UNDERGRADUATE STUDENTS' PERCEPTIONS OF CULTURALLY RESPONSIVE TEACHING AND THEIR SENSE OF BELONGING AND ACADEMIC SELF-EFFICACY IN HIGHER EDUCATION

by

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A Dissertation

Submitted to the Faculty of Purdue University

In Partial Fulfillment of the Requirements for the degree of

Doctor of Philosophy

Department of Agricultural Sciences Education and Communication

West Lafayette, Indiana

August 2019

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This dissertation is dedicated to my beloved husband Jonathan, who is my rock, my inspiration, my strength, my best friend and my strongest supporter. You are the best thing that has happened in my life and words can't describe how lucky and grateful I am to have you in my life. You always put a smile on my face and love me unconditionally.

Because of you, I am not afraid of anything
Because of you, I will continue to learn, evolve and grow to become a better me
I love you very much

To my parents and my brother, thank you and I love you

ACKNOWLEDGMENTS

As I complete my doctoral degree and enter the next chapter of my life, I want to take this opportunity to thank my committee members, family and friends who have supported me along this journey.

First, I would like to thank my major advisor Dr. Knobloch for his support and guidance. I am grateful for everything you have provided me. I learned a lot from you and I greatly appreciate your time, support and patience along this journey. I appreciate the time you took during our weekly meetings and resources you have provided me. Thank you Dr. Esters, for your continued support, encouragement, positive attitude, energy and commitment to mentoring students. Thank you Dr. Camacho, for serving on my committee and always being supportive. I was so fortunate to meet you during your visit to Purdue as the invited speaker for the 2017 Mentoring at Purdue program. I cannot thank you enough for your words of encouragement and support, for which I will be forever grateful. Thank you Dr. Wang, for your constructive feedback and advice, for challenging and pushing me to become a better scholar.

Most importantly, I want to thank my family and friends who have always believed in me and supported me.

To my parents Biyun Huang and Xiaoli Liang, thank you for raising me and for supporting me.

To my brother Maoliang Huang, I still remember we used to fight and argue when we were little; however, as we grew up, we have come to understand each other and have so many things to share and talk about with each other. I wish you all the best from the bottom of my heart.

To my cousin Tingting Liang, thank you for the laughter and joyful conversations. To my aunt Xiaochun Liang, you are the best auntie I could ask for.

To my dear husband Jonathan, you are the most intelligent, talented, bravest and hardworking person that I have seen in my life. You are kind, caring, down to earth and have such a golden heart. I always say you are like a dinosaur; it is rare to find a person like you in today's society and I truly mean it. You are the best thing that have ever happened in my life. To my in-laws Maria and Hein, thank you for the love you have given to me.

To my dear friends, Xiuli Zhu, Zhigang Liu, Haiyan Wang, Jie Chen, Alisa Vitello, Josh Vitello, Chaoxian Zhao, Shunli Zeng, Xing Gao, Yong Zhang, Zhili Song, Min Li and Min Wang. I appreciate your friendship and support over these many years. You all witnessed the ups and downs of my life and watch me grow to the person I am today. Thank you for believing in me and supporting me.

I have my imperfections and flaws, and I have had several challenges, confusion, uncertainties, setbacks and roadblocks throughout my life. But I am not afraid of those challenges and obstacles. Even if I fall, I will pick myself up and keep moving. While these experiences were not enjoyable, I genuinely appreciate the opportunity these challenges, confusion and setbacks have created; allowing me to learn and grow. I am grateful for everything that helped to shape who I am today, and I will always believe where there is a will, there is a way. As I enter into the next chapter of my life, I am excited to see what future has to offer and I will stay positive, grateful and strong to become the person I want to be.

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ABSTRACT

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Degree Received: August 2019
Title: Undergraduate Students' Perceptions of Culturally Responsive Teaching and Their Sense of Belonging and Academic Self-efficacy in Higher Education
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To address the U.S. labor shortage in the fields of agriculture and STEM, higher education needs to recruit, retain, and prepare more underrepresented minority students into agricultural and STEM disciplines. Teachers play important roles in student learning, which can lead to student academic and professional success. With university classrooms becoming more diverse, faculty need to adopt inclusive teaching methods in order to accommodate the needs and expectations of diverse students. Culturally responsive teaching embraces and integrates students' culture into the teaching and learning process. As a result, culturally responsive teaching can offer a more engaging learning experience for all students; however, in the context of higher education, there is a lack of understanding and application of culturally responsive teaching by faculty. This study examined students' perceptions of culturally responsive teaching practices in their first college mathematics course through a developed and modified instrument for higher education. Further, this study used a structural equation model to predict the relationships among students' perceptions of culturally responsive teaching, sense of belonging and academic self-efficacy. Data were collected through the anonymous questionnaire administrated through Qualtrics. Participants of this study were undergraduate students enrolled in the college of agriculture, college of science and college of liberal arts at a predominately white institution (PWI) and an Historically Black College and University (HBCU). Five conclusions were generated from the study. First, the scale developed to measure students' perceptions of culturally responsive teaching in higher education was a valid instrument. Second, college students observed and sensed different types of culturally responsive teaching differently. Third, students' perceptions of culturally responsive teaching predicted students' academic self-efficacy and sense of belonging. Fourth, students who had a higher sense of belonging were more confident as college students. Finally, African American students at an HBCU had higher perceptions of culturally responsive teaching. Implications for practice were provided to help

promote the application of culturally responsive teaching in higher education. Recommendations for future research were also discussed to inform future studies regarding culturally responsive teaching in university settings.

CHAPTER 1. INTRODUCTION

College students who are engaged through inclusive and learner-centered teaching methods are more likely to be motivated, persist and complete their degrees. This is especially important as the United States is expected to become more racially and ethnically diverse in the future (Vespa, Armstrong, & Medina, 2018). The U.S. population is estimated to reach 417 million by 2060 (Colby & Ortman, 2015), of which, one-third of the U.S. population will be non-white by 2060 according to the projection (Colby & Ortman, 2015). In comparison, the world population is estimated to be 9.7 billion by 2050 (United Nations, 2017). With this ever-growing population, our generation in this modern society is facing unprecedented challenges associated with food, poverty, public health, climate change and natural resources at both national and global levels (Food and Agriculture Organization of the United Nations, 2017). While agricultural productivity and efficiency need to be doubled in the future to provide the food demand for a growing population, all other challenges due to population growth are undoubtedly related to the disciplines including agriculture, science, technology, engineering and mathematics (STEM) (National Research Council, 2009).

Many career opportunities continue to increase in agriculture, food, natural resources, STEM (Science, Technology, Engineering, and Mathematics) and related disciplines. For instance, a report by Goecker, Smith, Fernandez, Ali and Theller (2015) revealed that there are around 57,900 job openings annually for qualified graduates specializing in agriculture and related disciplines between 2015-2020. On the other hand, STEM provides many more employment opportunities (Langdon, McKittrick, Beede, Kham, & Doms, 2011). According to the projection by Langdon et al. (2011), job opportunities in STEM areas will be growing three times faster compared to that in non-STEM fields in the next 10 years. For instance, around one million employment opportunities in STEM are available for qualified graduates (Goecker et al., 2015) to fill the workforce demand. On top of a large number of job positions, job compensation in STEM is also significantly higher than that in non-STEM areas (Langdon et al., 2011).

Agriculture and STEM both play very important roles in economic and social development due to their impacts on economic growth, food security, productivity, technology development and globalization (Carnevale, Smith, & Melton, 2011). Majority of future jobs will need a postsecondary education by 2020 (U.S. Department of Education et al., 2016).

1.1 Labor Shortage in Agriculture and STEM

Unfortunately, there are not enough graduates specializing in Agriculture and STEM to take advantage of job opportunities (Carnevale et al., 2011; Goecker et al., 2015). Carnevale et al. (2011) pointed out that the current STEM workforce primarily relies on foreign-born individuals. Therefore, to close the labor gap and keep the U.S. competitive at a global market, it is important to recruit and retain diverse population in agriculture, STEM and other professions (Allen-Ramdial & Campbell, 2014; Bruner, 2000; Goecker et al., 2015; Carnevale et al., 2011; Chen, 2013; National Research Council, 2012; Langdon et al., 2011; C. Akers et al., 2017; Wildman & Torres, 2001). As the minority population becomes the majority due to the demographic shift (Colby & Ortman, 2015), there is a potential opportunity to address the labor gap in agriculture and STEM by recruiting and retaining more underrepresented minority students in agriculture and STEM fields (Carnevale & Fry, 2000). This initiative has become a national concern and need, not only it could help to address the labor gap in many professions in the U.S., but it also helps to address social mobility and student success in the U.S. (U.S. Department of Education et al., 2016; Carnevale & Fry, 2000).

As a result of the Civil Rights Act in 1964 and the Higher Education Act of 1965, African American were provided with higher educational opportunities (Johnson, 2013). According to the data from the National Center for Education Statistics (2018a), the percentage of Black student enrollment in postsecondary institutions has increased from 9.6% to 13.6% from 1976 to 2017. In comparison, the percentage of Hispanic student enrollment in postsecondary institutions increased from 3.6% to 18.9% from 1976 to 2017 (NCES, 2018). Based on the enrollment projection by Hussar and Bailey (2013), from 2010-2021, White student enrollment is expected to increase by 4% in a post-secondary degree-granting institution. In comparison, Black and Hispanic student enrollment is expected to increase by 25% and 42 % respectively.

Regardless of increased enrollment of minority students in higher education, traditionally underrepresented students are falling behind White students in pursuit of higher education (U.S. Department of Education et al., 2016). The gap continues to exist in academia between minority students and their white counterparts in many ways as indicated by matriculation rates, graduation rates, academic achievement and access to resources and opportunities (Rowley & Wright, 2011; Coles & Blacknall, 2011; U.S. Department of Education et al., 2016; Iloh & Toldson, 2013). For example, according to U.S. Department of Education et al. (2016), the gap

for bachelor's degree attainment between White and Black students and White and Hispanic students has increased to 13% and 20% respectively, in 2014.

1.2 Agriculture and STEM Degrees Conferred in Higher Education

In the fields of agriculture and STEM, minority students are severely underrepresented compared to white students, who are the dominant workforce in academic and professional settings (NCES, 2016a; NCES 2016b; McKim et al., 2017). For example, according to NCES (2018e), from 2015-2016, among the 36,995 bachelor's degrees conferred in the field of agriculture and natural resources, 29,477 (80%) were awarded to White students, 1,105 (3%) were awarded to Black students, 2,922 (8%) were awarded to Hispanic students, 1,266 (3%) were awarded to Asian students, 54 (0.1%) were awarded to Pacific Islanders, and 212 (0.6%) were awarded to American Indian/Alaska Native. From 2015-2016, among the 106,789 bachelor's degrees conferred in the field of engineering, 65,841 (62%) were awarded to White students, 4,267 (4%) were awarded to Black students, 10,502 (10%) were awarded to Hispanic students, 12,207 (11%) were awarded to Asian students, 161 (0.2%) were awarded to Pacific Islanders, and 315 (0.3%) were awarded to American Indian/Alaska Native.

A similar pattern was seen from 2016-2017. Among the 37,719 bachelor's degrees conferred in the field of agriculture and natural resources, 29,577 (78%) were awarded to White students, 1,180 (3%) were awarded to Black students, 3,192 (8%) were awarded to Hispanic students, 1,315 (3%) were awarded to Asian students and 66 (0.2%) were awarded to Pacific Islanders. Among the 115,640 bachelor's degrees conferred in the field of engineering, 69,987 (61%) were awarded to White students, 4,505 (4%) were awarded to Black students, 11,871 (10%) were awarded to Hispanic students, 13,203 (11%) were awarded to Asian students, and 161 (0.1%) were awarded to Pacific Islanders. The fields of mathematics and sciences also followed a similar pattern where the majority of the conferred bachelor's degrees were awarded to White students.

According to the latest data through NCES (2018f), in total, there were 704,580 degrees conferred by postsecondary institutions from 2016-2017 in the field of science, technology, engineering and mathematics (STEM). Of which, 62.6% were awarded to White students, 8.5% were awarded to Black students, 12.7% were awarded to Hispanic students, 12% were awarded to Asian students, 0.2% for Pacific Islander and 0.6% for American Indian/Alaska Native.

Another interesting fact is that except for White students, African American, Hispanic, Asian and American Indian/Alaska Native female students received a higher percentage of degrees than their male peers in the field of STEM from 2016-2017 (NCES, 2018f).

1.3 Motivational Factors for Students to Pursue an Education in Agriculture and STEM

Several studies suggested that internal value such as personal academic interests and self-efficacy in agriculture are the major factors that attract students to choose agriculture (Vincent, Henry, & Anderson, 2012; Johnson, Broyles, & Hammond, 2018; Lingenfelter & Beierlein, 2006; Quiggins et al., 2016; Jones & Larke, 2003). Unfortunately, minority students reported to have negative attitudes and toward agriculture, associating it with slavery, labor-intensive and low status (Talbert, Larke & Jones, 1999; Morgan, 2000). In addition, studies have identified that agriculture exposure and ag-related experiences are associated with students' decision to pursue their degrees in the college of agriculture (Dyer, Lacery, & Osborne, 1996; Dyer, Breja, & Wittler, 2000; Wildman & Torres, 2001; Foreman, Retallick, & Smalley, 2018; Swan & Delay, 2014; California Department of Education, 2012; Cannon, Broyles, & Hillison, 2006; Lee, 2005; Swan & De Lay, 2014; Mclntyre, 2016; Wiley, Bowen, Bowen, & Heinsohn, 1997). Additionally, support from parents, family, and friends and availability of job opportunities can also influence students' educational choice in agriculture and STEM (Swan & De Lay, 2014; Wildman & Torres, 2001; Johnson et al., 2018; Esters, 2007; Palmer, Maramba, & Dancy, 2011; C.Akers et al., 2017; McKim et al., 2017; Jones & Larke, 2003; Myer, Breja, & Dyer, 2004).

1.4 Underrepresentation of Minority Students in Agriculture and STEM

For underrepresented minority students, many reasons contribute to their underrepresentation in agriculture and STEM in higher education (Moss, 2011; McKim et al., 2017; Carnevale et al., 2011). First, minority students lack agriculture and STEM background, exposure, experiences, and familiarity from secondary education (Talbert & Larke Jr, 1995a, 1995b). For example, very few minority students involve in after-school activities such as FFA and 4-H (Foreman, Retallick, & Smalley, 2018; Roberts et al., 2009). Participation in these activities and programs, however, are important to boost students' academic interests in agriculture and STEM.

Second, minority students lack the support from teachers, role models, mentors, parents, and families (Byrne, Willis, & Burke, 2012; Quiggins et al., 2016; Bettis et al., 2017; Jones & Larke, 2003; Johnson, Broyles, & Hammond, 2018; Retallick & Pate, 2009; Swan & De Lay, 2014; Wildman & Torres, 2001). Mentoring has been demonstrated to be effective that benefit students in higher education (Cole, 2011; Nugent, Childs, Jones, & Cook, 2004; Campbell & Campbell, 2007; Harris, 2012). Positive mentoring impacts are particularly significant on minority students (Crisp & Cruz, 2009). In Kincey (2007), the author used a racial and mentoring experiences scale to evaluate mentoring experiences for African American students at a PWI and its impacts on their academic performance. The results suggested that faculty-student interaction and peer interaction were related to African American students' persistence and retention in college. The results also showed that minority students considered mentoring to be beneficial and the mentoring was positively related to their academic performance (i.e., GPA). The results were supported by Harris (2012), who reported the effectiveness of a mentoring program on helping minority students to smoothly adjust to college life attending PWI, particularly towards male minority students.

Third, minority students lack social and cultural integration in higher education (Ladson-Billings, 2006). In addition, minority students experienced low expectation from their teachers (Ford, 1998; Tenenbaum & Ruck, 2007). Further, minority students lacked access to sufficient resources and financial aid (Taylor & Cantwell, 2018; Smith, Trygstad, & Banilower, 2016; U.S. Department of Education, 2016; Outley, 2008). Moreover, minority students such as African American students were more likely to experience racial discrimination, culture shock, sense of alienation and other negative experiences on campus (Sedlacek, 1999; Drape et al., 2017; Estepp, 2013; McKim et al., 2017; Pintrich & Zusho, 2007; Ginsberg & Wlodkowski, 1995, 2009; Swali, Redd, & Perna, 2003; Gardner, 2010). All these factors contributed to minority students' negative attitudes, unpleasant perceptions, decreased academic and career aspiration toward agriculture and STEM (Roberts et al., 2009; Gibso & Benjamn, 2014).

1.5 High Attrition Rates in STEM Programs

According to Carnevale et al. (2011), there were three major reasons that contribute to the insufficient supply of STEM workforce. First, students do not have a strong academic interest in choosing STEM at the college level. Second, students left STEM majors during college

education. Third, students who do not choose STEM as their professions upon graduation. Of these three major reasons, high attrition rates in STEM disciplines at the postsecondary level needs a closer look. Students are likely to withdraw the STEM majors at the starting period of college (Griffith, 2010). A significant number of students who initially chose STEM as their majors ended up shifting to non-STEM majors (Carnevale et al., 2011). Chen (2013) conducted a longitudinal study examining STEM attrition from 2003-2009. According to Chen (2013), among the degree-seeking students entering college who initially chose STEM as their majors, 48% left STEM majors for students who were pursuing a bachelor's degree and this number is even higher (69%) for students who were pursuing an associate degree (Chen & Weko, 2009). National Center for Educational Statistic (NCES, 2014) pointed out that among the undergraduate students entering colleges initially pursuing bachelor's degrees or associate degrees in STEM majors, 28% and 33% of them completely left STEM majors and switched to non-STEM majors respectively.

1.6 High Attrition Rates for Minority Students in STEM

Compared to white students, underrepresented minority students are more likely to have negative experiences in STEM disciplines where they feel that the environment is hostile and they feel unwelcomed or undervalued (Strayhorn, 2012). Minority students, who face more challenges and barriers in STEM disciplines, are thus more likely to drop out (Medina, 2015). According to Tinto and Goodsell (1993), the freshman year is the time when students are mostly like to drop out if they fail to academically and socially integrate into the institution (Tinto, 1975). Woosley (2003) also demonstrated that students' satisfactory experiences of adjusting to university social life at the beginning stage of their college life are highly associated with their degree completion. According to Chen (2013) and Chang, Sharkness, Hurtado and Newman (2014), among the students who initially selected STEM as their bachelor's degrees but later left STEM majors, Black students and Hispanic students had the highest attrition rates. In a similar study, NCES (2014) indicated that among the students who selected STEM as their beginning major, Black students have the highest percentage who either transferred to non-STEM majors or left the STEM program completely. According to the National Science Board (2007), minorities and women have a higher chance of shifting their majors into non-STEM areas during their college life. Rainey et al. (2018) found out that students of color and women are more likely to

lack a sense of belonging in STEM fields, which is one of the important factors that associate with their attrition. The fact that minority students have a higher level of dropping out from STEM could help to explain why graduation rates for minority students are still low in STEM, regardless of their increased enrollment.

Previous studies have identified some of the factors related to students' retention in STEM fields. Major factors are listed but not limited to the following: 1) precollege characteristics such as academic preparation (Elliott, Strenta, Adair, Matier, & Scott, 1996; Chang et al., 2014; Russell & Atwater, 2005; Chen, 2013; Medina, 2015), 2) demographic characteristics such as race, gender and socioeconomic status (Chen, 2013; Hill, Corbett, & Rose, 2010; Rainey et al., 2018; National Science Board, 2007), 3) interactions with faculty and peers (Daempfle, 2003; Good, Halpin, & Halpin, 2000; Rainey et al., 2018), 4) campus environment (Chang et al., 2014; Estrada, 2014; Hurlock, 2014), 5) role models (Carlone & Johnson, 2007; Herrmann et al., 2016; Hernandez et al., 2018; Chen, 2013), 6) scientific identity (Chang, Eagan, Lin, & Hurtado, 2011; Graham, Frederick, Byars-Winston, Hunter, & Handelsman, 2014; Hanauer, Graham, & Hatfull, 2016; Rainey et al., 2018), 7) research program and experiences (Chang et al., 2014), 8) STEM self-efficacy (Lent et al., 2005; Estrada, 2014; Hanauer et al., 2016; Chen, 2013; Burtner, 2005; Medina, 2015; Rainey et al., 2018), 9) financial need (Nora, Barlow, & Crisp, 2005; Castellanos & Jones, 2003; Longerbeam, Sedlacek, & Alatorre, 2004; Chen, 2013; Whalen & Shelly, 2010), 10) sense of belonging (Chen, 2013; Gardner, 2010; Figueroa & Hurtado, 2013; Medina, 2015), and 11) percentage of URM students in STEM fields (Griffith, 2010; Change et al., 2014).

1.7 Students' Experiences at PWIs and HBCUs

As demographics shift significantly in the U.S. population and in higher education, we expect a continued increasing enrollment of African American students at Predominately White Institutions (PWIs). However, African American students reported a less satisfactory academic achievement and more negative experiences enrolled in PWIs, compared to their peers who are enrolled in HBCUs (Allen, 1992; Allen, Jewell, Griffin, & Wolf, 2007; Chavous, 2002).

1.7.1 Minority Students at HBCUs

Although HBCUs have not received equal and sufficient attention and resources compared to PWIs (Bridges, Cambridge, Kuh, & Leegwater, 2005), HBCUs have been playing an important role in educating African American students (Allen et al., 2007; Rodger & Summer, 2008). Compared to PWIs, HBCUs carry a more supportive learning environment through which positive interactions among students and faculty were established (Seifert, Drummond, & Pascarella, 2006). HBCUs provide better support academically and socially as they build connections to cultural and racial identities for African American students (Bracey, 2017; William, 2017; Brown, 2003). Therefore, African American students feel more comfortable and included in HBCUs. In comparison, minority students enrolled at PWIs feel excluded, alienated and stereotyped in different ways (Love, 1993; Hurtado, Eagan, Tran, Newman, Chang, &Velasco, 2011). For example, Hurtado et al. (2011) conducted a mixed study to examine minority students' interactions with faculty. The study suggested that African American students gained better support and had positive interactions with faculty while studying in HBCUs. These positive faculty-student interactions, in turn, are important factors to promote minority students' success in the field of science.

There are 105 HBCUs in total comprising 3% of all colleges and universities across the country (Harmon, 2012). In 2016-2017, HBCUs account for 14% of bachelor's degrees earned by the Black students (NCES, 2018a). A majority of students enrolled in HBCUs are Black students (NCES, 2018a), but HBCUs have seen some diversity increase in its student population. As of fall, 2017, Black student enrollment in HBCUs was 226,843, comprising 76% of total enrollment in HBCUs (NCES, 2018b). Among the bachelor's degrees that were conferred from 2016-2017, 64.1% were conferred to White students, 10.5% were conferred to Black students and 13.5% were conferred to Hispanic students (NCES, 2018c). Among the master's degrees that were conferred from 2016-2017, 65.8% were conferred to White students compared to 13.6% and 10.2% to Black students and Hispanic students (NCES, 2018d). In total, there were 49,467 degrees that were conferred by HBCUs in 2016-2017. Of which, 14% and 6% of bachelor's and masters' degree earned by Black students were conferred from HBCUs (NCES, 2018a). Among these conferred degrees, 5,511 (11%) were associate's, 33,500 (68%) were bachelor's, 7,966 (16%) were master's and 2,490 (5%) were doctorate degrees (NCES, 2018b).

1.7.2 Minority Students' Experiences at PWIs

Numerous researchers have examined minority students' experiences in PWIs. PWIs have failed to support minority students to achieve their fullest potentials (Campbell & Campbell, 2007; Golde, 2005). Rodger and Summers (2008) discussed the retention of African American students attending PWIs by using Bean and Eaton's (2001) retention model. Bean and Eaton's (2001) model incorporated a cultural aspect providing an illustration of the psychological development process. Bean and Easton (2001) described several psychological components (e.g., self-efficacy, coping skills, attitude) as important factors leading to a successful academic and social adjustment and integration at college (Rodger & Summers, 2008). However, without a supportive and friendly environment, it is hard to develop those psychological components that are necessary to provide a smooth and desirable college integration for minority students.

To summarize, the challenges and barriers that African American students face in PWIs emerged into the following themes: 1) culture dissonance (Love, 1993; Tosolt, 2010;), 2) stereotyped lower academic credentials based on race or gender (Fries-Britt &Turner, 2001; Chang et al., 2011; Carrel, Page & West, 2013; Davis, 2004), 3) insufficient academic preparedness (Fletcher & Tienda, 2010; Thomason & Thurber, 1999), 4) hostile campus climate (Raque-Bogdon, Klingaman, Martin, & Lucas, 2013), 5) discrimination (Fries-Britt, Younger, & Hall, 2010; Gonzalez, 2006; MacLachlan, 2006), 6) unequal and unfair treatment (Johnson, 2013; Figueroa & Hurtado, 2013), 7) unequal access to education and resources (Hinton & Seo, 2013; Ntiri, 2001; Taylor & Cantwell, 2018; Trygstad & Banilower, 2016; Taylor & Cantwell, 2018), 8) lack of role models (Sedlacek, 1999; Thomas, Willis, & Davis, 2007; Dowell, 1996; Hoffman, Llaga, & Snyder, 2003; Bettis et al., 2017; Jones & Larke, 2003), 9) lack of academic and mentor support (Richardson, Rivers, & Whitelock, 2015; McKim et al., 2017; Allen & Solorzano, 2001; Drape et al., 2017; Glenn, Esters, & Retallick, 2012; Gale, 2002; Lease, 2004; Ellis, 2000; Chen, 2013), 10) difficulty in building positive faculty-student relationship (Love, 1993; Johnson, 2013), and 11) lower family social-economic status (Ramburuth & Hartel, 2010; U.S. Department of Education et al., 2016).

1.8 Culturally Responsive Teaching and Student Motivation

Pintrich and Zusho (2007) pointed out that college students lacking intrinsic motivation is a problem in higher education. Yet, intrinsic motivation plays an integral part in student learning. According to Deci and Ryan (2000, p. 56), the definition of intrinsic motivation is "doing of an activity for its inherent satisfactions rather than for some separable consequence." Numerous studies have documented positive impacts due to intrinsic motivation, both in academic and personal growth (Burton, Lydon, D'Alessandro, & Koestner, 2006; Standage, Duda, & Ntoumanis, 2006; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). Findings through those studies suggested that sustaining intrinsic motivation is the key for producing positive learning outcomes, engagement, and attitudes (Deci, Vallerand, Pelletier, & Ryan, 1991; Noels, Pelletier, Clement, & Vallerand, 2003; Gaumer Erickson, Noonan, Zheng, & Brussow, 2015). Pintrich and Zusho (2007) pointed that unmotivated students are disengaged from the learning which could lead to many problems (i.e., negative attitude toward learning, lack of learning interest) (Ginsberg & Wlodkowski, 2009). In addition, students who are not intrinsically motivated have a higher chance to drop out and experience low achievement according to Vallerand, Fortier and Guay (1997).

Culturally responsive teaching is embedded in intrinsic motivation, which plays an essential role in student learning and their academic success (Ginsberg & Wlodkowski, 1995, 2009). Based on the culturally responsive teaching motivational framework developed by Ginsberg and Woldkowski (1995, 2009), this pedagogy can promote minority students' learning through two major interrelated approaches: 1) instrumental level: conduct different effective teaching methods (e.g., learner-centered teaching) to engage students (Gerlach, 1994; Caswell & Labrie, 2017). This approach can enhance students' learning by connecting the learning content with students' cultural and social backgrounds, prior knowledge, and experiences; (2) relationship level: build a positive relationship and interactions between teachers and students. Rodriguez, Plax and Kearney (1996) and Chickering and Gamson (1987) identified that building a positive and effective relationship and interaction between student and instructor can be one of the strategies to increase student motivation. Establishing positive student-teacher relationships could foster students' academic self-efficacy and sense of belonging through teachers' caring behaviors (Ginsberg & Wlodkowski, 1995, 2009).

As faculty play a very major role in preparing students to succeed in agriculture and STEM professions (National Institute of Food and Agriculture, 2014), the application of culturally responsive teaching in university classrooms could motivate students to learn. Culturally responsive teaching promotes positive academic outcomes, engagement, and success for students (Hughes et al., 2004; Christianakis, 2011; Doherty et al., 2013; Bazron et al., 2005; Howard, 2003; Nieto, 2002). It also helps to seal the achievement gap between white and minority students (Cohen et al., 2009; Burns, Keyes, & Kusimo, 2006; Musu-Gillette et al., 2016).

As students in the U.S. are becoming more racially, ethnically and culturally diverse (Lin & Bates, 2014) culturally responsive teaching provides gateways for faculty to address social and educational inequality in academic settings (Ladson-Billings, 2006). In the context of higher education, culturally responsive teaching provides an opportunity to allow faculty to 1) improve their teaching skills toward diverse students, 2) address students' diverse backgrounds and needs, 3) develop positive relationships with students, and 4) foster students' sense of belonging and academic confidence. Through culturally responsive teaching practices, faculty could help the students to achieve their fullest potentials to succeed at both academic and personal levels (Au, 2009).

1.9 Problem Statement

There is a lack of application of culturally responsive teaching in university classrooms (Bonner, 2014; Wiens, 2015). Additionally, there is a lack of understanding of students' perceptions of culturally responsive teaching practices in higher education. Moreover, no quantitative measurement was found that could measure culturally responsive teaching from students' perspectives in higher education, and more specifically, in the context of agriculture and STEM programs (Hiramiak & Huang, 2015). Moreover, we do not fully understand the motivational mechanism of culturally responsive teaching on student academic motivation; especially to what extent that culturally responsive teaching can foster students' sense of belonging and academic self-efficacy in higher education. By understanding students' perceptions of culturally responsive teaching and its association with students' academic motivation, we could effectively promote the application of culturally responsive teaching as a

way to improve diversity and inclusion in Agriculture and STEM disciplines within higher education.

1.10 Significance of the Study

This study is significant in several ways. First, this study will examine culturally responsive teaching through students' perspectives. Second, this study will examine culturally responsive teaching practices in higher education focusing on agriculture and STEM disciplines. Third, this study will develop and validate an instrument that can be used to measure culturally responsive teaching in university classrooms. Additionally, this study will examine the relationships between students' perceptions of culturally responsive teaching practices and their sense of belonging and academic self-efficacy.

