3) Students question my credibility as instructor.
- 4) Students question my teaching methods.
- 5) Students ignore my questions or other requests.
- 6) Students make fun of my accent, pronunciation, or language proficiency.
- 7) Students are insensitive to my cultural perspectives and needs.
- 8) I feel stereotyped against by my students because of my racial and cultural background
- 9) I feel excluded from other graduate students because of my racial or cultural background.
- 10) Other graduate students are insensitive to my cultural perspectives and needs.

11) I feel stereotyped against by other graduate students because of my racial and cultural background.

12) I feel excluded from faculty members and/or administrators because of my racial or cultural background.

13) Faculty and/or administrators are insensitive to my cultural perspectives and needs.

14) I feel stereotyped against by faculty and/or administrators, because of my racial and cultural background

Q20 On a scale of 1-5, how often have you felt uncomfortable due to student aggressive behavior or use of language when teaching?

- ☐ Never (1)
- ☐ Rarely (2)
- ☐ Sometimes (3)
- ☐ Often (4)
- ☐ Every time (5)

Q21 On a scale of 1-5 (1, never; 5, every time), how often have you experienced the following when teaching in the U.S.?

- 1) I have difficulty in understanding what students are saying.
- 2) Students cannot understand me because of my accent/pronunciation.
- 3) I have difficulty in speaking English fluently.
- 4) I have difficulty in understanding students' jokes or knowing if they are making jokes.
- 5) I have difficulty in using scientific terms.

- 6) I have difficulty in maintaining appropriate physical contact with students.
- 7) I have difficulty in getting used to the teacher-student relationship norm in the U.S. classroom.
- 8) I have difficulty in being humorous.
- 9) I have difficulty in establishing rapport or building connections with students.
- 10) I have difficulty in knowing students' prior knowledge about the subject matter.
- 11) I have difficulty in classroom management.
- 12) I have difficulty in facilitating discussions.
- 13) I have difficulty in choosing effective teaching methods.
- 14) I have difficulty in grading students' assignments.
- 15) I have difficulty in getting support from department, faculty and peers related to teaching.

Q22 Do you have access to Teaching Professional Development opportunities to support your teaching as a graduate student

- ☐ Yes
- ☐ No

Q23 What type(s) of Teaching Professional Development (TPD) have you participated in?

- ☐ Institutional/University orientations before the start of the semester.
- ☐ Departmental orientation before the start of the semester.
- ☐ Course-specific orientations before the start of the semester

- Institution/university teaching professional development during the semester
- Departmental teaching seminars during the semester
- Teaching certificate programs
- Lab preparatory meetings
- Peer mentoring
- Teaching observations
- Review of teaching evaluations

Q24 Please estimate the number of hours you have spent in the following types of TA training in all institutions you have attended.

| | Hours |
|---|-------|
| University-wide training | |
| Departmental training | |
| Course(s) for college/university credit | |
| Other TA training (Please specify) | |

Q25 Overall, how effective has the TA training been in preparing you to teach?

- ☐ Not effective at all
- ☐ Only slightly effective
- ☐ Somewhat effective
- ☐ Moderately Effective
- ☐ Very Effective

Q26 Overall, how effective has the TA training you have received been in preparing you to work with students?

- Not effective
- Only slightly effective
- Somewhat effective
- Moderately effective
- Very Effective

Q27 Of the following teaching topics and skills, on a scale of 1-5 (1, never learned; 5, learned well), please rate how well you have learned these in TA training.

- 1) Grading
- 2) Presenting material to a large group of students
- 3) Motivating students
- 4) Interacting professionally one-on-one with your students
- 5) Assisting distressed students
- 6) Teaching students with different skill/knowledge levels
- 7) Power/authority relationships in the classroom
- 8) Communicating with course lead instructor
- 9) Managing disruptive students
- 10) Facilitating group discussions
- 11) Learning styles
- 12) Teaching culturally diverse students
- 13) Harassment
- 14) Teaching styles
- 15) Developing quizzes/exams

Q28 Compared to other TAs in your department how much teaching experience do you have?

- ☐ Less Experience
- ☐ Slightly Less Experience
- ☐ Equal Experience
- ☐ Slightly More Experience
- ☐ More Experience

Q29 What teaching responsibilities have you completed as a graduate student? Please select all that apply.

- ☐ Served as primary laboratory instructor
- ☐ Was the Teaching Assistant for a professor
- ☐ Was the Grader for a professor when I Graded student assignments
- ☐ Facilitate student discussions in a recitation section.
- ☐ Served as a Tutor for a course
- ☐ Served as the primary lecturer for a course

Q30 What types of laboratory courses have you taught as a graduate student? Please select all that apply.

- ☐ A traditional Laboratory course
- ☐ An inquiry-Based laboratory course
- ☐ A course-based Undergraduate Research (CURE) course
- ☐ A virtual laboratory course
- ☐ Other (please indicate the type of labs you have taught.)

Q31 On a scale of 1-5 (1, false; 5, true), please rate the truth of the statements below.

- I attend social functions with American people.
- I know how to prepare American food.
- I am familiar with important people in American history.
- I feel totally comfortable with American people.
- I am informed about current affairs in the United States.
- I like to eat American foods.
- I regularly read an American newspaper.
- I feel at home in the United States.
- I feel accepted by Americans.
- I have many American acquaintances.

Q32 When you are/were teaching in the laboratory, on a scale of 1-5 (1, never; 5, always), how often do you spend on the following teaching actions on average?

- Clarifying instructions
- Explaining concepts
- Listening to a student's question
- GTA (you) controls the conversations
- Students are contributing complete sentences in the conversations with you.
- Listening briefly to group conversations
- Actively listening to small groups or individuals without participating
- Listening to students presenting work to the class
- Listening to students responding to each other in a whole class discussion
- Not Interacting with students

Q33 Please leave your email address below, if you are interested in participating an virtual interview about your teaching experience as GTA in the U.S.

CHAPTER FOUR: SCIENCE INTERNATIONAL TEACHING ASSISTANTS' JOURNEY TO BECOME CULTURALLY COMPETENT INSTRUCTORS IN U.S. CLASSROOMS: A QUALITATIVE STUDY

Introduction

Zara, a chemistry Ph.D. student from Iran, described her experience as graduate teaching assistant in the first semester:

That guy (GTA supervisor) came to my class while students were there. I was like: “okay, what's happening?” (The supervisor said:) “One of your students came. She said she's confused.” And I was like: “Okay, using ruler, how she can be confused?” I was very surprised. And then I was like: “Oh, my goodness! Give me at least one class, three hours to get used to my method and then go and complain against me!” That girl dropped my class, but it was so hard. They didn't support me in terms of training me. And I didn't like that behavior that guy came to my class while my students were there...He could wait after my class to talk to me ...Or maybe it's the way that they (students) run labs at high school level, so they expected to see something like that. So, it was hard. I mean, it was the very first week. I was struggling with my own courses. I'm teaching in English, with language barrier and everything. And when she left my class. Oh, my goodness, it was trauma for me...I went home and cried. (Interview, January 14, 2021)

Graduate students are critical for college science teaching, especially in introductory courses and teaching laboratories (Schussler et al., 2015), and many of them are international teaching assistants (ITAs) like Zara from the quote above. According to the Institute of International Education (2019), a total of 377,943 international graduate students enrolled in U.S universities in 2019. The new enrollment of international graduate students has been increasing steadily since 2007, only with a slight decrease from 2015/2016. International students comprise 21.2% of all first-year graduate students in the U.S in 2016 (Okahana & Zhou, 2017), which means approximately for every five graduate students, approximately one is an international graduate student. The data (IIE, 2019; Figure 4.1) show the primary source of ITAs for American universities are Asian countries, followed by North Africa, Latin America, and Europe. Because of the large proportion of international graduate students in the U.S. and the role graduate students play in undergraduate science instruction, it is important to examine ITAs' cross-cultural teaching experiences in the U.S.

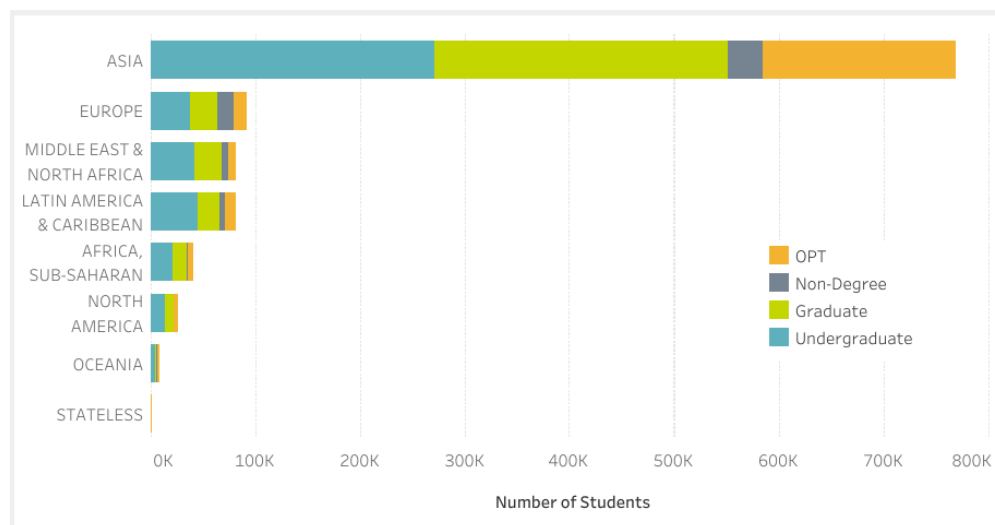


Figure 4. 1 The countries of origin of international students.

The ITA problem, which is the term to describe the intercultural communication problems between ITAs and their students in the U.S., is caused by the profound cultural differences between ITAs and their students (LaRocco, 2011). Undergraduate students' have prevalent negative perceptions and resistance against ITAs serving as their instructors (Kang, Rubin & Lindemann, 2015; Rubin, 2002), as in the case of Zara, when a student complained to her supervisor, and dropped the class afterward. Undergraduate student resistance has been so prevalent that it has come to be known as the "Oh No! Syndrome", a phrase that describes domestic students' reactions when they find out that an ITAs would be their instructors (Rao, 1994).

All GTAs would benefit from formal teaching professional development (TPD) (Gardner & Jones, 2011). However, ITAs, who were raised and educated in a different culture, also need specific training in language, culture, and pedagogy in addition to TPD (Hoekje & Williams, 1992; Zhou, 2009). In spite of ITAs' profound needs for training, there is significant variation in the length and types of GTA TPD provided by institutions of higher education (Reeves et al., 2016; Schussler et al., 2015). Despite the prevalent demand from GTAs for training in teaching techniques, learning theory, and lesson planning, oftentimes those types of training are not offered by colleges and universities (Schussler et al., 2015), and sometimes there is no training in any aspect of teaching at all, as seen in Zara's case. As Zara stated in the quote, while facing many other challenges as international graduate students (Mori, 2000), ITAs also have to overcome cultural and language barriers with students in teaching (Zhou, 2009).

There is limited research about science ITAs' cross-cultural teaching experiences, which I will discuss in the literature review section. No empirical study has been conducted to explore science ITAs' development of cultural competence in teaching students in the U.S. The large number of science ITAs have a significant impact on many students' learning experiences (Wheeler et al., 2019). Therefore, it is critical to gain a better understanding of their experiences and provide suggestions to better support ITAs in formal TPDs and informal settings. I aim to accomplish those goals by exploring science ITAs' cross-cultural teaching experiences, formal and informal TPD experiences a cultural competence perspective.

Theoretical Framework

In order to accomplish those goals, a well-recognized cultural competence framework was adapted from a well-recognized in the healthcare field (Campinha-Bacote, 2013, Figure 4.2) into the ITA context and utilized for this study. According to Diller & Moule (2005), cultural competence is the instructors' ability to teach students with different cultural backgrounds successfully. Culturally competent instructors should learn certain personal and interpersonal *awareness* and sensitivities, acquire relevant *cultural knowledge* and develop certain *skill sets*, which altogether indicates *effectiveness in cross-cultural teaching* (Diller & Moule, 2005). As Campinha-Bacote (2013) pointed out, a cultural encounter is "the foundational construct and beginning point" of the journey to becoming culturally competent (p. 43). I will describe each of these components of cultural competence in more detail and its connection to teaching below.

Suppose we conceptualize an ITAs' pedagogical context as someone who is providing service to their students with different cultural backgrounds. In that case, the

ITAs' situation is, in many ways, similar to healthcare providers who interact with patients with different cultural backgrounds every day. To support doctors and nurses in providing patients with cultural-sensitive services, *cultural competence* training has been widespread and is well developed in the healthcare field (Tanner & Allen, 2007; Shen, 2015). Cultural competence in healthcare is defined “as *the ongoing process* in which the healthcare professional (HCP) continuously strives to achieve the ability and availability to work effectively within the cultural context of the patient (individual, family, community)” (Campinha-Bacote, 2011, p. 43).

Therefore, in general, acquiring cultural competence can be defined as the ongoing process to achieve the ability to work effectively within other cultural groups' cultural contexts. In the context of ITAs, cultural competence is the ongoing process used to achieve the ability to teach U.S. students effectively within the U.S. educational system. One way to assist ITAs in conquering those challenges related to instruction as a whole is to utilize the theoretical lens of cultural competence to examine their instruction, conceptualizing language and pedagogy as cultural skills that are critical to classroom interactions.

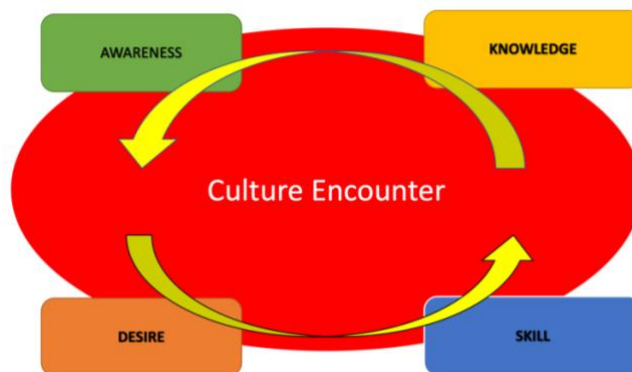


Figure 4. 2 Modified cultural competence framework based on Campinha-Bacote (2013).

The framework consists of five components that are essential for cultural competence development. *Cultural awareness* (Figure 4.2, top right) is the instructor's self-examination and in-depth exploration of one's biases, stereotypes, prejudices, and assumptions about their students who may differ from them (Arshavskaya, 2016). *Cultural knowledge* (Figure 4.2, bottom right) is the process of an instructor seeking and obtaining a sound educational base about diverse cultural groups of students and the instructors' level of understanding about diverse cultural groups. *Cultural skill* (Figure 4.2, bottom left) refers to an instructor's ability to collect and interpret incoming cultural information about their students regarding their beliefs, values, and behaviors that are then leveraged for more effective instruction. *Cultural desire* (Figure 4.2, top left) is the instructor's motivation of "wanting to", not "having to", engage in the process of becoming more culturally competent. *Cultural encounter* (Figure 4.2, center) is the continuous process of interacting with students from different cultural backgrounds to validate, refine, or modify existing values, beliefs, and practices about a cultural group and to develop the other four components of cultural competence. In the context of this study, the primary type of cultural encounter considered is the interactions between ITAs and undergraduate students in the U.S. Secondary cultural encounters referenced in this study include the interactions between ITAs and other graduate students, GTA supervisors, faculty, and administrators.

According to the modified version of this framework for ITAs in Chapter two of this dissertation (Figure 4.3), ITAs typically go through four phases to develop cultural competence.

Phase 1: ITAs experience challenges in teaching. ITAs often experience multiple challenges because of their personal limitations in teaching students in the U.S., especially in the first semester as GTAs (e.g., Arshavaskaya, 2015 & 2016). Based on a review of the literature, ITAs' challenges can be generally categorized into three domains: Linguistic challenges, instructional challenges, and cultural challenges (Chapter two, Table 4.1). *Linguistic challenges* are when ITAs experience difficulties interacting with students due to lack of English proficiency (Zhou, 2009), which is a critical cultural skill. *Instructional challenges* are difficulties that ITAs experience due to lack of cultural skills related to teaching practices. *Cultural challenges* occur when ITAs experience difficulties because they do not possess sufficient cultural knowledge and awareness, and they lack relevant skills to address culture-related problems in the classroom.