First, this study will address culturally responsive teaching through students' perspectives. This study could help faculty to understand students' views toward different types of culturally responsive teaching practices in university classrooms. An understanding of effective teaching practices through the lens from students could help faculty to be more selective and strategic to use culturally responsive teaching toward diverse students. By doing this, faculty could adjust their teaching strategies in classrooms to accommodate the needs and expectations of diverse students and would be able to offer students a more engaging learning experience through engaging teaching.

Second, this study will develop and validate an instrument that can measure students' perceptions of culturally responsive teaching in higher education. Being able to measure culturally responsive teaching, this study could help faculty identify the specific types of culturally responsive teaching practices that are considered as the most effective and inclusive perceived by students. The findings of the study could also help the administrators to prepare and provide training for faculty to be able to implement these teaching practices. The instrument could also be used by faculty in the classroom to get feedback from students regarding their teaching practices.

Third, this study will examine culturally responsive teaching in higher education in the context of agriculture and STEM disciplines. There is a lack of diversity in agriculture and STEM and high education need to engage, prepare and retain diverse students in the disciplines. By studying how culturally responsive teaching could promote student learning in agriculture

and STEM, this study could help faculty recognize the positive roles and outcomes of culturally responsive teaching and use it in their classrooms to engage students in the learning process.

Last, this study will examine the relationships between students' perceptions of culturally responsive teaching and students' sense of belonging and academic self-efficacy. There is a lack of understanding how and to what extent that culturally responsive teaching could promote students' academic motivation. The findings of this study could contribute to the current understanding of culturally responsive teaching in the context of higher education. The findings of this study could also help to identify the teaching strategies that help students to achieve academic and professional success.

In sum, the results from this study may shed light for faculty, staff, and administrators to be able to move forward as a collaborative unit, to establish a welcoming and encouraging a learning environment for all students through inclusive teaching practices and help students to succeed academically and professionally.

1.11 Purpose of the Study

The purpose of this study was twofold: 1) to develop and validate an instrument to measure culturally responsive teaching from undergraduate students enrolled in agriculture and STEM programs, and 2) to predict the relationships among students' perceptions of culturally responsive teaching practices, sense of belonging and academic self-efficacy.

1.12 Research Questions

There were five research questions for this study.

1. Does the developed instrument satisfactorily measure students' perceptions of culturally responsive teaching and sense of belonging in agriculture and STEM within higher education?
2. Does the structural equation model for this study demonstrate a good model fit?
3. What were the relationships among students' perceptions of culturally responsive teaching, sense of belonging and academic self-efficacy?

4. Were there any significant differences in students' perceptions of culturally responsive teaching among students in terms of race, academic classification, gender, college affiliation, and institution type?
5. What were the additional factors that can influence students' perceptions of culturally responsive teaching?

1.13 Assumptions

The following assumptions were identified for the study.

1. The researcher adopted a positive paradigm using a quantitative approach. According to the definition by Kaboub (2008), a positive paradigm assumes that reality exists and can be observed and revealed by using empirical and logical approach and analysis.
2. The instrument developed by the researcher was valid and reliable.
3. Participants were willing to complete the instrument as well as provided genuine responses to the questions on the questionnaire.
4. Participants were willing to provide information that accurately reflected their thoughts, perspectives, and observations regarding their perceptions of culturally responsive teaching, sense of belonging, and academic self-efficacy.
5. The study was conducted objectively.
6. The study was in compliance with the IRB guidelines and protocol.
7. Data analysis and interpretation were conducted in an objective manner and the researcher remained objective for this study during data interpretation and analysis for two open-ended questions.
8. The researcher was aware of different types of biases in social science and efforts were made to minimize these potential biases.

1.14 Definition of Terms

The following is a list of key terms used in this study.

Teacher: A person who helps other people to learn (Abbatt & McMahon, 1993). Teacher, educator, tutor were examples of different words conveying the same meaning (Prozesky, 2000).

This study is situated in the context of higher education, therefore, teacher and faculty were used interchangeably throughout this study.

Agriculture: "A program that focuses on the general principles and practices of agricultural research and production and that may prepare individuals to apply this knowledge to the solution of practical agricultural problems. Agriculture includes instruction in basic animal, plant, and soil science; animal husbandry and plant cultivation; soil conservation; and agricultural operations such as farming, ranching, and agricultural business." (NCES, 2010a)

Agriculture-Related Science Programs: "Instructional programs that focus on agriculture and related sciences and that prepare an individual to apply specific knowledge, methods, and techniques to the management and performance of agricultural operations." (NCES, 2010b)

STEM: Science, Technology, Engineering and Mathematics (NSF, 2017).

Underrepresented Minority: "Defined as a group, whose percentage of the population in a given group is lower than their percentage of the population in the country. Underrepresented minorities are generally considered to include: Hispanic/Latinx, African Americans, Native Americans, Native Hawaiian/Pacific Islanders, Asians, Pacific Islanders, and those of two or more races." (Pennsylvania State University, 2019; National Science Foundation, 2017)

HBCU: "Any Historically Black College or University that was established prior to 1964, whose principal mission was, and is, the education of Black Americans. HBCUs offer all students, regardless of race, an opportunity to develop their skills and talents. These institutions train young people who go on to serve domestically and internationally in the professions as entrepreneurs and in the public and private sectors." (U.S. Department of Education, n.d.)

PWI: Institution in which White students comprise 50% or more of the student population (Brown & Dancy, 2010).

Culturally Responsive Teaching: Teachers/educators embrace and value students' cultural backgrounds and assets, using inclusive instructional methods to engage students to learn; to achieve their full potential by connecting to their cultural aspects, promoting learning

opportunities for each other through different cultures and addressing social injustice issues that go beyond the classroom (Gay, 2000, 2010, 2011; Ladson-Billings, 1994, 1995a, 1995b, 2006).

Sense of Belonging: A human need to feel accepted and connected to others, such as people, community, organizations, and groups (Allen, Kern, & Mackay, 2017).

School Sense of Belonging: "The extent when students feel connected, accepted, respected and supported by peers, teachers, and others in school social environment." (Goodenow & Grady, 1993, p. 61)

Self-Efficacy: "People's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (Bandura, 1997, p.71). There are four major sources for one's self-efficacy: "mastery experience, vicarious experience, social persuasion, and somatic and emotional states." (Bandura, 1997, pp.71-72)

Academic Self-Efficacy: Individual's beliefs about their capabilities to successfully accomplish specific academic tasks, reach certain academic levels or academic goals (Bandura, 1997; Schunk, 1991).

Students of Color: African American student, Latino student, Native American student, Asian American student (Morrison, 2010).

1.15 Limitations

There were several limitations that the researcher faced during this research study. First, there was a short timeframe for data collection. The data collection occurred during April where participants were getting ready for final exams, therefore, the timing of data collection could have discouraged undergraduate students to participate in the study. Second, due to the time constraints, only two institutions granted the institutional review board approval for this study before April. Third, the number of minority students in agriculture and STEM programs are relatively small, therefore, it was challenging to recruit enough minority students at a PWI for this study. Further, the study only focused on undergraduate students' learning experiences about their first college mathematics course, therefore, the experiences and perspectives of the participants in this study cannot exemplify their experiences in other college courses. Moreover,

this study was quantitatively driven relied on self-reported data, therefore, it was challenging to capture an in-depth understanding of students' thoughts toward different teaching methods.

CHAPTER 2. LITERATURE REVIEW

In this Chapter, a review of literature was provided on the following topics: 1) barriers and challenges for minority students in higher education, 2) culturally responsive teaching, 3) students' sense of belonging in higher education, and 4) students' academic self-efficacy in higher education.

To understand and identify studies that have been conducted on the topics identified above, the researcher used several resources: 1) *North American Colleges and Teachers of Agriculture Journal*, 2) *Journal of Agricultural Education*, 3) Purdue Library, 4) Purdue e-Pubs, and 5) Google Scholar. The terms and keywords that were used in the search included but are not limited to the following: "minority student," "African American student," "underrepresented minority students," "nontraditional students," "agriculture," "agricultural sciences," "STEM," "science and engineering," " retention," "HBCU," "PWI," "higher education," "diversity and inclusion," "sense of belonging," "self-efficacy," " academic self-efficacy," and "academic engagement." The following paragraphs are a description of the findings and themes emerged from a review of the literature.

2.1 Barriers and Challenges for Minority Students in Agriculture and STEM

The literature on understanding and recognizing barriers and challenges for minority students in agriculture and STEM are well documented. The following section presents the findings from a review of literature regarding challenges and barriers for minority students in agricultural and STEM disciplines.

2.1.1 Lack of Academic Connection

Higher education tends to emphasize external motivation such as GPA and standardized test scores, which focus on a shallow understanding of knowledge and lower level of critical thinking skills (Ginsberg & Wlodkowski, 1995, 2009). In addition, minority students receive insufficient academic support (Richardson, Rivers, & Whitelock, 2015; McKim et al., 2017) and experience disconnection with curriculum and instruction (Warren, Ballenger, Ogonowski, Roseberry, & Hudicourt-Barnes, 2001). For example, according to Hurtado, Eagan, Pryor,

Whang and Tran (2012), teaching in STEM areas are still predominately teacher-centered, with goals of covering content as the priority (Froyd & Simpson, 2008). Teacher-centered instruction in higher education disengages minority students by not addressing their cultural backgrounds, individual needs and prior experiences (Bayer Corporation, 2012; Brown, 2000). In the context of agriculture, African American students and Hispanic students did not have sufficient rural backgrounds, agriculture exposure (Talbert & Larke Jr, 1995a, 1995b), and involvement in activities such as FFA, 4-H (Foreman et al., 2018; Roberts et al., 2009; Swan & De Lay, 2014) in secondary agricultural programs (California Department of Education, 2012). Therefore, the way that agriculture is taught in higher education could disengage minority students because of the academic disconnection between students' interest and prior experiences with the discipline. As institution and faculty both play a vital part in students' learning process in agriculture and STEM programs (Figueroa, 2015; Noguera, 2001; Navarro & Edwards, 2008), the curriculum in colleges of agriculture needs to change to be more relevant and inclusive toward students from different backgrounds (Estrada et al., 2016).

2.1.2 Lack of Enough Funding Support

According to Estrada et al. (2016), minority students have a higher portion of being first-generation students, which typically translates that their families experienced low socioeconomic status (Estrada et al., 2016). Financial burden and insufficient funding support can be another reason that pulls minority away from accomplishing academic success in higher education (Cullinan & Leewater, 2009; Richardson et al., 2015; Foreman et al., 2018; Outley, 2008; McKim et al., 2017; Bettis et al., 2017; C. Akers et al., 2017). Based on previous studies, providing financial support to minority students is important to help enroll and retain minority students in higher education, as a part of the efforts to increase diversity in agriculture and STEM areas (McKim et al., 2017; Ross et al., 2012; Outley, 2008; Bettis et al., 2017; Donnell, Edwards & Green, 2002; Dumas-Hines, Cochran, & Williams, 2001).

2.1.3 Hostile Campus Climate

A positive and supportive learning environment is one of the factors promoting minority students' sense of belonging, academic engagement and persistence (Palmer et al., 2011).

Minority students have reported negative experiences of encountering racial discrimination in the context of higher education (Hossain & Robinson, 2012; Raqye-Bogdan, Klingaman, Martin, & Lucas, 2013; Nettles, 1990). Jones, Castellanos and Cole (2002) conducted a focus group study of 35 participants to examine students' experiences in a PWI including African American, Asian American, Hispanic and Native American students. The results found out that students felt the institution was not fully committed to diversity and the campus climate was not welcoming. Minority students perceived a higher level of a sense of alienation than their white peers at school, which can negatively affect their academic performance (Hurtado & Carter, 1997). Similar results were found from Chen (2013), who revealed that minority students reported themselves to have experienced racism, discrimination and sense of alienation on campus. Another quantitative study conducted by Johnson (2014) also revealed that minority students were not feeling belonged and included on campus compared to white students.

Allen-Ramidial and Campbell (2014) suggested that institutional climate can impact students' sense of belonging. According to the Associations of Public & Land-Grant Universities (2016), institutions that have a desirable campus climate can better address and accommodate students' backgrounds and needs, which are important factors leading to student success. According to Figueroa (2015), the hostile institutional climate can be expressed in different forms such as racial discrimination, racial biases, stereotypes, judgments and microaggressions (Gonzalez, 2006; MacLachlan, 2006). Hostile campus climate leads to a sense of alienation and reinforces racial discrimination and stereotypes for minority students (Fries-Britt, Younger, & Hall, 2010), which negatively impacts students' learning experiences (Millet & Nettles, 2006; Golde, 2005). Tinto (1993) developed a model of college retention, which indicated the degree that a student successfully integrates to the university life determines their choice of staying or leaving. One of the major contributors leading to a positive integration is the extent that students feel accepted and connected to the classroom and campus community. In other words, the sense of alienation contributes to students' negative college experiences, which in turn increases the likelihood of student departure from higher education. This was supported by Medina (2015) and Terenzini and Reason (2005), which both used the model developed by Tinto (1993) in their studies describing students' academic drop out.

2.1.4 Lack of Role Models and Mentors

The roles that mentors and role models play in retaining students are crucial. Minority students lack mentors of color (Medina, 2005; Bettis et al., 2017; Jones & Larke, 2003). Effective mentoring assumes that mentor and mentee share similar backgrounds (i.e., race, gender) (Campbell & Campbell, 2007). Students of color tend to find a mentor of color that matches their race and gender (Blake-Beard, Bayne, Crosby, & Muller, 2011), whom they can relate based on similar backgrounds and experiences. African American students found it difficult to see that potential connection with white faculty due to cultural differences (Tinto, 1993). According to Tinto (1993), this is called "like-person role models." Tinto's point was supported by several studies, which suggested that African American students see African American faculty to be more supportive and culturally sensitive and thus perceive them as role models (Fries-Britt & Turner, 2002; Sedlacek & Brooks, 1973; Jackson, Kite, & Branscombe, 1996; Lee, 1999).

Campbell and Campbell (2007) conducted a study looking at long-term impacts of the mentoring relationship for 339 undergraduate students. The results suggested that students who paired with mentors in the same race demonstrated a higher GPA and retention rate. However, Goldenberg (2014) argued that race was not the dominant or only factor that determines a teacher's success in teaching, and the race match between teacher and students does not always guarantee successful teaching (Nieto, 2002). A couple of studies examined relationships between faculty's gender and students' enrollment and persistence in science and engineering. The results from several studies are mixed. Canes and Rosen (1995) did not support the notion that gender of faculty was positively associated with female students' enrollment in science and engineering. In this case, having more female faculty did not necessarily lead to the more female students enrolled in science and engineering program. This result was supported by Campbell and Campbell (2007) and Hollingsworth and Fassinger (2002), who also suggested no association between gender matching and mentoring effectiveness. However, Robst, Keil and Russo (1998) suggested there was a positive correlation between the number of female faculty and increased retention of female students in science and engineering program.

Unfortunately, African American faculty were also underrepresented in the higher education setting. For example, of the full-time faculty who were employed in postsecondary institutions in 2016, 76 % were White, 6% were Black, 5% were Hispanic, and 10% were

Asian/Pacific Islander (NCES, 2019). The underrepresentation of faculty of color in higher education further exacerbates the fact that African American students have difficulty finding African American role-models to support them (Dahlvig, 2010). As such, increasing the number of faculty of color, cross-mentoring training, and having multiple mentors are essential steps to take, to offer a quality mentoring for minority students that can encourage their stay in PWIs and help them to succeed (Dahlvig, 2010). Increasing the number of faculty of color could be one of the ways to address student diversity in agriculture and STEM disciplines (Nelson & Brammer, 2010; Allen & Solorzano, 2001; Drape et al., 2017).

2.2 Programs to Recruit and Retain Minority Students in STEM

There are many programs and practices that have been documented to recruit and retain more minority students in STEM areas. At the institutional level, Estrada et al. (2016) suggested that the establishment of an institutional tracking system to monitor students' progress in STEM programs could serve as the first step. Further, Estrada et al. (2016) suggested developing strategic partnerships, curriculum change, and financial aid resources that are available for minority students, to encourage their participation and persistence in STEM. This is supported by Allen-Ramidial and Campbell (2014), who suggested that the need and importance of establishing faculty partnerships between majority and minority-serving institutions. The purpose of faculty partnerships is to share and exchange teaching practices that are effective in serving minority students from different institutions. By exchanging information and learning from each other on instructional design and teaching process, minority students could benefit from a better and more engaging course design, which can promote their academic and professional development (Allen-Ramdial & Campbell, 2014).

Many programs have been designed and practiced in PWIs for the purpose of increasing retention for minority students (Johnson, 2013). For instance, Johnson (2013) used a qualitative approach using audiotaped interviews to study the advantages of a retention program for African American students at a PWI. The results indicated that the retention program helped student with their coursework and their achievement toward their academic and professional goals. Of the different retention programs, programs that fall into mentoring, tutoring and study skills training categories were reported as most beneficial (Johnson, 2013). Mentoring is built on an interactive, reflective and constant process (Roberts, 2000) and focuses on the long-term relationship

(Donaldson, Ensher, & Grant-Vallone, 2000), through which mentors provide support to mentees to help them grow academically and professionally (Thomas, Willis, & Davis, 2007). Mentoring process involved intentional efforts and commitment from both mentors and mentees, in order to promote mentees' academic, professional, emotional and personal growth (Terrion & Lenard, 2007). According to Drape and her colleagues (2017) and many other scholars, mentoring support should not only be limited to academic level. Instead, it should also include efforts to help students to navigate the resources and opportunities that can help students to achieve academic accomplishment, professional success and personal growth as a human being (Cohen, Tran, & Suarez, 2015; Allen & Solorzano, 2001; Drape et al., 2017; Glenn, Esters, & Retallick, 2012; Gale, 2002; Lease, 2004; Stolle-McAllister, 2011; Hatfield, 2011). Several programs have been documented with its focus on the establishment of mentoring approach for minority students, in order to foster a positive faculty and student relationship for them in the context of agriculture and STEM (Allen, Knobloch, & Esters, 2019; Johnson, 2013; Moss, 2011; Thompson & Scriven, 2008; McKim et al., 2017; Estrada et al., 2016; Lee & Harmon, 2013; Cohen et al., 2015).

2.3 Culturally Responsive Teaching Motivational Framework

Culturally responsive teaching motivational framework developed by Ginsberg and Wlodkowski (1995, 2009) informed this study (p. 34). The framework illustrates four intertwined approaches (i.e., establishing inclusion, developing attitude, enhancing meaning, engendering competence) that intrinsically motivate student learning from different aspects.

2.3.1 Four Different Motivational Approaches of Culturally Responsive Teaching

According to Ginsberg and Wlodkowski (2009, pp. 34-35), establishing inclusion refers to norms and procedures that help to create a learning environment where learners feel respected, included, valued and connected. This approach highlights the need to fulfill the need of students for a sense of belonging. Sample teaching practices underneath this category can be: 1) teachers encourage collaborative learning and promote cross-cultural interactions between students (Ginsberg & Woldkowski, 2009), and 2) teachers pay attention to every student and treat everyone equally (Montgomery, 2001; Ginsberg & Wlodkowski, 2009). Enhancing meaning

refers to norms and procedures that expand and challenge student learning that is relevant to their lives, prior experiences and values (Ginsberg & Woldkowski, 1995, 2009). This approach engages students with challenging learning tasks. Sample teaching practices underneath this category can be: 1) teachers propose challenging questions, and 2) teachers help students to navigate resources to find the answers (Ginsberg & Woldkowski, 2009). Based on what students have learned and want to learn, teachers become facilitators for the learning process that is student-driven.

Engendering competence refers to norms and procedures that teachers understand how students learn and effectively and authentically evaluate what they have truly learned (Ginsberg & Wlodkowski, 1995, 2009). This dimension associates with providing learning options and assessments considered as student-centered. Sample teaching practices underneath this category can be: 1) teacher allows different options of assessment to evaluate what their students have learned (i.e., self- assessment, conference presentation, community projects, essays, papers, tests) to accommodate different learning styles and learning contexts, and 2) teacher makes assessment relevant to students' lives, interests and experiences (Ginsberg & Wlodkowski, 2009).

Developing attitude refers to help students to establish a positive learning attitude to foster students' learning (Ginsberg & Wlodkowski, 2009, p. 35). Practices and examples that underneath this approach include: 1) teachers make the learning content that is relevant and personal to students (Ginsberg & Wlodkowski, 2009), and 2) teachers let students choose a studying project upon students' interests and preference. By making the learning relatable and personal, students are more likely to be interested, motivated and engaged in the learning process.

2.4 Theoretical Framework

Social cognitive theory (Bandura, 1986) guided this study. Albert Bandura developed social cognitive theory in 1986 and described that human behaviors are the product of combinational influences from personal, behavioral and environmental levels. Bandura (1986) suggested a model of triadic causation among personal, behavioral and environmental factors and described their interactional effects on human development. "Self-efficacy" and "sense of belonging" were two dependent variables in this study. The development of self-efficacy and sense of belonging included combined inputs and influential paths from people and the

surrounding environment. According to Bandura (1994, 1997), the development of self-efficacy over the lifespan involves different stages and pathways through the interactions and resources from the environment and others (i.e., family, peers). People and their behaviors both influence and are influenced by the social system and the surrounding environment. According to McMillan and Chavis (1986), the development of sense of community included interactions with people and the environment through major four steps. A sense of belonging is developed through the sharing of relatedness, a sense of importance, emotional connection, and a sense of needs fulfillment within a group. Human behaviors and activities are the products of dynamic interactions from people and the environment, during which a sense of community is formed and developed (McMillan & Chavis, 1986). Bandura (1986, 1999) pointed out reciprocal influences from personal, behavioral and environmental factors neither follow a sequential order nor similar strength. To further illustrate the model, Bandura (1999) broken down the triadic reciprocal interrelations among personal, behavioral and environmental determinants into different segments. Sakiz (2007) also described the triadic reciprocal relationships in the context of education.

First, a segment between personal characteristics and behaviors. This refers to the reciprocal interaction that a person's beliefs, thoughts, or feelings will influence a person's behaviors and vice versa (Bandura, 1986). In other words, what people think and believe in themselves will influence how they behave (Bandura, 1986). In the context of education, students who think they are smart and intelligent and believes their capabilities toward schoolwork will be actively involved in more challenging learning tasks and activities (Sakiz, 2007). In return, behaviors also influence personal beliefs (Bandura, 1986, 1999; Schunk, 1996). For instance, students who actively engage in challenging tasks and activities will positively reinforce their self-confidence about their capabilities to be successful.

Second, a segment between personal beliefs and environmental influences. This refers to the reciprocal interactions that personal characteristics influence their surrounding environment and vice versa. For instance, people's self-beliefs can influence other peoples' expectation of them and the level of social interaction within that environment (Sakiz, 2007; Schunk, 1996). In addition, personal attributes such as one's race, gender, and sexual orientation can also influence people's judgments toward the individual (Lerner, 1982). In the context of a classroom, a student who is super confident and motivated could increase their teacher's expectation for the student

(Sakiz, 2007; Schunk, 1996). The higher level of confidence might also increase the level of support the individual received from the teacher. In return, environmental influences also influence personal beliefs. For example, when a student of color is situated in a hostile environment where biases and stereotypes are frequently presented toward minority population, this environment could detriment students' confidence about themselves and student might doubt their capabilities to be successful.

Third, a segment between behaviors and environmental influences. This refers to the reciprocal interactions that behaviors influence the environment and vice versa. For instance, a faculty who actively promotes diversity and inclusion with dedicated endeavors could potentially change the environment of that department to be more inclusive and supportive for all students (Sakiz, 2007). In return, the environment influences how people behave and react within that environment. For instance, a friendly and welcoming learning environment will encourage students to be active learners during the learning process. A hostile and discriminating environment, on the other hand, could disengage students of color from the learning process and disrupt their connections with the community. In this case, the learning environment could potentially result in students' choice of dropping out.

Social cognitive theory has been frequently used in social science studies that focus on students' learnings in academic settings (Phan, & Ngu, 2014; Erlich, 2011; Chang & Chien, 2015; Artino, 2012; Dixon, 2012; Dykema, 2016; Dooley & Schrechhise, 2016; Harinie, Sudiro, Rahayu, & Fatchan, 2017; Ding, 2015). For instance, Sakiz (2007) conducted a study exploring perceived teacher support and its association with students' sense of belonging and academic self-efficacy. The study was conceptualized within the framework of social cognitive theory in the context of the middle school classroom. The study suggested that that interrelationship of students' perceptions of teacher support, students' sense of belonging and their academic self-efficacy is the product of triadic influences from personal, behavioral and environmental impacts. In another study, Gore, Leuwerke and Turley (2006) used social cognitive theory to study college students' intention to drop out through the analysis of college self-efficacy beliefs. The results of the study indicated that self-efficacy was indeed associated with students' academic performance and retention within a two years period. Quiggins et al. (2016) found out self-efficacy was one of the motivational resources for minority students in the college of agricultural sciences at Texas Tech University.

Culturally responsive teaching in a university setting were manifested through multi-directional and interrelated influences among environmental, behavioral and personal factors. By fostering positive relationships between students and faculty, faculty help to develop a sense of belonging and confidence for students. In return, a positive relationship can facilitate the development of a hospitable environment (Hurtado, 2007). Following a similar pattern, a hospitable environment, in turn, can positively influence student behaviors, personal beliefs, and motivation (Bandura, 1986, 1999).

2.5 Operational Framework

The researcher developed the operational framework (Figure 1) for this study based on the studies conducted by Dickson et al. (2016) and Chun and Dickson (2011). Dickson et al. (2016) extracted three factors (i.e., diverse teaching practice, cultural engagement, diverse language affirmation) to represent culturally responsive teaching. Chun and Dickson (2011) examined relationships among the culturally responsive teaching, academic self-efficacy and sense of belonging. The framework for this study included three constructs: students' measures of culturally responsive teaching, sense of belonging and academic self-efficacy. The independent variable for this study was operationalized as students' perceptions of culturally responsive teaching practices. This is a latent variable which was measured and indicated through students' perceptions of different types of culturally responsive teaching practices. In particular, two factors (i.e., diverse teaching practice, cultural engagement) from Dickson et al. (2016) and one added factor (i.e., relationship building practices) were operationalized as indicators for culturally responsive teaching: 1) diverse teaching practice, 2) cultural engagement practice, and 3) relationship-building practices. Two dependent variables were operationalized as the sense of belonging and academic self-efficacy. School sense of belonging indicates to what extent that students feel included and connected in a school setting (Goodenow & Grady, 1993). Academic self-efficacy indicates how confident that students feel about their capabilities in academic task activities (Bandura, 1997; Schunk, 1991). School sense of belonging and academic self-efficacy are both very important factors sustaining students' academic motivation and success (Deci & Ryan, 2000; Bandura, 1994; Linenbrink & Pintrich, 2003). The relationships and influential paths among the three independent variables and two dependent variables were explored and examined in this study (Figure1).

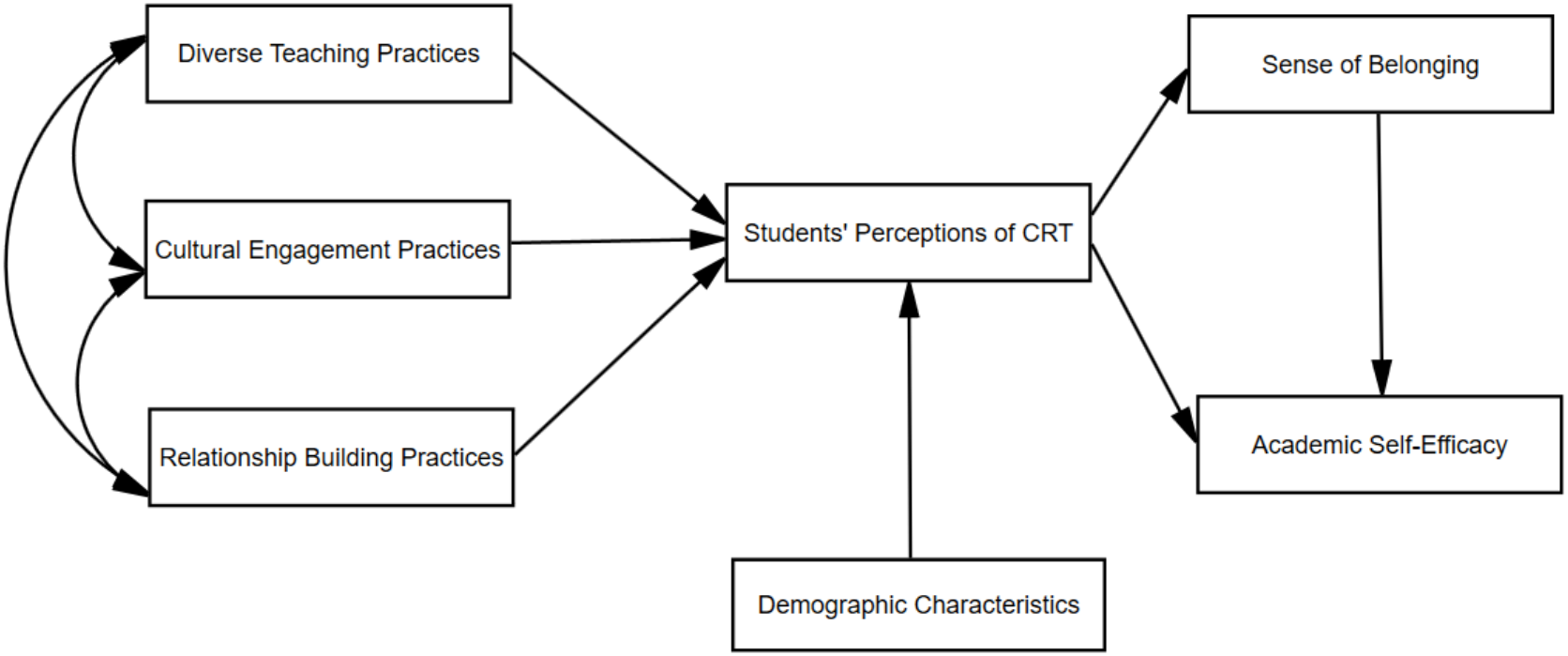

Figure 1. Operational Framework

2.6 The Definition of Culturally Responsive Teaching

Geneva Gay and Gloria Ladson-Billings are the foundational pioneers in culturally relevant education (Aronson & Laughter, 2016). Culturally responsive teaching focuses on the recognition and embracing of student's cultural backgrounds, previous knowledge, and experiences in response to conducting effective teaching towards students from various cultural and social backgrounds (Ladson-Billings, 1994; 1995a, 1995b; Gay, 2000, 2010; Au, 1993; Nieto, 2002, 2010; Delpit, 1995; Au & Jordan, 1981). Gay (2010) defined culturally responsive teaching as "using the cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning more relevant to and effective for them" (p.31). According to Ladson-Billings (1994), her definition of culturally relevant pedagogy is to "empower students intellectually, socially, emotionally and politically using cultural referents to impart knowledge, skills, and attitudes" (pp.16-17). According to Aronson and Laughter (2016), while culturally responsive teaching refers to teaching practices that are responsive to cultural differences, culturally relevant pedagogy focuses on pedagogy that influences teachers' attitudes, dispositions toward cultural differences, which in turn influences the instructional design and teaching activities (Aronson & Laughter, 2016). Although two terms (culturally responsive teaching vs. culturally relevant pedagogy) are different, they are used interchangeably by many researchers (Aronson & Laughter, 2016, p. 167). In this study, the researcher used the term culturally responsive teaching.

2.7 Examples of Culturally Responsive Teaching

Culturally responsive teaching can be manifested in classrooms through an appreciation for students' cultural assets and integration of students' culture into the teaching and learning process (Ladson-Billings, 1994, 1995a, 1995b; Gay, 2000, 2010). Dover (2013), Aronson and Laughter (2016) and other scholars summarized and described several dimensions of culturally responsive teaching. Through a review of literature, culturally responsive teaching can be manifested through the demonstration of the following characteristics: 1) values their students' cultural backgrounds (Ladson-Billings, 1994, 1995a, 1995b; Gay, 2000, 2010; Ginsberg & Wlodkowski, 1995, 2009), 2) teachers are culturally competent through understanding, respecting and supporting the values and norms of another culture (Sleetter, 2010; Byrd, 2016;

Gay, 2000; Dill & Moule, 2005; Han et al.,2014, Gay, 2002; Villegas & Lucas, 2002), 3) willing to integrate student's culture to make the learning more relevant and personal (Ladson-Billings, 1994, 1995a, 1995b; Gay, 2000, 2010; Ginsberg & Wlodkowski, 1995, 2009), 4) believes their students' potential to succeed (Ladson-Billings, 1994, 1995a, 1995b, 2006; Gay, 2000, 2010; Ginsberg & Wlodkowski, 1995, 2009; O'Connell, 2008), 5) have high expectations for all students (Samuels, 2018; Hill, 2012; Montgomery, 2001), 6) design the learning process that is culturally relevant and student-driven (Figueroa, 2015; Noguera, 2001; Samuels, 2018), 7) genuinely care about their students' success and development (Lowman, 1995; Alderman, 2008), 8) willing to help their students and build caring, trustworthy and positive relationships and interactions (Samuels, 2018; Kransnoff, 2016; Reschly, et al., 2008), 9) establish a supportive and inclusive learning environment (Ginsberg & Wlodkowski, 1995, 2009), 10) use different teaching methods to serve different learning styles and habits (Banks, 2006; Black-Vannoy, 2004; Guild, 1994; Burris, Heubert & Levin, 2006; Gay, 2002; Gerlach, 1994; Smith & Macgregor, 1992; Caswell & Labrie, 2017; Beckett, 2011; Macfarlane et al., 2007; Samuels, 2018), and 11) actively promote culturally responsive teaching in higher education (Little, 1999; Cochrane et al.,2017).

2.8 Components of Culturally Responsive Teaching

The following section will address the different components of culturally responsive teaching through a review of the literature. The components included in this study are listed as 1) diverse teaching practices, 2) cultural engagement practices, and 3) relationship-building practices. Of which, two components (i.e., diverse teaching practices, cultural engagement practices) were extracted based on the study by Dickson et al. (2016). The third component (relationship-building practices) were framed based on a review of the literature regarding culturally responsive teaching.

2.8.1 Diverse Teaching Practices

The first component of culturally responsive teaching framed in this study is diverse teaching practices. Teachers need to be aware of different learning styles and implement appropriate curriculum accordingly (Gay, 2002). Failure to recognize those differences in the

teaching process can negatively impact minority students' academic achievement (Morgan, 2010). Banks (2006) and Guild (1994) recognized that people with different racial and ethnical identity demonstrate different learning patterns. For example, Black-Vannoy (2004) discussed different learning styles between African American students and White students. The results indicated that African American students are more physically active and value social interaction during the learning process. In this study, African American students preferred teacher assistance while white students preferred limited teacher assistance (Black-Vannoy, 2004). Kasuya (2007) and Yoo (2014) indicated that students from different countries and various cultural backgrounds demonstrated different preferences on the instruction. For example, while students from Asian countries prefer a more structured classroom, students from western countries prefer less structured classroom. With different structures in the classroom, interactions and learning patterns could be different. Given the fact that students learn differently from a cultural aspect, the use of various teaching methods should be combined to best accommodate diverse students (Morgan, 2010).

John Dewey, Jean Piaget and Lev Vygotsky are major scholars and theorists that contributed to the development of learner-centered teaching (LCT) (Rallis, 1995; Dewey, 1938; Vygotsky, 1978). Learner-centered teaching (LCT) (i.e., student-centered teaching) can be in different forms such as active learning, inquiry learning and cooperative learning (Weimer, 2013; Caswell & Labrie, 2017; Bonwell & Eison, 1991). To be considered learner-centered, course design, instructional methods, and student learning outcome assessment are all developed around the student (Weimer, 2013, Bransford et al., 2000; Nilson, 2010; McKeachie, 1954; Albrecht & Gross, 1948; San Francisco State University, 2018).

Regardless of different forms of LCT, LCT aims to engage students in the learning process through 1) helps students to construct their own knowledge instead of focusing on pure content coverage (Barr & Tagg, 1995; Carr, Palmer, & Hagel, 2015; Chi, 2009; Vygotsky, 1978), 2) addresses personal needs and interests in the teaching and learning process to make learning more personal, relatable and engaging for students (San Francisco State University, 2018; Figueroa, 2015; Noguera, 2001; Navarro & Edwards, 2008; Bayer Corporation, 2012; Brown, 2000; Morgan, 2010; Weimer, 2002; Brame, 2016; Bownwell & Eison, 1991), 3) helps students to develop a positive learning attitude (Prince, 2004), and 4) promote student learning outcomes (Freeman et al., 2007; Ruiz-Primo, Briggs, Iverson, Talbot, & Shepard, 2011; Burris et al, 2006).

Therefore, LCT motivates students to learn and develop critical thinking skills (Nilson, 2010; Weimer, 2013; Mahavier, May, & Parker, 2006). In addition, LCT promotes interactions in the classroom and the development of the positive faculty-student relationship (Guiffrida, 2005; Gerlach, 1994; Smith & MacGregor, 1992). Moreover, LCT helps to establish a welcoming and open learning environment. As in the traditional classroom, students perceive teachers as dominant figures due to the power imbalance (Sidky, 2017). Cochrane et al. (2017) suggested that teachers needed to recognize and were willing to disrupt power imbalance in the classroom (i.e., teacher as a dominant role) in order to create a more pleasant learning environment and develop a good relationship with students. By establishing a welcoming and inclusive learning environment, faculty helps to foster a sense of belonging for students (Ginsberg &Wlodkowski, 2009).

The problem for the learning assessment used in current education is the universal expectation for all students (Montenegro & Jankowski, 2017). Wright (2011) explored how evaluation in higher education can be changed by using Weimer's (2002) definition of learner-centered teaching, emphasizing that grades should not become the priority during the learning and teaching process. LCT evaluation should focus more on the development of students' critical thinking skills and knowledge application (Epstein & Hundert, 2002) as cited in Schmitt, Hu, and Bachrach (2008). In other words, faculty should have developed appropriate assessment tools that align with student cultural backgrounds to evaluate what students have learned (Montenegro & Jankowski, 2017; Sedlacek, 1994). Examples of LCT assessment include providing timely feedback (Weimer, 2002), peer assessment (Knight & Wood, 2005; Lu & Law, 2012), technology use (Ervin-Kassb, 2014), and different options for students to choose how they can be assessed (i.e., self-reflection papers, journals, community projects, presentations, and group projects) (Grove, 2016; Gosselin & Gagne, 2014).

2.8.2 Cultural Engagement Practices

The second component of culturally responsive teaching framed in this study is cultural engagement practices, which refers to the integration of culture into the teaching and learning process. According to Kashima (2015), culture was defined as "a collection of non-genetic information that is transmissible from one person to another and can potentially influence a person' behavior" (p. 1307). Cultures are subject to change among different populations, groups

and their associated values (Hilton & Seo, 2013; Spencer-Oatey, 2012; Lustig & Koester, 1999). Culture plays an essential role in the student learning process and influences their learning styles (Strange & Banning, 2015). There is no "one fits all" teaching method when facing students with diverse learning styles. This was supported by Richardson (2010), who found that people who are different in racial and ethnic groups, demonstrated different learning patterns, communication styles as part of the learning process (Morgan, 2010). The instruction in higher education still favors dominant culture (Montenegro & Jankowski, 2017), which could disengage minority students, who bring their cultures into the classrooms that are not aligned with the dominant culture (Goldenberg, 2014).

Culturally responsive teaching requires teachers to have a sense of cultural competence. According to the National Education Association (2019), the term cultural competence refers to a set of skills and knowledge to effectively communicate and interact with populations other than one's own. In an educational context, according to Ladson-Billings (2006), cultural competence refers to teachers' awareness toward cultural differences and their abilities and efforts to help students to appreciate one's cultural identity while embracing other cultures that are different of one's own. Diller and Moule (2005) defined cultural competence as cultural knowledge and skills that integrate students' cultural differences leading to effective cross-cultural teaching. Faculty who fail to be culturally sensitive/competent could deepen that gap of academic and social disconnection and exacerbate cultural misunderstanding towards minority students (Fleming, 1984; Feagin, Vera, & Imani, 1996). According to Milner (2010), when teacher and student come from different cultural and social backgrounds and have different experiences (i.e., a white teacher with students of color or international students), cultural differences are one of the examples contributing to undesirable cultural conflicts, which can negatively impact the teaching and learning process for both parties. Johnson (2014) indicated that a faculty's lack of cultural competence also contributed to students' negative experiences. To develop culture competence, faculty need to know about themselves and their identity development through cultural lenses. This self-reflection process could help faculty themselves understand who they are as a teacher and why they decide to use culturally responsive teaching in the classroom (Sleeter, 2010). This process could also help faculty to be aware of their potential prejudice and biases, stereotypes and unfair treatment toward their minority students in the teaching and learning process (Sleeter, 2010; Patel, Li, & Sooknanan, 2011).

Villegas and Lucas (2002) pointed out that teachers who use CRT should develop a more culturally inclusive syllabus. To begin with, teachers make the coursework relevant to students to make learning more meaningful and engaging (Jenkins, 2016). Making learning materials relevant and useful for students in one important component to boost student motivation (Assor, Kaplan, & Roth, 2002; Husman & Lens, 1999; Larke, 2013). By integrating the culture into the curriculum and course design, faculty support building a sense of belonging at the instruction level. Knowing your audience and their cultural assets before teaching help students to establish a connection between learning content to daily life experiences (Ladson-Billings, 2009). For example, Morrel and Duncan-Andrade (2004) pointed out using hip-hop as an example in the teaching practice (Emdin, 2010; Envedy &Mukhopadhyay, 2007). These teachers used hip-hop in urban science and math classrooms by establishing a content connection. A similar study was conducted by Kim and Pulido (2015), in which hip-hop was used by an English language arts teacher to connect with Black students. In this study, hip-hop music was also used in a youth organization to connect with Latino students through community connection. The results indicated that using hip-hop as an example of applying CRT helped students to achieve academic success and made a connection to their own culture.

2.8.3 Relationship Building Practices

Yet, another component of culturally relevant teaching is relationship-building practices, which focuses on the development of a positive teacher-student relationship. According to Love (2008) and Love (1993), positive faculty-student interaction and relationship contribute to African American students' retention and academic success by developing a higher level of association and sense of belonging for them (Moss, 2011; Ginsberg & Wlodkowski, 2009). Furr and Elling (2002) conducted a study using a survey to identify the factors associated with African American students' retention at a PWI. The study included 183 African American freshmen students. The results indicated that on top of the pre-college factors (e.g. academic preparedness, family financial status, parents' education), the positive social and academic environment is very important in increasing the retention of African American students. Of which, positive social interaction with peers and teachers are most associated with students' retention. In another study, Meeuwisse, Severiens and Born (2010) studied the relationship between learning environment, sense of belonging, and social interaction with teachers and peers

for minority students via a developed questionnaire. The results confirmed that positive teacher-student and peer interaction could promote students' sense of belonging at school.

Caring is an important component of fulfilling human needs; caring teachers fulfill student's psychological needs as a human being and thus able to offer a better engaging experience for their students. Teachers who demonstrate caring not only focus on students' academic success, but also care about students' personal and professional growth (Wentzel, 1997). Teachers' caring is also a very crucial component for building a positive teacher-learner relationship (Lumpkin, 2007) toward a successful education (Noddings, 1992). Developing a positive teacher-student relationship is beneficial for students to gain academic and professional success as well as personal development (Tosolt, 2010; Crosnoe, Johnson & Elder, 2004; Murdock & Miller, 2003). A positive and caring teacher-student relationship creates a sense of community where students feel belonged, supported and motivated (Khalifa et al., 2016; Cassidy & Bates, 2005; Pang, 2005; Jacobsen et al., 2016; Epstein, 2003).

According to Lumpkin (2007), caring teachers demonstrate the following characteristics: 1) believe in students and their potentials to succeed (Garza, Alejandro, Blyth, & Fite, 2014; Tosolt, 2009), 2) dedicate to promote student learning through various ways (DeCastro-Ambrosetti & Cho, 2005; Shulman, 2004; Foster, 2008; O'Brien, 2010), and 3) being reflective on their own teaching and make accordingly adjustments for improvement along the teaching process (Bain, 2004). According to literature (Lumpkin, 2007; DeCastro-Ambrosetti & Cho, 2005; Lark, 2013), caring behaviors can be expressed in different forms. First, teachers have high expectation for all students (Ladson-Billings, 1994, 1995; Gay, 2000). For minority students, knowing that their teachers have high expectations for them increases minority students' sense of competence; believing in their potentials to succeed (Lark, 2013). This was supported by Villegas and Lucas (2008), who suggested that teachers' perspectives and judgment about their students impacted their expectations for students and their learning outcomes (Irvine, 1990; Pang & Sablan, 1998; Marks, 2005). Second, teachers provide resources to facilitate student learning and address students' questions and concerns (Ginsberg & Wlodkowski, 2009; Rosso-Gleicher, 2011; Meyer, 2009). Third, teachers demonstrate genuine support for students' academic and personal growth (Tosolt, 2010). Fourth, caring teachers initiate interactions with students and get to know students personally (Barrow, 2015; Haskell-McBee, 2007; O'Brien, 2010).

Additionally, caring teachers are open, approachable, fair and empathetic (Russo-Gleicher, 2011; Tosolt, 2009)

2.9 Academic Self-Efficacy

Self-efficacy is one of the fundamental motivational factors that contribute to students' academic engagement, commitment and achievement (Linnenbrink & Pintrich, 2003). According to Bandura (1994), self-efficacy is foundational motivational factors that could affect human behaviors. The extent to which students believe their capabilities in academic activities will thus determine their engagement in academic settings.

Academic self-efficacy refers to one's beliefs of their abilities in learning activities, individuals who have a higher level of academic self-efficacy are more confident about their abilities in learning (Boroumand & Sheykhi Fini, 2011). Many studies have been found that studied the impacts of on students' self-efficacy on their academic achievement and engagement (Yokoyama, 2019; Domenech-Betoret, Abellan-Rosello, & Gomez-Artiga, 2017; Chemers, Hu, & Garcia, 2001; Chang & Chien, 2015). Majority of studies indicated that self-efficacy was positively related to student academic engagement and performance. For example, Chang and Chien (2015) conducted a comprehensive literature review of 26 articles that focused on academic self -efficacy and academic engagement of American students. The results from this meta-analysis approach reported a significant positive association between the two constructs. In another similar study, Honicke and Broadbent (2016) also used a meta-analysis approach to examine the relationship between academic self-efficacy and academic performance by reviewing 59 studies having the same relevant research topics or focus. Honicke and Broadbent (2016) also reported a positive relationship between academic self-efficacy and academic performance. In another study, Blake and Lesser (2006) investigated the association between these two constructs by analyzing 2,500 students' academic self-efficacy and their performance on a math test. The researchers found that higher self-efficacy scores were associated with higher test scores. However, there are also some studies that provided different results. For example, a study conducted by Dogan (2017) produced the conflicting result, suggesting that there were no predictive effects of academic self-efficacy on academic performance based on the data from around 600 students.

2.9.1 Self-Efficacy in Higher Education

In the context of higher education, several studies were found that specifically looked at the relationship between students' self-efficacy and their academic performance (Choi, 2005; Turner, Chandler, & Heffer, 2009; Barber, 2009). The results from previous research regarding these two constructs were fairly consistent. For example, Chemers, Hu and Garcia (2001) conducted a study on freshman students at college and found out that students' academic self-efficacy was positively associated with many desirable outcomes. These positive outcomes included students' higher academic performance, better health status and stronger intention to stay in the program. In another study, Meral, Colak and Zereyak (2012) conducted a study with college students by using an adapted self-efficacy scale to investigate the relationship between college students' self-efficacy and their academic performance. The results found that self-efficacy and students' academic performance are positively related. This result was consistent with Brady-Amoon and Fuertes (2011), who also found a positive relationship between these two constructs based on a study of 271 undergraduate college students majoring in liberal arts. In another study, Barber (2009) examined the impacts of academic self-efficacy on college students. The findings were promising in that: the higher level of academic self-efficacy positively affected students' academic performance (e.g., first semester GPA) for both first-generation and non-first-generation students. In a more recent study, Kolo, Jaafar, and Ahmad (2017) conducted a study from 339 senior college students in Nigeria, the result is consistent with previous researches suggesting that there was a significant positive relationship between students' academic self-efficacy and their academic performance. In another similar study, Turner, Chandler and Heffer (2009) examined the impacts of students' achievement motivation and academic self-efficacy on their academic performance on 264 college undergraduate students. Academic self-efficacy was a predictor of academic performance measured by self-reported GPA.

2.10 Sense of Belonging

According to Maslow (1962) hierarchy of needs, belongingness is a basic human motivation and need after the physiological and safety needs are satisfied (Huitt, 2007). There are many definitions of sense of belonging. For instance, Goodenow (1993, p.25) defined it as

"students' sense of being accepted, valued, included, and encouraged by others (teachers and peers) in the academic classroom setting and of feeling oneself to be an important part of the life and activity of the class." Osterman (2000, p.324) defined it as "a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to being together."

According to Strayhorn (2012), the sense of belonging is a human need and a fundamental motive that can affect human behaviors in different contexts. In addition, the sense of belonging is subject to change depending on the contexts and influenced by people's social identities at different levels. Additionally, a sense of belonging has been demonstrating to associate with positive outcomes such as increasing student retention, engagement, and academic achievement.

2.10.1 Importance of Sense of Belonging

Previous researches have demonstrated the sense of belonging is highly related to students' academic motivation, achievement, retention and general well-being (Anderman, 2003; Osterman, 2000; Pittman & Richmond, 2008; Freeman, Anderman, & Jenson, 2007; Newman, Lohman, & Newman, 2007; Lam, Chen, Zhang, & Liang, 2015; Hausmann, Scholfield &Woods, 2007; Fink, 2014; Walton & Cohen, 2011). Sense of belonging has been reported to be related to one's confidence in their academic skills and capabilities. For example, Sahaghi, Birgani, Mohammadi and Jelodari (2015) examined the relationship between school sense of belonging and academic self-efficacy of 180 high students. In their study, Sahaghi et al. (2015) used school sense of belonging scale developed by Sakiz (2007) and academic self-efficacy scale developed by Patrick, Hicks, and Ryan (1997). The results suggested that there was a significant positive relationship between the two variables. Sakiz (2007) conducted a study examining relationships among perceived teacher support, sense of belonging, academic self-efficacy, and academic enjoyment of 377 middle school students. The study was based on social-cognitive theory with results indicating that the sense of belonging positively impacted academic self-efficacy.

2.10.2 Sense of Belonging and Academic Motivation and Achievement

Sense of belonging has also been studied in relation to academic motivation and achievement. Previous researches have generated consistent results. For example, Moallem (2013) examined the relationship between students' sense of belonging and academic achievement and persistence by conducting a meta-analysis of 27 articles. The results supported that school sense of belonging is positively associated with academic performance. In another study, Anderson (2010) examined school sense belonging to academic motivation and achievement including 143 college student-athletes, the study also supported the hypothesis that achievement motivation is positively related with school sense of belonging. In another study, Freeman, Anderman, and Jensen (2007) studied first-year college students' sense of belonging at two distinct levels: classroom sense of belonging and campus sense of belonging. The study suggested that freshman's classroom sense of belonging is positively associated with their academic self-efficacy in the class and intrinsic motivation. Classroom sense of belonging, perceived of faculty caring and interaction, combined with social experiences contributed to students' sense of belonging at the campus level as well. In another similar study, Lam, Chen, Zhang and Liang (2015) studied the relationship between the sense of belonging and academic achievement of 406 junior high school students. The study used the Chinese version Psychological Sense of School Belonging developed by Goodenow (1993) and self-reported GPA to collect data. The results supported the hypothesis that there is a significant positive relationship between school sense of belonging and academic achievement. Students with a higher level of school sense of belonging have a higher level of academic achievement. However, there is one study by Capps (2003), who used PSSM scale to measure the sense of belonging of 2000 middle school students, the findings did not support the hypothesized associations between the school sense of belonging and academic achievement.

2.10.3 Sense of Belonging and Students' Retention in College

O'Keeffe (2013) suggested that a lack of sense of belonging was an important factor that contributes to students' attrition in college, particularly for minority students and students who are socially and academically disadvantaged. This result is consistent with the study by Rainey et al. (2018), who also suggested that students of color are more likely to lack a sense of belonging

in college. This was supported by Johnson et al. (2007), who studied first-year students' sense of belonging among different racial groups of students. Johnson et al. (2007) revealed that underrepresented minority students were more likely to lack a sense of belonging compared to their white peers. Studies conducted by Tovar et al. (2009) and Hausman, Schofield and Woods (2007) suggested that students' sense of belonging is associated with their intentions to persist in college. Ostrove, Stewart and Curtin (2011) found out that sense of belonging for graduate students influenced their career aspirations into academia. This result is consistent with O'Meara, Griffin, Kuvaeva, Nyunt and Robinson (2017), who found out that graduate students' sense of belonging influenced their retention and success in graduate programs.

In addition, while both white students and African American students agreed that campus racial climate significantly influences their sense of belonging, African American students were most likely to negatively rate campus racial climate. For example, minority male students had a lower level of sense of belonging compared to their white counterparts in STEM fields (Strayhorn, 2012). Additionally, O'Meara et al. (2017) suggested that the development of positive professional relationships enhance graduate student sense of belonging the most. O'Keeffe (2013) suggested that the development of positive faculty-student relationships would help to establish a caring and welcoming learning environment for students, to promote students 'sense of belonging and retention in college. Hoffman, Richmond, Morrow and Salomone (2002) conducted a study on first-year college students' sense of belonging. Hoffman et al. (2002) examined different aspects of the sense of belonging through a developmental process of an instrument to measure first-year college students' sense of belonging. Their study suggested that a quality peer-peer relationship, faculty-student relationship, and interaction, and perceived classroom support all contributed to the development of students' sense of belonging. In another similar study, Morrow and Ackermann (2012) studied 960 first-year undergraduate students regarding their school sense of belonging and how it related to students' intention to stay. The study measured the sense of belonging by using the scale developed by Hoffman et al. (2002). The study suggested that faculty support, a component contributing to the development of a sense of belonging, was positively related to students' intention to persist.

2.10.4 Sense of Belonging and General Well-being

Sense of belonging has been studied in relation to the general well-being of a student and positive behaviors in school. Stebleton, Soria and Huesman (2014) studied first-generation students' sense of belonging and their mental health in college. The study suggested that first-generation students generally have more challenges and barriers in their college life due to their minority backgrounds, low socioeconomic status, language barriers, financial disadvantages and other factors (Bui, 2002; Engle & Tinto, 2008; Stebleton et al., 2014). As a result, compared to their peers who are not first-generation students, first-generation students are more likely to feel a sense of alienation and disconnection on campus (Stebleton et al., 2014). The study administrated the SERU survey (Student Experience in the Research University) to students in six higher education institutions. The results confirmed that first-generation students had a significantly lower level of sense of belonging and a higher level of stress or depression. The study also suggested that students' sense of belonging was negatively associated with student's mental health, in other words, students who have a higher level of sense of belonging is associated with a lower level of mental health problems. This is consistent with a more recent study by Davis (2017), which studied relationships among sense of belonging, perceived social support and mental health of college students. The results suggested that student sense of belonging is negatively associated with depressive symptoms (i.e., depression, irritability, aggression). In other words, a higher level of sense of belonging is associated with a lower level of depressive symptoms. Mounts (2004) and Fink (2014) generated similar results through their studies on students' mental health in a college setting. Both studies suggested that a student's sense of belonging is associated with and predicted college student's mental health. The results were supported by Walton and Cohen (2011), who found out that application of an interventional practice designed to foster African American students' sense of belonging was associated with increased GPA as well as improved students' health. Another recent study conducted by Thompson, Wood and MacNevin (2019) generated similar results by administrating an online survey to 941 students. The study results suggested that a sense of belonging was reported to have a negative association with students' mental issues.

2.10.5 Sense of Belonging of African American Students in Higher Education

A number of studies were found that studied minority students' sense of belonging in higher education. Strayhorn (2012) combined the data from four different projects in order to understand undergraduate students' sense of belonging in STEM. Strayhorn (2012) found that sense of belonging was very important for undergraduate students and their success, particularly towards minority students. Moreover, Strayhorn (2012) found that students' different identities impact their perceptions of sense of belonging in STEM and their general experiences of college life. For instance, the study found that perceptions of sense of belonging could vary across gender, race, economic status or intersectional effects due to different identities. In other words, a minority first-generation male student and a minority male student coming from low-income families can have different experiences and sense of belonging even though they all come from a minority group.

Wright (2016) conducted a qualitative study exploring a sense of belonging for African American male students in a PWI. The participants in this study indicated that engagement in student organizations and perceived faculty and peer support were important components of fostering their sense of belonging. The results of the study also provided consistent results as found in many types of research, suggesting that the mentor plays an important role in promoting students' academic success in higher education. In a recent study, Jackson (2016) studied the sense of belonging of Black student enrolled in STEM programs and its relations to students' GPA. The study used a modified version of the PSSM scale to measure participants' sense of belonging in the first stage of data collection. The study suggested that although the sense of belonging was not a predictor of college GPA, interpersonal relationships with faculty and peers play an important role fostering their sense of belonging that contributed to participants' positive experiences in the institution. Recently, Druery (2018) studied three different Black initiative programs and examined their influences in fostering Black students' sense of belonging. Several themes emerged from the study that helped to develop Black students' sense of belonging and promoted their academic success included the following: 1) peer connection and mentoring, 2) positive faculty-student relationship, 3) professional development and network opportunities, and 4) campus resources and support. Roberts (2018) took a different approach exploring the sense of belonging for African American students in the mathematics field by investigating experiences of five successful African American students in a community college. The author

argued while African American students are traditionally marginalized and underrepresented compared to their white counterparts, valuable lessons can be gained by understanding the experiences of these five individuals who were successful in the field of mathematics. The results of the study suggested that instructor's support from both inside and outside of the school, instructors' encouragement and effective teaching practices helped to build students' confidence in their capabilities for mathematics. In an addition, the study also suggested that teacher's confidence on students' math skills, students' perception of perceived support from both peers and faculty, and students' active engagement in math learning community were key components of developing students' sense of belonging as well as academic success in mathematics.

2.10.6 Sense of Belonging of Hispanic/Latino in Higher Education

Several studies were found that investigated a sense of belonging for Hispanic/Latino students in a college setting. Previous studies have identified several barriers that hinder Hispanic students' success in college. For example, Sanchez (2012) suggested that Hispanic/Latino students lack faculty support navigating them toward success. Harper and Hurtado (2007), Cerezo and Chang (2013), and Hurtado and Carter (1997) found similar results suggesting that Hispanic students, like other minority students, are more likely to experience a hostile campus climate. Several studies also identified factors that could support Hispanic/Latino students' success. For instance, identifying role models and developing a positive relationship with peers could promote their success in college (Good, Halpin, & Halpin, 2000; Carlone & Johnson, 2007; Herrmann et al., 2016; Hernandez et al., 2018). Cramer et al. (n.d.) found that first-generation Latino male students found it difficult to adjust to life in a predominately white campus. Cramer et al. (n.d.) also suggested while Latino male students preferred to have mentors who share similar race and backgrounds with them, students had difficulty developing a positive relationship with their mentors. Hurtado and Carter (1997) identified that Latino students' membership and engagement in student and social organizations and academic activities (i.e. course discussions) were positively associated with their sense of belonging. The results are consistent with Maestas, Vaquera and Zehr (2007), who identified factors that influence students' sense of belonging who were enrolled in a Hispanic-Serving Institution. Maestas et al. (2007) found out that students' engagement in academic programs and learning activities (e.g., course discussion), students' perceptions of faculty' interest and support on their development, as

well as financial support are positively associated with their sense of belonging. In another similar study, Nunez (2009) identified several predictors that contribute to Latino college students' sense of belonging. Positive factors included: 1) perceived faculty's interest on students, 2) engagement in class and learning activities (e.g., course discussion), 3) cross-racial interaction, and 4) diversity curriculum.