In addition to those challenges that are primarily caused by ITAs' personal limitations, students' negative perceptions and microaggressions against ITAs create profound challenges for ITAs. Although previous research has focused on training ITAs to fix the "ITA problem", there is abundant evidence showing that students' negative perceptions, attitudes, and microaggressions *create problems and challenges for ITAs*. Gomez et al. (2011) explored the microaggression experiences of three ITAs from Chile, Indian, and South Korea. "Microaggressions are subtle displays of racism that are more difficult to recognize or analyze than overt displays of racism (p. 1189)". Through semi-structured interviews, this study revealed that those ITAs shared the experience that students in the U.S (primarily Americans) subtly challenged their teaching. Those students perceived ITAs, who are often from Asia, Africa, and South America, to be different from themselves in race, ethnicity, language, religious, and cultural backgrounds

(Gomez et al., 2011). Those differences make some domestic students believe that ITAs could not understand their beliefs, experiences, and pedagogical choices. Therefore, those U.S. graduate students challenged ITAs' instructional choices with subtle techniques.

Table 4. 1

ITAs' Challenges in Teaching Students in the U.S.

| Types | | Specific challenges | | | |
|--------------------------|---------------------------|----------------------|-------------------------|-----------------|---------|
| Linguistic challenges | Listening | Accent | Fluency | Humor | Jargon |
| Cultural challenges | Student negative attitude | Physical contact | Power dynamics | Humor | Rapport |
| Instructional challenges | Student prior knowledge | Classroom management | Facilitating discussion | Teaching method | Grading |

Phase 2: ITAs codevelop cultural awareness and cultural knowledge. ITAs experience the aforementioned challenges in cultural encounters with students in U.S classrooms. In response to those challenges, personal reflection on their teaching by ITAs can lead to the co-development of cultural awareness and cultural knowledge of the differences between their own and the U.S. culture (e.g., Arshaskaya, 2015 & 2016; Chae et al., 2009; Kim, 2014).

Phase 3: Experiencing pedagogical challenges: ITAs struggle to make culturally competent instructional changes without formal TPD training. In response to the co-development of cultural awareness and cultural knowledge, ITAs may develop

the cultural desire (Arshavaskaya, 2015 & 2018; Zhang, 2019) to make instructional changes in their classroom practice (Figure 4.3) (Arshavaskaya, 2015 & 2016; Chae et al., 2009). Many ITAs, however, express that they are struggling with making instructional changes, and those changes are often not culturally competent without external support (e.g., Chae et al., 2009; Zhou, 2014; Li, Mazer & Ju, 2011; Gomez, Khurshid, Freitag & Lachuk, 2011; Figure 4.3). In this case, a cultural desire to be a more culturally competent instructor is limited by their ability to access support and teaching professional development to develop cultural skills.

Phase 4: ITAs make culturally competent instructional changes with TPD training. As argued in the previous section, facilitating culturally competent ITAs requires they develop a skillset. The skillset ITAs need for instruction is difficult to develop informally and is likely best supported by formal TPD programs (Chapter two). In other words, the best way to promote the development of culturally competent instructional skills in ITAs might be to harness their cultural desire as well as their informally gathered knowledge during formal TPD sessions. TPD activities such as deliberate noticing while watching a previously videotaped classroom observation (Williams and Case, 2015), one-on-one mentoring (Arshavaskaya, 2018), taking a teaching method course (Wheeler et al., 2019), and/or intercultural communication course (LeGros et al., 2012), and TPDs explicitly addressing cultural competence (Dimitrov et al., 2014; Meadows et al., 2015) have all been shown to help ITAs to develop necessary cultural skills to become more culturally competent instructors (Chapter 2).

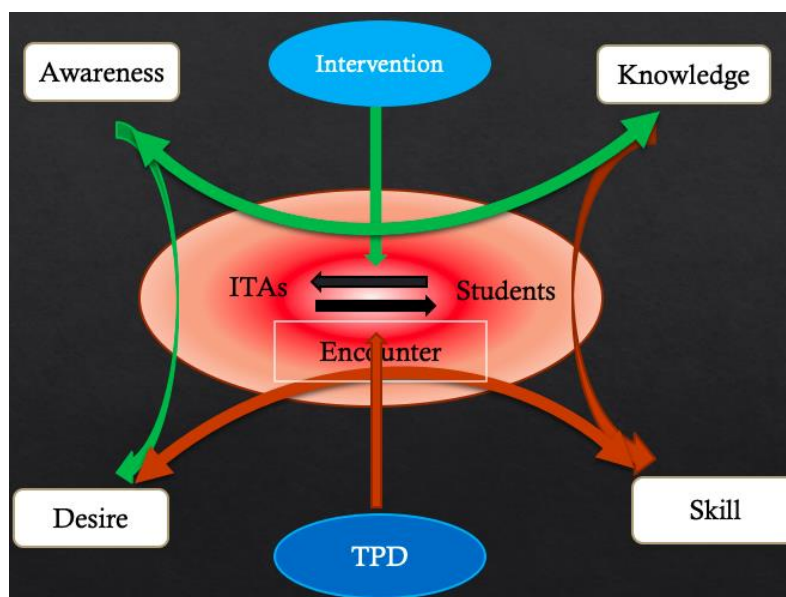


Figure 4. 3 Proposed Framework for cultural competence in teaching

Literature Review

Research on Science ITAs

Only three empirical studies that focused on science ITAs' teaching-related experiences have been published in science education journals (Wheeler, Sturtevant & Mumba, 2019; Walsh, Jia & Vernon, 2020; Erumit, Akerson & Buck's, 2021). In Wheeler et al. (2019), ITAs taught project-based guided inquiry (PBGI) chemistry laboratory and took a semester-long Teaching Method course with all department TAs. The results showed that ITAs who took the teaching method course were perceived by students more positively in terms of instructional practices and learning outcomes than those students taught by ITAs who did not. Specifically, ITAs who took the teaching method course were reported to be significantly more supportive, interactive, and effective, with an increased understanding of their role as facilitators of student learning.

It was revealed that the Teaching Method course and teaching experience improved ITAs' confidence in teaching PBGI laboratories and creating a supportive learning environment for students. This study reported student evaluations of ITAs' instructions, but they did not provide a measure of ITAs' teaching practices. Therefore, no claims can be made regarding ITAs' development of cultural knowledge, cultural awareness, and cultural desire. The students' positive evaluations, however, provide strong evidence that those ITAs who took the teaching method course had become more culturally competent instructors.

Walsh et al. (2020) conducted a survey among 1,065 undergraduate students and their 31 biology GTAs, eight of whom were international graduate students. They found that the biology ITAs had difficulty grading written assignments. They need a longer time to grade a single paper than native GTAs. In addition, ITAs can only work for 20 hours every week because of their visa status.

Erumit et al.'s (2021) qualitative study explored the experiences of ITAs from science and math education departments and how their students perceived their learning experiences with ITAs. The authors conducted semi-structured interviews with seven ITAs and their students. The findings revealed ITAs experienced linguistic challenges, such as accent and fluency in speaking, the correct pronunciation of the words, and the differences in science jargon across different countries. ITAs' cultural challenges included difficulty in understanding US humor, customs, values, and beliefs. They found that ITAs had developed coping strategies such as honesty and being open to students.

Those studies provided insights into ITAs' cross-cultural teaching experiences by focusing on one or several sequences or aspects of their teaching practices, such as

science ITAs' challenges in teaching and coping strategies (Erumit et al., 2021; Walsh et al., 2020), their experiences of teaching professional development and how those TPD experiences impact their teaching practices (Wheeler et al., 2019), and the association between ITAs' teaching practices and student outcomes (Walsh et al., 2020). None of the studies, however, connects those pieces together so that we can obtain a more in-depth and comprehensive understanding of science ITAs' teaching-related experience as a continuous learning process. I will achieve that by adopting the lens of cultural competence development to capture their whole journey from teaching for the first time in the U.S. to having become a highly culturally competent ITA.

ITAs' development of cultural competence

As early as 1987, in a commentary paper, Bernhardt (1987) provided insights on the understanding of the ITA problem from the cultural perspective. Previous researchers commonly attributed the ITA problem to their language barriers, but Bernhardt (1987) pointed out that "language is not necessarily at the root of the problem" (p. 67). The evidence is that non-Anglo TAs received complaints about their teaching incompetence from students because of their language skills, even if they are native speakers. Bernhardt (1987) contended that the difficulties that both U.S. students and ITAs experienced in the classroom were mainly caused by cultural differences.

Bernhardt (1987) pointed out two important areas, ITAs' knowledge about U.S. institutions of higher education and ITAs' need to understand "the framework of U.S. classroom" (p. 67). According to Bernhardt, lack of empathy, which is caused by lack of shared experience, is "at the core of any cross-cultural difficulty foreign teaching assistants and U.S. students may encounter" (p. 68). Those statements support the pivotal

role that cultural encounter plays in the cultural competence framework. It is through cultural encounters that ITAs and U.S. students have the opportunity to share their own experiences and find out what they have in common, as well as develop their cultural competence through those encounters.

In her dissertation, LaRocco (2011) conducted a qualitative study to describe the essence of the development of intercultural competence from the lived experiences of seven Chinese ITAs (Three in chemistry, one pharmacy, one electrical engineering, one mechanical engineering, and one business administration) with a minimum of one-semester teaching experience participated in the study. LaRocco (2011) found three essential components of the development of intercultural competence. First, those ITAs develop perceptions of U.S culture, their own culture, and the cultural differences between Chinese and U.S. education. Second, ITAs engaged in intercultural experiences and interactions with undergraduate students, faculty, and peers. Third, ITAs adopted communication and teaching strategies to communicate better with undergraduate students and develop intercultural competence. Those Chinese ITAs “intentionally develop intercultural competence by learning language and culture, by communicating with others, by focusing on cultural similarities, by learning and respecting cultural differences, and by learning through experience and time” (LaRocco, 2011, p. 126). Those findings are consistent with the adapted cultural competence framework in teaching (Figure 4.3).

With a quasi-experimental research design, Staples et al.’s (2014) tested 94 undergraduate students’ perceptions of ITAs’ accent, comprehensibility, and teaching quality before and after an intercultural contact program. The participants were 94

undergraduates and 58 international partners (international students, scholars, and staff). The undergraduate students and their international partners meet once a week for eight weeks for one hour each time. The program was designed based on Rubin and Lanutti's (2001) principles for intergroup contact. The results indicated that U.S. undergraduates who interacted with international partners rated ITAs significantly higher on accent measures, comprehensibility measures, and teaching ability measures. This means that undergraduates found ITAs less accented, more comprehensible, and more competent at teaching after the intercultural interactions (Staples et al., 2014).

Dimitrov et al. (2014) conducted focus group interviews with 20 international graduate students (from Iran, China, Pakistan, and Latin American and Eastern European cultures) from various disciplinary backgrounds and 4 Canadian graduate students to determine what opportunities two GTA teaching professional development programs provide for ITAs' development of cultural competence. All ITAs participated in both Teaching Assistant Training Program (TATP) and the Teaching in the Canadian Classroom program (TCC). TATP was designed for all GTAs, with the goal of introducing graduate students to teach at the university level. TATP included an intercultural training session with a two-hour video case study about teaching in an intercultural classroom. TCC was a workshop that was designed specifically for ITAs, with a focus to discuss cultural differences in terms of "communication styles, feedback styles, expectations for teachers and student behavior" (Dimitrov et al., 2014, p. 92). The Results showed that both ITAs and Canadian GTAs increased cultural awareness about their own cultural identity and cultural assumptions. ITAs learned to expect cultural differences in new situations and "with-held judgment until they understood the

intentions of those with whom they were interacting” (p. 93). Moreover, the ITAs showed the “ability to reflect on intercultural interactions with their students and choose *culturally appropriate* communication strategies during challenging interpersonal situations” (p. 93). Furthermore, they also transferred cultural competence with students to the interactions with faculty, peers, and staff. This was not found among ITAs who participated in TPD without addressing cultural competence explicitly (Williams & Case, 2015; Arshavskaya, 2018; Wheeler et al., 2019).

Therefore, since Bernhardt (1987) pointed out the necessity to explore the ITA problem from the cultural perspective, a few empirical studies have been conducted focusing on different aspects and different sub-groups of ITAs: the development of cultural competence of Chinese ITAs (LaRacco, 2011), students’ changed perceptions of ITAs after intercultural contact (Staples et al., 2014), and GTA TPD’s impact on ITAs development of cultural competence (Dimitrov et al., 2014). The results of those studies, however, do not address the specific issues of ITAs who are teaching science with different cultural backgrounds at different stages of their GTA career. Therefore, the current study aims to explore the cultural competence development process of science ITAs from various cultural backgrounds through varied teaching-related experiences, such as interactions with students in classroom, TPDs, and informal conversations with peer and faculty. I achieved this goal by adopting the adaptive cultural competence framework in Chapter two of this dissertation with four sub-research questions addressing each of the four phases in the framework. Science ITAs’ responses for these questions helped the researcher to gain insights into science ITAs’ experiences of developing cultural competence in teaching students in U.S. classrooms.

Research questions:

1. What challenges have science ITAs experienced in teaching students in the United States?
2. How do science ITAs perceive the teaching-related cultural differences between themselves and the students?
3. What cultural skills related to teaching have ITAs developed to address the different types of challenges related to cultural differences?
4. What teaching professional development experiences have science ITAs had? How have those teaching professional development experiences impacted their teaching practices?

METHODOLOGY

Undergraduate students in the U.S. have been complaining about ITAs' instruction for several decades (Bailey, 1983; Zhou, 2009). This study intends to provide insights into this "ITA problem" by adopting the theoretical frame of cultural competence to better understand ITAs who are struggling with cross-cultural teaching. The purpose of this study was to provide evidence for the proposed framework for ITAs' development of cultural competence with science ITAs' experiences of teaching students in U.S. classrooms. In addition, the study attempts to gain insights into the essence of science ITAs' cross-cultural teaching experiences in U.S. classrooms.

The phenomenological methodology was utilized for this study to explore the essence of ITAs' lived experience of teaching students in the U.S. classroom.

Phenomenological approaches "requires methodologically, carefully, and thoroughly

capturing and describing how people experience some phenomenon” (Patton, 2002, p. 104) through gathering data about their perceptions, descriptions, understandings, and conversations with others. Conducting in-depth interviews with people who have direct experience of the target phenomenon is the fundamental way to collect data of their “lived experience” (Patton, 2002).

Study Participants

Researcher description and positionality. According to Patton (2015), the major goal of the phenomenological method is to understand the essence of someone’s lived experience. Moreover, “the only way for us to really know what another person experiences is to experience the phenomenon as directly as possible for ourselves. This leads to the importance of participant observation and in-depth interview” (van Manen, 1990, p. 10). To achieve this goal, it is critical that the researchers have direct contact with that experience.

As the primary researcher of this study, I was a fifth-year international Ph.D. student from Asia with four years of teaching experience in the U.S. English was my second language and I had no prior teaching experiences in the U.S. before I taught biology laboratory as GTA. I experienced the challenges that most ITAs would commonly experience at the early stage of teaching biology in U.S., such as language barrier, cross-cultural communication problems, and lack of pedagogical skills. However, with personal efforts and the support from peer, faculty, and TPD, I improved my English proficiency and developed pedagogical skills, and I can relate to more students in my classroom. I served as the lead GTA for spring 2019, received positive evaluative feedback from students, and taught a lecture course as the instructor of record for two

semesters. Therefore, I had sufficient and in-depth experience of the phenomenon of cross-cultural science teaching in the U.S. Besides, I had ample knowledge about the literature on ITA research. Prior to this study, I had completed a manuscript of a critical literature synthesis ITAs' development of cultural competence. I was also a co-author for a publication on supporting ITAs in grading science writing assignments (Walsh, Jia & Vernon, 2020). I had qualitative research experiences with GTAs and scientific discourse, and in this project, one of my responsibility was a coder for part of the classroom discussion data.

According to Moustakas (2011), it is necessary to keep a distance from the research before analyzing the data. My experiences could impact my interpretation of the data, as I would draw my own experiences, perceptions, and perspectives to make sense of the data. My knowledge about ITA research could also influence the interpretation of the data. Therefore, I adopted some strategies to reduce bias and to establish trustworthiness for the project. I wrote analytical memos after every interview, which included my reflections, summaries, and thoughts about the interviews. I sent the transcriptions and researcher interpretation of the transcriptions to the participants for member checking by email. This is a way not only to test the clarity and credibility of transcriptions and interpretation but also to provide both internal and external validity evidence.

Participants Recruitment

Researcher-Participant Relationship. I knew three participants (Zara, Yamei & James) personally before the interview. We had interactions when we were GTAs for the same courses, or working at the same office, or had conversations at conferences. I

emailed them about my intention of interviewing them and informed them of the IRB approval information. They made the decision to be interviewed voluntarily. For other participants, I had no prior relationship or interactions with them prior to data collection.

The recruitment was conducted through email. In Chapter 3, I conducted a cross-sectional survey study and I received $n=69$ completed responses. In the survey, I asked the participants to leave their email addresses if they were interested in participating the interview study. The participants were told that they would have the opportunity to receive a drawing of 25\$ Amazon gift cards as compensation for participation.

I conducted interviews with a total 16 participants. In the data collection phase, I interviewed all the participants that fell into the inclusion criteria below and who agreed to be interviewed. The number of participants in the proposal was 12 with 4 in each discipline. However, I halted data collection when I had 16 interviews, with at least 2 participants from all three disciplines, biology, chemistry, and physics. There was a variety of cultural backgrounds among the participants (Table 4.3).

Sample inclusion criteria:

1. They are international graduate students who received their bachelor's degree in non-English speaking countries, preferably from Asia and Africa.
2. They teach science courses such as biology, chemistry, and physics.
3. For their teaching assignments, they should have direct interactions with students rather than just grading.

Participants Selection

I used purposeful selection of participants for semi-structured interviews based on the responses from a cross-sectional survey study (Chapter 3). To make sure that I had a maximum variation in my sample, I chose participants with a variety of cultural backgrounds, years of teaching experiences in the United States, teaching professional development experiences, content disciplines, etc. I recruited a total of $n=16$ participants for interviews, which is more than 20% of the survey sample. I anticipated that there may be differences among those disciplines in terms of class design, department culture, and in-class limitations in the theoretical framework. “In academia, the discipline is the primary cultural unit, where students are introduced to a unique set of values, codes of conduct, and epistemological views”, and “the pool of experiences that faculty appear to draw upon when planning and teaching their courses are grounded in a specific cultural context that imprints upon individual students and faculty a particular way of thinking about teaching and learning” (Oleson & Hora, 2014; p. 42). I selected the nine out of the sixteen participants to conduct data analysis with the purposive sampling strategy. The nine participants provided the most comprehensive responses regarding the phenomena of interest.

The basic demographic information of the 9 participants for data analysis were showed in table 4.3. First, I kept Ming and Tao because they were the only two participants in physics. Second, as half of the 16 participants were from China, I only kept three of them to keep a balance of participants of different nationalities. Third, Antonio and Joy were selected because they were the only two participants from South America. James was the only participant from Africa, so he was selected too. Fourth, Idika and Sara were selected to increase variation in years of teaching experiences. Sara

only had one year of teaching experience and Idika had five years. Finally, Zara was selected for her background in chemistry education. In addition, her teaching experiences in the first semester was very typical for ITAs whose first language was not English. Zara was also one of the two participants from Middle East. The other participant from Middle East was from Turkey. She learned the science knowledge in English so her first semester could not be representative for non-native English speakers.

Table 4. 2

Basic Background Information of Participants.

| Pseudonym | Nationality | discipline | Years of teaching experience | Gender |
|-----------|---------------|---------------------|------------------------------|--------|
| Zara | Iran | Chemistry education | Three years | Female |
| Yamei | China | Chemistry education | Two years | Female |
| Joy | North America | Biology | Three years | Female |
| Ming | China | physics | One year and half | Male |
| Sara | India | biology | One year | Female |
| James | Ghana | biology | Three years | Male |
| Tao | China | Physics | One year and half | Male |
| Idika | India | biology | Five years | Female |
| Antonio | Bolivia | biology | Five years | Male |

The participants in the study all had direct experience of teaching science as ITAs in the U.S. In phenomenology, however, the participants selected should have a certain distance from their lived experience to be able to reflect on it (van Manen, 1990), as a reflection on lived experiences is always a recollective effort about past experience rather than current experience (van Manen, 1990). Therefore, phenomenological reflection is by nature retrospective instead of introspective (van Manen, 1990). The study focused on the phenomenon of science ITAs' development of cultural competence in cross-cultural teaching experience in U.S. universities. Therefore, all the participants selected for this study had taught at least one year (Sara), during which time they had "lived through" some cross-cultural teaching experiences as ITAs. They were at a stage when they could make sense of their teaching as past experiences and transform those experiences into conscience by retrospective reflection during in-depth interviews.

Data collection

The interview data was collected from January 2021-February 2021. The interviews were conducted on Zoom. I chose Zoom as the interview platform for three reasons. First, Zoom allowed the interviewer and participants to see each other during interviews. This helped the interviewer to establish rapport with the participants, so the participants were more willing to share their experiences. Second, Zoom had a recording function, so I did not need to use additional recording device. However, I did have another recording device to secure the data collection. Third, Zoom provided free transcribing service. A link of the transcription would be sent to the interviewer by email shortly after each interview. The interviews were held for 34-90 minutes with an average interview time of 59 minutes. Most interviews were between 50-70 minutes. The

interviews were all conducted in English. The participants from China used Chinese occasionally, and as a native speaker of Chinese, I translated them into English later.

Interview Protocol and Analytic Framework

An interview protocol with open-ended questions was used to capture the participants' experiences in teaching science to students with different cultural backgrounds than themselves, with a varied degree of formal support from Teaching Professional Development (TPD) and varied informal support from faculty and peer graduate students. The interview protocol was at first constructed based on a cultural competence framework (Campinha-Bacote, 2013). One or two questions were constructed to elicit responses aligned with each of one of the five components in the framework (e.g., cultural desire).

In order to test the functionality of the interview protocol, it was used in the pilot study, in which I conducted interviews with three international graduate students. The interview protocol was helpful to gather data regarding ITAs' teaching-related experiences from the cultural competence perspective. However, the interview protocol was not able to capture the developmental process of ITAs' cultural competence. Therefore, the interview protocol was modified based on the results of Chapter two of this dissertation. Four interview questions were included in the interview protocol to explore those ITAs' experiences at each of the four phases that ITAs go through to develop cultural competence in teaching students in the U.S.: 1) ITAs experience challenges in teaching; 2) ITAs increase their cultural knowledge and awareness in teaching; 3) ITAs struggle to make instructional changes without TPD support, even with

strong cultural desire; 4) ITAs can make culturally competent changes with sufficient TPD support. All the five components were incorporated into those open-ended questions with teaching experiences and TPD as the cultural encounters and making instructional changes as the primary cultural skill. The interview protocol can be found in Appendix 4A.

I wrote analytical memos after every interview. The analytical memos included the basic demographic information of the participants, a general description of their teaching experiences and TPD experiences, and the stories that were relevant to my research questions. In addition, I also wrote initial analysis about the developmental process of their cultural competence. With all those information, the analytical memos helped me to select participants and to conduct in-depth data analysis later. The full analytical memos for all nine participants can be found in Appendix 4B.

Data Analysis

Units of Analysis. The “unit of analysis” could mean the level of the subjects, whether it is a person, program, or institution; or in terms of textual content: words, phrase, sentences, or the whole documents (Patton, 2014; Roller & Lavrakas, 2015). In my study, I attempted to make sense of the lived experiences of ITAs by focusing on individual participant and the specific sentences in transcriptions.

According to Patton (2014), phenomenology focuses on understanding the essence of lived experiences for people generally. The level of analysis in this study was individual international graduate students. The units of analysis were their lived experiences of teaching science to students in the U.S. in the form of sentences in the transcriptions. The research questions were constructed based on the units of analysis for

this study: individual ITAs. For example, the first research question was to explore the challenges that those science ITAs experienced in teaching students in the U.S. For this research question, the specific sentences that the participants used to describe a particular challenge in teaching students in the U.S. was one “unit”. For example, many participants talked about their experience of having difficulty using the jargon, the science terminology. Therefore, the sentences that the participant described this challenge including the description and explanation was considered as one “unit”. One of the practical uses of the findings for this research question was to help GTA supervisors to understand the unique challenges science ITAs commonly experienced.

The working environment of Dedoose. I used research data analysis software Dedoose to store, organize and analyze the interview data. I chose Dedoose for its strength in analyzing qualitative data. First, I created the project and named it “ITA-cultural competence”, and then imported the transcriptions into the page for the project. Second, on the “codes” page of the project, I entered the preexisting codes and descriptions, such as the five components of cultural competence (e.g., cultural knowledge, cultural desire). Third, on the homepage, I opened one of the transcriptions. I would see the full transcription of one participant in the center, and the codes on the right. Fourth, I read through the transcription, I would select an excerpt and drag it to the specific code when I identified a string of text matching the description of the code. Fifth, I created a new code in “codes” section by clicking the “+” button. I added the sub-theme by clicking the “child code” button on an existing code. For example, “co-teaching” was a sub-theme under “TPD”, so added “co-teaching” under the “TPD” by clicking on the

“child code” button on TPD. Fifth, I clicked on “linked memo” and wrote memos for a specific excerpt.

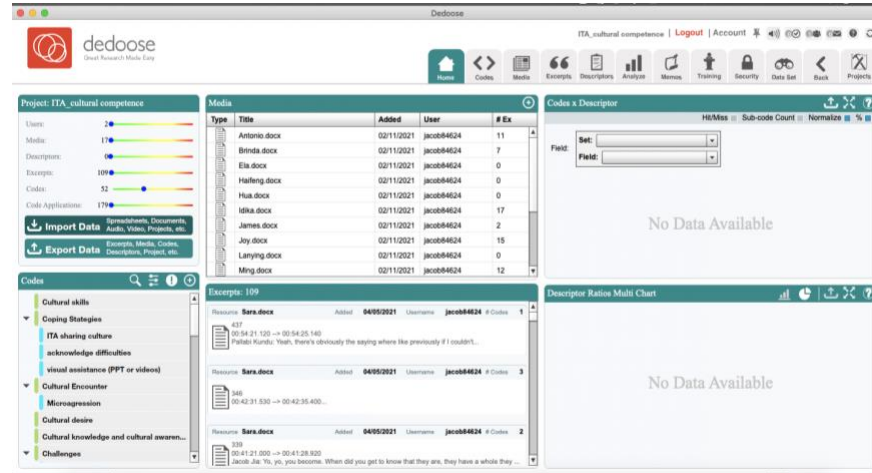


Figure 4. 4. The working environment of Dedoose.

The Data Analysis Process.

The transcripts of the interviews were analyzed following the procedure suggested in phenomenological methods: (1) the epoché (or epoche), (2) horizontalization, (3) textual analysis, (4) structural analysis, and (5) identification of the essence of the phenomenon (Moustakas, 1994; Padilla-Diaz, 2015; Creswell, 2013).

Epoché. Epoché was Greek word meaning doubt (Padilla-Diaz, 2015). At this stage, researchers need to suspend or suppress their preconceptions, prejudices, judgements to protect objectivity during the data analysis process. At the beginning of this method section, I described my own experience with the phenomenon of teaching students in the U.S. as an ITA and science education researcher. The goal was to tease out my personal beliefs and ideas regarding the phenomenon being studied. I engaged in this stage before and during the interviews, and through the data analysis process.

Horizontalization. This refers to the process in which the researcher identifies all relevant quotes and group them together. At this stage, I read the analytic memo for each participant before I reread their manuscripts. The purpose was not only to get some basic information about the participants, but also to look for quotes and stories that were relevant to the phenomenon in this study. I identified and highlighted all the participants' statements relevant to the topic of cultural competence.

Textual and structural analysis. This stage refers to grouping relevant units of analysis, the excerpts. I listened to the whole interview again while underlining quotes and making brief notes such as *cultural knowledge* on printed transcriptions. I coded for international teaching assistants' lived experiences using the cultural competence framework (Figure 4.3) as an analytical framework and I used thematic analysis methods. I would first reread the transcription for one participant, paid attention to the interviewers' questions, which could normally indicate the contents of participants' answers. For example, the interviewer asked the participants "what teaching professional development opportunities do you have for teaching?" Some participants may ask what teaching professional development meant. After clarification, the participants would say if they had any TPD at all. If they answered: "No, I don't have any." I would ask if they had any training for language or weekly lab meetings. I would mention the common types of training for ITAs as I was familiar with relevant research. I would code this excerpt as "No training for teaching" if the participants could not think of any types of TPD. Oftentimes, the participants would start with a particular type of TPD, for example, weekly lab meeting. I would code this unit "weekly lab meeting". The unit ended when the participant started talked about other types of TPD.

After coding this unit, I would write analytical memos in Dedoose for the units that fit into the analytical framework. For example, Antonio thought GTA supervisor's feedback after observation was very helpful for him to improve teaching skills. I made notes in the memo that being observed by GTA supervisor and provided feedback was a very effective type of TPD. In addition, I also wrote my challenges in coding. For example, some participants reflected on the reasons that they were having difficulty in leading discussions. The reasons were rooted in the cultural differences between the U.S. and their home countries. However, they were also talking about their instructional challenges. Therefore, I would put multiple codes on this unit (cultural differences, cultural knowledge, cultural awareness and instructional challenges) and wrote an explanation for the coding. In the meantime, I added new codes in Dedoose when new themes emerged. For example, many participants talked about their conversations with professors about teaching. I made the decision to add "informal support for training" as a new code, because this was a common type of support for teaching both in literature, in my own experiences as GTA, and among the participants in the study. Sometimes, I added a new code the first time I identified the unit, because I remembered that many participants had mentioned this in the interviews and/or it was reported in the literature.

Identifying the essence. This refers to the final stage of the analysis in which I identify the essence of science ITAs' teaching experiences in the U.S. by looking for repeating themes. The process was conducted through all the data collection and analysis process. I was looking for common themes during the pilot study, making field notes during interviews, wrote analytic memos right after the interviews, and during the textual and structural analysis process.

The five components from the cultural competence framework were the preliminary themes. The codebook is displayed in table 4.2. In addition, the results from the literature synthesis in Chapter two of this dissertation were also sources of preexisting themes. For example, the types of challenges ITAs commonly experiences (Table 2.1) and the types of TPD were themes from the literature review. However, some coding categories emerged from the analyzing process. For example, first semester was constantly mentioned by the participants as the most challenging period as ITAs. Therefore, I made “first semester” as a new theme. One major type of emerging themes was ITAs’ teaching self-efficacy. Some participants talked about their confidence in achieving teaching goals. I encouraged them to talk about this topic because they could be valuable data for Chapter three.

Table 4. 3

Analytic Codebook for Interview Data

| Code | Description | Example Response |
|--------------------|--|--|
| Cultural knowledge | The process of seeking and obtaining a sound educational base about diverse cultural groups. | “In my country, education is free for students...but here people pay to come and receive this service to learn something. So when you pay something, maybe your expectations can be different. And I don't want to judge which system is better, but it's different here. I see that students work very hard. They pay” (Zara) |
| Cultural awareness | Self-examination and in-depth exploration of one’s biases, stereotypes, prejudices, and | “(In India), I had never really participated in a proper discussion like that. It was |

| | | |
|--------------------|---|--|
| | <p>assumptions that one holds about students who are different from them. However, cultural awareness was sometimes defined as being aware of cultural differences (Arshavskaya, 2016). Both definitions are valid in this study.</p> | <p>just the teacher says A is equal to B. That's what it is. And so coming here, knowing that a lot of these students, the way the school in the school system, so the way the university is that they encourage this kind of participation” (Idika).</p> |
| Cultural desire | <p>The motivation of “wanting to”, not “having to”, engage in the process of becoming more culturally competent instructors.</p> | <p>“I'm actually really interested in teaching, and that's something that I wanted to after I finished my Ph.D. And so, I want to have all of my sort of arsenal ready (for teaching). I really enjoy all of those. I really enjoyed the workshops. I really enjoy attending stuff like that. It's kind of second nature to me whenever I see something to do with teaching, and I would attend that” (Idika).</p> |
| Cultural skill | <p>The ability to collect and interpret cultural data regarding beliefs, values, and behaviors for more effective instruction.</p> | <p>“I just realized that, on the flip side, there are international students that we have to teach. And <i>I think I can relate to them well</i> because I'm used to interacting with different kinds of people and like my parents are from China” (Joy).</p> |
| Cultural encounter | <p>The continuous process of interacting with students from different cultural background to validate, refine, or modify existing values, beliefs, and practices about a cultural group and to develop the other four components of cultural competence</p> | <p>“So, there's this organization here called international students fellowship. Before the pandemic, they would host dinners every month... So, their main purpose was to talk about Christianity with international students ...then, they will talk about</p> |

Christianity or Jesus, and then there will be dessert. So, I've had conversations with a lot of people who believe things like that (Evolution is not true). That was surprising. The first time I realized that people actually believe that” (Sara).

Trustworthiness

The adequacy of the data. It is critical to capture the experiences of participants with diverse cultural backgrounds. The author was a biology ITA from China. Therefore, even 8 of the 16 participants were Chinese, to maximize variation and increase diversity in data collection, only the interviews of three Chinese participants were selected to be analyzed. In addition, four participants were from chemistry and physics, other than biology.

Inter-rater reliability. I asked a graduate student in the MSE program to check the coding and the interpretation for interrater reliability. The graduate student was familiar with the context, research design and goals of the study; he also had experiences of doing qualitative research. We had discussions about the codebook to make sure he was familiar with the definitions of the codes. For the most part, the graduate student and I were consistent with the coding and interpretations.