According to Strayhorn (2012), practices that help students to develop a sense of belonging could start from administration level (i.e., Provost) to establish policies, activities, and resources to promote students' sense of belonging through networking and faculty-student collaboration. Department head and faculty members can use the student orientation program as an opportunity to engage with students and help them to adjust to the new environment. Developing positive interactions and relationship with peers and faculty as well as establish a welcoming and supportive campus climate are important facets that foster students' sense of belonging (Hoffman et al., 2003; Chavous, 2005)

2.11 The Need for the Study

Sense of belonging, self-efficacy, and culturally responsive teaching have been studied separately in many pieces of research situated in different settings. A majority of the sense of belonging studies examined its influences on students' retention (Hurtado, Dey, Gurin, & Gurin, 2003; Quiggins et al., 2016). Similarly, self-efficacy has also been studied in regard to student motivation, academic engagement in the learning process (Yokoyama, 2019; Domenech-Betoret, Abellan-Rosello, & Gomez-Artiga, 2017; Chang & Chien, 2015). Despite a number of studies that have examined students' sense of belonging and self-efficacy in academic settings in general, more research needs to be done in relation to students' sense of belonging and self-efficacy in the context of agriculture and STEM at higher education. Moreover, there is a scarcity of research that examined the role of culture in agricultural classrooms in higher education. Tubbs (2015) conducted a study that synthesized research that addressed culture in the field of agriculture education. According to the findings from Tubbs (2015), the research that addressed culture in agriculture education seemed to have a major focus on secondary education or teacher education (Haygood, Baker, Hogg, & Bullock, 2004; Vincent, Kirby, Deeds, & Faulkner, 2014; Andreasen, Seevers, Dormody, & VanLeeuwen, 2007). Therefore, more research are needed to examine culture in agriculture education from students' perspectives.

Culturally responsive teaching has been studied in different research and reported effective influences on student motivation (Dickson et al., 2016; Chun & Dickson, 2011; Hughes et al., 2004; Christianakis, 2011; Doherty et al., 2013). Many studies on CRT focus on K-12 audiences in the context of primary and secondary education (Han et al., 2014; Irizarry, 2007). For instance, Melchior (2011) conducted a case study that demonstrated CRT strategies used in a dance class in New Zealand. Wearmouth and Tsyrlina-Spady (2007) studied using CRT to foster literacy learning. Ukpokodu (2011) talked about how to use CRT in a math class to empower students' learning. While CRT practices are commonly available in the K-12 level of education as part of teacher education (Han et al., 2014; Irizarry, 2007). There is a need for more research on CRT in higher education.

Only a limited number of research was found that looked at CRT in higher education. Of which, some research tried to identify the examples or categories of culturally responsive teaching in higher education. Other research addressed the application of CRT in higher education. For instance, Jackson (2015) conducted a study that investigated perspectives from pre-service teachers of color towards CRT, the study indicated although teachers of color can share the similar experiences and characteristics with students of color, race-match does not guarantee that the teaching was naturally culturally responsive or effective (Jackson, 2015; Nieto, 2002; Gay, 2010). In a more recent study, Jenkins (2016) studied about the motivation of white faculty towards the use of CRT. Jenkins (2016) found out that moral obligation, personal backgrounds, and thoughts provoking experiences (Alfred, 2002) were contributing factors to encourage the use of CRT. In a similar study, Han et al. (2014) conducted a collaborative self-study involving seven teachers in the college of education and pointed out the importance of faculty's cultural competence self-development on their intention to apply CRT in classrooms. Moreover, the majority of culturally responsive teaching studies have been relying on qualitative methods to identify specific culturally responsive teaching practices (Gorham, 2013; Hramiak & Huang, 2015). Qualitative studies have advantages providing an opportunity to explore people's thoughts, opinions, and perceptions in details. However, the qualitative approach also provides unavoidable subjective biases when it comes to data interpretation and the generalization and transferability of the results.

No quantitative instrument was found to measure students' perceptions of culturally responsive teaching in higher education, particularly in the context of agriculture and STEM.

Without a valid measurement, we cannot fully understand to what extent and how different types of culturally responsive teaching practices could promote students' intrinsic motivation through an increased sense of belonging and self-efficacy.

Last, the interrelated relationships among culturally responsive teaching, sense of belonging and academic self-efficacy were rarely studied. Only one study was found which included three constructs (i.e., culturally responsive teaching, sense of belonging, and academic self-efficacy) all together in a single study (Chun & Dickson, 2011).

To address the gap in the literature, this study developed and validated a quantitative instrument that measures students' perceptions of CRT, sense of belonging and academic self-efficacy in a university setting. Moreover, the instrument collected the data for the three variables of interest in this study (i.e., students' perceptions of culturally responsive teaching, sense of belonging and academic self-efficacy). This study thus would help us to identify the effectiveness of culturally responsive teaching practices and promote CRT application in higher education. This result of this study could also help the faculty to reflect on their teaching practices and make accordingly adjustments to better engage all students in the classroom. Additionally, the results of this study could benefit all students through an inclusive teaching approach to increase their academic engagement, motivation and learning outcomes at large.

CHAPTER 3. METHODOLOGY

3.1 Introduction

This chapter will illustrate the research design and procedures used in this study. This chapter will describe the research purpose, research questions, and participants for this study. Additionally, this chapter will illustrate procedures for instrument development, validity and reliability, data collection, and data analysis.

3.2 Purpose of the Study

The purpose of this study was twofold: 1) to develop and validate an instrument to measure culturally responsive teaching from undergraduate students enrolled in agriculture and STEM programs, and 2) to predict the relationships between students' perceptions of culturally responsive teaching practices and their sense of belonging and academic self-efficacy in the context of higher education.

3.3 Research Questions

There were five research questions for this study.

1. Does the developed instrument satisfactorily measure students' perceptions of culturally responsive teaching and sense of belonging in agriculture and STEM within higher education?
2. Does the structural equation model demonstrate a good model fit?
3. What were the relationships among students' perceptions of culturally responsive teaching, sense of belonging and academic self-efficacy?
4. Were there any significant differences in students' perceptions of culturally responsive teaching among students in terms of race, academic classification, gender, college affiliation, and institution type?
5. What were the additional factors that can influence students' perceptions of culturally responsive teaching?

3.4 Research Design

The researcher adopted a positive paradigm using a quantitative approach. Positive paradigm assumes that reality exists and can be explored and described through logical and systematic analysis (Kaboub, 2008). A quantitative approach was chosen for this study because of the following reasons: 1) students' perceptions of culturally responsive teaching in a university context can be measured through a valid instrument; 2) students' perceptions of culturally responsive teaching were rarely studied and quantified; 3) the associations among the three variables (i.e., students' perceptions of culturally responsive teaching, sense of belonging and academic self-efficacy) were rarely studied and quantified; and 4) the associations among the three variables (i.e., students' perceptions of culturally responsive teaching, sense of belonging and academic self-efficacy) are complicated and multi-directional, 5) using a survey method is cost-effective and allow the researcher to collect data in different contexts, 6) the results from a quantitative approach such as survey method allows for comparisons within and across groups, and 7) the results from quantitative analysis have the potentials to be generalized into different contexts. By using the structural equation modeling technique in the framework of social cognitive theory, this study was to examine and describe the paths of associations among the three variables in this study.

For this study, the first college math course was selected to allow study participants to specifically reflect on their perceptions of culturally responsive teaching of the math faculty for that course. There were several reasons that a college math course was selected. First, mathematics is a crucial subject for all STEM programs (Chen, 2013). For example, undergraduate students are generally required to take a college math course during their college education. Second, the content of introductory mathematics courses is fairly consistent in higher education. Third, undergraduate students usually take a college math course (e.g., calculus, algebra) in the first year or second year of their college education. Fourth, introductory mathematics courses serve as gateway courses for students to continue in STEM majors. Crisp, Nora and Taggart (2009) and Shaw and Barbuti (2010) pointed out that the level of math course and students' experiences in introductory math course are associated with their decision to stay or departure in STEM majors. This finding is consistent with Chen (2013), who found out that STEM math credits earned in the first college year were negatively related to STEM attrition rates. In other words, students who earned math credits from calculus or other advanced math

course are more likely to stay in STEM compared to their peers who earned fewer credits and left STEM. Fifth, an introductory mathematics course (e.g., algebra) can also predict academic success (Ganga & Mazzariello, 2018). Last, for this study, participants from these two institutions have to take at least one math course (e.g., college algebra or calculus) as part of core requirements.

3.5 Institution Context

The context of this study was situated in agriculture and STEM disciplines at a Predominantly White Institution (PWI) and a Historically Black Colleges and University (HBCU). This study used convenience sampling and census approach. Two institutions served as the convenience populations of the study: Purdue University (PWI) and the University of Arkansas at Pine Bluff (HBCU). Convenience sampling is a non-probability technique based on availability and convenience to access the targeted population (Etikan, Musa, & Alkassim (2016). The researcher chose the Purdue University and the University of Arkansas at Pine Bluff for this study due to the following reasons: First, two institutions were selected because they are both land-grant institutions with an agriculture and STEM focus. Second, in order to include a diverse student population in this study, an HBCU was selected on purpose where minority students (i.e., African American) are well represented. Third, supported by the literature, students, particularly minority students have different learning experiences studying at PWIs and HBCUs campuses (Seifert et al., 2006; Campbell & Campbell, 2007), it is valuable to study students' perceptions of culturally responsive teaching in two different institutional contexts. Fourth, the researcher is a current graduate student enrolled in the college of agriculture at Purdue University and she graduated from the University of Arkansas at Pine Bluff in 2016. Based on her affiliation with both Purdue and UAPB, she had developed connections with both two institutions to be able to have access to students to conduct this study at these two institutions. This experience provided her opportunities to connect with appropriate personnel to carry out the study.

Purdue University is a land-grant university located in the Midwestern region of the United States. As of Fall 2018, there were 43,411, undergraduate students enrolled, which comprised 75 % of the student population. In comparison, there were 9,795 graduate students enrolled, which comprised 23% of the student population (Purdue Data Digest, 2018). As a land-

grant university, Purdue University is well known for its notable engineering and agriculture programs. However, as a predominately-white institution, Purdue University also faces challenges to recruit and retain unrepresented minority students as part of the school's mission to promote diversity and inclusion. For example, as of Fall 2018, 58% of students were White, 21% of students were international, 8% were Asian, 3% were Black, 3% of students were biracial and multiracial, 5% of students were Hispanic/Latino, 2% were unknown for their race/ethnicity and 0.1% of students were American Indian, Native Hawaiian and Pacific Islander based on the latest data as of Fall, 2018 (Purdue Data Digest, 2018). To explore the number of underrepresented minority students across four colleges including agriculture, engineering, science, and liberal arts as of fall, 2018, there are 44 African American students and 108 Hispanic students in the College of Agriculture, 170 African American students and 449 Hispanic students in the College of Engineering, 75 African American and 142 Hispanic students in the College of Science and 143 African American in the College of Liberal Arts.

The University of Arkansas at Pine Bluff (UAPB) is 1890 historically Black Land Grant institution. The university is located in Pine Bluff, Arkansas. Student enrollment at UAPB is around 2,300 as of Spring 2019. Of which, 2,218 were undergraduates and 99 were graduate students. According to UAPB institutional report for the academic year 2017-2018, African American students comprise 91% of the student population. In total, there were 30 Bachelor's, 8 Master's and 1 Doctoral program that were offered during 2017-2018. The top four largest student enrollment was from the School of Agriculture, Fisheries & Human Sciences, Schools of Arts and Sciences, School of Business & Management, and School of Education (UAPB, 2019)

3.6 Participants

The population for this study was undergraduate students who were enrolled in the College of Agriculture, College of Science, and College of Liberal Arts at Purdue University and the School of Agriculture, Fisheries and Human Science, and School of Arts and Science at the University of Arkansas at Pine Bluff. The reasons three colleges at Purdue were selected included: 1) The purpose of this study was to examine undergraduate students' perceptions of culturally responsive teaching in the context of agriculture and STEM programs; therefore, college of agriculture and college of science were included in this study, 2) Minority students are underrepresented in PWI campus, in order to include more minority students at Purdue in this

study, the researcher included the college of liberal arts Purdue, which enrolled 377 underrepresented minority students. The reasons two schools at UAPB were selected included: 1) agriculture and STEM programs were offered through the school of agriculture, fisheries and human sciences and school of arts and science, and 2) student enrollment of these two schools comprise 71% of the undergraduate student population at UAPB.

In order to be included in the study, study participants had to meet the following requirements: 1) were at least 18 years older, 2) were undergraduate students currently enrolled in the Spring, 2019 semester at Purdue University or UAPB, and 3) were undergraduate students currently enrolled in at least one of the following colleges or schools: College of Agriculture, College of Science, College of Liberal Arts, School of Agriculture, Fisheries, and Human Sciences and School of Arts and Science. In total, there were 10,000 students in the targeted population who met the criteria and were included in the study.

3.7 Sampling

The researcher conducted a census by sending out the instrument to all potential participants who have met the criteria to be included in the study. The advantages of the census approach include: 1) Higher accuracy. Every unit in the targeted group is included in the study and thus this technique provided access to collect more information, and 2) this technique is more inclusive in a heterogeneous context. Every unit in the targeted group can present different characteristics, by including all units, this technique can include and absorb different information due to the heterogeneous nature of the units inside the group (Martinez-Mesa et al., 2016; Gupta, Zurn, Diallo, & Dal Poz, 2003; Kish, 1979).

3.8 Role of the Researcher

The researcher was currently enrolled as a graduate student studying agriculture in s public land-grant university. The researcher did not grow up with a traditional agricultural background, however, the researcher was aware of stereotypes and biases associated with the agricultural industry. Consistent with findings from the literature review, the researcher was also aware of barriers and challenges that influence students' perceptions, attitude and thoughts toward agriculture as an academic study or future careers. The researcher acknowledged how

culture can play important roles in one's academic aspiration and achievement as it influences our thinking and social behaviors. Although the researcher did not have formal teaching experiences in U.S. classrooms, she was particularly interested in how culturally responsive teaching could better promote students' academic motivation and learning experiences in higher education.

In addition, the researcher had opportunities to have formal education at an HBCU as well as at a PWI. This unique experience provided her familiarity and first-hand experience of understanding educational differences in two types of land-grant institutions. The different learning experience at these two institutions provided her an opportunity to examine the research questions and interpret the responses aware of differences in these two institutions (i.e., student and faculty demographics, campus culture, student life on campus).

3.9 Instrument

This study used a web survey through Qualtrics.com. Compared to the mailed survey, web surveys are convenient to operate with the use of growing information technology (Dillman, Smyth, & Christian, 2014). Web surveys thus can reach a large number of audiences in a short amount of time with relatively low financial cost (Dillman et al., 2014). However, one of the disadvantages of the Internet survey is a low response rate (Vaske, 2011). In compliance with IRB guidelines, the researchers followed several protocols from Dillman et al. (2014) to increase participants' response rates to complete the online questionnaire.

Based on the literature review on culturally responsive teaching, no instrument was found to measure students' perceptions of culturally responsive teaching in the context of higher education, particularly in the context of agriculture and STEM programs. The only instrument that was found to quantitatively measure students' perceptions of culturally responsive teaching was developed by Dickson, Chun and Fernandez (2016). This instrument was used in the context of middle school. In addition, no research was found that included all three variables in a single study focusing on undergraduate students' perceptions of culturally responsive teaching, sense of belonging, academic self-efficacy in the context of higher education. The only research that was found, which included all three variables in a single study, was conducted by Chun and Dickson (2011). However, Chun and Dickson (2011) framed the study focused on middle school students. Instruments were found to measure students' sense of belonging and academic self-efficacy

respectively in higher education. The researcher used two established scales to measure the sense of belonging and academic self-efficacy and modified the items on the scales accordingly to reflect the research context in higher education.

The final instrument included six sections (see Appendix A): 1) questionnaire consent form and cover page, 2) affiliation information, 3) students' perceptions of culturally responsive teaching practices, 4) sense of belonging, 4) academic self-efficacy, 5) open-ended questions, and 6) demographic characteristics. The two open-ended questions were used to gather additional information: 1) students' perceptions and opinions toward teachers' engaging teaching practices in a university math classroom, and 2) students' perceptions of teachers' behaviors that help to build a positive teacher-student relationship. The responses from these two open-ended questions served as additional information for understanding teachers' culturally responsive teaching practices and their influences on students' motivation.

The first section was the cover letter and consent form. This section provides detailed information for the research including research topic, research purpose, research questions, research procedures, the use of data and confidentiality and voluntary nature of participation. This session invited participants to reflect on their first college math class and gave their honest responses to questions on the questionnaire. This session also provided contact information regarding this project and served as a consent to participate in the study based on a voluntary manner. The participants who consented to participate clicked on the "I agree" button and were able to proceed the next screen to take the questionnaire.

The second section was about affiliation information. There was one question asking about participants' institutional affiliations. Another question asked participants to indicate the math course they identified to complete the questionnaire (e.g. algebra, calculus and other).

The third section focused on students' perceptions of culturally responsive teaching. This section is developed and modified based on the Student Measure of Culturally Responsive Teaching Scale (SMCRT) developed by Dickson et al. (2016). SMCRT measures middle school students' perceptions of culturally responsive teaching. Dickson et al. (2016) developed and validated SMCRT on the foundation of CRTSE (Culturally responsive teaching self-efficacy), a scale developed by Siwatu (2005, 2011). The items from the SMCRT were reworded from CRTSE to reflect students' perceptions of culturally responsive teaching. SMCRT is the only scale that has been found to measure students' perceptions of culturally responsive teaching

practices. The original development and validation of SMCRT scale included exploratory and confirmatory factor analysis through Dickson et al. (2016). Three factors of culturally responsive teaching were identified by Dickson et al. (2016): (1) diverse teaching practices, (2) cultural engagement, and (3) diverse language affirmation. The study for this dissertation, however, was framed in the context of agriculture and STEM in higher education. As such, the researcher adjusted the items from SMCRT and modified the questions to reflect agriculture and STEM disciplines in the university setting.

It is worth mentioning that the authors of SMCRT scale suggested that items from SMCRT do not fully represent culturally responsive teaching practices and should be adjusted for future research with the different student body and academic setting. Additionally, this study focused on a college math course at two land-grant institutions in the U.S., English was the primary language used in a college course at U.S institutions. Therefore, in this study, the researcher eliminated the items that measured foreign language confirmation but added relationship-building practices as the third component.

In alignment of literature review on culturally responsive teaching, one of the motivating mechanisms of culturally responsive teaching for students is when teachers build a positive relationship with students. To measure the student-teacher relationship, the researcher used the items from several student-relationship instruments as combined and validated in the Composite Student-Teacher Relationship Instrument (C-STRI) by Barch (2015). The researcher adjusted the items accordingly to reflect a focus on the context of higher education. Items in the C-STRI reflected several components for a student to build a positive teacher-student relationship. The scale included various teacher characteristics and behaviors, of which, students were able to perceive them as important factors to build a positive teacher-student relationship. For instance, a teacher who is caring and willing to provide academic support and social support are considered as essential components and factors contributing to the establishment of a positive teacher-student relationship (Barch, 2015; Johnson, Johnson, Buckman, & Richards, 1985; Mantzicopoulos & Neuharth-Pritcgett, 2003).

The researcher for this study then added relationship-building practices to replace foreign language confirmation practices. For example, questions such as “My teachers speak in Spanish,” and “Allow students to speak in Spanish at times in class.” were removed. Instead, teaching practices that demonstrate caring behaviors and having high expectation for students

were added. For example, questions included “My math teacher really cared about how much I learned,” and “My math teacher was approachable after class.” Eight teaching practices were as relationship-building practices. These eight teaching practices were grouped into the third component labeled as *relationship building*. Now the adjusted SMCRT scale included three components: 1) diverse teaching practices, 2) cultural engagement practices, and 3) relationship-building practices.

Each item in the third section of the questionnaire asked students to rate that to what extent they agreed/observed that their first math teacher in college used specified teaching practice. The responses used a 5-point Likert-scale: 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, 5 = *Always*. Sample questions included: “My math teacher used different study resources representing different cultures to help us learn,” and “My math teacher tried to find out my prior knowledge regarding the studying content.” There were 23 items in this section; scores were summated across 23 items. A higher score indicated a higher degree of students’ observation and sensation of culturally responsive teaching. A lower score indicated a lower degree of students’ observation and sensation of culturally responsive teaching.

The fourth section focused on school sense of belonging. This section used the Psychological Sense of School Membership (PSSM) scale developed by Goodenow and Grady (1993) and the items from the scale developed by Hoffman (2003) to measure first-year college students’ sense of belonging. The researcher adjusted items derived from the two scales to reflect the context in higher education for this study. The original PSSM scale measured to what extent a student feels respected and included by their peers and teachers in the school. The PSSM scale has been widely used in many studies (Abubakar et al., 2016; Cheung, 2004; Pittman & Richmond, 2008). Previous research using the PSSM scale to measure school sense of belonging have indicated reliable Cronbach’s alpha coefficients (Allen, Kern, & MacKay, 2016). The original PSSM scale has items using a five-point Likert-scale ranging from: Not all true to completely true. In this study, the PSSM scale was adjusted by using a five-point scale: 1 = *Strongly Disagree*, 2 = *Agree*, 3 = *Neutral*, 4 = *Agree*, 5 = *Strongly Agree*. The scale developed by Hoffman (2003) included items that measured students’ comfort levels and interactions in classrooms that contribute to a sense of belonging. The scale developed by Hoffman (2003) has been widely used in different research and demonstrated satisfactory reliability (see Table 8). This section included and adjusted the measuring items from both PSSM and the scale developed

by Hoffman (2003). The new scale used five-point Likert-scale: 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Neutral*, 4 = *Agree*, 5 = *Strongly Agree*. Sample questions in this section included: "I can really be myself at [university]," or "It is hard for people like me to be accepted at [university]." There were 11 items in total for this section. Scores were summated and divided by 11. A higher average score indicated a higher degree of school sense of belonging and a lower average score indicated a lower degree of school sense of belonging.

The fifth section focused on academic self-efficacy. This section asked participants to rate to what extent they were confident with their capabilities to complete the academic tasks and activities. The scale for this section was based on the original College Academic Self-Efficacy scale, developed by Owen and Froman (1988). The original college academic self-efficacy scale had 33 items based on a five-point scale. The researcher modified the scale to reflect the research context of this study. The adjusted scale included 10 items using five-point Likert-scale: 1 = *Not at all*, 2 = *Little*, 3 = *Somewhat*, 4 = *A lot*, 5 = *Absolutely*. Sample questions in this section included: "I can master content in a math course that I am not interested in," or "I earn good grades in my math class." Scores from these 10 items were summated and divided by 10. A higher average score indicated a higher degree of academic self-efficacy and a lower average score indicated a lower degree of academic self-efficacy.

The sixth section included two open-ended questions that allowed participants the opportunity to provide additional information regarding their reflection and perspectives on their learning experience in their first college math course. Two open-ended questions were: 1) What did your math teacher do that engaged you most in their class? (2) In what ways did your math teacher do to make you feel that you could develop a good teacher-student relationship with them? Responses from these two questions were coded and themes were generated to help interpret the quantitative data results and provided additional information related to the research topic.

The last section included demographics items. This section collected information regarding participants' social and academic characteristics. In particular, items solicited information related to race (e.g., African American, White, Hispanic, Native American, Multiracial), gender (e.g., Female, Male), academic classification (e.g., freshman, sophomore, junior, senior), degree program (e.g., Agriculture, Engineering, Science), number of credits registered, and graduate degree plans (e.g., Master's, Ph.D.). Demographic characteristics

provided additional information for subsequent group comparison and data analysis based on different levels of demographic characteristics.

3.10 Institutional Review Board Approval

On February 1st, 2019, the researcher and her major advisor submitted the first application to the Institutional Review Board of Purdue University by using the PROPEL tool. In that application, the researcher provided the following information: research title, research purpose, methods, participants, research procedures and the incentives for the study participants.

On February 6th, the researcher received the PROPEL determination letter from Purdue IRB for this study (PROPEL# 69002035). On February 7th, an amendment letter and email were received from Purdue IRB informing an exemption classification change for the first PROPEL determination letter. This research was then determined by Purdue IRB to have met the criteria for exemption category 2 under CFR 46.101 (b). Therefore, this research was granted the exemption of "Students' academic motivation and perceptions of culturally responsive teaching in higher education" from Institutional Review Boards of Purdue University (IRB protocol #1902021678) (Appendix B). On February 5th, the researcher contacted the vice chancellor for academic affairs for the University of Arkansas at Pine Bluff (UAPB) through email for his approval for this study including undergraduate students enrolled in UAPB. On February 14th, the researcher received the approval letter from the vice chancellor for the University of Arkansas at Pine Bluff (UAPB) for this study. On February 22nd, the researcher contacted the chairperson of IRB from the University of Arkansas through email regarding the IRB application process to UAPB. On March 27th, the researcher was granted an approval letter for "Students' academic motivation and perception of culturally responsive teaching in higher education" from the Institutional Review Boards from the University of Arkansas at Pine Bluff (Protocol # IORG 0002614) (Appendix C).

3.11 Data Collection

On February 22nd, the researcher contacted associate deans of academic programs of the College of Agriculture, College of Science and College of Liberal Arts at Purdue University through email about this study. In the email, the researcher provided a detailed explanation for

the research study, accompanied by an attachment of Purdue IRB exemption letter. The information shared with the deans included the following: research title, research purpose, research objectives, research procedures, participants, and data collection process. Dillman et al. (2014) suggested delivering the survey in the early morning in order to increase the response rate. In addition, Dillman et al. (2014) suggested obtaining experts' reviews and their experiences and familiarity with the targeted population (Dillman et al., 2014) in terms of effective survey distribution methods. The researcher was connected to a student outcomes assessment expert on campus and was advised to send the survey out in the morning.

On April 1st, the researcher sent out the first email embedded with an anonymous link to access the survey to all Purdue participants through Qualtrics. The deadline to complete the survey was set on April 26th. According to Dillman et al. (2014), a welcoming page and survey message are very important in order to encourage people to participate in the survey. Therefore, this survey was designed in a way when participants opened the survey, there was a welcoming page included the following information: research topic, research procedure, research purpose, important of participation, contact information, a brief introduction of the survey and instructions. The researcher highlighted the sentence emphasizing that the participation of the survey is voluntary and confidential because IRB generally requires that participation of the survey is voluntary. The researcher also informed participants that they had an option to enter a random drawing for an Amazon gift card upon the survey completion. Dillman et al. (2014) reported the use of financial incentives is effective to boost the response rate. Further, in order to boost response rates, the researcher followed the guidelines by Dillman et al. (2014) to personalize the survey. Dillman et al. (2014) suggested that the use of personalized survey can be very important and effective to increase responses. Dillman et al. (2014) cited Heerwegh (2005) and Joinson and Reips (2007) suggesting that the use of personalized survey have increased the response rates for both Heerwegh (2005) and Jonison and Reips (2007). In this study, in order to personalize the survey invitation for each participant, the author used the students' first names. Personalized survey invitations were sent to each participant starting with a personalized salutation as Dear [student's first name] for the first invitation email.

Dillman et al. (2014) also suggested multiple contacts and follow-up reminders are needed in the web-based survey. There was no definite answer for how frequent follow-up reminder emails should be sent after the first survey invitation, but it was advised by Dillman et

al. (2014) to plan a sufficient timeframe that best fit the research goal and purpose in order to space out the follow-up reminder emails. Nulty (2008) suggested that online survey response rates are much lower than that of paper-survey. Sending repeated reminder emails and having incentives for respondents are examples of strategies that can be used to increase response rate (Nulty, 2008; Anderson, Brown, & Spaeth, 2006; Sahlqvist et al., 2011).

On April 9th, the researcher sent out a reminder email to encourage participants at Purdue to complete (Appendix D). The reminder email was sent through the office of enrollment management at Purdue University. In this reminder email, the researcher encouraged participants who have not had a chance to complete the survey to do so. In this reminder email, the researcher shared the same information regarding the study and reminded participants to take the survey only once.

On April 24th, the researcher sent out a final reminder email to encourage participants at Purdue to complete the survey. The reminder email was sent through the office of enrollment management at Purdue University. In this reminder email, the researcher thanked participants for their participation and encouraged participants who have not completed the survey to do so. Considering that students were busy preparing for final exams; the survey availability time was extended to April 30th to allow participants to have more time to complete the survey.

On April 8th, the first email was sent out to all participants at the University of Arkansas at Pine Bluff with an anonymous link to access the survey. The email was sent by the director of the IT department on behalf of the researcher due to the researcher's lack of access to students' email addresses. In the email, the researcher informed UAPB students with the following information: research topic, research procedure, research purpose, data collection, contact information, confidentiality, and voluntary nature of participation. The researcher also shared the information with participants that they had an option to enter a random drawing for a $ 50 Amazon gift card upon the survey completion.

On April 15th, a reminder email was sent to encourage UAPB participants to complete the survey. The reminder email was sent by the director IT department at UAPB on behalf of the researcher. In the reminder email, the researcher shared the same information as in the first email and reminded participants to complete the survey only once.

On April 24th, a final reminder email was sent to participants at UAPB through the director of the IT department at UAPB on behalf of the researcher. In the final reminder email,

the researcher provided the same information regarding the study as in the previous two emails. In the final reminder email, the researcher thanked participants for this participation and reminded highly encouraged students at UAPB who have not had a chance to complete the survey to do so before April 30th.

On May 1st, the researcher closed the survey through Qualtrics and all the responses were recorded and collected. The data collection was completed on May 1st at 9:00 am (EDT). Quantitative data collected through an online questionnaire was imported from Qualtrics.com to SPSS. To follow IRB guidelines of protecting participants' confidentiality, the researcher took the following steps: 1) SPSS files containing the original data was stored in the department drive, only the researcher and the PI have the access to open the file, 2) an anonymous link to enter a random drawing for a $50 Amazon gift card was separated from the survey, therefore, there is no way to link participants' responses to the email they provided for the drawing, and 3) the SPSS file is permanently deleted once the current study is finished.