Member Checks. The transcriptions were returned to the participants for feedback. For the sake of saving the participants’ time, I only sent the parts of transcriptions that were relevant to this study. Along with the transcriptions, I also asked the participants for credibility of the interpretations and findings. I also shared the

analytic memos with the participants asking for clarification. Those feedback from the participants provided evidence for both internal and external validity of my study. Those conversations with participations also helped me to set aside my judgement and prejudices, and ensured the objectivity of the analysis.

RESULTS

In this section, I will present the data to support the framework of ITAs' development of cultural competence. In Chapter two, using the extant literature as my data source, I found that one way to make sense of ITAs' development of cultural competence was that ITAs went through four phases to develop cultural competence in teaching students in the U.S. The results from the interviews with science ITAs provided more evidence for each of the four phases in the ITA cultural competence framework. In the first phase, science ITAs experienced challenges through cultural encounters, which was teaching students in the U.S. Second, those science ITAs developed cultural knowledge and awareness through experiencing those challenges and reflection. Third, science ITAs developed significant cultural desire to improve cultural skills to overcome the challenges in teaching, but they were struggling to develop cultural skills without formal TPD support. Finally, in the fourth phase, ITAs developed cultural skills effectively to become more culturally competent science instructors with sufficient TPD support.

Phase 1: Cultural Shock in Cultural Encounter: ITAs Experience Challenges When Teaching Science in U.S. Classroom (Figure 4.4).

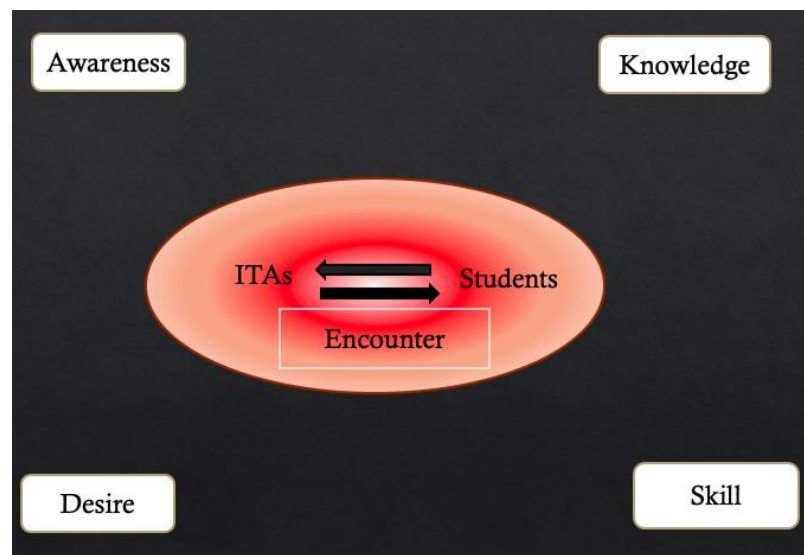


Figure 4. 5 ITAs experienced multiple challenges when teaching students in the U.S.

In the first phase of the proposed framework (Figure 4.4), those science ITAs experienced various types of challenges when teaching students in the U.S. The participants in this study mentioned 7 types of challenges: Teaching in the first semester, linguistic challenges, problematic schedule, humor, teacher-student relationship, teaching methods and microaggression (Table 4.4).

The first category of challenge was science ITAs' first semester, as most ITAs considered this period to be most challenging because they were experiencing multiple challenges at the same time. Six of the participants mentioned this type of challenges. The second type of challenges was problematic schedules without taking ITAs' unique needs into consideration, which only made their life more miserable. Two of the participants noted this type of challenges. For ITAs (some African, East Asian, South American) who are non-native English-speaking teachers (NAESTs), linguistic challenges (accent, pronunciation, understanding students, fluency & science

terminology) were their major difficulties in teaching. Eight of the participants noted this type of challenges. Six participants mentioned their challenge in understanding and producing humor and seven talked about having different expectations of teacher-student relationships. Finally, four ITAs had the experience of microaggression, which includes feeling excluded from other graduate students or faculty and being questioned by students. I will first provide a summary of science ITAs' common challenges (Table 4.4) before describing each of the 7 challenges in more detail, providing transcript excerpts as examples of those challenges.

Table 4. 4

ITAs' Common Challenges

| Challenges | Descriptions |
|----------------------------------|---|
| First-semester (6) | ITAs experienced multiple profound challenges simultaneously |
| Problematic schedule (2) | ITAs' unique challenges were not considered in their schedules |
| Language barrier (8) | Spoken English and listening; Jargon; More serious for ITAs who are non-native English-speakers |
| Humor (6) | Difficulty in understanding and producing humor. |
| Teacher-student relationship (7) | Different expectations for the teacher-student relationship |
| Pedagogy (6) | Having difficulty facilitating discussions |
| Microaggression (4) | ITAs feel excluded by other graduate students |

Note. The number after each challenge was the number of participants who mentioned this particular type of challenge in the interview.

Challenge type 1: First Semester

The first semester is the most challenging time for all science ITAs in my studies. They often experienced multiple challenges in teaching at the same time, along with their challenges in taking courses and doing research. I will use Zara's experiences to demonstrate the profound challenges science ITAs were experiencing in their first semester. I selected Zara because she started to teach science in her first semester in the U.S. without TPD support, and English was not her first language. Struggling ITAs often share all or at least some of those characteristics. Zara described her teaching in the first semester as a "trauma" experience, as she experienced multiple challenges at the same time, even to the point of considering quitting the program. Besides language barriers, she also mentioned that the schedule was not reasonable. In addition, she talked about how she did not have support from TPD, and there was no weekly lab meeting to prepare her for the next lab. As a result, she wanted to quit the program. The following excerpt from the interview Zara meant to demonstrate the significance of her challenges in her first semester:

I remember they gave us a notebook. I can call that cookbook for students for different experiments, and it was experiment 123. I don't know until 12. And they gave us a syllabus, and I expected to do the experiments in order, for example, one first week to secondary whatever. So, it was the fourth week that I prepared for the fourth experiment, and I went to the class. And it was an 8 am class on Monday, so I was the very first group. So even I didn't have any group before me to observe. That was happening. So, I went to the class, and I was like: "Oh, my goodness! I have prepared something else! And this equipment is for something

else! So I started crying. I needed to be prepared in terms of English, you know. Of course, I knew the theory behind that, and I know what's going on, and I could use that technology thing. But I was not prepared for teaching in English. So, I started crying, and I went to Casey (Pseudonym for a native GTA): "What should I do? I have prepared something else." And she came and said: "Okay, you know what's going on. Just calm down. You will be fine." She helped me, and I handle that. I mean nothing happened. But it was so hard... Maybe someone should remind us, okay people, these experiments are not in order. Or at least this is an international student. Let's don't put her as the very first group; at least give her a chance to observe someone else's class. So yeah, it was hard, so the first semester. Oh, my goodness!

Interviewer: I see. You have to make an effort to find support, and it is a miracle that Casey was in the next lab.

Zara: Exactly, I was lucky. But we do not have weekly lab meetings... Every semester, you have one-hour training about safety, the same guy comes and says some redundant information and leaves. And sometimes we receive some emails that "Okay, for example, we have printed out lab hands out. Please give them to your students" or, this semester we have changed the type of acid that we are using ...this kind of information that is for all TAs, and they send that email, or to report your grades, by the end of the week, something like this, *but nothing about class, teaching... nothing.*

Interviewer: So, the first semester was really challenging for you.

Zara: Yeah! *I wanted to quit the program. Really, I had a plan. Even until the second semester, I was like, I don't want to stay here. I will find another program in engineering and leave.* (Interview, January 14, 2021)

Challenge type 2: Problematic Schedule

Several ITAs (Zara, Ming, and Tao) mentioned they struggled with unreasonable schedules. ITAs' challenges were not considered when their teaching assignments and coursework were scheduled. For example, Zara's schedule made her life very challenging, as she taught the first lab of the week, two labs in one day, and she was also taking a course from 6 pm-9 pm. The schedule made her exhausted and miserable. Her advisor should have been more mindful of her challenges as first-time GTA when designing her schedule. ITAs can often be exhausted after teaching just one lab in English in their first semester. Tao had similar experiences, as he was arranged to teach eight hours in a single day when he was teaching for the first semester. Zara described how her unreasonable schedule made her first semester more challenging:

They sent me to the class directly, without any training and even without making sure that I can handle that. And it put so much pressure on me, and they assigned me the first lab of the week at 8 am. I was teaching until 11. And then I was teaching two to five, and then I have a class six to nine with Dr. Brady (pseudonym). Teaching six hours in English and being in class three more hours in English from 8 am until 9 pm. Maybe this semester, I don't know, in my third year or the fourth year, I can do that easily without any problem. But for the first year, why you put two classes for teaching and on the same day that the student

needs to go to a late-night class? It was so hard for me, and I remember that when I was in Dr. Brady's class, I was like, okay, I don't understand English anymore. I cannot. I'm tired... So, I was there, eight to nine teaching two classes back to back, very stressful situation, and then go to class to take care of your own course...yeah, this is what it is... I was like: "Oh, my goodness! They have assigned me. I cannot change that. But oh, my goodness, first at 8 am. Oh my!"
(Interview, January 14, 2021)

Challenge type 3: Language Barrier

For ITAs whose first language was not English and those who did not live in English-speaking countries for a significant time before teaching, the language barrier was their most profound challenge. For example, Zara talked in detail about the language barriers she had experienced and why it was important. She felt she had more responsibility when teaching, resulting in more pressure on her when she cannot express herself well in English during teaching when she can when talking to peers. She further explained that her students might have little experience interacting with ITAs who were non-native English speakers. When she struggled with English, her student might have perceived her as inadequate and thus did not trust her knowledge. Therefore, the language barrier was also a threat to her identity as the knowledge authority in her classroom:

Oh my goodness, the language barrier. It makes it ten times harder. You know, I have full confidence in my knowledge and in my teaching if I want to talk in Farsi. But my confidence suffered when I want to talk in English because I think language is the first tool that you need for teaching. And if you struggle with that

part, it's very hard. For example, I don't feel uncomfortable talking in English with you or my American friends or even faculty members. But it's harder when I'm talking with my students because there (in teaching), I have a responsibility. For example, here in our conversation, if I don't understand anything, for example, a sentence, I can ask. And I won't be embarrassed, (because) you are my friend. But in class, it's different. I'm responsible for their learning, for their grades. So, if I cannot transfer, whatever that I want to, or if I cannot facilitate whatever that's happening in that classroom or if I cannot understand the questions, it's hard. I think language is very important in that situation... *It's maybe I'm thinking about how my students judge my English...Based on my experience when you cannot verbalize your thoughts sometimes people think that it's something related to your cognitive ability and your intellectual ability,* So when you cannot tell something clearly, your students may think: “Okay, she doesn't know anything about chemistry”. And they are young...For example, I taught General Chemistry one. Maybe they have not seen many international students, international peers, or teachers whose second language is English. That's why they don't have experience interacting with international people. That's why when I cannot speak clearly, or I have an accent, sometimes they think: “okay, she's stupid. She doesn't know.” They don't trust my knowledge, and it's hard. (Interview, January 14, 2021)

Zara also struggled with chemistry terminologies because the chemistry was not her major in college. This is a common challenge for ITAs who did not learn science in English:

At first, I had some problems with terminology...Although I have graduated from a university in Iran that we used to use English textbooks and even our tests were in English. But the main official language in that university was Farsi. I was familiar with some words in my major, material science, it is somehow related to chemistry. But still, in chemistry, there are some terms that it was new for me. For example, the technologies that we are using in the laboratory here, I had problems with them. I needed to be prepared and even memorize those terms before my teaching.

Zara talked more about language barriers the next excerpt. She avoided making jokes. She thought that her accent was a big problem. She had a different accent from the students, and students have different accents among themselves too:

Right now, yes, right now, I'm trying to make connections with students and talk to them. And sometimes, making jokes still it's so hard for me, but I'm trying. But when I started teaching, Oh, my goodness, I was avoiding. Because I was like, "okay, if they asked something that I don't understand, what should I do?" so, I have problems something else that when you learn English. For example, we have different accents in English, too. And here we live in the south part. So, I learned English with a different accent, and when I started teaching here, I had many students with totally different accents. And accent was one of my difficulties. They were talking in a different way, so I need some time to get used to that accent, and it was so hard. (Interview, January 14, 2021)

ITAs Whose First Language was English Experienced Less Challenges in Language.

English was Sara's first language, and she had stayed in the U.S. as a Ph.D. student for two years before she worked as GTA. Those cultural encounters prepared her well to communicate with students in the U.S. Comparing to the Chinese students (Yamei, Tao & Ming), who had no cultural encounters before teaching and English is not their first language, Sara had an advantage in English proficiency and her teaching experience was less challenging:

Interviewer: Your case is interesting because you worked as a research assistant for two years in the States before you teach(sic), so that how do you think those two years have prepared you to teach American students?

Sara: *I mean, So, to be fair, like English was already like my first language in school. So that wasn't that difficult in terms of speaking.* So that was helpful. But I guess the first two years helped me, like one of the most important things that I still find a little challenging sometimes is to understand when someone is speaking too fast, like an American speaking too fast. So, I guess the first two years since I got to meet a lot of other people. It helped me understand the students a little bit better, without going into too much trouble and asking them to repeat a bunch of times. So that's definitely been helpful. (Interview, January 7, 2021)

Challenge type 4: Humor

Having difficulty understanding students' jokes and being humorous was a most common challenge among science ITAs, even with ITAs whose first language is English. The reason is that understanding humor and making funny jokes requires both linguistic

and cultural skills (Williams, Case & Reinhart, 2018). For example, James talked a lot about his challenge in humor. He believed that to laugh together with students was very important to create a relaxed classroom environment and to his relationship with students. Therefore, it is a common theme that not being able to understand and be humorous is a barrier to a closer teacher-student relationship, whether ITAs consider it important or not:

James: There are jokes that they make, sometimes they use TV shows or movies that you have never seen before...*there are some words that only people from that country understand and know what it means. So, when they make those jokes, you see them laughing. And they're expecting (you) to laugh, but you don't understand it.* And the same way. Sometimes I also make a joke... Sometimes because of the words you use, your sentences, the way you speak English, they don't get it...It can be difficult...*because you make those jokes so that the classroom will be lively and relaxed. So if they don't get it, it can affect the classroom environment.* So, somebody who is tensed may be unhappy or is frustrated with the materials may still be unhappy and frustrated if your jokes don't get across to help them release tension. So, we can affect the classroom environment. I mean, personally, I don't really feel, maybe, bond. It can affect my work. (Interview, January 05, 2021)

Challenge type 5: Teacher-Student Relationship.

The different expectations for teacher-student relationship led to another common challenge for the science ITAs in this study. For example, Idika mentioned a major culture difference was that Indian students were supposed to listen and obey, not

questioning the instructor. She perceived that American students often saw themselves as equal, and they would not hesitate to ask questions. It was a challenge for her because she was expecting students just to listen and learn. Moreover, because of lacking experiences of participating in discussions in her home country, she found it challenging to lead the discussions in the US classroom. She developed a strategy to cope with the cultural difference by acknowledging her expectations for student questions and her recognition of students' right to ask questions. Leading discussions is a common cultural skill that science ITAs are struggling with, and Idika's explanation provided insights into the root of this problem. Those ITAs struggled with leading discussions because they were educated in a culture that participating in the discussion was not encouraged, and the teacher-student relationship was authoritarian than being equal (democratic):

I think one of the main cultural differences was, back home, it was mostly like we kind of prescribe to the belief that the *teacher is like a form of God*, essentially because they're giving you knowledge, they're helping you grow. They're essentially molding you into the person that you are going to be. I think that is great, and you should have that kind of respect for teachers because now that I am one, I see all the background work that goes through it. *But I feel that for learning in India, it became what the teacher says is fact. So you cannot question it. You cannot discuss it. You cannot tell the teacher, "I don't agree with this," and there wasn't so much possibility of having that kind of discussion, which is why I think discussions are so difficult for me to figure out. And I had never really participated in a proper discussion like that.* It was just, Okay, the teacher says A is equal to B. That's what it is. And so, coming here, knowing that a lot of these

students, the way in the school system, so the way the university is that they encourage this kind of participation. If you don't agree or if you have something that's contradictory, you should express it, so that it's a learning experience for everybody else as well. And so, I think that was one of the main things that were very difficult to get through because it wasn't that students were challenging me or anything. So, I was a bit lucky that way. But it was just whenever that did happen or whenever they did have something that was contradictory, *it kind of, you know, put me in the spotlight, all of a sudden, because I usually wouldn't be expecting.* So that was a little difficult. *I think my judgment of the students later on was affected because I would come back saying: "why can't they just listen to what I'm saying. I know what I'm saying. I mean, I have a presentation. I have words and then why can't they just stick to that?"* And so, I think that reaction came from the fact that somewhere in my mind I also expect them not to be questioning me or what I'm saying. But again, that is something that you know I've had to consciously change. Along the years, I think actually doing that has made it easier to be in a classroom where I can directly put the expectation for them, by saying that if you do have something new that you found, or, if you read something and it's not what we are doing here, you should bring that up. And we should be talking about that. So, I think that change only has come over these last few semesters like after taking all of these workshops essentially, and that was the biggest one I face. (Interview, February 2, 2021)

Challenge type 6: Teaching Methods

Most of those science ITAs experienced difficulty in teaching methods. As Sara stated above, facilitating discussions was a common challenge for the science ITAs in my study. For example, Ming talked about how he felt too anxious to lead discussions in the lab and he would let the other TA to do that instead in his first- year teaching:

So, in the first year, especially in the first semester, I'm really nervous when doing that kind of stuff (Leading discussions). So, normally I would just ask the other TA to do that. So, most of the time the job I do is go over table to table and solve their problem personally. And the overall discussion will be done by the other TA, which may be a native speaker, or some senior TA compared with me. That feels good, but I have just escaping something and just not able or not willing to do overall discussion in front of other people...that is good but sometimes it's missing something, you know...Sometimes I feel I should have done that but I just don't dare. (Interview, January 7, 2021)

Those conversations provide insights into the reason for ITAs' difficulty in leading discussion. First, ITAs were struggling with leading discussions because of language barriers, which have been described earlier. Second, Idika explained how the different teacher-student relationship in her home country made it almost impossible to have discussions when she was educated in India. Ming also talked about that he was not confident in leading discussions because he did not have enough experiences of giving speeches and participating in discussion as a student in China.

Besides all the above reasons, James provided another explanation from the perspective of the relationship among students. James believed that it was challenging for

him to lead discussions because his students did not talk to each other outside of the classroom. It was a cultural difference between U.S. and his home country Ghana in which classmates were often friends outside of the classroom:

Now that facilitating discussions...sometimes I mean...students don't really care about each other outside of class, which I think affects discussion among themselves. So, I think that is what I see as a difficulty to get them sometimes, not always, to discuss among themselves. Sometimes you want them to work together, but then somebody doesn't want to work with them... and somebody wants to be alone. That was the challenge. (Interview, January 5, 2021)

Challenge type 7: Microaggression

Many of the participants felt excluded from peers, which was their most common microaggression experience. For example, Zara joined the chemistry education program in the spring semester, so she did not have a cohort. She had a feeling that many graduate students did not want to talk to her. She did not think it was because they had some personal reasons against her, but they may not know how to interact with her as an international student. Her difficulty to engage in conversations with peers, especially native speakers, made it challenging for her to establish supporting network for teaching, especially in the first semester, when she needed support most:

American students, I don't know. Sometimes, maybe they respect your space, or they are not sure how to interact with you, maybe they are scared to come close and interact with you. Maybe that's why they exclude you... it's not always with a negative and bad purpose. Sometimes they don't know what should they do... I'm saying that they excluded you, but it's not just that, for example, they have any

problem with my race or my language or whatever. I don't think it's true. I'm saying that in some cases, they just may be, "this girl, this international student is more comfortable if we leave her alone"It's very complicated, you cannot see what's happening, but these differences...It takes a high activation energy when two different people want to start talking and interaction. And someone should be open in this relation, you know, for example, we both were international students, and you did a great job in starting to talk to me. I'm not that person who can start this thing, but it doesn't mean that I don't want to talk to, for example, other people, or I don't want to talk to native speakers or American students. But it's hard for me starting a relationship, starting a conversation is hard for me. For example, you took care of that part for us start talking to me or telling me "Okay, if you need help, let me know". But maybe other people, native speakers in chemistry department, they were like me, it was hard for them to starting a conversation. It's hard for me for starting a conversation, so no conversation happened. You know, someone should be active in the starting. (Interview, January 14, 2021)

Phase 2: ITAs develop cultural knowledge and awareness through teaching experiences.

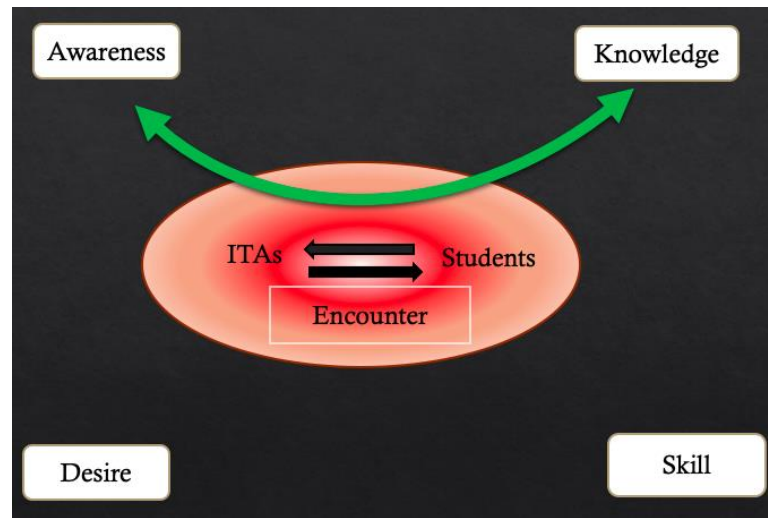


Figure 4. 6 ITAs codevelop cultural awareness and cultural knowledge through teaching.

In the second phase of the proposed framework, Science ITAs often could increase their cultural knowledge and awareness through interactions with students in classroom. The interaction between ITAs and students are the major type of cultural encounters in which ITAs develop cultural knowledge and awareness. In addition, TPD activities and social activities were also common cultural encounters for ITAs to gain knowledge about U.S. education and become aware of the cultural differences. I found four types of cultural differences: teaching methods, teacher-student relationship, perceptions of evolution, and physical contact.

All the participants mentioned the cultural difference in teacher-student relationship and pedagogy. One participant mentioned the difference in perception of evolution. Four of the participants talked about the cultural difference in physical contact. In this section, I will discuss four common cultural differences in more detail, providing transcript excerpts as examples of those cultural differences that the participants had noticed in those encounters (Table 4.5).

Table 4. 5

A summary of Four Common Cultural Differences

| Category of difference | U.S. | Home Country |
|----------------------------------|---|---|
| Teaching methods (9) | More interactive; More discussions | Lectures is the dominant teaching method |
| Teacher-student relationship (9) | More equal; Students are like customers | Teachers are more respected, and they have more authority |
| Perceptions of evolution (1) | Many students' religious beliefs conflict with evolution | Less resistance towards evolution |
| Physical contact (4) | Very clear physical boundary between teacher and students | Physical touch as a way to establish rapport |

The number after each challenge was the number of participants who mentioned the type of cultural difference in the interviews.

Cultural difference 1: Teaching Methods

All those science ITAs found that American classrooms are more interactive, and students expect the instructor to be approachable and willing to answer their questions. For example, Zara noticed the cultural difference in teaching methods between her home country and U.S.:

Of course, the way of teaching is different. For example, in my country, lecturing and direct instruction is the most common way for teaching. And here I understood that at least they try to engage students in conversation...so I needed to think about that, and how should I implement that in my classroom. (Interview, January 14, 2021)

During the cultural encounters of co-teaching with American TAs, Ming reflected on the reason that American TAs were more confident in leading discussion and communication skills. He believed that, besides being native speakers, there were cultural reasons. Ming observed that American TAs were used to talk to strangers, giving presentations, and participating in discussions. However, Chinese students often did not have sufficient opportunities to develop those cultural skills because they grew up in a different culture where those skills were not essential. Instead, the academic life in China focused on getting better grades on exams. By working with American TAs, he improved his lecture and communication skill. Therefore, ITAs and American students have been adapted to different cultures of learning and teaching, so ITAs need to improve some specific cultural skills to teach American students effectively:

The lab instructor had some tips for us on how to give a better discussion, such as some interact more with the class and picking student up and ask them “What do you think?” And don't never tell them the answer... so I kind of learned that during my teaching assistant time. Um, but, you know, sometimes I kind of feel...*the reason is, like for kids like me, born In China, and go to school and step by step and the only thing that we care about in the early age is the grades and the exam. So, I don't have that many chances to practice or to develop my speaking skills or interaction with people.* We have friends, but it's a little different. You normally had to interact with someone you don't really know that much, especially in the beginning. But for friends, it's kind of natural. Maybe he's your classmates, or he's your deskmate. And you work together every day. And you know him. *I think American children's or maybe some other culture's*

children and they are kind of more active and more encouraged to more communication and do more speech while they grew up. So, they have more practice and skills. And they are more relaxing or trained or practiced to give speech and give discussions. So, I think it makes sense that they do better than us. And obviously, they are confident. Americans I met are more confident compared with especially us. So, most of the Chinese students, I admit, are not that confident. I think it's kind of culture difference and the experience we have when we grow up. I sometimes feel they kind of give a better speech and have more interaction with people and more confident. While working with them, I kind of get some skill, of giving speech and talking with people, but is there is still different because many years ago, we got different experience. (Interview, January 7, 2021)

Cultural difference 2: Teacher-Student Relationship

All the participants became aware of the different teacher-student relationship in U.S. from their home country. ITAs were often educated in a culture where instructors possess authority over students, especially for ITAs from Asia (e.g., Zara, Sara, Idika) and Africa (James). For example, Zara noticed this difference and she explained the difference in education system may contribute to the different teacher-student relationship. According to Zara, Iran students did not have to pay to go to college, but American students have to work hard to pay their tuition, which could make a big difference in teacher-student relationship:

The relationship between the teacher and the students is different. I'm not saying that people here don't respect teachers, but it's different. The relationships are

more friendly. For example, *here people call the advisor with first name but it's not normal in my country.* for example, right now, I cannot call my advisor by Matthew (pseudonym). I call him Dr. Perry (pseudonym), because I don't feel comfortable with doing that...because I have been in that culture, and I have done that for 20 something years. So, the relation is different. I needed to adjust. I didn't have any problem with that, and actually I like this perspective more than what we have in my country. Most of the time, I'm flexible person in this kind of stuff. But I changed that, I mean, for example, if I was in Iran, maybe I didn't like my students call me Zara. But here my students, they do that and I'm one hundred percent fine with that. And, *the other thing is in my country, education is free for students. So, universities and teachers, most of the time are the authority of the educational system. but here people pay to come and receive this service to learn something. So, when you pay something, maybe your expectations can be different.* And I don't want to judge which system is better, *but it's different. So here, I see that students work very hard. They pay. So maybe their expectations are higher.* ...I cannot say in terms of quality of education, but maybe the design of the education system should be based on what they want. It's good that they want to play important role in the way that my faculty members or president of the university run whatever that is happening. In Iran, maybe since educational system is free, it's like in Iran, we think universities are faculty members and university President. But here this university is students, they pay to come... I exaggerate, but I feel in this way. (Interview, January 14, 2021)

As Sara had stated in an earlier quote, teachers were perceived “like a form of God” in India. In her interview, she talked more about the different teacher-student relationships between India and U.S. Furthermore, she provided some insights about how difference educational systems were at the root of those differences:

I would say *in the United States, it's a lot more informal than what I'm used to in India*. In India we would have to ask the teacher every time if we wanted to step out of the room. *So, there was a lot of respect, or more importance on authority and respect in India as opposed to here*. Here, if a student needs to like go outside. It's not something they will ask. They will inform me that I need to go outside. And then they can just walk back into the class. They don't have to ask permission from me to come back into the class. So that was something very different ... So, the first class I took after I came here and I was like a couple minutes late. I went to the class and the teacher was already there and talking. So, I just stood at the door, and I was like: “May I come in?” And he was like: “What?” He was very surprised that why would someone asked to come into the class. So that's definitely different. *I prefer this way of learning, because in India, I would have questions, and I would probably not ask them, because it's like I'm wasting the classes time and wasting the teachers' time. The teacher might say that “I just explained this. Why don't you understand it?” Like that. But here I feel like it's a lot easier to clarify things to make sure that you understand. And it's even encouraged to participate in class and discuss. So, I find that a better way of learning.*

Interviewer: Do you think American students have different expectations from teachers?

Sara: I guess. *Yes, because It's more like the teachers are facilitating learning here in America, while in India, it's more authoritative, like they're just telling you what to do and you just do ...Even if you don't understand, you are not always inclined to ask questions, because that's not encouraged as much. But here I guess, students expect that they will get something out of the class, and that that will help them in the future in some way...The difference is like here, you can choose the major, right? So, if you are learning something, and you don't like it, you can change your major. You can audit a bunch of classes and see which one fits you. But the curriculum in India is when you get admitted to college, you get admitted to a specific program...All the students in the same core takes the same classes. I don't have a choice to say: "Oh, I don't like this class, I will just take something else". It's mandatory. So even if I'm not understanding or enjoying the class, I cannot tell the teacher to change it or remove myself from the situation. I have to take the class and pass the class to go to the next Level... Yeah, so they if they can assess if they are learning and if they're not learning and they can tell you if there are problems...There are ways to change things up, which I think is a little more stricter in India than here...Like you cannot go tell the head of the department that you don't like this teacher because he's the only teacher who teaches the specific subject. You cannot do anything about it. (Interview, January 7, 2021)*

Cultural difference 3: Perceptions of Evolution

For some ITAs, evolution was accepted as truth in their home country, and they were surprised when they found that many Americans were questioning the validity of evolution. For example, during social activities, Sara talked to some American Christians from local churches. During those cultural encounters, which occurred before she taught evolution to her students, she learned that some Americans had different beliefs regarding evolution. This is a cultural difference related to the teaching of specific science content. ITAs need to know student prior knowledge about those topics to be culturally competent instructors:

Interviewer: When did you get to know that some Americans have different beliefs about evolution?

Sara: That probably was because I spent some time in America before teaching. So, there's this organization here called international student fellowship. Before the pandemic, they would host dinners every month, like one Friday every month. They are all affiliated with different churches who come together. So, their main purpose was to talk about Christianity with international students. And so there will be food, dinner at the beginning and then they will talk about Christianity or Jesus. And then there will be dessert. So, I've had conversations with a lot of people like who believe, things like that (Evolution is not true). That was surprising. The first time I realized that people actually believe that but yeah...

Interviewer: So before teaching evolution to American students you already know some of them are Christians and they don't believe in evolution. How did that affect your teaching?

Sara: *I try to focus on things that are evidentiary, like, why do we think that Earth is this many years older. This time, bacteria have been founded this time, because of the fossil records and blah blah, so not be too obvious about it, because they won't get exam questions on it. ...to make them understand that it's not numbers that are pulled from the air. They have evidence and they're real. But since no one has really challenged me so I guess I'm just overconfident that no one will. But I didn't have to have this conversation in class, but I had to have this conversation outside with like the organization I mentioned international student fellowship. So I had this conversation with this person in a picnic thing in the summer, like, a year ago or so. And these two people were talking, and I was sitting at the same place. And one of them said, so they almost hit a deer coming from somewhere on a highway, and then they were like: "So why haven't the deer evolved to realize that cars are predators?" ...I didn't want to get into it, but I couldn't stop myself. I just said that it hasn't been that long that cars around along with deer. And then this one other person was very interested. And they started talking and saying stuff about evolution. So, I said something and they were like: "So when was the last time you took a class that talked about evolution? And so I was taking an animal behavior class at the time. So it's like "last week!". And they were like, "Oh really? I thought they stopped with that thing. I thought they don't teach evolution in college or like my tax dollars are going to teach to like kids about evolution? I mean, Christians have many denominations and differences but Catholics, like the Pope believes in evolution. So, does that not count? Anyway...evolution is the biggest concern. (Interview, January 7, 2021)*

Cultural difference 4. Physical Contact

Many ITAs learned about physical boundaries that instructors should maintain with students in the U.S., which could be explained by the different teacher-student relationship. For example, Zara noticed the cultural differences in physical contact with students between U.S. and her home country:

In Iran, people can touch each other...it's a normal thing. For example, if I see you, I can tap on your shoulder...touching is not something bad. But when I came here I understood that some people are very sensitive to this. So I was very careful to not touch my students, even, for example, they answered a very hard question and I want to encourage them. Something like this is very normal in Iran to touch people and say: "Okay good job". But I was trying to not to do that here.

(Interview, January 14, 2021)

Phase 3: Even with strong cultural desire, science ITAs had difficulty developing cultural skills without formal TPD support.