3.12 Validity

Scales used in this study are valid. Validity refers to how accurately our instrument measures concept we want to measure (Heale & Twycross, 2015). For instance, a survey measuring students' mental health status will not be a valid survey to measure students' learning styles. To address the face and content validity for the developed questionnaire, the researcher worked with a panel of experts, whose research areas and experiences focused on program evaluation, STEM education, mathematics, agricultural education, and diversity and inclusion in higher education. The panel included four faculty members, three Ph.D. students and one master's student. Experts were chosen because of their knowledge and relevant experiences for the research topic. The panel provided feedback for the questions on the questionnaire that were not clear and provided constructive comments regarding the questionnaire layout, length, and design. For instance, based on panel's comments, a question "My math teacher believes in me that I can do challenging work," was reworded to "My math teacher expected to me to do well in their class." Another question "My math teacher is interested in my life," was reworded to "My math teacher was very interested in knowing my family and home life." Two open-ended questions were reworded to: 1) What did your math teacher do that engaged you most in their

class? 2) In what ways did your math teacher do to make you feel that you could develop a good teacher-student relationship with them?

3.13 Reliability

Scales used in this study are reliable (See Table 8). Reliability refers to instrument accuracy over repeated occasions to generate consistent results (Heale & Twycross, 2015). The questionnaire developed for this study used existing scales that were identified through a literature review. The SMCRT scale was developed and validated by Dickson et al. (2016) with a reliability coefficient of 0.90. The two subscales (teacher's social support & academic support) from the C-STRI demonstrated a reliability coefficient of 0.86 and 0.90 respectively. The PSSM scale was developed by Goodenow & Grady (1993) with a reliability coefficient of 0.88. The PSSM scale has been widely used in several studies (Dickson et al., 2016; Barch, 2015; Gaete et al., 2016; McMahon, Parnes, Keys, & Viola, 2008; Ahn, 2010) and have demonstrated satisfactory reliability coefficient all above 0.80. The sense of belonging scale developed by Hoffman (2003) has demonstrated a reliability coefficient of 0.91. Last, the scale to measure students' academic self-efficacy was based on the college academic self-efficacy scale. This scale was developed by Owen and Froman (1988) and was tested on two different occasions with a reliability coefficient from 0.90 to 0.92. This scale has been used by different researchers and has demonstrated satisfactory reliability coefficient above 0.90 (Barber, 2009; Choi, 2005; Ayiku, 2005; Papa, 2015).

3.14 Pilot Test

A pilot test is encouraged to help the survey designer to have a big picture of the questionnaire (Dillman et al., 2014). In this process, the survey designer could potentially identify some problems and come up with solutions to improve the survey before it was sent to the participants (Dilllman et al., 2014).

A pilot test with three groups was conducted on March 08th, March 18th and March 22nd, 2019. The pilot test with three groups was conducted with graduate students from the college of agriculture, undergraduate students from the college of education and the college of engineering. The purpose of the pilot test was to gain the feedback on the following: 1) clarity of the questions

on the survey, 2) average time to complete the survey, 3) reliability coefficient for the scales, 4) survey layout for laptop and smartphones, and 4) technical issues during the survey completion. There were 39 responses from the pilot test, based on the results, the time to complete the survey ranged from 8 minutes to 16 minutes. Participants gave positive comments on the survey length indicating that the survey length was good. According to previous research (Galesic, Bosnjak, & Notes, 2009; Sahlqvist et al., 2011), the length of the survey is negatively associated with the response rate. In other words, the shorter the survey, the higher the chance that students are going to participate in the survey. Based on the feedback from the pilot test, the researcher made the following changes to the final questionnaire:1) a progress bar was added to the survey. Dillman et al. (2014) indicated that adding a progress bar is an effective way to encourage participants' completion of the survey if the survey is short, 2) "neutral" option was added to Likert-scale items, Dillman et al. (2014) suggested that providing the response options such as "Don't' know," or "Prefer not to answer," will decrease the likelihood of getting dishonest answers or wrong answers otherwise, 3) the question "I am included in many activities at this university," was reworded to "I am involved in many activities at this university," 4) the question "My math teacher socialized with students outside of class," was deleted due to its similarity to question # 18, and 5) a demographic question " What college is your major located in? " was reworded to "What college are you in?"

The final questionnaire included 44 Likert-scale questions, 9 demographic questions, and two open-ended questions. In addition, an anonymous link to enter into a random drawing for a $ 50 Amazon gift card was provided separately at the end of the questionnaire.

3.15 Data Analysis Plan

This research was quantitatively driven, and the researcher used Statistical Package for the Social Sciences (SPSS) version 25 (IBM, 2017) and Analysis of Moment Structures (AMOS) version 25 to conduct data analyses. The researcher used confirmatory factor analysis and structural equation model analysis for research questions from one to three with the use of AMOS software version 25. According to Hox and Bechger (1998), SEM offers different options to address the complexity of latent variables. The researcher believed that using SEM was appropriate for this research for the following reasons: 1) this research had multiple independent variables (students' perceptions of diverse teaching, cultural engagement and relationship

building) and dependent variables (sense of belonging and academic self-efficacy), 2) independent variables and dependent variables are latent variables, 3) the relationships between variables are interrelated and multi-directional, and 4) the complexity of paths for variable covariance. For research question four, the researcher used SPSS one-way ANOVA, independent samples *t*-test to examine group differences. In particular, one-way ANOVA tests were used for three groups and above (i.e., freshmen, sophomore, junior and senior). Independent sample *t*-test was used for two groups (i.e., UAPB vs. Purdue). Descriptive statistics were reported to describe participants' demographic characteristics. For example, frequencies, means, standard deviations were used to describe participants. In addition, descriptive statistics were also used to report frequencies, means and standard deviation of the responses for independent and dependent variables in this study. For research question five, the researcher analyzed the qualitative responses for the two open-ended questions through the coding process. Saldana (2013) guided the coding procedures. The researcher used descriptive coding method for these two open-ended questions for this study. The themes were generated, and the results were reported in the form of frequencies.

Raw data collected from an online survey through Qualtrics were imported into SPSS version 25. To make sure the imported data from Qualtrics into SPSS was accurate, the researcher conducted an outlier check through SPSS. Two negative measuring items were reverse coded. Moving forward, the researcher removed all empty cases, which contain missing values for all variables in the questionnaire. These empty cases were present because participants just opened the questionnaire but did not actually complete the questionnaire.

3.16 Missing Data Treatment in SEM

In general, there are three major ways to deal with missing data in SEM (Byrne, 2001). According to Byrne (2001), maximum likelihood estimation was suggested due to its foundation on the theoretical rationale. Additionally, the maximum likelihood has advantages due to its use of all available information for missing value estimation, producing a more accurate estimate (Enders & Bandalos, 2001). In this study, the researcher used the maximum likelihood method to treat the missing data in SEM.

3.17 Model Fit Indices

There are different model fit indices for SEM. These model fit indices included Model Chi-Square, Goodness of Fit (GFI), Adjusted GFI (AGFI), Tucker-Lewis Index (TLI) (Tucker & Lewis, 1973), Comparative Fit Index (CFI), Normed Fit Index (NFL) (Bentler & Bonett, 1980) and Root Mean Square Error of Approximation (RMSEA) (Hox & Bechger, 1998). In this study, the researcher used Chi-Square, CFI and RMSEA. A non-significant Chi-Square value ($p > 0.05$) indicates a good model fit. However, while Gagne and Hancock (2006) suggested a large sample is good when using a structural equation model, Hooper, Coughlan and Mullen (2008) cited Bentler and Bonnet (1980) suggesting that model is likely to be rejected with a significant Chi-square when the sample size is large (Kenny, 2015). Therefore, the other two model indices (CFI & RMSEA) were used to evaluate the model fit.

For CFI (comparative fit index), a value greater than 0.90 indicates a good fit (Hu & Bentler, 1999). For the root mean square error of approximation (RMSEA), a value between 0.08 to 0.10 indicates medium fit (Byrne, 2001); a value below 0.08 indicates a good fit (MacCallum et al., 1996; Schreiber, Nora, Stage, Barlow & King, 2006). However, according to Hu and Bentler (1999), the cut-off point for RMSEA value is set at 0.06.

3.18 Statistical Analysis

For research question 1 (Does the new scales satisfactorily measure students' perceptions of culturally responsive teaching and sense of belonging in agriculture and STEM within higher education?), the researcher used exploratory and confirmatory factor analysis to validate the new scale for culturally responsive teaching and used confirmatory factor analysis to validate the scale for sense of belonging. The researcher conducted an assumption check for using confirmatory factor analysis. Three model fit indices were used for the confirmatory factor analysis: 1) Model-Chi-Square; 2) Confirmatory Factor Index (CFI); 3) Root Mean Square Error of Approximation (RMSEA) (Hox & Bechger, 1998). Factor loadings and model fit for the new scales was examined and reported in Chapter 4.

For research question 2 (Does the structural equation model demonstrate a satisfactory model fit?), the researcher used AMOS to examine the structural equation model fit. The assumption for conducting structural equation model was used. Normality, linearity, outliers of

the data were checked to meet the SEM assumption. Model fit indices such as Chi-Square, RMSEA were used to test the model fit. The results were reported in Chapter 4.

For research question 3 (What were the relationships among students' perceptions of culturally responsive teaching, sense of belonging and academic self-efficacy?), associations among the variables were reported based on the path coefficients from the structural equation model results. In addition, descriptive statistics were reported including frequencies, means and standard deviations for independent and dependent variables. The results were reported in Chapter 4.

For research question 4 (were there any significant differences in students' perceptions of culturally responsive teaching among students in terms of race, academic classification and college affiliation?), frequencies were reported for each type of culturally responsive teaching practices identified in this study. The means and standard deviation of students' perceptions of culturally responsive teaching were reported for different student groups in terms of race, academic classification, gender, and institution type. One-way ANOVA tests were conducted to compare the differences for the following groups: 1) students of color' perceptions toward culturally responsive teaching vs. white students' perceptions of culturally responsive teaching, 2) freshman, sophomore, junior and senior students' perceptions of culturally responsive teaching, 3) students' perceptions of culturally responsive teaching in the college of agriculture, college of science and college of liberal arts, and 4) students' perceptions of culturally responsive teaching at a PWI vs. an HBCU. The results were reported in Chapter 4.

Before doing the analysis, assumptions of ANOVA test were conducted. The assumption check included the following: 1) normal distribution of the dependent variable, 2) homogeneity of group variance, and 3) absence of significant outliners. Brown and Forsythe's tests were used when the homogeneity assumption was violated. When p was less than 0.05 at 95% confidence level, which means there were significant differences in student's measure of culturally responsive teaching across three groups. Subsequently, a post hoc test was used to identify specified groups with the differences. Turkey's HSD test was conducted when the assumption of equal group variance was met. Games Howell post hoc test was used for the post-hoc test when the assumption of equal group variance was violated.

For research question 5 (What are the additional factors that can influence students' perceptions of culturally responsive teaching?), data from these two open-ended questions were

recorded and coded. To increase the accuracy of interpretation of the qualitative data, the researcher followed several procedures to maximum alleviate biases and ambiguity: (1) worked with her major advisor in terms of the coding process for responses; (2) worked with her major advisor to ensure the accuracy of generating themes emerged from the coding process. The researcher generated the themes and reported the themes by reporting frequencies. The findings from the two open-ended questions provided additional information for the interpretation of the quantitative data. The emerged themes from two open-ended questions were reported in Chapter 4.

Table 1
Research Questions, Variables, Scales of Measurement and Data Analysis

Research Questions	Independent Variables	Dependent Variables	Scales of Measurement	Data Analysis
RQ 1. Did the developed instrument satisfactorily measure students' perceptions of culturally responsive teaching and sense of belonging in agriculture and STEM within higher education?		Students' perceptions of diverse teaching, cultural engagement, & relationship building Sense of belonging	Interval	Mean Standard deviation Exploratory factor analysis Confirmatory factor analysis
RQ 2. Did the structural equation model for this study demonstrate a good model fit?	Students' perceptions of diverse teaching, cultural Engagement, & Relationship building	Sense of belonging Academic self-efficacy	Interval	Structural equation model
RQ 3. What were the relationships among students' perceptions of culturally responsive teaching, sense of belonging and academic self-efficacy?	Students' perceptions of, diverse teaching, cultural engagement, & relationship building	Sense of belonging Academic self-efficacy	Interval	Mean Standard deviation Correlations Path coefficient
RQ 4. Were there any significant differences in students' perceptions of culturally responsive teaching among students in terms of race, academic classification, gender, college affiliation, and institution type?	Student race Academic classification Gender College Affiliation Institution Type	Students' perceptions of culturally responsive teaching practices	Nominal Interval	Mean Standard deviation ANOVA (for 3 groups and above) Independent samples t-test (for 2 groups)
RQ 5. What were the additional factors that can influence students' perceptions of culturally responsive teaching?			Nominal	Codes and themes

CHAPTER 4. RESULTS

4.1 Introduction

This chapter will provide results from data analysis. The findings included preliminary analysis results such as survey statistics, school affiliation and course statistics, demographic characteristics of participants, descriptive analysis of culturally responsive teaching practices, reliability of the scales and correlations between the latent variables. Primary analysis results included measurement fit for the scales and model fit for the structural equation model. Findings from the two open-ended questions were also provided in this chapter.

4.2 Research Questions

1. Does the developed instrument satisfactorily measure students' perceptions of culturally responsive teaching and sense of belonging in higher education?
2. Does the structural equation model for this study demonstrate a good model fit?
3. What were the relationships among students' perceptions of culturally responsive teaching, sense of belonging and academic self-efficacy?
4. Were there any significant differences in students' perceptions of culturally responsive teaching among students in terms of race, academic classification, gender, college affiliation, and institution type?
5. What were the additional factors that can influence students' perceptions of culturally responsive teaching?

4.3 Preliminary Analysis

Preliminary analysis was conducted before the confirmatory factor analysis, structural equational model and one-way ANOVA and independent samples *t*-test in the primary analysis. The purpose of this preliminary analysis included: 1) provide the background information of the survey and participants in this study, and 2) report the results from descriptive analysis such as frequency and standard deviation for each variable. Results from the preliminary analysis in this section included survey statistics, institution affiliation, math course statistics, demographic

characteristics of participants, reliability of scales, descriptive analysis of culturally responsive teaching practices, sense of belonging and academic self-efficacy.

4.4 Survey Statistics

Total recorded survey responses were 1,347. Of which, 130 were completely empty cases, 147 were cases where participants only answered two pre-survey questions about their institutional affiliation and the math course they identified. In other words, these 147 cases are not useable because participants opened the survey but did not actually complete the survey. Nine cases were completed by graduate students. Therefore, a total of 286 cases were removed, which left 1,061 cases that were considered as useable for subsequent data analysis. Nearly 45% of participants (N = 600) completed the survey through the first email invitation on April 1st, nearly 19% of participants (N = 261) completed the survey on the day when the first reminder was sent on April 9th and 14% of participants (N = 184) completed the survey on the day when the second reminder was sent on April 24th.

4.5 School and Course Statistics

Of the 1,059 participants who indicated their institution affiliation, 92.3% (N = 977) were from Purdue University, and 7.7% (N = 82) were from the University of Arkansas at Pine Bluff (Table 2). Regarding the college math courses that participants identified, around 13.5% (N = 143) were algebra, 70.7% (N = 747) were calculus, and 15.8% (N = 167) were other (Table 2). Other math courses included statistics (N = 34), pre-calculus (N = 53), different equations (N = 9), quantitative reasoning (N = 13), quantitative literacy (N = 6), trigonometry (N = 9), linear algebra (N = 10), and other (N = 24) (probability, MA 155, business math, econometrics, analysis) (Table 3). About 87.5% of participants (N = 928) indicated their first college math course was taken at Purdue University, 7.4% (N = 79) of participants indicated their first college math course was taken at the University of Arkansas at Pine Bluff (UAPB), and 5.1% (N = 54) of participants indicated their first college math course was taken at other institutions (Table 2).

Table 2
Institution Affiliation and Math Courses Identified by Participants

School and math course statistics		Frequency (f)	Percentage (%)
Affiliation			
	Purdue University	977	92.3
	UAPB	82	7.7
	Total	1059	100.0
Math course			
	Calculus	747	70.7
	Algebra	143	13.5
	Other	167	15.8
	Total	1057	100.0
Where was the math course taken			
	Purdue University	928	87.5
	UAPB	79	7.4
	Other	54	5.1
	Total	1061	100.0

Note. Affiliation indicates the institution where participants were enrolled in Spring, 2019. Math course indicates the math class that participants self-identified for this study. Where was the math course taken indicates the institution that participants took the math course. Total indicates the number of participants who indicated affiliation, math course and where was the math course taken.

Table 3
Other Math Courses Identified by Participants

Courses	Frequency (f)	Percentage (%)
Pre-calculus	53	33.5
Statistics	34	21.5
Linear algebra	10	6.3
Quantitative reasoning	13	8.2
Different equations	9	5.7
Trigonometry	9	5.7
Quantitative literacy	6	3.8
Other (MA 155, business math, probability)	24	15.2
Total	158	100.0

Note. Total responses = 158. Other courses (Probability, Real analysis, MA 158, Applied calculus, Agricultural Economics, Business math, Econometrics, Financial derivatives, Introduction to calculus, Introduction to real calculus, Mathematics and thoughts).

4.6 Demographic Characteristics of Participants

Of the 918 participants who indicated their gender, 66% of them (*N* = 601) were female, 33% of them (*N* = 301) were male, 0.9% of them (*N* = 9) were non-binary and 0.8% of them (*N* = 7) preferred not to disclose (Table 4).

Of the 916 participants who indicated their race/ethnicity, 67% of them (*N* = 615) were White, 9% of them (*N* = 82) were African American, 18% of them (*N* = 160) were Asian, 3% of them (*N* = 27) were Hispanic/Latino, 3% of them (*N* = 30) were multiracial, and 0.2% of them (*N* = 2) were Pacific Islander (Table 4).

Of the 918 participants who indicated their classification in college, 28% of them (*N* = 261) were freshman, 27% of them (*N* = 244) were sophomore, 22% of them (*N* = 200) were junior, and 23% of them (*N* = 213) were senior (Table 4).

Of the 915 participants who indicated their college, 34% of them (*N* = 310) were from the college of agriculture, 43% of them (*N* = 392) were from the college of science, 19% of them (*N* = 174) were from the college of liberal arts, and 4% of them (*N* = 39) were from the college of liberal arts and science (Table 5). Student race was described at two institutions by Table 6.

Of the 918 participants who indicated their plan to apply to graduate school upon their completion of the undergraduate degree, 58% of them (*N* = 534) indicated they planned to apply to graduate school and 42% of them (*N* = 383) indicated they did not plan to apply to graduate school after undergraduate degree.

Of the 717 participants who indicated the graduate degree they would like to pursue, 54% of them (*N* = 390) indicated they planned to pursue a master's degree, 20% of them (*N* = 143) indicated they planned to pursue a Ph.D., and 26% of them (*N* = 184) indicated they planned to pursue a professional degree (e.g., DVM, MD, JD).

Of the 816 participants who indicated the race/ethnicity of their math teacher, 62% of teachers (*N* = 508) were White, 5% of teachers (*N* = 39) were African American, 4% of teachers (*N* = 36) were Hispanic/Latino, 26% of teachers (*N* = 215) were Asian, 0.2% of teachers (*N* = 2) were Native American, 0.2% of teachers (*N* = 2) were Pacific Islander, and 2% of teachers (*N* = 14) were multiracial (Table 7).

Table 4
Demographic Characteristics of Participants

Demographic characteristics of Participants		**Frequency (f)**	**Percentage (%)**
Gender			
	Female	601	65.5
	Male	301	32.8
	Non-Binary	9	0.9
	Prefer not to disclose	7	0.8
	Total	918	100.0
Student Race/Ethnicity			
	White	615	67.1
	African American	82	9.0
	Hispanic/Latino	27	2.9
	Asian	160	17.5
	Pacific Islander	2	0.2
	Multiracial	30	3.3
	Total	916	100.0
Academic Classification			
	Freshman	261	28.4
	Sophomore	244	26.6
	Junior	200	21.8
	Senior	213	23.2
	Total	918	100.0

Table 5
Student Race Across Different Colleges

Colleges	Student Race	Frequency (f)	Percentage (%)
Agriculture	African American	17	5.5
	White	254	82.2
	Hispanic/Latino	11	3.7
	Asian	20	6.5
	Pacific Islander	1	0.3
	Multiracial	6	1.9
	Total	310	100.0
Science	African American	26	6.6
	White	233	59.6
	Hispanic/Latino	7	1.8
	Asian	108	27.6
	Pacific Islander	1	0.3
	Multiracial	16	4.1
	Total	391	100.0
Liberal Arts	African American	14	8.1
	White	121	69.9
	Hispanic/Latino	7	4.0
	Asian	23	13.3
	Multiracial	8	4.6
	Total	174	100.0
Arts and Science	African American	23	59.0
	White	6	15.4
	Hispanic/Latino	2	5.1
	Asian	8	20.5
	Total	39	100.0

Note. Arts and Science included students who are from the college of science and the college of liberal arts at the same time at Purdue. Arts and Science also included students who are from the school of arts and science at the University of Arkansas at Pine Bluff.

Table 6
Student Race at Two Institutions

Institution	Student Race	Frequency (f)	Percentage (%)
Purdue University	African American	20	2.4
	White	612	72.4
	Hispanic/Latino	24	2.8
	Asian	158	18.7
	Pacific Islander	2	0.2
	Multiracial	29	3.4
	Total	845	100
UAPB	African American	61	88.4
	White	2	2.9
	Hispanic/Latino	3	4.3
	Asian	2	2.9
	Multiracial	1	1.4
	Total	69	100

Table 7
Demographic Characteristics of Math Teacher

Demographic characteristics of math teacher		Frequency (f)	Percentage (%)
Gender	Female	252	27.5
	Male	652	71.0
	Non-Binary	5	0.5
	I am not sure	9	1.0
	Total	918	100.0
Race	White	508	62.3
	African American	39	4.8
	Hispanic/Latino	36	4.4
	Asian	215	26.4
	Native American	2	0.2
	Pacific Islander	2	0.2
	Multiracial	14	1.7
	Total	816	100.0

4.7 Reliability of Measures Used in this Study

As described in Chapter 3, the newly developed scale that measures students' perceptions of culturally responsive teaching was based on the SMCRT scale developed by Dickson et al. (2016) and the Composite Student-Teacher Relationship Instrument (C-STRI) developed by Barch (2015). The new scale included 23 items using 5-point Likert scale (i.e., 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, 5 = *Always*). The scale that measured students' sense of belonging was based on Psychological Sense of School Membership Scale (PSSM) developed by Goodenow and Grady (1993) and the scale developed by Hoffman (2003) that measures first-year college students' sense of belonging. The new sense of belonging scale included 11 items using a 5-point Likert scale (i.e., 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Neutral*, 4 = *Agree*, 5 = *Strongly Agree*). The academic self-efficacy scale was based on the scale developed by Owen and Froman (1988). The new academic self-efficacy scale included 10 items using 5-point Likert scale (i.e., 1 = *Not at all*, 2 = *Little*, 3 = *Somewhat*, 4 = *A lot*, 5 = *Absolutely*). Table 8 provided the reliability for these three new scales used in this study.

Table 8
Reliability for the Scales Used for this Study

Scales	**Cronbach's Alpha**	
	Original	In this study
Students' perceptions of culturally responsive teaching	0.90	0.95
Sense of belonging	0.88	0.82
Academic self-efficacy	0.85	0.89

4.8 Descriptive Analysis of Culturally Responsive Teaching Practices

There were 23 items in part one of the questionnaire to measure students' perceptions of culturally responsive teaching. Each item is based on 5-point Likert scale (i.e., 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, 5 = *Always*). A higher score indicated a higher frequency of that specific teaching practice/behavior perceived by students. A total summated score of items 1-8 indicated an overall rating of students' perceptions of teacher's diverse teaching practices (scores ranging from 8-40). An average score of items 1-8 indicated an average rating of students' perceptions of teacher's diverse teaching practices. A higher score indicated an average

higher level of diverse teaching practices perceived by students. A lower score indicated an average lower level of diverse teaching practices perceived by students (i.e., 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, 5 = *Always*). A total summated score of items 9-15 indicated an overall rating of students' perceptions of teachers' cultural engagement teaching practices (scores ranging from 7-35). An average score of items 9-15 indicated an average rating of students' perceptions of cultural engagement practices. A higher score indicated an average higher level of cultural engagement teaching practices perceived by students. A lower score indicated an average lower level of cultural engagement teaching practices perceived by students (i.e., 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, 5 = *Always*). A total summated score of items 16-23 indicated an overall rating of students' perceptions of teacher's relationship-building practices (scores ranging from 8-40). An average score of items 16-23 indicated an average rating of students' perceptions of teachers' relationship-building practices. A higher score indicated an average higher level of relationship-building practices perceived by students. A lower score indicated an average lower level of relationship-building practices perceived by students (i.e., 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, 5 = *Always*). Finally, a total summated score of 23 items in part one of the questionnaire indicated an overall rating of students' perceptions of culturally responsive teaching (scores ranging from 23-115). An average score of items 1-23 indicated an average rating of students' perceptions of culturally responsive teaching. A higher score indicated an average higher level of culturally responsive teaching practices perceived by students. A lower score indicated an average lower level of culturally responsive teaching practices perceived by students (i.e., 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, 5 = *Always*).

Table 9 provided the descriptive analyses such as frequency of responses to each culturally responsive teaching practices in part one of the questionnaire. Of the 23 items, the item "My math teacher was interested in knowing my family and home life." had the most participants (68%) selecting "never" on the Likert scale. This indicated that most participants thought their math teacher never took efforts to know their personal life beyond the campus. The item "My math teacher used different things (e.g., pictures, videos) to help us understand the subject." had the most participants (29%) selecting "rarely" on the Likert scale. This indicated that one-third of participants rarely perceived their math teacher to use different ways to explain the subject. The item "My math teacher explained what we were learning in different ways to

help us learn." had the most participants (34%) selecting "sometimes" on the Likert scale. This indicated that the majority of participants sometimes perceived their teachers using different ways to help students learn. The item "My math teacher provided timely feedback on my assignments." had the most participants (37%) selecting "often" on the Likert scale. This indicated that the majority of participants often perceived their teaching providing timely feedback on their assignment. The item "My math teacher was approachable after class." had the most participants selecting "always" on the Likert scale. This indicated that nearly half of the participants perceived their math teachers were always approachable after class.

On average, participants' perceptions of diverse teaching practices from items 1-8 was more toward the "sometimes" on the Likert scale (M = 2.94, SD = 0.89), indicating that students sometimes perceived their teachers demonstrating diverse teaching practices. Moreover, participants' perceptions of cultural engagement practices from items 9-15 was toward the "rarely" on the Likert scale (M = 1.82, SD = 0.96), indicating that students rarely perceived teachers demonstrating cultural engagement practices in the teaching process. Finally, participants' perceptions of relationship-building practices from items 16-23 were toward the "often" on the Likert scale (M = 3.74, SD = 0.95), indicating that participants often perceived teachers demonstrating relationship-building practices.

4.9 Descriptive Analysis of Students' Sense of Belonging and Academic Self-Efficacy

There were 11 items in part two of the questionnaire to measure students' sense of belonging. Each question was based on a 5-point Likert scale (i.e., 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Neutral*, 4 = *Agree*, 5 = *Strongly Agree*). On average, the overall sense of belonging for all participants was toward "Agree" on the Likert scale (M = 3.87, SD = 0.86). This indicated that participants agreed that they felt a sense of belonging in their current institution. The average responses of sense of belonging for students in terms of race were: White (M = 3.91, SD = 0.81), African American (M = 4.04, SD = 1.11), Hispanic/Latino (M = 3.86, SD = 0.83), Asian (M = 3.67, SD = 0.91), Pacific Islander (M = 3.50, SD = 1.61), and multiracial students (M = 3.81, SD = 0.66). In particular, sense of belonging for African American students at Purdue was (M = 3.5. SD = 0.69) and sense of belonging for African American students at UAPB was (M = 4.2, SD = 1.1). Welch test F (5, 10) = 1.88, p = .18 and Brown-Forsythe test F (5, 4) = 1.81, p = .27 suggested no significant difference in sense of

belonging among different student groups. Independent samples *t*-test suggested there was a significance difference in sense of belonging of African American students at Purdue and the UAPB, t *(56)* = -3.055, $p = .003$. There were 10 items in part three of the questionnaire to measure students' academic self-efficacy. Each question was based on a 5-point Likert scale (i.e., 1 = *Not at all*, 2 = *Little*, 3 = *Somewhat*, 4 = *A lot*, 5 = *Absolutely*). There was no significant difference in academic self-efficacy among different student groups, Welch F (5, 10) = 2.01, $p = .16$. On average, the overall academic self-efficacy for all participants was toward "A lot" on the Likert scale ($M = 3.59$, $SD = 0.73$). This indicated that students felt a lot of confidence toward their academic capabilities. The average responses of academic self-efficacy for students in terms of race were: White ($M = 3.59$, $SD = 0.69$), African American ($M = 3.81$, $SD = 0.79$), Hispanic/Latino ($M = 3.47$, $SD = 0.66$), Asian ($M = 3.49$, $SD = 0.81$), Pacific Islander ($M = 2.9$, $SD = 1.56$), and multiracial students ($M = 3.78$, $SD = 0.65$).