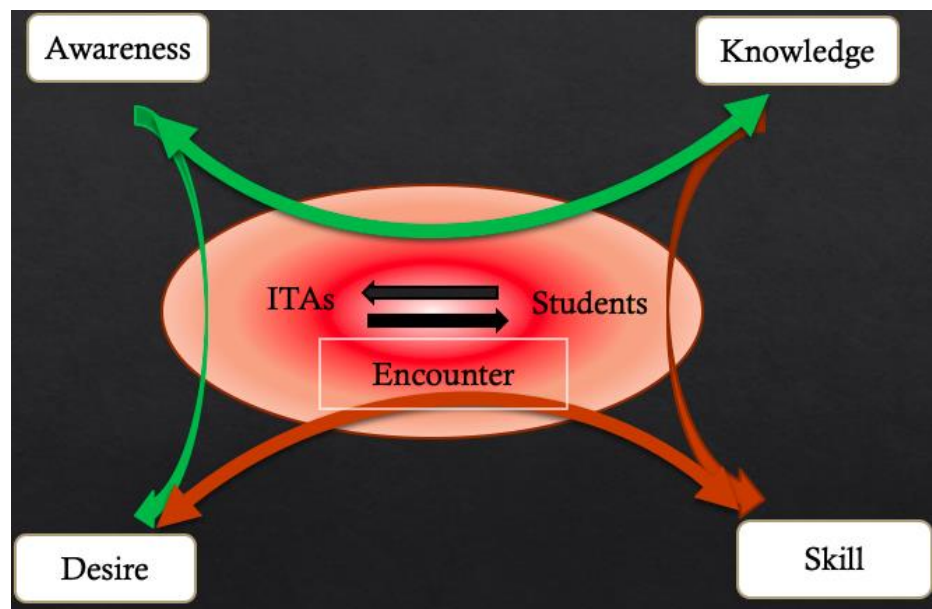


Figure 4. 7 ITAs are struggling to make culturally competent instructional changes without TPD. Red arrows represent that ITAs cannot transfer their cultural desire, knowledge, and awareness into cultural skills without formal TPD support.

In phase 3 of the proposed framework (Figure 4.6), those science ITAs had developed cultural knowledge of the U.S. classroom and increased their awareness of the differences between U.S. and their home country primarily through teaching experiences. They also developed the motivation, the cultural desire, to overcome the challenges that they were facing as ITAs. However, without formal TPD support, they often had difficulty improving some cultural skills. I found three types of cultural skills: linguistic, pedagogical, and cross-cultural communication. Most of the participants talked about those three cultural skills in interviews. However, after teaching for at least three semesters, three of them were still struggling with linguistic skill, four with pedagogy and cross-cultural communication skills (Table 4.6).

Table 4. 6

Three Cultural Skills for Science ITAs

| Type | Descriptions |
|----------------------------------|--|
| Linguistic (3) | English proficiency |
| Pedagogy (4) | Teaching methods |
| Cross-cultural communication (4) | The ability to establish rapport with and relate to students from cultural groups other than their own |

In the next session, I will use the excerpts from Yamei's case to illustrate this phase. Yamei was very motivated to improve her teaching and she wanted to pursue career of teaching chemistry. However, after teaching for 2 years, without formal TPD support and lack of opportunities for cultural encounters, she still had difficulty developing cultural skills such as English proficiency, engaging students in scientific discourse, communicating with students from different cultural backgrounds.

Cultural Skill 1: Linguistic

Yamei had been struggling with language barriers since she started to teach chemistry as TA, especially in the area of spoken English and chemistry terminology. Besides, she was not confident with her English and teaching, because she thought English was a major problem for her. The quote below was her descriptions of her language barriers in teaching:

I enjoy teaching, but I feel it will be better if I can speak English fluently. If I can have no language barrier, I will enjoy more...I think the first reason is I don't

think my oral English is good and I spent a lot of time to pass the TOEFL. My speaking English is very poor. I'm not confident when I speak to others in English. No matter I teach others or even talk with others. And the second reason is actually I'm good at chemistry, but I never read a chemistry book in English. I don't know how to teach students the chemistry materials in English because I never talk about it (in English) before. This is a big burden for me. So, before every class I will prepare a lot, like write down the materials, I will speak in the class. It caused me a lot of time. I don't like this part. But I have to do it.

(Interview, January 13, 2021)

Cultural Skill 2: Pedagogy

Yamei was also struggling with engaging students in discussions after teaching. She was frustrated when she asked students questions, but no students responded. She did not realize that she was asking close-ended questions, which was not effective in eliciting student thinking:

Yeah, so in my review session, I teach students one question. And after I taught them. I asked: "does it make sense?" No people answered me. I'm so embarrassed. I don't know what to do. I really need to see a response. But they don't respond to me, and I don't know if it is okay for me to go to the next question or I need to wait until they give me a response. So I don't know how to judge the situation. (Interview, January 13, 2021)

Cultural Skill Type 3: Cross-cultural communication

Yamei had difficulty interpreting students' response because she had little cultural encounters with people from different cultural backgrounds. In the quote below, Yamei

talked about how she was struggling with developing cultural skills to communicate with students in the U.S. because of lacking cultural encounters. Cultural skills, in her context, include how to interpret her students' words and body languages. Yamei had profound difficulty understanding American students and international students from other countries:

I feel it's a little weird that you talk with foreign students. For us (Chinese students), American students or other international students are all foreign people to us. In China, we don't have the chance to talk with foreigners, right? So, you just don't know what they're thinking about. When you talk with them, you don't know if they like the topic that you are talking about. Or if they keep silent, does that means they understand what you are talking about, or they just feel totally lost, or they don't want to talk with you anymore. So, there's a lot of uncertainty.

Yeah, so this is why I feel no confidence. (Interview, January 13, 2021)

Informal Support for Teaching

Yamei had no formal TPD support for teaching. Her advisor was her only support for teaching. Her conversation with the professor could be perceived as an informal TPD. The professor encouraged her by complementing her English and convinced her that English should not be a problem for teaching. She encouraged her to talk more and clarified that no student response was normal. After the conversation, she was more motivated to teach:

That happened several times, but later I feel better because when I talked about my feeling with the instructor for that class. And she encouraged me and she told me it is totally okay and it is very common... I feel more confident after talking to

her and not feel stressful when teaching students or answer their questions. I just think I just need to do my best to do what I can do, and ignore the language barrier. *I like her response, maybe I just need some encouragement. When I get the encouragement I need, I can have more energy to prepare for the class, with or better feeling, with a better mood...* Not just she, but all instructors I matched with are very nice... *While I talk to them. I'm afraid I cannot give the class very well because of the language barrier and they all encouraged me and said: "Oh, your English is very good. Feel comfortable to speak out. And you can handle it, or something like that. That give me a lot of encouragement.* When I have some questions, I feel free to talk with them. One important point I get from them, is that they don't think language barrier is a problem for international students. It seems that it's only me worried about it, and even instructors and others don't think this is a problem. So yeah I think maybe I think too much. I just don't care about language barrier, just talk with students as much as I can.

Strong Cultural Desire

Yamei had developed the cultural desire to improve her teaching through the cultural encounters in teaching and informal TPD. In the following quote, she talked about her career plan to teach chemistry:

I don't have to feel I'm not good at speaking English. That's why I need to spend a lot of time on it. I will think: "Oh, this is a good chance for me to practice my English. I can handle it"...Although now I still feel nervous to be TA in a class. But I will not feel like I don't want to go to the class. I don't have that kind of feeling. *I just want to practice myself and I actually enjoy interacting with*

students, because my aim is to be a chemistry teacher in the future. So, I really enjoy helping students if they don't know how to solve this chemistry problem, but with my help, they can understand it and I will say: “wow, yeah. It's so easy! Right? Yeah. That was it. Oh, it's not that difficult!”. It's really encouraging.

(Interview, January 13, 2021)

Yamei considered teaching as an opportunity to improve her English. She even developed the self-efficacy to be a chemistry teacher in the future as she enjoyed interacting with students. She felt the sense of satisfaction in teaching. However, those conversations with her professor were merely emotional support. They did not talk about how she could improve her teaching methods and make her classroom more interactive. Therefore, her cultural skills did not improve as much as those ITAs (Ming and Antonio) with sufficient formal TPDs. One primary function for those TPD activities is to provide ITAs the cultural encounters to develop cultural skills.

No Formal Training for Teaching

Yamei had no formal TPD support and she expressed her need for training in teaching. She never mentioned any teaching strategies in the interview. When she was talking about training for teaching, she was thinking about helping GTAs to be familiar with the contents and procedures of the lab, not pedagogy:

I actually have no training for teaching. I think we should have some training like how to teach students...Instructors just tell you, today we will do this experiment and tell students what to do or something like that. We even don't have those training. But for being a TA for a class, not for the lab, I feel a little better because the instructor for that class only has one TA. It's me. So she will talk a lot

of issues with me about the courses including students problems...and we have more interaction. *So it's not a formal training, but through the process, I can learn something. But it's hard to say what I have actually learned from her.*

Lacking cultural encounters

Yamei talked about how she was lacking the time to practice English. Her roommates and classmates are majorly Chinese. She did not feel comfortable talking to Americans just for the sake of practicing English. However, when there were social activities in the department, she was glad to talk to Americans. The pandemic was also a factor of lacking social activities:

I don't think I have a lot of opportunities speaking English. I meet with my advisor once a week. And every time it is about a one hour. And being TA like now, this year, I only get students come to my office hour. *My roommates are all Chinese and we speak Chinese together. And my lab mate is Chinese. We do have a postdoc (who is American), but we don't communicate a lot. I don't like to go out, just to make friends, just to practice your English.* A lot of people advised me to do this. I just don't like it. So my way is maybe watch some English TV show, like Friends...*If we have activities in the department and we gather together, I'm glad to talk with other graduate students in English. I will not avoid talking with others.* I'm glad to do, but I just don't want to create some activities intentionally. Before covid-19, we will attend a seminar every week. And in the seminar, I can meet with other graduate students, and we can talk with each other. But I haven't met them for almost a year. (Interview, January 13, 2021)

Yamei's case illustrates well the pivotal role that cultural encounters played in ITAs' development of cultural competence. To support ITAs to develop cultural skills, TPDs are essential because they provide ITAs with opportunities for different types of cultural encounters. Therefore, I will discuss how sufficient and high-quality TPD activities help ITAs to develop cultural skills in the next session, in the case of Antonio and Ming.

Phase 4: With sufficient TPD support, ITAs develop cultural skills to teach effectively and become more culturally competent instructors.

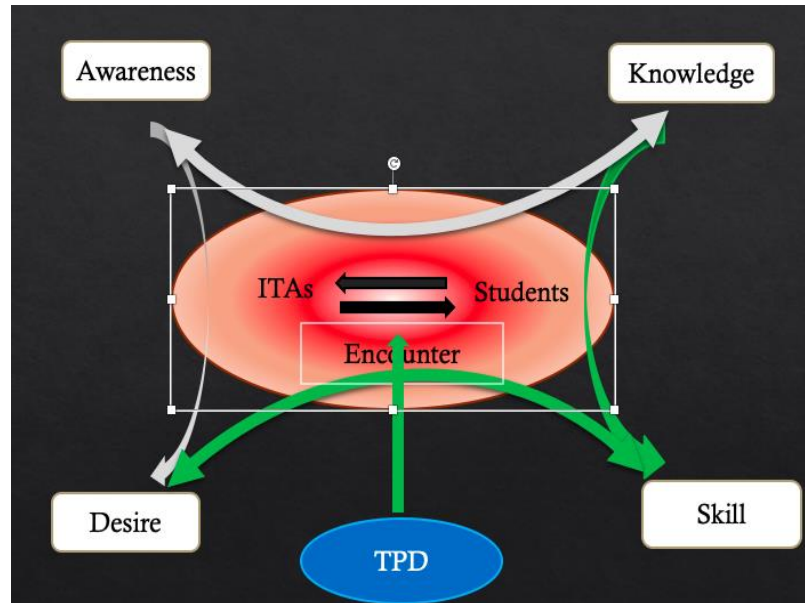


Figure 4. 8 ITAs can make culturally competent instructional changes with TPD. Green arrows represents that with sufficient and high-quality TPD support, ITAs can effectively develop cultural skills.

For those science ITAs with sufficient TPD support, in phase 4 of the proposed framework (Figure 4.7), they developed cultural skills efficiently and became more culturally competent instructors (Green arrows in Figure 4.7). They started to get positive evaluations from students and acknowledgement from faculty for their quality of

teaching (Antonio). Those ITAs also enjoyed teaching at this phase more than ever (Ming). Both Antonio and Ming had experienced profound and various challenges in teaching at the beginning of their GTA career. With the sufficient and systemic support for teaching they obtained from their university, department and faculty; however, their cultural skills had improved dramatically. Therefore, I will discuss phase 4 primarily with Antonio and Ming's experiences. In the next section, I will present the four major types of TPD that addresses ITAs' specific needs to develop cultural competence: English as Second Language (ESL) training, ITA program, observing other TAs, Co-teaching with another TA, being observed by GTA supervisor (Table 4.7). In general, the frequencies of those types of TPD that the participants mentioned were low, with ITA program mentioned three times as the most common one (Table 4.7).

Table 4. 7 *Four Types of Effective TPDs to Support ITAs' Development of Cultural Competence*

| Types of TPD | Cultural skills |
|----------------------------------|----------------------------------|
| ESL Training | English; communication |
| ITA program | English; pedagogy; communication |
| Observing other TAs | Pedagogy; English |
| Co-Teaching with another TA | Pedagogy; communication |
| Being observed by GTA instructor | English; pedagogy; communication |

TPD Type 1: English as Second Language (ESL) Training

Antonio talked about how pre-teaching program (ESL) helped him with his English skills, improved his pedagogical skills, and develop cross-cultural communication skills by making friends with ITAs from different cultural backgrounds. In ESL training, those ITAs shared their own cultures, and this can be considered a type of cultural competence training. They also had the opportunity to establish supporting network with the ESL instructor and peers. Those kinds of training were exactly what Yamei, Tao, and Zara needed to overcome their language barriers, as this program created various opportunities of cultural encounters:

Antonio: According to Texas state, as soon as I get here, they gave me a prep session, a position, so I just gotta set up the labs, put all the material together, because during that semester, I was required to take the ESL course. Just like a class. They train you for one semester on how to teach classes, how to speak in front of people. They make you practice a lot, so at the end if you pass the class, that means that you are allowed to teach. They think that you can teach a class here in the university.

Interviewer: So, do you think that course prepare you well for the course?

Antonio: Oh yes, a lot, because it was the first time here in the USA. So, I practice English in my country, but it was just in classes. I never had a chance to practice like person to person or an area like we're doing right now. The first class, for example, help for you to try to organize your ideas in English. Don't get nervous and get used to be in front of people. Be able to organize your ideas in English was the hardest part for me to do like. *Okay, I think this, but I think it in Spanish, then I get it translated in English. Well, the students are not going to*

wait for you to do that. It's gotta be kind of a fluent class so yeah, it helped me a lot, especially in order to get out the nervousness like stopping such nervous. And with that pass of the time, I am more like I can do, I can organize my ideas in a faster way. I kind of speak more fluently... The good thing about that class was like the students that were in that class came from different countries, so I was from Bolivia, I had people from Germany, China, India. *So, we use kind of like a perspective of our cultures to be introduced to the other students. So, you would be teaching something about your culture, and that was a way that we can share our experiences. In a way, that we are the same thing teaching for them. We're teaching about how kids go to school, how you usually spend your weekends, what are the national holidays in your country, so you are not only a class, but also we were using cultural resources to be part in the class, so I think that I learned a lot and I make good friends. It was very nice.* (Interview, January 30, 2021)

TPD Type 2: ITA Program

Idika participated in a university-wide ITA training program before she actually taught any courses in the U.S. It was helpful but she did not apply those teaching strategies into her class when teaching. The problem with this ITA program was that it was before ITAs had any teaching experiences in the U.S. and the content seemed "foreign", and it was very general and ITAs found it hard to connect to the specific course they were teaching. She mentioned later that the TPD in her department filled this "gap":

The university does have an ITA workshop at the beginning, which is before the semester you start teaching. So, it's compulsory for all the international for us to go through that before you can get a teaching position. But I think that one was more catered towards how an American classroom would look like, and there was more emphasis on the way you speak or the way you present yourself. When you're talking, you may want to emphasize certain words, so I mean they did also have these micro-teaching events as well, but it was more towards you getting just a little bit comfortable being in front of a class. And that was actually before I even taught it. It made me a bit comfortable standing in front of the class, because almost every other day we had to present something in front of everybody, and so just constantly being in front of the room and having everyone look at you, I think it helped a lot that way. And they did actually in practice do a lot of these *discussion techniques* with us, they did a lot of those techniques, where you have like what is your muddiest point... Then they had us, talk to our neighbor, the *think-pair-share techniques and things like that they did actually use in practice, which I do remember noting down, but for some reason, did not directly put that into practice, which I think was on me*. But they did they did actually you know show a lot of those techniques in practice. I don't think I actually got it at that point. But then later on looking back at it and looking through my notes, I kind of realized that you know they actually had done a lot of that stuff as well. *I think for a lot of us who didn't really know what a classroom in the US would look like, these techniques seemed a little foreign and I wasn't entirely sure how to put it*

into practice, which is probably why I didn't. Because I wasn't sure what kind of success I would get out of that. (Interview, February 2, 2021)

TPD Type 3: Observing other TAs' Teaching

Antonio found that observing experienced TA teach was very helpful in preparing him to teach for the first time. In addition, co-teaching with another TA also includes observing other TAs' teaching, for which I will discuss in Ming's case in the next session:

The good thing like during that prep session time, my advisor told me go to other classes to see experienced TAs. Just go in a corner and let's see how they do it. I was spending a lot of time, also in other classes, so I kind of like get an experience or the way of American classroom. So, the next semester immediately, I was selected to teach those classes. (Interview, January 30, 2021)

TPD Type 4: Co-teaching

Ming was paired with another TAs since he started teaching in the first semester. He considered this type of TPD very helpful. Based on Ming's case, co-teaching appears to be one of the most effective TPD activities to support ITAs in developing cultural competence in teaching. Therefore, I will discuss in detail the process of how co-teaching with another TA helped Ming to become a more culturally competent instructor.

First, Ming observed his partner leading discussion and engaging students in one-on-one conversations. Thus, co-teaching provided him the opportunity to learn from a role model for teaching. Even though, at the beginning, Ming would ask his partners to

lead the discussion and avoided doing that himself, he had developed the motivation (cultural desire) as he felt he was “missing something”, and he “should have done that”:

Since you have a partner, you got some help. Especially in the first year, *I learned how to behave when I work together with another TA. They do something and I can just learn that, or I can learn how they talk when they do discussion or how they talk when they instruct student table by table.* So that's what helps me when working with others... So, in the first year, especially in the first semester, I'm really nervous when doing that kind of stuff. So, normally I would just ask the other TA to do that. So, most of the time the job I do is go over table to table and solve their problem personally. And the overall discussion will be done by the other TA, which may be a native speaker, or some senior TA compared with me. *That feels good, but I have just escaping something and just not able or not willing to do overall discussion in front of other people ...that is good but sometimes it's missing something, you know...Sometimes I feel I should have done that, but I just don't dare.* (Interview, January 7, 2021)

Second, with some experience of co-teaching with other TAs, Ming started to appreciate having an American TA as his partner and he improved cultural skills, such as linguistic, pedagogical and cross-cultural communication skills, in those cultural encounters. In the excerpt below, Ming explained the benefits of having a Chinese partner and an American partner. He learned more about teaching, culture and language, when paired with American TAs:

Interviewer: Would you prefer to be paired with another Chinese TA or American TA?

Ming: Having a partner with Chinese TA...the good thing is...it's more easy and relaxing when communicating with them, because you can just speak Chinese. And, as a Chinese, I feel most comfortable when I speak Chinese, compared to speaking English. *But the good thing to having a native speaker partner is that you got to know something different from you, either culture or the way they speak, or the way they do things.* So, you learn a little from that difference. ...So, *chatting with people from different country always brings me some new thoughts and new experience.* So, it's also good. you know, making friends don't rely on nationalities. *So, you can make friends with Americans, with Chinese, with people from all over the world.* (Interview, January 7, 2021)

Third, Ming started to compare the American partners with himself and his fellow Chinese ITAs. He captured the qualities that those American TAs possessed and their techniques to lead a successful discussion. He noticed that the key quality that American ITAs had was confidence. Ming even reflected on why in general Chinese TAs were not as confident as American TAs. During those cultural encounters, Ming was developing cultural awareness and knowledge and improving his pedagogical skills:

I will ask the native speaker to do the discussion because they know the physics (terms). Physics is not that hard, the hard thing is talk. So, they will do that confidently...American students are always confident...So they do that really well... first they are willing to do that. And sometimes when I was paired with a native speaker, they're kind of offered to do that. So, you don't even have to ask whether you want to do that. And you know *in the in the later time, I have to say:*

"Can I do that?" So, I will do that. And I guess they kind of have the feeling that a foreigner don't want to that...They are confident, and they want to keep the answer a mystery. So we have some words to get you through it. But they don't really want to tell the answer, like, yeah, I don't want to tell the answer when I was doing the discussion, but I don't feel that I have that tension when I talk, but they have that kind of tension, which is good, which is a little amazing and it kind of feel it's doing a good job to like grab the attention of student, which I don't think I have the ability to do that. So having them to do the discussion kind of helped me a lot and let me learn something. That kind of thing, most of time, only appears on the native speakers. Some of the other international students do discussions, and I don't think there is some ...maybe a passion...(Interview, January 7, 2021)

Fourth, even with hesitancy and doubts, Ming attempted to lead the discussion himself, after observing his partners do that "lab after lab". Even Ming did not want to do it in the way American TA did it, he still tried because he saw the benefits. Ming explained his reservations, because he considered the process of leading whole class discussions "time-consuming", and he felt that he did not have the power to put one student on spot, by asking them to present their thoughts on the board. Ming demonstrates the cultural desire to learn and practice the cultural skill of learning discussion:

Sometimes, actually I can also do that kind of interaction. *But I just don't want to do it.* I just don't want to pick a student out and make him write something on the board. Sometimes I do that, because sometimes the instructor said it's good to do

that, but *I just don't feel comfortable doing that. I just feel I just don't think I have the power to just take a student and do things_...Actually, I'm kind of learning that... after. So after lab by lab, I kind of want to do that. I mean, maybe not want to that, but I kind of do that, like, what do you think, and I'll give the pen to one of the students and let him write something, you know, sometimes it's really wasting time. Maybe I shouldn't say wasting time. But it's time consuming.* It's kind of you pick some student and he just to work on the board really slowly and he didn't seem to be willing to do that. And sometimes he wrote something on it and it's not correct. So, I have to pick another student working really slowly on the board and write again until maybe sometimes I found it, or after several trials but no one gets the answer. So, I have to start over. (Interview, January 7, 2021)

For leading discussions, Ming was anxious, and he avoided doing it at the beginning. Then he started to try himself after observing his partners for a while, even he was still hesitant and questioning the efficiency of the teaching method.

Fifth, in the end, he was actively seeking opportunities to lead discussion and genuinely enjoyed applying this particular cultural skill in his teaching. In the following quote, Ming described his gratifying feeling of leading a successful whole class discussion:

It is satisfying and amusing when you see students really understand something that you explain. So, I kind of enjoy having a whole class discussion in a later time, because I kind of feel, when you talk about something. It's like some mysterious to the student in the beginning, and then you talk about like peeling an onion, you know, you just push a thing a little step forward. And they feel kind of:

“Oh, there might be something behind it”. And then you do a little push more. And then they just got more sense. And after that, in the end, they just go: “Oh, that's it!”. That's the whole thing and that's the physics. That's kind of like you guide them through the maze, and they finally found the result by themselves or under your guide, no matter what. It's kind of amusing that they are really willing to listen to you and think about it. And you are already getting them through the whole process so that kind of gives me a good feel. (Interview, January 7, 2021)

TPD Type 5: Being Observed by the GTA Supervisor

The GTA supervisor observed Antonio's lab regularly and provided specific feedback on his teaching, which was very helpful. This type of TPD provided Antonio specific suggestions based on his teaching practice. It is a very effective TPD activity to help ITAs to increase cultural awareness and knowledge and develop cultural skills:

The advisor of the course used to come to our classes for an hour and two hours and making notes. So, every week, at the end of the week, he called us in his office and say: “Okay you're making some wrong pronunciation in these things. You are moving your hands too much you gotta be able to include all of your students.” *He was a huge help. Because he was not trying to criticize you. Instead, he was trying to give you a positive feedback, so you can improve your teaching skills. So I think I learned a lot from him.* Especially for new TAs, the first three or four weeks, he was in our classes, I used to teach twice a week...he would come to one of my classes and stay for one hour there, the next time the next week. *With the advice that he has already given us, so he will see (whether)*

you actually were applying and, at the end of the week again. So, in my case, he was just three times and he said: “Okay, I think you're ready. You can do it on your own. “But there are other TAs, he was like going 5, 6, 7 times, because they were like getting problems in the class. *And I think the most useful for me was the way that you need to interact with your students...* Usually, in my country, for example, I used to teach one class in one university. It was like: “OK, I need to get the lecture and the students are there just to listen, get notes”. That's it. But he (the GTA supervisor) requires a lot of interaction between students and the teacher. So, it's like: “Okay, don't just lecture and tell them. Make them work as a group”. *He really helped me a lot in that kind of stuff. So my way of teaching changes, a lot like 180 degrees like. Just me in order to be interactive in class. ...* For tips, for example, “don't put your hands in the pocket, because that gives you like a feeling to the students, that you are not interested in what you're teaching. Try to move your hands more and increase a lot of your voice. Don't speak like in the same tone of voice like that, because it's kind of boring...Go down, move around the students, call them by their names, look them always in the eyes”. So those kinds of small tips, but actually that makes a huge difference in the class. (Interview, January 30, 2021)

Discussion

The purpose of this phenomenological study was to provided evidence for the proposed framework about ITAs’ development of cultural competence in the literature synthesis, chapter 2 of the dissertation. Consistent to previous research on ITAs in

general (Arshavskaya, 2015), science ITAs experienced profound challenges in teaching students in the U.S., especially in their first semester. Teaching professional development opportunities are critical for science ITAs to develop cultural skills including English proficiency, pedagogy, and cross-cultural communication (Dimitrov et al., 2014; Meadows, Olsen, Dimitrov & Dowson, 2015; LeGros & Faez, 2012.). Those three types of cultural skills expand upon the findings from the literature synthesis in which making instructional changes was the primary cultural skill acquired by ITA samples in the reviewed studies.

The results of this study provide important implications for designing teaching professional development programs for science ITAs. First, cultural skills should be the focus of TPDs because ITAs had difficulty developing those skills through teaching experiences alone. Yamei, Tao, and Zara were all struggling with cultural skills even after teaching for more than one year because they did not have sufficient and relevant support from TPD. Language, pedagogy, and cross-cultural communication skills are the three primary categories of training that ITAs need most. All the participants, including native English speakers (Idika & Sara), experienced continuous difficulty with language, especially in the areas of accent and humor, which was consistent with prior research on science ITAs (Erumit et al., 2020; Arshavskaya, 2015). For ITAs who were non-native English speakers, language barriers were often the most challenging part of teaching (e.g. Zara, Yamei, Tao & James) (Li, Mazer & Ju, 2011). The language barriers are also connected to their ability to lead discussions (Zhou, 2014), as in the case Ming & Yamei. Ming, Idika & Sara explained their struggles in leading discussion with their learning experiences in their home country, where participating in discussion was not expected in

class and they were expected to listen to teachers' lectures instead. This different culture in teacher-student relationships posted a barrier for ITAs to lead discussions in U.S. as some of them are resisting it because they could not even appreciate the value of such pedagogy at the beginning (Ming & Idika). Some ITAs were not confident in communicating with students because they did not have ample cross-cultural communication experiences (Ming, Yamei, Tao). However, Joy believed she could relate to the international students in her classroom because she could understand their experiences as she was an international student herself.

ITAs supervisors should be mindful of ITAs' unique challenges when assigning teaching tasks and selecting instructional course work for ITAs, especially for those who are teaching in their first semester. Zara and Tao had "painful" and "trauma" experiences in their first semester as GTAs, partly because their schedules were not reasonable. GTAs' supervisors should recommend or even require science ITAs to participate in different types of PD according to ITAs' specific needs, as Antonio and Ming's GTA supervisors had done for them. For ITAs who are non-native English speakers and have little living experiences in the U.S., English language training like ESL will be critical for ITAs to function as effective science instructors (e.g., Antonio) (Gorsuch, 2011). Professional Development sessions within the department such as weekly lab meetings are crucial for ITAs to be familiar with the context and jargon in their specific disciplines (Jia & Bergerson, 2007). Cultural awareness and knowledge training could start before the semester to help ITAs to prepare for their first semester, along with language training.

Finally, GTA supervisors, peers, and faculty are essential for science ITAs' support network for teaching (Reid & Gardner, 2020). Observing other TAs and co-

teaching with other TAs are very effective ways for novice ITAs to learn from their peers (Howlett & Nguyen, 2020). GTA supervisors should observe ITAs' teaching and provide feedback to help ITAs improve, which is probably the best way for ITAs to get specific suggestions for their teaching. Among all the participants, only Antonio had such support and he believed it was extremely helpful. ITA programs, which address ITAs' needs for teacher training specifically, are a very effective way to improve ITAs' ability to communicate and establish rapport with people with different cultural backgrounds in a low-stress environment. However, ITA program should be continuous across ITAs early years of teaching rather than a one-time training.

ITAs with different cultural backgrounds and prior teaching and learning experiences have different needs for cultural competence development (Jia & Bergerson, 2007). For example, James, Antonio, Zara, Yamei, Ming and Tao are non-native English speakers, and they had no teaching or learning experiences in the U.S. before they taught their first time in America. Language barriers were their major challenge and they also needed training in cultural knowledge, cultural awareness, and cultural skills related to pedagogy and communication. However, Sara, Joy, Idika were native English-speakers, so their English proficiency was sufficient before their first teaching experience. Sara had already stayed in the U.S. for two years before she worked as GTA, so she had gained some cultural awareness and knowledge. For ITAs like her, training should focus on improving pedagogical skills.

Future research should focus on creating an instrument to measure science ITAs' cultural competence in teaching and conducting survey studies of science ITAs in a large scale. In such survey studies, researchers should explore and summarize ITAs' specific

challenges related to different cultural backgrounds and prior experiences. Due to the covid-19 pandemic, I was not able to conduct observations on science ITAs' teaching practices using observation protocols and conduct interviews with ITAs while they are watching their teaching recordings. That should be another future research direction because more insights can be gained into the ITA problem through direct observation of ITAs' teaching practices rather than merely through ITAs' own perceptions. Finally, more studies need to measure the effectiveness of different types of TPDs in supporting ITAs' cultural competence development.

Conclusion

The results from this study have provided validity evidence for the ITA cultural competence framework that I reconstructed in chapter 2. First, cultural encounters are the pivotal component and the driving force for science ITAs to develop cultural competence in teaching. Those cultural encounters include ITAs' teaching experiences as GTAs in the U.S., participating in teaching professional development programs, and informal PD such as conversations with advisors and peers. Second, ITAs experience different types of challenges in teaching and those challenges are often profound, especially in their first semesters, as some ITAs had traumatized experience and student learning was compromised. Third, science ITAs can develop cultural awareness, knowledge and desire in teaching experiences, but only through TPDs can they develop critical cultural skills efficiently such as English proficiency, pedagogy, and cross-cultural communication skills. Thus, TPDs are essential in support ITAs' development of cultural competence and

developing cultural skills should be the focus of the training ITA in develop cultural competence.

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Appendix 4A

Interview protocol for ITAs' process of developing cultural competence.

1. What challenges have you experienced in teaching students in the United States?
2. How do you perceive the culture differences between themselves and the students?
3. What instructional changes have you made to address the challenges based on their perceptions of cultural differences between themselves and the students? Why?
4. What teaching professional development experiences have you had? How have those teaching professional development experiences impact your teaching practices?
5. How do you perceive students' perceptions of and attitude towards them? And how have those perceptions and attitude impact your teaching practices?
6. What strategies have you adopted to change students' negative perceptions, if they exist? And how effective are those strategies?

Appendix 4B

Analytical Memo for Participants after Interviews

Biology ITA from South America-Antonio

Antonio was from Bolivia. He was very confident and very fluent in English. He talked very fast. He had been teaching the same lab for ten semesters. The GTA instructor, who had retired now, would observe his class, helped him with pronunciations, and made a suggestion on how to interact with students. The instructor also encouraged new TAs to talk to more experienced TAs for help. He also participated in an ESL course, which helped him a lot with his English and cultural awareness. He gained a lot of confidence in teaching, partly because of the positive feedback he got from students. And he got to teach more advanced students. He thought that his increase in content knowledge helped improve his confidence. He thought his teaching experiences helped him to become more confident in giving a lecture. He wanted to pursue a career that involved teaching biology.