Table 9

Frequency of Participants' Responses for Each Culturally Responsive Teaching Practice in Part One of the Questionnaire

Teaching practices	Description	Percentage				
		Never	Rarely	Sometimes	Often	Always
DT1_1	My math teacher explained what we were learning in different ways to help us learn.	5.6%	18.0%	33.5%	27.0%	16.0%
DT2_1	My math teacher used different things (e.g. videos, pictures, slides) to help us understand the subject.	20.4%	29.1%	24.8%	14.5%	11.2%
DT3_1	My math teacher used what I already knew to help me understand new ideas.	5.3%	14.1%	32.8%	32.5%	15.2%
DT4-1	My math teacher tried to find out what interested me.	37.2%	26.8%	18.4%	10.9%	6.7%
DT5_1	My math teacher used real-life examples to help explain the subject.	10.2%	20.4%	28.2%	25.1%	16.1%
DT6_1	My math teacher provided timely feedback on my assignments.	7.2%	8.7%	17.6%	37.1%	29.5%
DT7_1	My math teacher encouraged collaborative learning with other students.	17.1%	22.7%	25.1%	18.2%	16.8%
DT8_1	My math teacher used different types of assessments (e.g. group project, presentation) to assess what I learned.	47.4%	22.8%	13.6%	8.0%	8.1%
CE1_1	My math teacher recognized that school culture was different from my home culture.	33.6%	20.1%	25.2%	13.2%	7.8%
CE2_1	My math teacher was very interested in my culture.	53.1%	22.2%	14.6%	5.7%	4.5%
CE3_1	My math teacher was interested in knowing my family and home life.	67.9%	16.0%	8.9%	4.1%	3.2%

(continued)

Table 9 continued

CE4_1	My math teacher encouraged all students to learn about others and their cultures.	56.3%	19.1%	15.8%	5.0%	3.9%
CE5_1	My math teacher spoke about contributions that my culture had made to science.	63.7%	17.9%	11.4%	3.4%	3.6%
CE6_1	My math teacher designed lessons that showed how other cultural groups had made use of mathematics.	64.7%	18.3%	10.0%	3.2%	3.9%
CE7_1	My math teacher used examples from my culture when teaching.	58.9%	15.7%	14.1%	6.9%	4.4%
RB1_1	My math teacher treated all students as important members of the classroom	4.1%	6.5%	17.0%	30.9%	41.5%
RB2_1	My math teacher created a learning environment where I was comfortable to voice my opinions.	7.7%	11.5%	23.6%	26.2%	31.0%
RB3_1	My math teacher was approachable after class.	4.1%	7.1%	16.7%	28.9%	43.3%
RB4_1	My math teacher helped me when I did not understand the content.	5.8%	7.5%	25.5%	28.4%	32.9%
RB5_1	My math teacher really cared about how much I learned.	9.6%	12.0%	24.5%	29.4%	24.4%
RB6_1	My math teacher cared about my point of view when we discussed questions.	10.3%	13.7%	26.7%	27.4%	21.9%
RB7_1	My math teacher expected me to do well in their class.	3.9%	7.3%	18.1%	34.3%	36.5%
RB8_1	My math teacher showed high expectations for all students.	5.0%	7.6%	21.1%	31.7%	34.6%

Note. DT1_1 to DT8_1 = Diversity teaching practice 1-8. CE1_1 to CE7_1 = Cultural engagement 1-7. RB1_1 to RB8_1 = Relationship building 1-8.

4.10 Correlations between the Five Latent Variables

The scale that was developed to measure students' perceptions of culturally responsive teaching included three subscales: 1) diverse teaching practices, 2) cultural engagement practices, and 3) relationship-building practices. The correlations between these three subscales and their associations with students' sense of belonging and academic self-efficacy were explored (Table 10).

Table 10
Correlations between the five latent Variables

	SE	SB	RB	CE	DT
Diverse Teaching Practices (DT)	0.47**	0.53**	0.71**	0.63**	1.00
Cultural Engagement (CE)	0.31**	0.33**	0.38**	1.00	
Relationship Building (RB)	0.48**	0.56**	1.00		
Sense of belonging (SB)	0.63**	1.00			
Academic self-efficacy (SE)	1.00				

Note. Pearson correlations. **Correlation is significant at the 0.01 level (2-tailed).
Diverse teaching practices subscale included eight items using a 5-point Likert scale. Scores were summated across eight items. Cultural Engagement subscale included seven items using a 5-point Likert scale. Scores were summated across seven items. Relationship building subscale included eight items using a 5-point Likert scale. Scores were summated across eight items. Sense of belonging included 11 items using a 5-point Likert scale. Scores were averaged across 11 items. Academic self-efficacy included 10 items using a 5-point Likert scale. Scores were averaged across 11 items.

As shown in Table 11, there was a moderate and significant positive relationship between students' perceptions of diverse teaching practices and students' academic self-efficacy (r = .47, n = 921, $p < 0.001$). Coefficient of determination R^2 = .22 indicated that 22% of the variance in student' academic self-efficacy was explained by students' perceptions of diverse teaching practices. There was a high and significant positive relationship between students' perceptions of diverse teaching practices and students' sense of belonging (r = .53, n = 940, $p < 0.001$). Coefficient of determination R^2 = .28 indicated that 28% of the variance in student' sense of belonging was explained by students' perceptions of diverse practices. There was a very high

positive and significant relationship between students' perceptions of diverse teaching practices and students' perceptions of relationship-building practices (r = .71, n = 980, p < 0.001). Coefficient of determination R^2 = .50 indicated that 50% of the variance in students' perceptions of relationship-building practices was explained by students' perceptions of diverse teaching practices. The relationship between students' perceptions of cultural engagement practices and diverse teaching practices was high, significant and positive (r = .63, n = 1012, p < 0.001). Coefficient of determination R^2 = .40 indicated that 40% of the variance in students' perceptions of cultural engagement practices was explained by students' perceptions of diverse teaching practices. Moreover, there was a moderate positive significant relationship between students' perceptions of cultural engagement practices and students' academic self-efficacy (r = .31, n = 921, p < 0.001). Coefficient of determination R^2 = .09 indicated that 9% of the variance in students' academic self-efficacy was explained by student's perceptions of cultural engagement practices. There was a moderate positive significant relationship between students' perceptions of cultural engagement practices and student's sense of belonging (r = .33, n = 940, p < 0.001). Coefficient of determination R^2 = .11 indicated that 11% of the variance in students' sense of belonging was explained by students' perceptions of cultural engagement practices. Finally, there was a moderate positive significant relationship between students' perceptions of cultural engagement practices and students' perceptions of relationship building (r = .38, n = 980, p < 0.001). Coefficient of determination R^2 = .14 indicated that 14% of the variance in students' perceptions of relationship-building was explained by students' perceptions of cultural engagement practices.

Students' perceptions of relationship-building practices have a moderate positive significant relationship with students' academic self-efficacy (r = .48, n = 921, p < 0.001).

Coefficient of determination $R^2 = .23$ indicated that 23% of the variance in students' academic self-efficacy was explained by students' perceptions of relationship-building practices. Students' perceptions of relationship-building practices had a high positive significant relationship with students' sense of belonging ($r = .56$, n = 939, $p < 0.001$). Coefficient of determination $R^2 = .31$ indicated 31% of the variance in students' sense of belonging was explained by students' perceptions of relationship-building practices. Lastly, students' sense of belonging and students' academic self-efficacy has a positive high and significant association ($r = .63$, n = 920, $p < 0.001$). Coefficient of determination $R^2 = .39$ indicated that 39% of the variance in students' academic self-efficacy was explained by students' sense of belonging.

Table 11
Correlation Coefficient and Description (Hopkins, 2002)

Correlation Coefficient	Description
±0.90 to ±1.00	Almost perfect correlation
±0.70 to ±0.90	Very high correlation
±0.50 to ±0.70	High correlation
±0.30 to ±0.50	Moderate correlation
±0.10 to ±0.30	Low correlation
<0.01	Little if any correlation

4.11 Primary Analysis

The primary analysis included exploratory factor analysis, confirmatory factor analysis, structural equational model, independent samples *t*-test, and one-way ANOVA. The results from the primary analysis were to answer research questions one to four. Generated themes from students' responses to two open-ended questions were to answer the research question number five.

4.11.1 Research Question 1: Does the Developed Instrument Satisfactorily Measure Students' Perceptions of Culturally Responsive Teaching and Sense of Belonging in Higher Education?

The original scale to measure students' perceptions of culturally responsive teaching included 18 items, which were indicated by three subscales: diverse teaching practices, cultural engagement practices, and foreign language affirmation. The new scale added 10 items based on a review of the literature. These 10 items measured the student-teacher relationship and were thus grouped as the third subscale labeled as "relationship building." The new subscale relationship-building thus replaced the old subscale foreign language affirmation. Therefore, the new culturally responsive teaching scale included 23 items in total. Exploratory factor analysis and confirmatory factor analysis were conducted to describe the measurement fit of the scale.

To conduct exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) for this scale, partially completed responses where participants only answered a few questions on part one of the questionnaire were removed (the completion rate was less than 70% for part one). After removing the 80 partially completed cases, the useable data/cases for confirmatory factor analysis were 982. Prior to CFA, EFA analysis was conducted to extract the factors from the 23 items. EFA analysis used a Promax oblique rotation method due to the correlations between the factors. Three factors were extracted based on eigenvalues greater than one and a scree plot

(Figure 2). Table 12 provided the factor loadings of each item on the three extracted factors from EFA. Table 13 provided the variances explained by each factor and the cumulative variances explained by all three factors. CFA was conducted after EFA, to determine the measurement fit of the new scale. Figure 3 provided the structure of the new scale and illustrated the relationships between the latent variables in this scale. Table 14 described factor loadings between the indicators/items and latent variables from CFA.

Table 12
Factor Loadings of Each Item on the Three Extracted Factors through EFA

	Factor 1	Factor 2	Factor 3
DT1_1			0.53
DT2_1			0.73
DT3_1			0.51
DT4_1			0.59
DT5_1			0.43
DT6_1	0.46		
DT7_1			0.54
DT8_1			0.63
CE1_1		0.55	
CE2_1		0.82	
CE3_1		0.85	
CE4_1		0.86	
CE5_1		0.92	
CE6_1		0.84	
CE7_1		0.84	
RB1_1	0.81		
RB2_1	0.75		
RB3_1	0.83		
RB4_1	0.76		
RB5_1	0.73		
RB6_1	0.66		
RB7_1	0.83		
RB8_1	0.79		

Note. DT1_1to DT8_1: Diverse teaching practice 1-8.
CE1_1 to CE7_1: Cultural engagement practice 1-7.
RB1_1 to RB8_1: Relationship building practice 1-8.

Table 13
Variances Explained by Three Extracted Factors

	Variance Explained	
Factor	% of Variance	Cumulative %
1	44%	44%
2	14%	58%
3	3%	61%

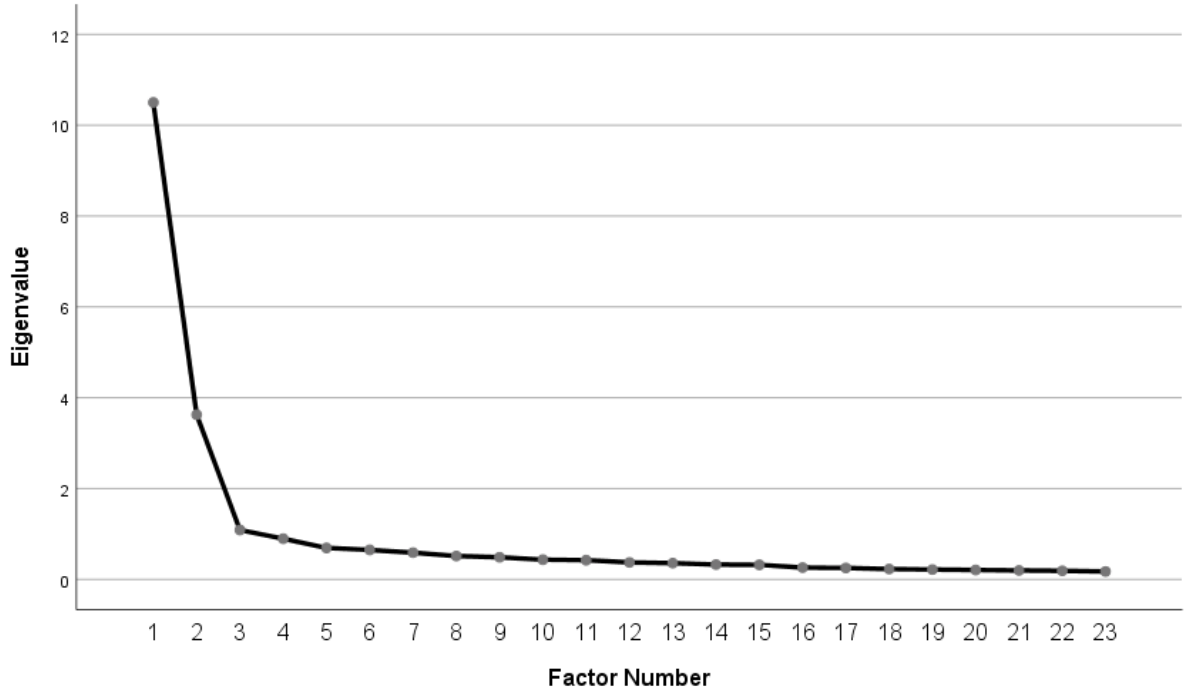

Figure 2. Scree Plot of Factors Extraction for Exploratory Factor Analysis

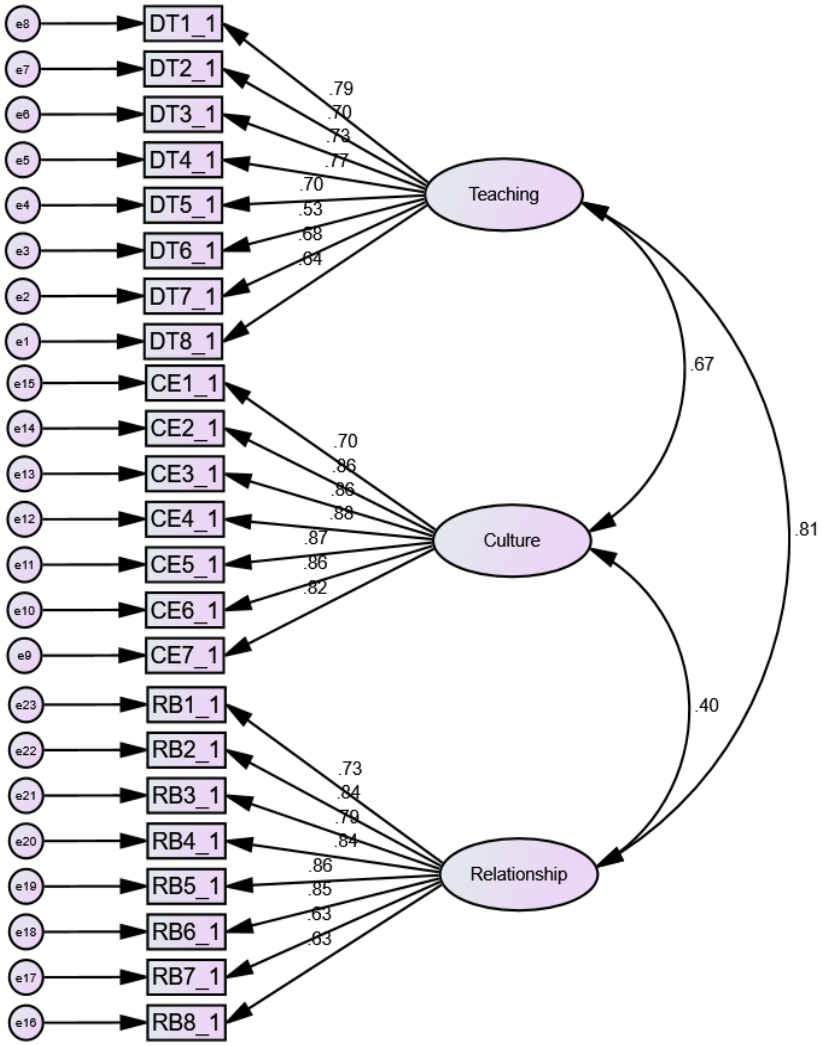

Figure 3. Confirmatory Factor Analysis of the Students' Perceptions of Culturally Responsive Teaching Scale

Note. Teaching = Diverse teaching practices. Culture = Cultural Engagement. Relationship = Relationship building. DT1_1 to DT8_1: Diverse teaching practice 1-8. CE1_1 to CE7_1: Cultural engagement practice 1-7. RB1_1 to RB8_1: Relationship building practice 1-8.

Table 14
The List of Factor Loadings of Each Indicator on the Three Latent Variables of Culturally Responsive Teaching

			Factor Loadings			
Indicators		**Latent variables**	**Unstandardized**	**S.E.**	**Standardized**	**P**
DT8_1	<---	Teaching	0.87	0.04	0.64	***
DT7_1	<---	Teaching	0.96	0.04	0.68	***
DT6_1	<---	Teaching	0.66	0.04	0.53	***
DT5_1	<---	Teaching	0.90	0.04	0.70	***
DT4_1	<---	Teaching	1.00		0.77	
DT3_1	<---	Teaching	0.83	0.04	0.73	***
DT2_1	<---	Teaching	0.93	0.04	0.70	***
DT1_1	<---	Teaching	0.93	0.04	0.80	***
CE7_1	<---	Culture	0.98	0.03	0.82	***
CE6_1	<---	Culture	0.93	0.03	0.86	***
CE5_1	<---	Culture	0.94	0.02	0.87	***
CE4_1	<---	Culture	1.00		0.88	
CE3_1	<---	Culture	0.91	0.02	0.86	***
CE2_1	<---	Culture	1.01	0.03	0.86	***
CE1_1	<---	Culture	0.92	0.04	0.70	***
RB8_1	<---	Relationship	0.66	0.03	0.63	***
RB7_1	<---	Relationship	0.64	0.03	0.63	***
RB6_1	<---	Relationship	0.98	0.03	0.85	***
RB5_1	<---	Relationship	1.00		0.86	
RB4_1	<---	Relationship	0.91	0.03	0.85	***
RB3_1	<---	Relationship	0.82	0.03	0.79	***
RB2_1	<---	Relationship	0.97	0.03	0.84	***
RB1_1	<---	Relationship	0.75	0.03	0.73	***

Note. ***significant at $p < 0.001$ level. $N = 982$.
Teaching = Diverse teaching practices. Culture = Cultural Engagement. Relationship = Relationship building. DT1_1 to DT8_1: Diverse teaching practice 1-8. CE1_1 to CE7_1: Cultural engagement practice 1-7. RB1_1 to RB8_1: Relationship building practice 1-8.

Table 14 illustrated that all items in this section were significantly loaded ($p < 0.001$) on each latent variable. Standardized factor loadings for each indicator were provided (Table 14). The covariance between teaching and culture variables was 0.67, significant at $p < 0.001$. The covariance between teaching and relationship variables was 0.81, with a significant $p < 0.001$.

Lastly, the covariance between culture and relationship variables was 0.40, with a significant $p < 0.001$.

4.11.1.1 Model Fit of the Culturally Responsive Teaching Scale

For the model fit of the culturally responsive teaching scale, Chi-square ($df = 227$) was 2000.7 with $p < 0.001$. Significant Chi-square does not suggest a good model fit. However, Chi-square is also sensitive to large sample size greater than 200. Therefore, other model fit indices were considered to determine the model fit. For the confirmatory factor analysis of this new scale, model fit indices produced CFI = 0.90. According to Hu and Bentler (1999), CFI greater than 0.90 will suggest a good fit, a more recent CFI cut-off point is 0.95. In this case, CFI = 0.90 suggested a good model fit. The model fit indices suggested RMSEA = 0.09. According to the conventional recommendation for RMSEA (Byrne, 2001; MacCallum et al., 1996), RMSEA less than 0.08 will suggest a good fit, RMSEA between 0.08-0.10 will suggest a mediocre fit. A more recent cut-off point for RMSEA of a good fit is less than 0.60 (Hu & Bentler, 1999). In this case, RMSEA = 0.09 suggested a mediocre fit but not a great fit based on the conventional recommended value of RMSEA.

4.11.1.2 Modification of Model Fit of the Culturally Responsive Teaching Scale

According to modification indices provided by AMOS to improve the model fit, error term covariance was suggested that are under the same factor. For example, e16-e17 (M.I. = 389) for observed variables RB7_1 (i.e., My math teacher expected me to do well in their class) and RB8_1 (i.e., My math teacher showed high expectations for all students), e20-e21 (M.I. = 67) for observed variables RB4_1 (i.e., My math teacher treated all students as important members of the classroom) and RB3_1 (i.e., My math teacher was approachable after class), e14-e15 (M.I. =

107) for observed variables CE1_1 (i.e., My math teacher recognized that school culture was different from my home culture) and CE2_1 (i.e., My math teacher was very interested in my culture), e1-e2 (M.I. = 43) for observed variables DT7_1 (i.e., My math teacher encouraged collaborative learning with other students) and DT8_1 (i.e., My math teacher used different types of assessment to assess what I learned). After error covariance as described above was applied, the second round of confirmatory factors analysis for this new scale was analyzed. Figure 4 provided the updated structure of the scale. Table 15 provided the updated list of factor loadings of each item on the latent variables.

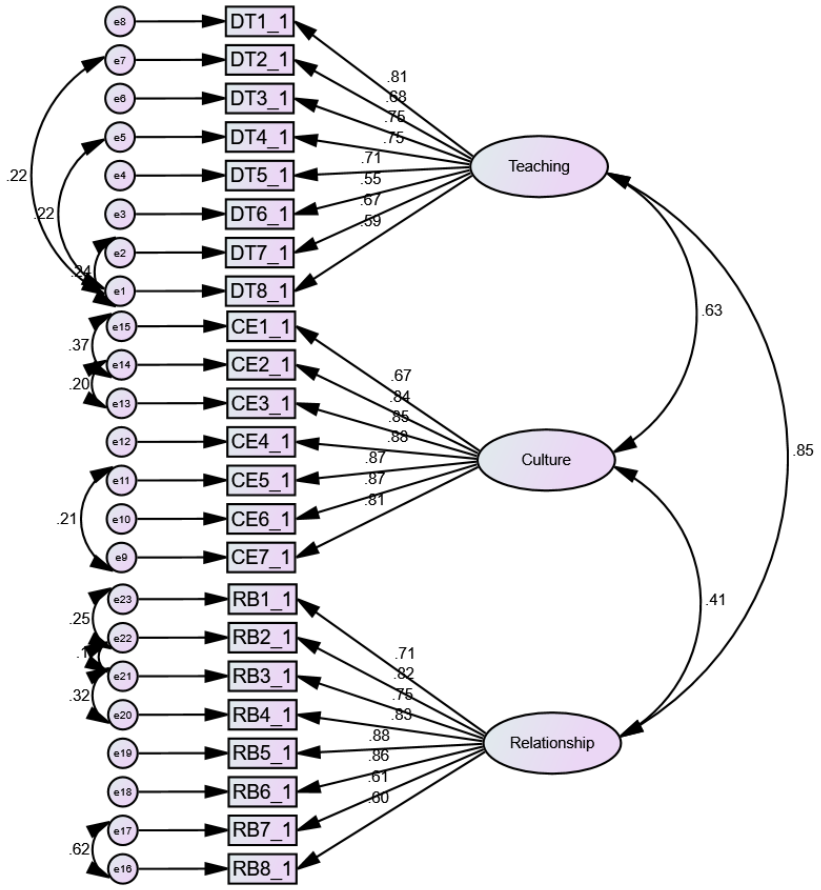

Figure 4. Confirmatory Factor Analysis of the Scale of Students' Perceptions of Culturally Responsive Teaching II

Table 15
The Updated List of Factor Loadings of Each Indicator on the Latent Variables

			Factor Loadings			
Indicators		**Latent variables**	**Unstandardized**	**S.E.**	**Standardized**	**P**
DT8_1	<---	Teaching	0.81	0.04	0.59	***
DT7_1	<---	Teaching	0.96	0.05	0.67	***
DT6_1	<---	Teaching	0.70	0.01	0.55	***
DT5_1	<---	Teaching	0.92	0.04	0.71	***
DT4_1	<---	Teaching	1.00		0.75	
DT3_1	<---	Teaching	0.87	0.04	0.75	***
DT2_1	<---	Teaching	0.93	0.04	0.69	***
DT1_1	<---	Teaching	0.97	0.04	0.81	***
CE7_1	<---	Culture	0.97	0.03	0.81	***
CE6_1	<---	Culture	0.94	0.03	0.87	***
CE5_1	<---	Culture	0.93	0.03	0.87	***
CE4_1	<---	Culture	1.00		0.88	
CE3_1	<---	Culture	0.90	0.03	0.85	***
CE2_1	<---	Culture	0.98	0.03	0.84	***
CE1_1	<---	Culture	0.88	0.04	0.67	***
RB8_1	<---	Relationship	0.63	0.03	0.60	***
RB7_1	<---	Relationship	0.60	0.03	0.61	***
RB6_1	<---	Relationship	0.99	0.03	0.87	***
RB5_1	<---	Relationship	1.00		0.88	
RB4_1	<---	Relationship	0.88	0.03	0.84	***
RB3_1	<---	Relationship	0.77	0.03	0.75	***
RB2_1	<---	Relationship	0.93	0.03	0.82	***
RB1_1	<---	Relationship	0.71	0.03	0.71	***

Note. ***significant at $p < 0.001$ level. $N = 982$.
Teaching = Diverse teaching practices. Culture = Cultural engagement practices. Relationship = Relationship building practices. DT1_1 to DT8_1: Diverse teaching practice 1-8. CE1_1 to CE7_1: Cultural engagement practice 1-7. RB_1 to RB8_1: Relationship building practice 1-8.

Table 15 illustrated that all indicators were significantly loaded ($p < 0.001$) on each latent variable. This suggested that the indicators provided good measurement for each latent variable. Standardized factor loadings for each item were provided through Table 15. In addition, the correlation between teaching and culture variables was 0.63, with a significant $p < 0.001$, the covariance between teaching and relationship variables was 0.85, with a significant $p < 0.001$,

and the covariance between culture and relationship variables was 0.41, with a significant $p < 0.001$.

The results of squared multiple correlations indicated the variances explained by latent variables for each indicator. Diverse teaching explained 65% of variance for DT 1_1 (i.e., Math teacher explained what we were learning in different ways to help us learn), 47% of variance for DT2_1 (i.e., Math teacher used different things, e.g. videos, pictures, slides to help us learn), 57% of variance for DT3_1 (i.e., Math teacher used what I already knew to help me understand new ideas), 56% of variance for DT4_1 (i.e., Math teacher tried to find out what interested me), 50% of variance for DT5_1 (i.e., Math teacher used real-life examples to help explain the subject), 30% of variance for DT6_1 (i.e., Math teacher provided timely feedback on my assignment), 44% of variance for DT7_1 (i.e., Math teacher encouraged collaborative learning with other students), 35% of variance for DT8_1 (i.e., Math teacher used different types of assessment to assess what I learned). Cultural engagement explained 45% of variance for CE1_1 (i.e., Math teacher recognized that school culture was different from my home culture), 70% of variance for CE2_1 (i.e., Math teacher was very interested in my culture), 73% of variance for CE3_1 (i.e., Math teacher was interested in knowing my family and home life), 77% of variance for CE4_1 (i.e., Math teacher encouraged all students to learn about others and their cultures), 75% of variance for CE5_1 (i.e., Math teacher spoke about contributions that my culture had made to science), 76% of variance for CE6_1 (i.e., Math teacher designed lessons that showed how other cultural groups had made use of mathematics), and 66% of variance for CE7_1 (i.e., Math teacher used examples from my culture when teaching). Finally, relationship building explained 50% of the variance for RB1_1 (i.e., Math teacher treated all students as important members of the classroom), 68% of variance for RB2_1 (i.e., Math teacher created a learning

environment where I was comfortable to voice my opinions), 56% of variance for RB3_1 (i.e., Math teacher was approachable after class), 70% of variance for RB4_1 (i.e., Math teacher helped me when I did not understand the content), 77% of variance for RB5_1 (i.e., Math teacher really cared about how much I learned), 75% of variance for RB6_1 (i.e., Math teacher cared about my point of view when we discussed questions), 37% of variance for RB7_1 (i.e., Math teacher expected me to do well in their class), and 36% of variance for RB8_1 (i.e., Math teacher showed high expectation for all students).

4.11.1.3 Final Model Fit for the Scale of Culturally Responsive Teaching

The final model for the scale of culturally responsive teaching had an improved model fit. Model fit indices suggested that Chi-square (df = 276) decreased to 1049 with a significant $p <$ 0.001. Again, this is due to the sensitivity of Chi-square to large sample size greater than 200. Other model fit indices were seen improvement as well. CFI was increased to 0.95. According to Hu and Bentler (1999), CFI greater than 0.90 will suggest a good model fit. In the meantime, RMSEA was decreased to 0.06. Conventionally, according to Hooper et al. (2008), who cited MacCallum et al. (1996), RMSEA less than 0.08 will indicate a good fit, RMSEA between 0.08 to 0.10 will suggest a mediocre fit (Byrne, 2001). According to a more recent cut-off point by Hu and Bentler (1999), RMSEA less than 0.06 will suggest a good fit. In this case, the results of the confirmatory factor analysis suggested a good model fit by meeting and exceeding the recommended value of RMSEA at both conventional and more recent levels.

4.11.1.4 Confirmatory Factor Analysis of the Sense of Belonging Scale

The new scale to measure students' sense of belonging was based on the PSSM scale developed by Goodenow and Grady (1993) and items extracted from Hoffman (2003). A

confirmatory factor analysis was conducted to examine the measurement fit of the scale and the model fit for the sampled data. Figure 5 described the structure of the scale. Table 16 described the factor loadings of each item/indicators on the latent variable.