Biology ITA from India-Idika

Idika had been teaching biology for five years. She was super motivated to teach and wanted to pursue a teaching career. She had so many opportunities for support in teaching. She taught labs most of the time, except for last summer when she taught a “lecture + lab” course with a peer. The biggest challenge teaching in her first year was that she did not know students’ prior knowledge. She asked lots of closed-ended questions and expected students to answer without giving them opportunities to have a discussion first. The biggest challenge for her now is to apply what she had learned in

TPD to her classes. She mentioned that faculty were supportive, but the majority of them did not know how to support her in the way that she most needed it. In general, she thought she was well respected by the students. She said the reason was that there are many international TAs in the department, and students had more experience with ITAs. The major cultural difference was the teacher-student relationship. In India, the teachers are the authority, and students are supposed to listen, not argue. But in the U.S., students, and teachers are more equal. This is why it is difficult for Idika to lead the discussions because she had never had that experience in India as a student. Idika mentioned that she learned most of the content knowledge in English, and it was a great advantage for her to teach in the U.S. But she was frustrated when students could not understand her because of her accent.

Biology ITA from Africa-James

James was a biology graduate student from Ghana who had two and half years' teaching experiences at two universities. He carried a pretty strong accent, and I had difficulty understanding him sometimes. James was not comfortable with the power that American students have in the classroom. He said American students would not obey what the instructors told them to do. He often met with student resistance. He also talked about how he dealt with those situations. He considered that those incidents were affecting his relationship with students. He spent a lot of time about humor. He thought that laughing together with students was very important to create a positive learning environment. He got better at making jokes other than understanding jokes over time. In the end, he mentioned ITAs should have the support that helps them to overcome cultural differences so that ITAs can be accepted well by students. But those kinds of training are

not available. The cultural differences between the U.S. and his home country Ghana play a big role in his teaching, as he seemed to carry his expectations for students in Ghana, into the U.S. classroom, in terms of students' behavior. He admitted that some students did not like him because they could not understand him.

Biology ITA from India-Sara

Sara was from India and her English was very good because English was the official language that she was using in school all her life. She also had stayed in the U.S for two years before she taught biology lab for the first semester. She had taught biology to non-major students for two semesters. She mentioned three major challenges: understanding and telling jokes, her British English, and grading. She said she could not use some humor that she learned from her teacher in India, as those jokes were not funny in American culture. One example is when she teaches evolution, one student jokes about the age of the earth. "Isn't the age of earth only 10,000 years old?" She thought the student was serious, as she knows from conversations during her visit to a church activity that many Christians hold that belief (young earth). She described her relationship with students as "neutral", or "professional". She is very careful, not taking the risk of making inappropriate jokes. One cultural difference she mentioned that was significant was that the variation in students' prior knowledge.

Biology ITA from North America-Joy

Joy's parents are Chinese, and they speak Cantonese at home. But in school, she always used English. She still carries an accent, and her English is not as fluent as a native English speaker. She grew up in North America. She was a TA when she was a master's student. She felt that she did not get enough support from the department. She

wanted to learn how to relate to every student in the classroom. She felt she could do a better job relating to the international students because she knew what they were going through, and she understood their culture.

Physics ITA from China-Ming

Ming is a fourth-year Ph.D. student in physics from China. He started to teach lab when he first came to the U.S., with no prior teaching experiences. He joined the PhD program right after getting his bachelor's degree in China. He seemed to have sufficient support for teaching (weekly lab meetings, teaching method courses, English courses, university orientation, etc.). He even thought that his support was “too much”. He was always teaching the lab with a partner, who could be an American TA or another international TA. In the first semester, he preferred to let other TA lead the discussion as he was not confident in doing that. But later, he developed the confidence and the skill to lead the discussion. He improved his English significantly through teaching. He showed a strong desire to become competent in teaching in the U.S. as he really appreciated his teaching experience.

Physics ITA from China -Tao

Tao and Ming were classmates in college in China before they came to the U.S. to get a Ph.D. in physics. However, they had very different experiences of teaching physics in the U.S. Like Ming, he taught the first three semesters after he came to U.S. Tao did not like teaching, and he considered it a very painful and sometimes embarrassing experience. He was struggling with spoken English and jargon. Tao thought his students were not learning a lot from him. Therefore, it seemed a lose-lose situation. Unlike Ming, Tao was teaching the physics lab all by himself, without partner. To make it worse, he

had to teach four lab sessions, 8 hours in one day during his first semester in the U.S. He just wanted to get teaching done so that he could do other assignments for research and course work. Tao rejected the assignment to teach physics again in his fourth year. But he said he did improve his English and can teach more effectively later. He did not think the PD was helpful. The lead GTA was not aware of his challenges. He never told the lead GTA because he did not think that would help. Tao mentioned students' complaints about his teaching. Students considered his introduction of the experiment procedures a waste of time because they couldn't understand him, and they could find the instructions in the learning materials.

Chemistry ITA from China-Yamei

Yamei was a third-year Ph.D. student in chemistry education. She got her bachelor's and master's degrees in China. She was not very confident in her English. But she was passionate about teaching and confident in her chemistry content knowledge and her ability to explain things. She did not have sufficient opportunity to talk to native speakers to improve her English and communication skills. Her roommates and most of her lab mates were Chinese. She made lots of efforts to prepare for every teaching assignment. She wanted to teach chemistry in the future rather than doing research. Her conversation with her professor helped her to improve her confidence in teaching. Those conversations were her major source of support for teaching. She showed strong motivation to improve her teaching, but she did not have form TPD support.

Chemistry ITA from Iran-Zara

Zara was a third-year Ph.D. student in chemistry education. She was from Iran, and she got her undergraduate and master's degree in Iran. She was assigned to teach a

chemistry lab in her first semester, which was the very first lab of the week. Therefore, she could not observe other TA's lab before teaching. She had no TPD opportunities except for safety training. Zara considered the language barrier as the no.1 challenge for her to teach. A peer GTA helped her when she had problems in teaching and she became her major source of support for teaching.

CHAPTER FIVE: DISCUSSION

International graduate students are an essential part of undergraduate STEM education in the U.S. (Okahana & Zhou, 2017). ITAs often experience multiple challenges in teaching (Arshavskaya, 2015; Hoekje & Williams, 1992; Zhou, 2009). Undergraduate students in the U.S. tend to have negative perceptions of and resistance towards ITAs (Bailey, 1983; Kang, Rubin & Lindemann, 2015; Plakans, 1997). The “ITA problem” describes the intercultural communication problems between ITAs and their students in the U.S. (Bailey, 1983; LaRocco, 2011; Zhu & Bresnahan, 2020). The purpose of this dissertation was to gain understandings of the ITA problem by focusing on studying science ITAs’ development of cultural competence and teaching self-efficacy. In addition to the literature synthesis, two empirical studies were conducted and reported. The primary findings are summarized in this chapter with a brief discussion and reflection of those findings. The intent is not to repeat the Discussion sections in Chapter 3 and 4 of this dissertation, but to take a holistic view of the impacts of this work for ITA professional development and cultural competence.

In Chapter two, I conducted a literature synthesis to explore ITAs’ development of cultural competence by adopting a cultural competence framework from healthcare (Campinha-Bacote, 2013). The result of Chapter two was a modified framework for ITAs’ development of cultural competence. In this framework, the cultural encounters between ITAs and their students are at the center, as the driving force for cultural competence development. ITAs experience challenges in teaching, and they co-develop cultural awareness and cultural knowledge. In the meantime, they often develop the cultural desire to make instructional changes to overcome those challenges. Without

sufficient TPD support, however, those instructional changes are often ineffectively and do not lead to improvement in student learning outcomes. When TPD support is available, ITAs often can transform their cultural desire, knowledge, and awareness into cultural skills, developing the ability to make culturally competent instructional changes. Students' negative perceptions and attitudes can also be a challenge for ITAs (Arshavaskaya, 2015; Kang et al., 2015; Staples et al., 2014), but can be changed by participating in intercultural activities. Therefore, ITAs and undergraduate students share the responsibility in creating a culturally inclusive classroom environment, by participating in cultural encounters such as TPDs or intercultural interventions (Manohar & Appiah, 2016; Kang et al., 2015; Staples et al., 2014).

In Chapter three, using a sequential explanatory mix-methods design, I conducted a cross-sectional survey and follow-up interviews to explore science ITAs' development of teaching self-efficacy, adding to the growing body of literature on STEM GTAs' development of teaching self-efficacy (DeChenne et al., 2015; Smith and Delgalo, 2021). The results showed that science ITAs can improve teaching self-efficacy significantly with sufficient support for teaching and ample teaching experiences. To build positive department teaching climates individuals should focus on providing formal teaching professional development in which ITAs can establish supportive relationship with peers and supervisors.

In Chapter four, I conducted semi-structured interviews with science ITAs to gain insight into ITAs' experiences of teaching science to students with different cultural backgrounds in U.S. classrooms with the phenomenological methodology (Patton, 2002; van Manen, 1990). The results provide evidence for the validity of the proposed ITA

cultural competence framework in Chapter two of this dissertation with empirical data. Cultural encounters, including teaching experiences as GTAs and participating in TPD, are the pivotal components and the driving force for science ITAs to develop cultural competence in teaching. GTA supervisors should be aware of ITAs' unique, profound and variable challenges and support them by engaging ITAs in TPD to develop critical cultural skills such as English proficiency, pedagogy, and cross-cultural communication skills.

One of the primary goals for the dissertation to accomplish was to raise awareness of ITAs' challenges in teaching science in U.S. classroom. By reading the ITAs' stories and the interview reflections, I hope readers can obtain some degree of cultural awareness and foundational cultural knowledge of science ITAs. I hope the deans and department chairs can gain more awareness of the importance of creating a supportive department culture by providing sufficient and high-quality teaching professional development and informal opportunities for cultural encounters among undergraduate students, graduate students and faculty with different cultural backgrounds. ITAs are only one group of science instructors who need support to develop cultural competence. The ITA problem is not only a one-sided problem for ITAs; but students also play an important role for quality instruction (Pae, 2001). Everyone who works in a science department should develop cultural competence to increase equity and inclusiveness in science more broadly.

My future research directions include: 1) develop a cultural competence instrument to measure science ITAs' cultural competence, identify each ITAs' specific needs, and inform GTA supervisors to provide appropriate training for them; 2) validate

and refine the science ITA teaching self-efficacy model and identify the best practices to improve ITAs' teaching self-efficacy; 3) develop an observation protocol for science ITAs' teaching practices in the laboratory. My long-term research interests are to establish an online ITA platform to provide professional development for STEM ITAs and establish supporting network for ITAs across institutions.

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Appendix: IRB Approval Letter

IRB

INSTITUTIONAL REVIEW BOARD

Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129
FWA: 00005331/IRB Regn. 0003571



IRBN001 - EXPEDITED PROTOCOL APPROVAL NOTICE

Wednesday, October 28, 2020

Protocol Title **Science International Teaching Assistants' teaching practices and development of cultural competence**

Protocol ID **21-2049 7qv**

Principal Investigator **Zhigang Jia (Student)**

Faculty Advisor **Grant Gardner**

Co-Investigators **NONE**

Investigator Email(s) **zj2e@mtmail.mtsu.edu; grant.gardner@mtsu.edu**

Department **MSE Program (PI) and Biology (FA)**

Funding **NONE**

Dear Investigator(s),

The above identified research proposal has been reviewed by the MTSU IRB through the **EXPEDITED** mechanism under 45 CFR 46.110 and 21 CFR 56.110 within the category (7) *Research on individual or group characteristics or behavior*. A summary of the IRB action is tabulated below:

| | | | |
|---------------------|---|----------------------------|------------------------|
| IRB Action | APPROVED for ONE YEAR | | |
| Date of Expiration | 10/31/2021 | Date of Approval: 10/28/20 | Recent Amendment: NONE |
| Sample Size | ONE THOUSAND (1,000) | | |
| Participant Pool | Target Population: Primary Classification: Healthy Adults (18 years or older) Specific Classification: International graduate students who teach sciences to undergraduate students in the United States | | |
| Type of Interaction | <input checked="" type="checkbox"/> Virtual/Remote/Online interaction <input type="checkbox"/> In person or physical interaction – Mandatory COVID-19 Management | | |
| Exceptions | 1. Permitted to administer online informed consent for the Qualtrics survey. 2. Verbal consent is permitted for the Zoom interviews. 3. Audio recording is allowed. | | |
| Restrictions | 1. Mandatory ACTIVE Informed Consent for Qualtrics and Zoom interactions. 2. Other than the exceptions above, identifiable data/artifacts, such as, audio/video data, photographs, handwriting samples, personal address, driving records, social security number, and etc., MUST NOT be collected. 3. Mandatory Final report (refer last page). 4. CDC guidelines and MTSU safe practice must be followed | | |
| Approved Templates | IRB Templates: Qualtrics Informed Consent, Zoom Interview Informed Consent, and Recruitment Email scripts Non-MTSU Templates: Social Media Recruitment Script | | |
| Research Inducement | Raffle for \$25 gift cards; participant signature is allowed | | |
| Comments | NONE | | |

Post-approval Requirements

The PI and FA must read and abide by the post-approval conditions (Refer "Quick Links" in the bottom):

- **Reporting Adverse Events:** The PI must report research-related adversities suffered by the participants, deviations from the protocol, misconduct, and etc., within 48 hours from when they were discovered.
- **Final Report:** The FA is responsible for submitting a final report to close-out this protocol before **10/31/2021** (Refer to the Continuing Review section below); **REMINDERS WILL NOT BE SENT. Failure to close-out or request for a continuing review may result in penalties** including cancellation of the data collected using this protocol and/or withholding student diploma.
- **Protocol Amendments:** An IRB approval must be obtained for all types of amendments, such as: addition/removal of subject population or investigating team; sample size increases; changes to the research sites (appropriate permission letter(s) may be needed); alternation to funding; and etc. The proposed amendments must be requested by the FA in an addendum request form. The proposed changes must be consistent with the approval category and they must comply with expedited review requirements
- **Research Participant Compensation:** Compensation for research participation must be awarded as proposed in Chapter 6 of the Expedited protocol. The documentation of the monetary compensation must Appendix J and MUST NOT include protocol details when reporting to the MTSU Business Office.
- **COVID-19:** Regardless whether this study poses a threat to the participants or not, refer to the COVID-19 Management section for important information for the FA.

Continuing Review (The PI has requested early termination)

Although this protocol can be continued for up to THREE years, The PI has opted to end the study by **10/31/2021**. **The PI must close-out this protocol by submitting a final report before 10/31/2021. Failure to close-out may result in penalties that include cancellation of the data collected using this protocol and delays in graduation of the student PI.**

Post-approval Protocol Amendments:

The current MTSU IRB policies allow the investigators to implement minor and significant amendments that would fit within this approval category. **Only TWO procedural amendments will be entertained per year** (changes like addition/removal of research personnel are not restricted by this rule).

| Date | Amendment(s) | IRB Comments |
|------|--------------|--------------|
| NONE | NONE. | NONE |

Other Post-approval Actions:

The following actions are done subsequent to the approval of this protocol on request by the PI/FA or on recommendation by the IRB or by both.

| Date | IRB Action(s) | IRB Comments |
|------|---------------|--------------|
| NONE | NONE | NONE |

COVID-19 Management:

The PI must follow social distancing guidelines and other practices to avoid viral exposure to the participants and other workers when physical contact with the subjects is made during the study.

- The study must be stopped if a participant or an investigator should test positive for COVID-19 within 14 days of the research interaction. This must be reported to the IRB as an "adverse event."
- The MTSU's "Return-to-work" questionnaire found in Pipeline must be filled by the investigators on the day of the research interaction prior to physical contact.
- PPE must be worn if the participant would be within 6 feet from the each other or with an investigator.
- Physical surfaces that will come in contact with the participants must be sanitized between use
- **FA's Responsibility:** The FA is given the administrative authority to make emergency changes to protect the wellbeing of the participants and student researchers during the COVID-19 pandemic. However, the FA must notify the IRB after such changes have been made. The IRB will audit the changes at a later date and the FA will be instructed to carryout remedial measures if needed.

Data Management & Storage:

All research-related records (signed consent forms, investigator training and etc.) must be retained by the PI or the faculty advisor (if the PI is a student) at the secure location mentioned in the protocol application.

The data must be stored for at least three (3) years after the study is closed. Additional Tennessee State data retention requirement may apply (*refer "Quick Links" for MTSU policy 129 below*). The data may be destroyed in a manner that maintains confidentiality and anonymity of the research subjects.

The MTSU IRB reserves the right to modify/update the approval criteria or change/cancel the terms listed in this letter without prior notice. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board
Middle Tennessee State University

Quick Links:

- Post-approval Responsibilities: <http://www.mtsu.edu/irb/FAQ/PostApprovalResponsibilities.php>
- Expedited Procedures: <https://mtsu.edu/irb/ExpeditedProcedures.php>
- MTSU Policy 129: Records retention & Disposal: <https://www.mtsu.edu/policies/general/129.php>