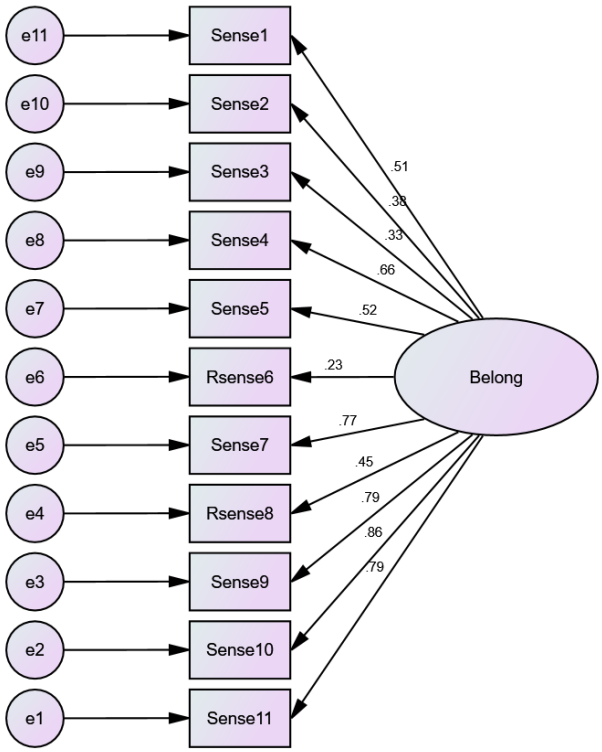

Figure 5. Confirmatory Factor Analysis of the Scale for Students' Sense of Belonging
Note. Belong = Sense of belonging
Sense 1-10 = Sense of belonging practice 1-10
Rsense 6 = Reverse coded sense of belonging 6
Rsense 8 = Reverse coded sense of belonging 8

Table 16
Factor Loading of Each Indicator on the Latent Variable Belong

			Factor Loadings			
Indicators		Latent variables	Unstandardized	S.E.	Standardized	P
Sense11	<---	Belong	1.00		0.79	***
Sense10	<---	Belong	0.98	0.03	0.86	***
Sense9	<---	Belong	0.94	0.04	0.79	***
Rsense8	<---	Belong	0.43	0.03	0.45	***
Sense7	<---	Belong	0.89	0.04	0.77	***
Rsense6	<---	Belong	0.22	0.03	0.23	***
Sense5	<---	Belong	0.68	0.04	0.52	***
Sense4	<---	Belong	0.84	0.04	0.66	***
Sense3	<---	Belong	0.45	0.05	0.33	***
Sense2	<---	Belong	0.56	0.05	0.38	***
Sense1	<---	Belong	0.69	0.04	0.51	***

Note. ***significant at $p < 0.001$ level. $N = 982$.
Sense 1-11: Sense of belonging 1-11. Rsense6: Reverse code sense of belonging 6. Rsense8: Reverse code sense of belonging 8.

Table 16 indicated that all 11 items/indicators were significantly loaded on the factor/latent variable "Belong" ($p < 0.001$). However, Sense 2 (i.e., I made new friends as a result of my enrollment in the math course), Sense 3 (i.e., I participate in study groups with other students), Rsense 6 (i.e., I feel people of my race/ethnicity are more likely to experience discrimination on campus) and Rsense 8 (i.e., Faculty and staff have made me doubt whether I belong in this program) had factor loadings less than 0.50. This indicated that these four items were probably not great indicators for the factor "Belong." Therefore, these four items were removed. Figure 6 provided the updated structure of the scale and Table 17 provided the updated list of factor loadings of each item on the factor.

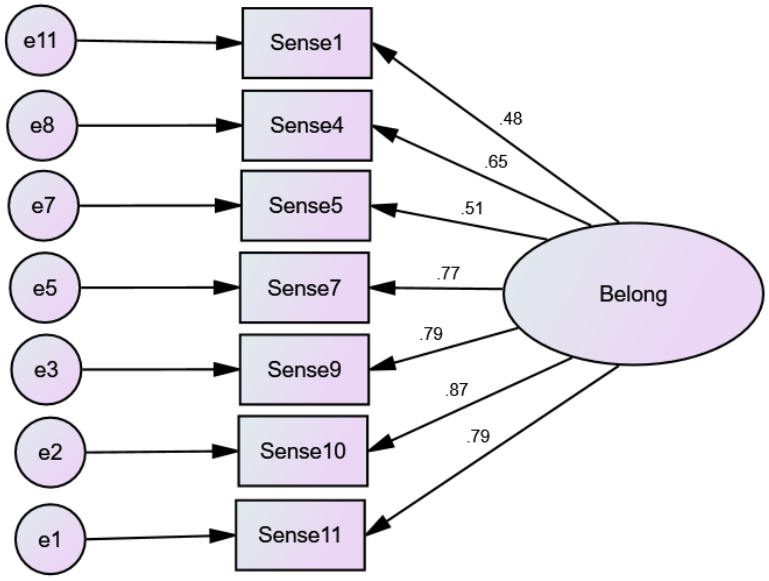

Figure 6. Confirmatory Factor Analysis of the Scale for Students' Sense of Belonging II
Note. Belong = Sense of belonging.
Sense 1, 4, 5, 7, 9, 10 11 = Sense of belonging 1, 4, 5, 7, 9, 10, 11

Table 17
The Updated List of Factor Loadings on the Latent Variable Belong

		Factor Loadings				
Indicators		Latent variables	Unstandardized	S.E.	Standardized	P
Sense11	<---	Belong	1.00		0.79	***
Sense5	<---	Belong	0.68	0.04	0.51	***
Sense4	<---	Belong	0.82	0.04	0.65	***
Sense1	<---	Belong	0.66	0.05	0.49	***
Sense7	<---	Belong	0.89	0.04	0.77	***
Sense9	<---	Belong	0.94	0.04	0.79	***
Sense10	<---	Belong	0.99	0.03	0.87	***

Note. ***significant at $p < 0.001$ level. $N = 982$.
Belong = Sense of belonging. Sense 1, 4, 5, 7, 9, 11 = Sense of belonging 1, 4, 5, 7, 9, 11.

Table 17 illustrated that all seven items were significantly loaded on the factor ($p <$ 0.001). Sense 1 (i.e., I feel comfortable contributing to class discussions) had a standardized factor loading of 0.49, sense 4 (i.e., I feel the university is committed to establishing a

welcoming and positive environment for students) had a standardized factor loading of 0.65, sense 5 (i.e., I am included in many activities at this university) had a standardized factor loading of 0.51, sense 7 (i.e., Faculty and staff at this university treat me with respect) had a standardized factor loading of 0.77, sense 9 (i.e., I am treated with as much respect as other students) had a standardized factor loading of 0.79, sense 10 (i.e., People at this university are friendly to me) had a standardized factor loading of 0.87, and sense 11 (i.e., I can really be myself at this university) had a standardized factor loading of 0.79. This indicated that all seven indicators provided a good measurement for the factor.

4.11.1.5 Revises Model Fit of the Sense of Belonging Scale

Results of model fit indices suggested that Chi-square = 140, df =14, $p < 0.001$. Although Chi-square was significant, this is due to a large sample size greater than 200. In this case, other model fit indices were considered to determine the model fit. For example, CFI was 0.96, which exceeded the recommended value of 0.90 as a good fit. RMSEA was 0.09. Conventionally, according to Hooper et al. (2008), who cited MacCallum et al. (1996), RMSEA less than 0.08 will indicate a good fit, RMSEA between 0.08 to 0.10 will suggest a mediocre fit (Byrne, 2001). In this case, RMSEA was 0.09, which fell into the range between 0.08-0.10 to meet a recommended value for a medium fit. NFI was 0.95, IFI was 0.96, which all exceeded the recommended value of 0.95 as a good fit.

4.11.2 Research Question 2. Does the Structural Equation Model for This Study Demonstrate A Good Model Fit?

Figure 7 illustrated the structural equation model that describes the relationship between culturally responsive teaching, sense of belonging and academic self-efficacy. As culturally

responsive teaching was indicated by three sub-variables: diverse teaching, cultural engagement and relationship building. The structural equation model describes the relationships between these five latent variables.

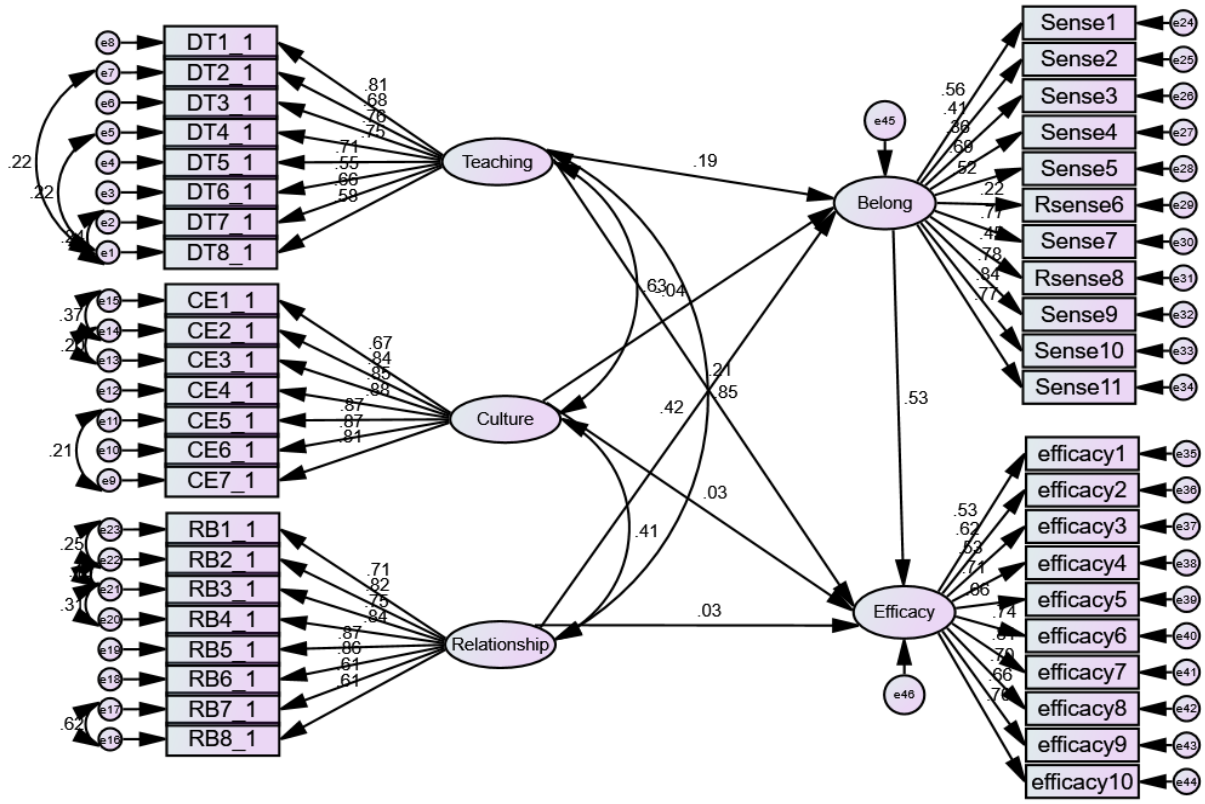

Figure 7. Structural Equation Model

4.11.2.1 Overall Model Fit for the Structural Equation Model

Model fit indices suggested a satisfactory fit for the structural equation model for this study. Chi-Square (df = 882) was 4,095 with a significant value $p < 0.001$. However, Chi-Square is sensitive to large sample size greater than 200. Other model indices were thus considered to determine the model fit. Model fit indices produced CFI = 0.89, which was very close to 0.90 as a suggested value for a good fit. Model fit indices provided RMSEA = 0.06. According to the conventional recommendation for RMSEA (Byrne, 2001; MacCallum et al., 1996; Hooper et al., 2008), RMSEA less than 0.08 will suggest a good fit, RMSEA between 0.08-0.10 will suggest a

mediocre fit. A more recent cut-off point of a good fit for RMSEA was less than 0.60 (Hu & Bentler, 1999). In this case, RMSEA = 0.6, which exceeded the recommended value for a good fit on a more recent cut-off point (Hu & Bentler, 1999).

4.11.2.2 Factor Loadings for the Model

Table 18 provided the list of factor loadings of each item (indicators) on latent variables. All indicators were significantly loaded on the latent variable ($p < 0.001$). Most standardized factor loadings of indicators on latent variables exceeded 0.50 except for four indicators. For example, indicator sense 2 (i.e., I made new friends as a results of my enrollment in the math course) had a factor loading of 0.41, sense 3 (i.e., I participate in study groups with other students) had a factor loading of 0.36, resense 6 (i.e., I feel people of my race/ethnicity are more likely to experience discrimination on campus than others) had a factor loading of 0.22, and rsense 8 (i.e., Faculty and staff at this university treat me with respect) had a factor loading of 0.46. Low factor loadings suggested that these items were not the great indicators that measure the latent variable for a sense of belonging in the model. To improve the model fit, these four indicators (items) were deleted and the model was re-tested (Figure 8).

Table 18
Factor Loadings of Each Indicator on Latent Variables

			Factor Loading			
Indicators		Latent variables	Unstandardized	S.E.	Standardized	P
DT8_1	<---	Teaching	0.81	0.04	0.59	***
DT7_1	<---	Teaching	0.96	0.05	0.66	***
DT6_1	<---	Teaching	0.71	0.04	0.55	***
DT5_1	<---	Teaching	0.93	0.04	0.71	***
DT4_1	<---	Teaching	1.00		0.75	
DT3_1	<---	Teaching	0.88	0.04	0.76	***
DT2_1	<---	Teaching	0.94	0.04	0.68	***
DT1_1	<---	Teaching	0.97	0.04	0.81	***
CE7_1	<---	Culture	0.97	0.03	0.81	***
CE6_1	<---	Culture	0.94	0.03	0.87	***
CE5_1	<---	Culture	0.93	0.03	0.87	***
CE4_1	<---	Culture	1.00		0.88	
CE3_1	<---	Culture	0.90	0.03	0.85	***
CE2_1	<---	Culture	0.98	0.03	0.84	***
CE1_1	<---	Culture	0.88	0.04	0.67	***
RB8_1	<---	Relationship	0.63	0.03	0.61	***
RB7_1	<---	Relationship	0.61	0.03	0.61	***
RB6_1	<---	Relationship	0.99	0.03	0.86	***
RB5_1	<---	Relationship	1.00		0.87	
RB4_1	<---	Relationship	0.89	0.03	0.84	***
RB3_1	<---	Relationship	0.77	0.03	0.75	***
RB2_1	<---	Relationship	0.94	0.03	0.82	***
RB1_1	<---	Relationship	0.72	0.03	0.71	***
Sense1	<---	Belong	1.00		0.56	
Sense2	<---	Belong	0.79	0.07	0.41	***
Sense3	<---	Belong	0.64	0.07	0.36	***
Sense4	<---	Belong	1.16	0.07	0.69	***
Sense5	<---	Belong	0.91	0.07	0.52	***
Rsense6	<---	Belong	0.28	0.05	0.22	***
Sense7	<---	Belong	1.18	0.07	0.77	***
Rsense8	<---	Belong	0.58	0.05	0.46	***
Sense9	<---	Belong	1.23	0.07	0.78	***
Sense10	<---	Belong	1.26	0.07	0.84	***
Sense11	<---	Belong	1.31	0.08	0.77	***
efficacy1	<---	Efficacy	1.00		0.53	

(continued)

Table 18 continued

efficacy2	<---	Efficacy	1.33	0.09	0.62	***
efficacy3	<---	Efficacy	0.93	0.07	0.53	***
efficacy4	<---	Efficacy	1.32	0.09	0.71	***
efficacy5	<---	Efficacy	1.48	0.10	0.66	***
efficacy6	<---	Efficacy	1.53	0.10	0.74	***
efficacy7	<---	Efficacy	1.47	0.09	0.81	***
efficacy8	<---	Efficacy	1.42	0.09	0.70	***
efficacy9	<---	Efficacy	1.50	0.10	0.66	***
efficacy10	<---	Efficacy	1.46	0.10	0.70	***

Note. ***significant at $p < 0.001$ level. $N = 982$.
Teaching = Diverse teaching practices. Culture = Cultural Engagement. Relationship = Relationship building. Belong = Sense of belonging. Efficacy = Academic self-efficacy. DT1_1 to DT8_1: Diverse teaching practice 1-8. CE1_1 to CE7_1: Cultural engagement practice 1-7. RB1_1 to RB8_1: Relationship building practice 1-8. Sense1 to Sense 11: Sense of belonging 1-11. Rsense 6: Reverse coded sense 6. Rsense 8: Reverse coded sense 8. Efficacy 1 to Efficacy 10: Efficacy 1-10.

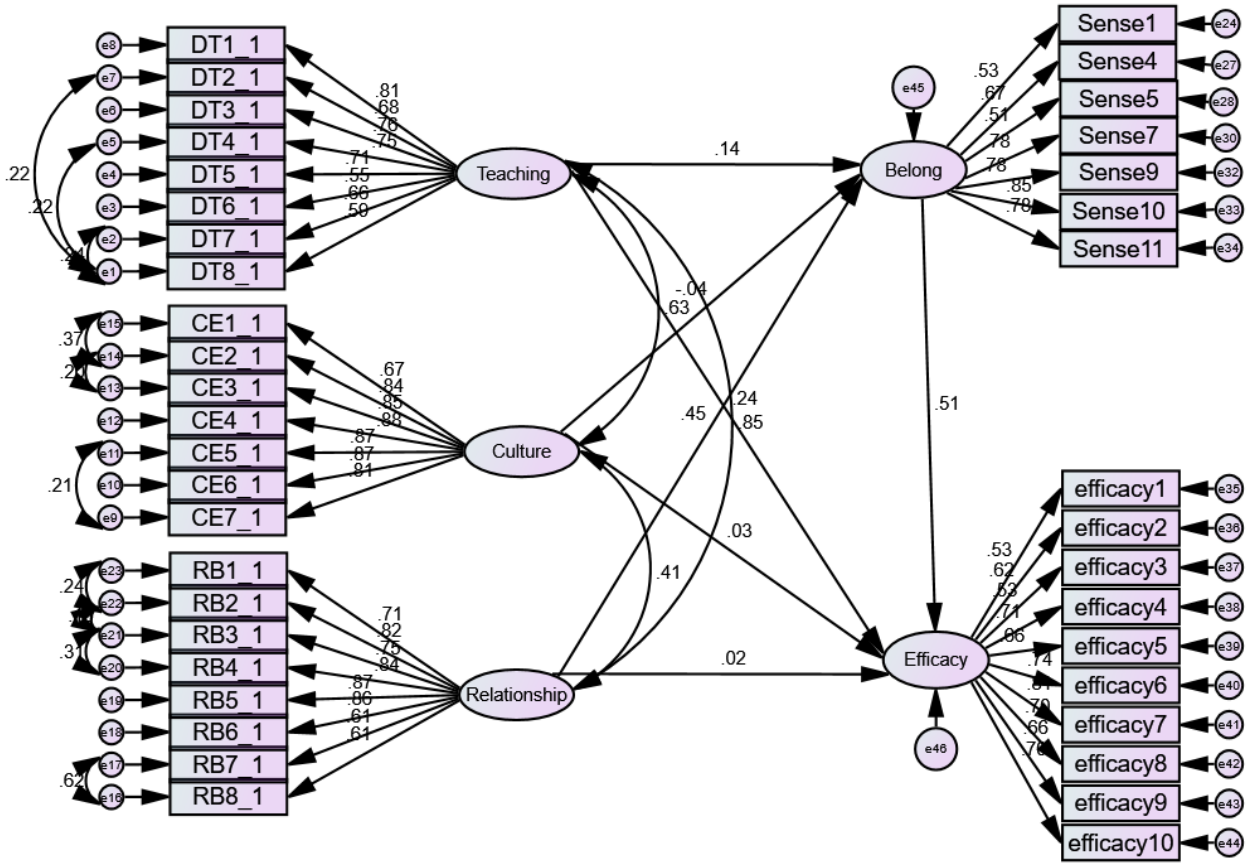

Figure 8. Structural Equation Model II

Table 19
The Updated List of Factor Loadings for Each Latent Variable in the Structural Equation Model

			Factor Loadings			
Indicators		Latent Variables	Unstandardized	S.E.	Standardized	P
DT8_1	<---	Teaching	0.81	0.04	0.59	***
DT7_1	<---	Teaching	0.96	0.05	0.66	***
DT6_1	<---	Teaching	0.71	0.04	0.55	***
DT5_1	<---	Teaching	0.93	0.04	0.71	***
DT4_1	<---	Teaching	1.00		0.75	
DT3_1	<---	Teaching	0.88	0.04	0.76	***
DT2_1	<---	Teaching	0.93	0.04	0.68	***
DT1_1	<---	Teaching	0.97	0.04	0.81	***
CE7_1	<---	Culture	0.97	0.03	0.81	***
CE6_1	<---	Culture	0.94	0.03	0.87	***
CE5_1	<---	Culture	0.93	0.03	0.87	***
CE4_1	<---	Culture	1.00		0.88	
CE3_1	<---	Culture	0.90	0.03	0.85	***
CE2_1	<---	Culture	0.98	0.03	0.84	***
CE1_1	<---	Culture	0.88	0.04	0.67	***
RB8_1	<---	Relationship	0.63	0.03	0.61	***
RB7_1	<---	Relationship	0.61	0.03	0.61	***
RB6_1	<---	Relationship	0.99	0.03	0.86	***
RB5_1	<---	Relationship	1.00		0.87	
RB4_1	<---	Relationship	0.89	0.03	0.84	***
RB3_1	<---	Relationship	0.77	0.03	0.75	***
RB2_1	<---	Relationship	0.94	0.03	0.82	***
RB1_1	<---	Relationship	0.72	0.03	0.71	***
Sense1	<---	Belong	1.00		0.53	
Sense4	<---	Belong	1.18	0.08	0.67	***
Sense5	<---	Belong	0.95	0.08	0.51	***
Sense7	<---	Belong	1.25	0.08	0.78	***
Sense9	<---	Belong	1.30	0.08	0.78	***
Sense10	<---	Belong	1.35	0.08	0.85	***
Sense11	<---	Belong	1.37	0.09	0.78	***
efficacy1	<---	Efficacy	1.00		0.53	
efficacy2	<---	Efficacy	1.33	0.09	0.62	***
efficacy3	<---	Efficacy	0.93	0.07	0.53	***
efficacy4	<---	Efficacy	1.32	0.09	0.71	***
efficacy5	<---	Efficacy	1.48	0.10	0.66	***

(continued)

Table 19 continued

efficacy6	<---	Efficacy	1.53	0.10	0.74	***
efficacy7	<---	Efficacy	1.47	0.09	0.81	***
efficacy8	<---	Efficacy	1.42	0.09	0.71	***
efficacy9	<---	Efficacy	1.49	0.10	0.66	***
efficacy10	<---	Efficacy	1.46	0.10	0.70	***

Note. ***significant at $p < 0.001$ level. $N = 982$.
Teaching = Diverse teaching practices. Culture = Cultural Engagement. Relationship = Relationship building. Belong = Sense of belonging. Efficacy = Academic self-efficacy. DT1_1 to DT8_1: Diverse teaching practice 1-8. CE1_1 to CE7_1: Cultural engagement practice 1-7. RB1_1 to RB8_1: Relationship building 1-8. Sense 1, 4, 5, 7, 9, 10, 11: Sense of belonging 1, 4, 5, 7, 9, 10, 11. Efficacy 1 to Efficacy 10: Efficacy 1-10.

Table 19 provided the updated list of factor loadings of each item on the latent variables in the model. All items were significantly loaded on the latent variable ($p < 0.001$). All standardized factors loadings exceeded 0.50. This suggested that items were good indicators measuring the latent variables for the study.

4.11.2.3 Finalized Overall Model Fit for the Structural Equation Model

The results indicated a satisfactory model fit for the sample data. According to the model fit indices, Chi-square was decreased to 3,108 with a significant $p < 0.001$. Although a significant Chi-square did not suggest a good model fit, this is due to Chi-square sensitivity to large sample size greater than 200. Other model fit indices were therefore used to determine the model fit. CFI = 0.91, IFL = 0.91, TLI = 0.90, NFI = 0.90, RMSEA = 0.058. According to a review of the literature, CFI greater than 0.90 will indicate a good fit. RMSEA less than 0.08 will indicate a good fit based on the conventional procedure (Byrne, 2001; MacCallum et al., 1996). A more recent RMSEA cut-off point is 0.06 to indicate a good fit (Hu & Bentler, 1998). In this model, all the model indices (except Chi-square) all exceeded the recommendation. Therefore, the model in this study provided a satisfactory model fit for the sample data.

4.11.3 Research Question 3: What Were the Relationships Among Students' Perceptions of Culturally Responsive Teaching, Sense of Belonging and Academic Self-Efficacy?

The results of the structural equation model provided standardized regression coefficients between the latent variables. Of the non-significant standardized coefficients, diverse teaching and sense of belonging is $\beta = .14$, $p = .16$, cultural engagement and sense of belonging was $\beta = -.04$, $p = 0.38$, relationship building and academic self-efficacy is $\beta = .02$, $p = .76$, cultural engagement and academic self-efficacy was $\beta = .03$, $p = .43$. Of the significant standardized regression coefficients, diverse teaching and academic self-efficacy are $\beta = .24$, $p = .01$, this suggested that students' perceptions of diverse teaching practices had a direct positive effect of 0.24 on students' academic self-efficacy. A unit increase in students' perceptions of diverse teaching practices will project a 0.24 increase in students' academic self-efficacy. Relationship building and students' sense of belonging was $\beta = .45$, $p < 0.001$. This suggested that students' perception of relationship-building practices had a direct positive effect of 0.45 on students' sense of belonging. A unit increase in students' perceptions of relationship-building practices will project a 0.45 increase in students' sense of belonging. In addition, the sense of belonging and academic self-efficacy had $\beta = .51$, $p < 0.001$, this suggested that students' sense of belonging was a predictor for students' academic self-efficacy. A unit increase in the sense of belonging will project a 0.51 increase in academic self-efficacy. Covariances were also significant among three variables: diverse teaching, culture engagement and relationship building. Of which, diverse teaching and culture engagement was $r = .63$, $p < 0.001$, culture engagement and relationship building was $r = .4$, $p < 0.001$, and diverse teaching and relationship was $r = .85$, $p < 0.001$.

4.11.4 Research Question 4: Were There Any Significant Differences in Students' Perceptions of Culturally Responsive Teaching in Terms of Race, Academic Classification, Gender, College Affiliation, and Institution Type?

4.11.4.1 Were there any significant differences in student's perceptions of culturally responsive teaching (CRT) in terms of race?

One-way ANOVA test was used to examine the differences in students' perception of culturally responsive teaching between White students, African American students, Hispanic students, Asian students, Pacific Islanders, and multiracial students. The score of CRT is summated through 23 items in part one of the questionnaire. The assumption of normality, independence, and homogeneity of variances of the ANOVA test was met. Results from ANOVA indicated that there was a significant difference of student race on students' perceptions of culturally responsive teaching F (2, 910) = 9.89, $p < 0.001$ at a confidence level of 0.95. Results from post hoc test indicated that African American students (M = 79, SD = 21) have a significantly higher score of CRT than white students (M = 64, SD = 17), Hispanic/Latino students (M = 64, SD = 16), and Asian students (M = 66, SD = 18). This suggested that African American students perceived more teaching practices as culturally responsive teaching than students from other ethnic groups. Eta squared $\eta^2 = 0.05$ suggested a medium effect size (Cohen, 1988; Miles & Shevlin, 2001). Although the variance of homogeneity is satisfied to conduct one-way ANOVA, considering the unequal sample size of student race in this study, Brown-Forsythe F test (Brown & Forsythe, 1978) and Welch's F (Welch, 1951) test were also conducted to compare the results. The result from Brown-Forsyth F test was F (5, 27) = 10, $p < 0.001$. The result from Welch's F test was F (5, 10) = 5, $p = .007$. The results provided consistent results indicating that there was a significant difference in students' perceptions of culturally responsive teaching in terms of student's race/ethnicity. Brown-Forsyth F and Welch test supported that African American students' perceptions of culturally responsive teaching were significantly

different from white students, Hispanic students, and Asian students. Further, the results of planned contrasts indicated that there was no significant difference in students' perceptions of culturally responsive teaching between white students and non-white students altogether (t = -.57, df = 910, p = .06).

4.11.4.2 Were there any significant differences in students' perceptions of culturally responsive teaching in terms of the academic year?

One-way ANOVA test was used to examine the differences in students' perceptions of culturally responsive teaching between freshman, sophomore, junior and senior students. The score of culturally responsive teaching is summated across 23 items in part one of the questionnaire. The assumption of normality, independence, and homogeneity of variances of ANOVA was met. Results from ANOVA test indicated that there was a significant difference of the academic year on students' perceptions of culturally responsive teaching with F (3, 914) = 2.57, p = .05 at a confidence level of 0.95. Eta squared η^2 = 0.01 suggested a small effect size (Cohen, 1988; Miles & Shevlin, 2001). Results of post hoc tests (p = .037) indicated that there was a significant difference between freshman and senior students regarding their CRT scores. Freshman students had a significantly higher score of culturally responsive teaching (M = 68, SD = 17) than the senior student (M = 64, SD = 19). The result suggested that freshman students perceived more teaching practices as culturally responsive teaching than senior students.

4.11.4.3 Were there any significant differences in students' perceptions of culturally responsive teaching in terms of institution type?

An independent samples t-test was conducted to examine the differences between two groups: students' perceptions of culturally responsive teaching at Purdue University with students at the University of Arkansas at Pine Bluff. The score of culturally responsive teaching

is summated through 23 items in part one of the questionnaire. The assumptions of normality and independence of *t*-test were met. However, the assumption of equal variance was not met. In addition, the sample size is significantly unequal between the two groups. Therefore, a Welch method was conducted. The results of Welch test F (1, 90) = 37.39, $p < 0.001$ indicated that there was a significant difference of institution type on students' perceptions of culturally responsive teaching at a confidence level of 0.95. Cohen's *d* was 0.83 suggesting a large effect size (Cohen, 1988). Of which, students at the University of Arkansas at Pine Bluff (M = 79, SD = 24) had significantly higher scores of CRT than students at Purdue University (M = 62, SD = 19). The average score of CRT for students at the University of Arkansas at Pine Bluff was (M = 3.6, SD = 0.9), this suggested that UAPB student sometimes perceived their teachers using culturally responsive teaching (i.e., 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, 5 = *Always*). The average score of CRT for students at Purdue University was (M = 2.8, SD = 0.8), this suggested that Purdue students rarely perceived their teachers using culturally responsive teaching (i.e., 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, 5 = *Always*). In particular, African American students at the University of Arkansas at Pine Bluff (M = 82, SD = 22) had significant higher scores of CRT than African American students at Purdue University (M = 67, SD = 15), t (79) = -2.882, p = 0.005 at a confidence level of 0.95. Further, the result from factorial ANOVA indicated that there was a significant effect of institution affiliation on the students' perceptions of CRT in a college math course, F (1, 903) = 14.31, $p < 0.001$. The average score of CRT for African American students at the University of Arkansas at Pine Bluff was (M = 3.6, SD = 0.9), this suggested that African American students at UAPB sometimes perceived their teachers using culturally responsive teaching (i.e., 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, 5 = *Always*). The average score of CRT for African American students at Purdue was (M = 2.9, SD =

0.6), this suggested that African American students at Purdue rarely perceived their teachers using culturally responsive teaching (i.e., 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, 5 = *Always*).

4.11.4.4 Were there any significant differences in students' perceptions of culturally responsive teaching in terms of gender?

A one-way ANOVA test was conducted to examine the differences in students' perceptions of culturally responsive teaching between female, male and non-binary students. The scores of culturally responsive teaching were summated through 23 items in part one of the questionnaire. The assumptions of normality, independence and homogeneity were met for the test. The results F (3, 914) = 0.55, p = .65 indicated that there was no significant difference of gender on students' perceptions of culturally responsive teaching at the confidence level of 0.95. In addition, an independent samples *t*-test was conducted between female and male students, the results suggested there was no significant difference in students' perceptions of CRT between female and male students (t = -.054, df = 663, p = 0.95).

4.11.4.5 Were there any significant differences in students' perceptions of culturally responsive teaching in terms of college?

A one-way ANOVA test was conducted to examine the differences in students' perceptions of culturally responsive teaching among the college of agriculture, college of science, and college of liberal arts. 39 cases from the college of arts and science were removed for the comparison. This is because 39 cases included students who had double majors in both the college of arts and the college of science and students enrolled in the school of arts and science at UAPB. The scores of culturally responsive teaching were summated through 23 items in part one of the questionnaire. The assumptions of normality and independence were met.

However, the assumption of homogeneity of variances was not met. In addition, there was also an unequal sample size among the group. Therefore, the Brown-Forsythe test and the Welch test were used to compare the means. The results from Welch test F (2, 432) = 2.33, p = .098 and Brown-Forsythe test F (2, 584) = 2.41, p = .09 both indicated that there was no significant difference of college on students' perceptions of culturally responsive teaching at a confidence level of 0.95.

4.11.5 Research Question 5: What were the Additional Factors that Influence Students' Perception of Culturally Responsive Teaching?

Two open-ended questions were provided in part five of the questionnaire. The purpose of these two open-ended questions allowed participants to describe: 1) To what extent did the teachers engage the students in the learning process? 2) In what ways did the teachers do to help develop a good student-teacher relationship? Therefore, the responses from these two questions would provide additional information regarding students' perception of culturally responsive teaching in higher education.

In total, 614 participants responded to the open-ended question 1, and 600 participants responded to the open-ended question 2. Responses were downloaded from Qualtrics to SPSS and then transformed into a word file for further coding. Saldana (2013) guided the coding procedures. The researcher used descriptive coding method for these two open-ended questions for this study. Considering a large number of responses, the researchers used Nvivo Pro 12 for the coding process.

4.11.5.1 Open-ended question 1: What did your math teacher do that engaged you most in their class?

There were 610 keywords and phrases generated to summarize participants' responses to this question. Through NVivo 12, 129 nodes (i.e., codes) were created and developed to categorize 610 keywords and phrases. The researcher then further grouped 129 codes and generated 10 themes that summarized the responses to this question. Table 20 provided the list of the themes generated and their frequencies. Table 21 provided the sample answers for each theme. Ten themes were listed and illustrated as the following.

1) Different teaching skills and methods, this theme included the diverse teaching practices such as "provided real-world examples," "used different ways to explain the concept, " "used the whiteboard to work out the problem," or "used I-clicker in the classroom," "draw graphics and pictures."
2) Teachers being responsible. This theme included responsible teaching behaviors such as "asked us questions," "make sure we understood the concept," "the teacher answered the questions," and "teachers did everything to help students learn."
3) Jokes. This theme included the use of jokes in the classroom such as "told jokes," "the teacher had a sense of humor," "used jokes to wake us up in an early morning class," "made jokes while teaching," and "math jokes."
4) Class atmosphere. This theme included the positive and comfortable learning environment, such as "create fun class activities," "class is more like a conversation," "open class with the discussion."
5) Group work. This theme included learning through group work activities such as "group project discussion," and "worked out the problem together in the class."

6) Teachers' personality. This theme included several teacher characteristics such as "friendly," "patient," "sympathetic," and "personal."

7) Teachers' passion. This theme refers to teachers' demonstration of enthusiasm in the class, such as "excited to teach," "energy level is to the roof," and "hype about teaching."

8) Care about students. This theme refers to teachers' genuine care about student academic success such as "have high expectation for students," "believe in students," and "want students to be successful."

9) Teachers' communication skills. This theme refers to how teachers communicate with students. Example practices are "listen to students," "speak clearly and loudly," and "spoke with clarity."

10) Teaching assistant. This theme refers to a teaching assistant that helped students to learn. Examples were "TA is really helpful," and "TA can really relate to us."

Table 20
Themes Generated from the Responses for the Open-ended Question 1

Themes	Frequency (f)	Percentage (%)
Different teaching skills and methods	245	40
Teachers being responsible	112	18
Jokes	56	9
Class atmosphere	53	9
Group work	39	6
Teacher's personality	37	6
Teacher's passion	27	4
Care about students	18	3
Teacher's communication skills	14	2
Teaching assistant	9	1
Total	610	100

Note. Total responses = 614. Open-ended question 1: What did your math teacher do that engaged you most in their class?

Table 21
Themes and Sample Answers for Open-ended Question 1

Themes	Categories	Sample answers
Different teaching skills and methods	"provide real-life examples" "write notes" "use whiteboards" "made videos"	"Wrote notes on the chalkboard" "He would use real-life examples both current and past so I felt like I was learning something that would apply to my life"
Teachers being responsible	"know the topic and prepare for class" "Being thorough" "ask questions"	"Asked us to answer questions" "He would make sure we knew what was going on" "He provided a lot of feedback"
Jokes	"math jokes" "funny"	"He uses funny real-life examples to help us understand the materials better" "Use jokes to wake us up in an early morning class"
Class atmosphere	"comfortable atmosphere" "open and encouraging"	"He made lectures very conversational" "He never looked down on us" "He was open and encouraging of all students" "He made me feel like I wasn't below him in the classroom setting"
Group work	"group project discussion" "group quiz"	"Gave group quizzes" "He does groups questions"
Teacher's personality	"patient" "friendly"	"She got to know students well"
Teacher's passion	"enthusiasm" "passionate"	"was very passionate"
Care about students	"ask about student's life" "talk with students"	"Tried to care and help us" "Care about me personally and professionally"
Teacher's communication skills	"speak clearly" "nice pace"	"Talk loud" "Gave notes at a good pace"
Teaching Assistant	"good TA" "TA helps"	"I had a TA and he was the best TA I have had at Purdue"

4.11.5.2 Open-ended question 2: In what ways did your math teacher do to make you feel that you could develop a good teacher-student relationship with them?

There were 670 keywords and phrases generated to summarize participants' responses to this question. Through Nvivo Pro 12, 88 nodes (i.e., codes) were created and developed to categorize 670 keywords and phrases. The researcher then grouped the codes and generated 10 themes that summarized the responses to this question. Table 22 provided the list of the themes and their frequencies. Table 23 provided sample answers for each theme.

Ten themes were described and illustrated as the following:

1) Offer office hour. This theme refers to teachers provided office hours. Examples are "encouraged us to come to her office hours for anything we need," "invited us to office hours," and "mentioning office hours every day."
2) Available and approachable. This theme included that students felt teachers can easily be approached for questions. Examples are "made themselves available and approachable by lowering the power dynamic," "it was like we were equals," "encouraged us to approach her with any questions," and "would approach all students with a smile."
3) Personality. This theme included teacher characteristics such as "kind," "personable," and "respectful."
4) Encourage questions and answer questions. This theme refers to teachers encourage students to ask questions and are willing to answer students' questions. Examples are "ask the class if we had any questions," "always asked for questions," and "his dedication to understanding students' questions and concerns."
5) Willing to help and care for students. This theme refers to caring and helpful behaviors from teachers. Examples are "care about student learning," "have high expectation for students,"

"care about me as a person," "always wanted to help," and "willing to help no matter the situation."

6) Provide help and review sessions on homework and exam. This theme refers to different ways that were used by the teacher to help student on their assignment and exams. Examples are "hold review session," "she indulged in conversation on assignment," "gave feedback," "returned grades in a timely manner," "provide a study guide," "schedule a review session for two hours at night," and "study groups before the exam."

7) Socialize with students. This theme refers to teachers socialize with students outside of the class. Examples are "have lunch with students," "get to know students," "learn students names," "talk to students," and "get to know students on a personal basis outside of the lecture."

8) Open and positive atmosphere. This theme included creating a comfortable learning environment. Examples were "walk around the class," "being open and welcoming," "positive reinforcement for doing well in her classes," and "very interactive in lectures."

9) Responsive to emails. This theme included the use of email to help students with their questions. Examples were "respond to emails quickly," "easy access to questions via email," and "responded to emails promptly."

10) Sense of humor. This theme includes the use of jokes in the classroom. Examples were "jokes and being funny," and "good sense of humor."

Table 22
Themes Generated from the Responses for the Open-ended Question 2

Themes	Frequency (f)	Percentage (%)
Offering office hour	120	18
Available and approachable	109	16
Personality	88	13
Encourage questions and answer students' questions	82	12
Willing to help and care for student	67	10
Provide help and review sessions	56	8
Socialize with students	55	8
Open and positive class atmosphere	46	7
Responsive to emails	28	4
Sense of humor	19	3
Total	670	100

Note. Total responses = 600. Open-ended question 2: In what ways did your math teacher do to make you feel that you could develop a good teacher-student relationship with them?

Table 23
Themes and Sample Answers for Open-ended Question 2

Themes	**Categories**	**Sample answers**
Offering office hour	"invite us to office hour"	"Held office hours"
Available and approachable	"available for questions" "approach for questions"	"Very approachable and willing to help you succeed"
Personality	"kind" "personable" "respectful"	"He was patient whenever I asked questions" "He always seems to be in a good mood"
Encourage questions and answer students' questions	"always ask for questions" "answer students' questions"	"Encouraged students to ask question"
Willing to help and care for students	"care about student learning" "always want to help"	"He said he cares about us learning more than our grades"
Provide help and review sessions	"hold review session" "provide a study guide"	"Emphasized tutoring session"

(Continued)

Table 23 Continued

Socialize with students	"get to know students" "have lunch with students"	"Learned out names within a couple of classes" "She would have short conversations with us if we showed up early" "He offered the class to go to lunch with him"
Open and positive class atmosphere	"being open and welcoming" "walk around the class"	"Open to questions" "The faculty is a great guy to talk to and is open for students to discuss or ask questions either during or after his lectures" "She was open about making mistakes"
Responsive to emails	"respond to emails quickly" "email her for questions"	"Let us know we could email him"
Sense of humor	"being funny" "good sense of humor"	"They added a lot of humor to their lectures"

CHAPTER 5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This research study focused on culturally responsive teaching from undergraduate students' perspectives in the context of higher education. Using a quantitative approach, the researcher developed and validated an instrument that could measure students' perceptions of culturally responsive teaching in higher education. Additionally, the study used a structural equation model to examine the relationships between students' perceptions of culturally responsive teaching, sense of belonging, and academic self-efficacy. Moreover, the study examined differences in students' perceptions of culturally responsive teaching in terms of race, gender, academic classification and institution type. This chapter will present a summary of findings from the results and suggest several recommendations for the future study.

5.2 Purpose of the Study

The purpose of this study was to develop and validate an instrument that could measure students' perceptions of culturally responsive teaching in higher education. Additionally, the study intended to examine the relationships among students' perceptions of culturally responsive teaching, sense of belonging and academic self-efficacy.

5.3 Conclusion 1.

The first conclusion is that three factors were confirmed to measure students' perceptions of culturally responsive teaching using a reliable and valid instrument. In this study, a new scale was adapted and developed to measure student's perceptions of culturally responsive teaching in university classrooms (e.g., college math course). The new scale was based on student measures'

of culturally responsive teaching (SMCRT) scale developed by Dickson et al. (2016) and several items extracted from different teacher-student relationship scales combined and validated by Barch (2005). In total, there were 10 new items added to the new scale and all items were reviewed by an expert panel, pilot tested, and adjusted to reflect the higher education context. The new scale extracted three factors and produced reliability of 0.95 in this study. The subscale of diversity teaching practices had a reliability coefficient of 0.93, the subscale of cultural engagement had a reliability coefficient of 0.96 in this study, and the subscale of relationship-building practices had a reliability coefficient of 0.94 in this study. Prior to confirmatory factor analysis, exploratory factor analysis was examined to extract factors from 23 items through the use of Promax oblique rotation method. All three factors explained 61% of the variance of students' perceptions of culturally responsive teaching. Confirmatory factor analysis was conducted after EFA and indicated that all 23 items were significantly loaded on each component of culturally responsive teaching. Model fit indices suggested a satisfactory model fit (CFI = 0.95, RMSEA = 0.06) of the culturally responsive teaching scale to the sampled data. The results of exploratory factor analysis and confirmatory factor analysis thus supported the validity and measurement fit of the culturally responsive teaching scale.

5.4 Conclusion 2.

The second conclusion is that regarding three types of culturally responsive teaching, college students were able to perceive relationship building and diverse teaching practices, college students rarely perceived cultural engagement practices. Culturally responsive teaching was conceptualized and manifested in classrooms through three major aspects in this study: 1) teachers' diverse teaching practices, 2) teachers' cultural engagement practices, and 3) teachers' relationship-building practices with students. Diverse teaching practices included the use of

different teaching methods to help students to learn. Cultural engagement included the integration of culture in the lesson plan and classroom instruction. Relationship building included the efforts that teachers made to build a positive relationship with students.

This study examined culturally responsive teaching in a college math course. On average, participants often perceived their first college math teacher demonstrating relationship-building behaviors. These findings suggest that undergraduate students were able to identify and observe relationship-building behaviors demonstrated by their mathematics faculty the most. Behaviors such as "teachers treat all students as important members," "teachers being approachable after class," "teachers helped me to understand the content," and "teacher expected me to do well," were examples of relationship-building behaviors perceived by students. This finding was supported by the participants' responses to open-ended question two at the end of the questionnaire. When asked what their math teachers did to help to develop a positive student-teacher relationship, participants responded to this question and suggested four major factors.

First, teachers provided office hours. This was the behavior that students mentioned most and felt it was helpful to develop a good relationship with their mathematics faculty. Students pointed out that the first college math course was usually a large course, and it was difficult for both teachers and students to know each other. Office hours can play an important role, not only provide students an opportunity to seek assistance related to their math study, but it also provides an opportunity for both faculty and students to talk, interact and develop a better relationship.

Second, students shared teachers being approachable after class as important to develop a good faculty-student relationship. Responses indicated that when faculty were available and approachable after class, students perceived that faculty were willing to put efforts to help students learn.

Third, students shared that faculty with a nice personality helped them to develop a good teacher-student relationship. Responses indicated that faculty's personality played an important role in developing a positive faculty-student relationship. Participants suggested that when faculty are positive, kind, fair, respectful, and personable, students are more likely to see the potentials of developing a trustworthy and positive relationship with the faculty

Fourth, students shared that faculty encouraging students to ask questions and answer students' questions were helpful to develop a good faculty-student relationship. Students perceived faculty asking questions as a sign of caring and being responsible. Responses from participants indicated that when faculty encouraged students to ask questions and tried their best to address the students' questions, students perceived that faculty wanted to make sure that students understood the content and they cared for student learning. When students felt that the faculty cared about them, it fulfills students' basic human needs, which can motivate students to learn and set up a positive tone for relationship building.

In addition, participants sometimes perceived their math faculty demonstrating diverse teaching practices. Behaviors such as "teachers use what I already know to help me learn," "the teacher explained what we were learning in different ways," "teachers provided timely feedback on assignment," and "teachers used real-life examples to help explain the subject," were examples of diverse teaching behaviors that were sometimes perceived by students. The findings were supported by the participants' responses to open-ended question one at the end of the questionnaire. When asked what their math teachers did to help students engage in the learning process, participants suggested that faculty using multiple teaching methods, being a responsible teacher and having a sense of humor were the most frequently mentioned behaviors. In terms of multiple teaching methods, participants mentioned that the use of different real-world, interesting

and relevant examples to help explain the subject was very useful. Other engaging teaching methods included the use of whiteboards, videos, pictures, and teachers addressing homework questions in class.

In comparison, participants rarely perceived their math teachers demonstrating the use of culture in the teaching. Behaviors such as "teacher was interested in getting to know students," and "teachers using different cultures in the lesson plans," were barely observed by students. This finding can be attributed to two possible reasons: 1) there was a lack of cultural engagement behaviors in a college math classroom, and 2) students did not identify and observe the teaching behaviors that emphasized cultural engagement. It is possible that math is a straightforward and less engaging subject. Faculty may have difficulty integrating students' culture into the lesson plans or they did not know how to do so. Therefore, there was a limited cultural component involved in the teaching process. It was also possible that there was a disparity between students' perceptions of cultural engagement in the class and teachers' perceptions and understanding of the use of culture in the teaching process. This notion was supported by Dickson et al. (2016), who cited Conderman, Walker, Neto, and Kackar-Cam (2013) and Waxman (1989). Conderman et al. (2013) and Waxman (1989) suggested that student and teachers might have different perceptions and interpretations toward the classroom experiences. It is possible that some of the math faculty did demonstrate the use of culture in the teaching process but students in this study were just unable to perceive it and observe it.

Moreover, students' perceptions of diverse teaching practices were highly correlated with students' perceptions of relationship-building practices. This implies that the more students perceived faculty using different methods in the teaching process, the more students perceived that faculty tried to develop a positive relationship with students. It is possible that when students

perceived that faculty were trying their best to help students to learn in different ways, they felt that faculty were responsible and cared about student learning. When students perceived the faculty wanted them to learn well and be successful, students intend to feel more engaged in the learning process because they feel that faculty care. For example, responses from participants suggested that students appreciated their math faculty asking many questions in class. This implies that students perceived the questions from faculty as a sign that the faculty really cared. This conclusion supported previous literature (Lumpkin, 2007; Noddings, 1992), which indicated that caring is an important component of developing a positive teacher-student relationship. When students perceive a caring disposition from their teachers, they are more likely to develop a trustworthy and good relationship with their teachers (Lumpkin, 2007). In addition, when teachers use different teaching methods, it accommodates different learning needs and styles of the students (DeCastro-Ambrosetti & Cho, 2005; Banks, 2006; Black-Vannoy, 2004). When learning becomes more relevant and practical to students' lives, students are more likely to develop a positive learning attitude and gain more positive learning experience in the classroom (Ginsberg & Wlodkowski, 2009), which in turn helps students to develop a positive relationship with their teachers.

5.5 Conclusion 3.

The third conclusion is that students' perceptions of diverse teaching practices predicted students' academic self-efficacy, and their perceptions of relationship-building practices predicted a sense of belonging. Using the structural equation model in this study, perceptions of teachers' diverse teaching and relationship building significantly predicted students' academic self-efficacy and a sense of belonging respectively. To begin with, undergraduate students in this study who perceived a higher level of teachers' diverse teaching practices were more likely to

have a higher level of academic self-efficacy. This conclusion supported the findings of several studies (Gay, 2002; Banks, 2006; Black-Vannoy, 2004; Tripp, 2011), which indicated that students learn differently and a combination of various teaching methods is needed. By using diverse teaching methods that are student-centered, it will better accommodate students' learning needs by making the learning more relevant and engaging (Figueroa, 2015; Morgan, 2010; Ginsberg & Woldkowski, 1995, 2009). As university classrooms are becoming more diverse, students come from different cultural and social backgrounds and they all have different needs and expectations (Lin & Bates, 2014). By implementing diverse teaching methods that are student-centered, it will make learning more pleasant and fun. Through pleasant and fun learning experiences, students are most likely to develop positive learning attitude toward learning. Engaging learning experience then could help students to learn better, construct their own knowledge and develop critical thinking skills that are important for personal and professional growth (Prince, 2004; Morgan, 2010; Nilson, 2010; Guiffrida, 2005). In this study, students indicated that their math faculty who used real-life examples, worked out the problem together, and explained the concept in different ways were most helpful in learning mathematics. This finding is consistent with Ginsberg and Wlodkowsi (2009) which indicates that different instructional methods under the tenet of culturally responsive teaching helped to increase students' learning capabilities and academic engagement. Increased learning capabilities can be explained through increased self-efficacy through Bandura' s self-efficacy theory (Bandura, 1994). According to Bandura (1994), there are four major resources for one's self-efficacy including mastery experience, vicarious experience, social persuasion, and somatic and emotional states. It is possible that when faculty help students to learn in different ways, it better helps a student to master the content. When students master the content and learn well, students

become more confident about their ability to learn and are more willing to engage in more challenging tasks. In addition, undergraduate students who perceived a higher level of teachers' relationship-building practices were more likely to have a higher level of sense of belonging. The result is consistent with previous studies (Love, 2008; Moss, 2011; Ginsberg & Wlodkowski, 2009), indicating that a positive student-teacher relationship helps students to develop a sense of community.

Several relationship-building behaviors were identified and perceived by participants. For example, when the faculty treats students with respect, students feel that they are important members in the classroom and are valued by the faculty. When a teacher establishes an open and welcoming learning environment where students feel comfortable voicing their opinions and questions, it makes students feel included and welcomed in that learning community. Similarly, Ginsberg and Wlodkowski (2009) found that establishing an inclusive and welcoming learning environment is one of the motivational approaches under culturally responsive teaching. When a positive teacher-student relationship is formed, students feel more comfortable asking questions, seeking help and gaining rapport from their teachers in order to achieve academic success. Moreover, the benefits of a positive teacher-student relationship extend beyond the classroom. It is possible that when students feel valued and included in a classroom setting, they will have more positive learning experiences, develop a more positive learning attitude and encounter more positive interactions with others. This positive learning experience, in turn, will help students to feel they are welcomed and valued in a larger learning community. In other words, a sense of belonging gained in the classroom can also help students to develop their sense of belonging at the campus level (Freeman et al., 2007).

5.6 Conclusion 4.

The fourth conclusion is that students who had a higher sense of belonging were more confident as college students. In this study, a structural equation model indicated that undergraduate graduate students who had a higher level of sense of belonging indicated a higher level of academic self-efficacy. This result is consistent with previous research suggesting that a sense of belonging and academic self-efficacy was positively correlated (Sahaghi, et al., 2015; Sakiz, 2007; Freeman et al., 2007). It is understandable that sense of belonging is a basic human need and fundamental motive that can affect human behaviors in different contexts including academia (Strayhorn, 2012). Having a feeling of being valued, respected and welcomed in classrooms and on campus are an integral part of achieving a satisfactory student academic experience (Goodenow, 1993; Anderman, 2003, Osterman, 2000; O'Keeffe, 2013; Lam, Chen, Zhang, & Liang, 2015; Hausmann, Scholfield, &Woods, 2007; Fink, 2014; Walton & Cohen, 2011). According to Deci and Ryan (2000), a sense of relatedness was one of three major components for producing an intrinsic motivation. Sustaining intrinsic motivation plays an important role in the learning process (Deci et al., 1991; Gaumer Erickson et al., 2015). Sense of belonging was associated with academic motivation and academic achievement (Anderson, 2010). Increased sense of belonging was reported to increase one's confidence in their academic skills and learning capabilities (Sahaghi et al., 2015; Sakiz, 2007). When the need of feeling accepted and included in a group have been met, students are more motivated to engage and involve in academic learning (Moallem, 2013). When students are intrinsically motivated, they are more willing to take challenging tasks. In turn, when students are successful in the learning process and master the content, it produces mastery experience for students. Hence, mastery experiences positively reinforce students' beliefs about their learning capability, which can boost their academic confidence (Bandura, 1994).

5.7 Conclusion 5.

The fifth conclusion is that African American students at an HBCU had higher perceptions of CRT. Freshmen students had higher perceptions of CRT than senior students. Based on the results of this study, African American students' perceptions of overall culturally responsive teaching were significantly different from white students, Hispanic students, and Asian students. When comparing African American students at Purdue University and African American students at the University of Arkansas at Pine Bluff in terms of their perceptions of overall culturally responsive teaching, African American students at UAPB had significantly higher scores of CRT than their peers at Purdue. In addition, there were no significant differences in CRT between African American students and other students at Purdue University. Further, the result from factorial ANOVA indicated that while controlling for student race, the type of institution had a significant effect on students' perceptions of CRT. This suggested that the fact that African American students in this study reported a higher level of culturally responsive teaching of their math faculty was due to the fact that they were from an HBCU. As the majority of African American students in this study were from an HBCU, the result indicates that African-American students at HBCU were able to perceive more culturally responsive teaching practices. Previous research indicating that HBCUs provide a more positive experience for African American students (Chavous, 2002; Strayhorn & Terrell, 2010). For example, according to Seifert et al. (2006), HBCUs establish a more supportive learning environment where positive interactions between faculty and students are encouraged (Seifert et al., 2006). In addition, African American students are more likely to maintain their cultural identity between the school and their cultural heritage in the HBCU environment (Bracey, 2017; William, 2017). Therefore, it is possible that African American students feel their education is more relevant to their personal life and cultural identity, and they perceive the faculty as being more supportive of

their academic success. Therefore, they perceived instructions and class interactions more positively. Moreover, African American students can find mentors and role models more easily to support their academic and personal growth in HBCUs. As such, the results from this study reinforced the fact that African American students gained more support from faculty in an HBCU and are more likely to develop a positive relationship with their teachers.

Further, the results indicated that freshmen had a higher level of perceptions of overall culturally responsive teaching than senior students. However, the effect size was really small. Because no studies were found that studied culturally responsive teaching between freshman, sophomore, junior and senior students in universities, the results of this study provided an interesting perspective for future scholars to identify the factors that could influence freshmen and senior students' perceptions of culturally responsive teaching. It is possible that when freshmen participants reflected on their first college math course, their memories of their teachers' teaching behaviors were more recent and they could more accurately recall the behaviors identified in the questionnaire. Furthermore, freshmen may interpret their recent experiences in their first college mathematics course as an important gatekeeping course compared to seniors who have successfully completed more course and may interpret their first mathematics course as being less important than they would have when they were freshmen.

5.8 Implications for Practice

There is a still long way to go to address the labor gap and achievement gap in agriculture and STEM disciplines accompanied by the demographic shift of student population in higher education. Culturally responsive teaching can contribute to addressing the gap by making college experiences more inclusive and engaging for all students.

Regardless, the results of this study provided a better understanding of culturally responsive teaching in a college mathematics course as a proximal indicator of early college learning experiences, and thus inform some practical applications in terms of inclusive teaching. As such, increasing and improving the application of culturally responsive teaching in university classrooms would provide a more engaging learning experience for all students with different cultural and social backgrounds.

To begin with, faculty should adopt different teaching methods for classroom instruction. Faculty who use a combination of different instruction methods would be able to better address diverse cognitive, motivational, social, cultural and emotional needs of all students. To be able to do this, faculty are encouraged to get to know their students. Understanding students' learning needs and their prior experiences will help teachers better design their lesson plans and class activities to accommodate student learning (Brown, 2000; Association of Public and Land-Grant Universities, 2016). Moreover, faculty are encouraged to design the class to be student-centered (Figueroa, 2015; Morgan, 2010; Nilson, 210; Weimer, 2013). Instead of focusing on content coverage, faculty should serve as facilitators in the learning process (Estrada et al., 2016). For example, faculty could engage students in learning by posing questions that encourage students to learn and construct their own knowledge through various student-centered learning activities. By doing so, the faculty helped students to develop critical thinking skills that are important in today's competitive society (Brame, 2016; Estrada et al., 2016; Bownwell & Eison, 1991). Faculty asking students question and encourage students to ask questions are effective ways to know whether students understand and master the content. By doing so, faculty can address the problems and concerns that students have in a timely manner. Moreover, asking student questions can allow faculty to get real-time feedback about their teaching progress and make

accordingly adjustments in their instruction methods for improvement. Other effective teaching examples also included: 1) faculty could provide the learning assignment that is relevant to students' life and interests, 2) faculty could use the technology to help make the class fun and engaging, 3) faculty could walk around the classroom during the class and increase their interaction with students, 4) faculty could use whiteboards to demonstrate the steps to solve the problem, and 5) faculty provide different examples and ways to explain the concept.

Second, faculty should establish a welcoming and open learning environment for all students. To be able to do this, faculty members are encouraged to develop their cultural competence towards diverse student populations. Faculty should understand how culture and cultural differences could influence students learning and social interactions. Moreover, faculty should establish an open and friendly learning environment in their classroom where students feel comfortable raising questions and voicing their opinions without feeling judged or suppressed. This is particularly important for underrepresented minority students, who are more likely to be marginalized in agriculture and STEM disciplines in a predominately white learning environment (Sedlacek, 1999; McKim et al., 2017; Gardner, 2010). Previous research suggests that African American students are more likely to experience challenges and barriers in academic settings (Bui, 2002; Engle & Tinto, 2008; Stebleton et al., 2014). For example, African American students are more likely to experience disconnection from the content and instruction in current education (Stebleton et al., 2014; Warren et al., 2001). In agriculture and STEM disciplines where African American students are underrepresented, they are more likely to feel a sense of alienation from the learning community (Stebleton et al., 2014). By providing a safe learning environment for all students, it encourages students' participation and involvement in the learning process. In addition, an open and welcoming learning environment could also encourage

positive interaction between students, which will enhance students' learning through group work, class discussion, and group projects. Group work is an effective way to promote interaction between students and it enhances students' learning experiences in class. When faculty set up the class in a friendly, open and welcoming tone, it helps students to develop a positive attitude toward diversity. In this way, teachers are helping students to grow and function as global citizens to deal with 21stcentury challenges at national and international levels.

Third, faculty should realize that a positive faculty-student relationship plays an important role in students' learning process. Faculty should realize that there are many benefits when positive teacher-student relationships are developed (Tosolt, 2000; Khalifa et al., 2016). A good faculty-student relationship not only engages students in the learning of that particular subject, but it also enhances students' sense of belonging in the classroom (Hurtado, 2007). When students feel that they are valued and included in a particular course, they are motivated to learn better and take on challenging learning tasks (Ginsberg & Wlodkowski, 2009). Positive teacher-student relationships and mentoring could also support students' learning activities and experiences outside of the classroom (Drape et al., 2017). When students feel they have faculty they could trust and get support, it also boosts their confidence in their learning capabilities to achieve academic accomplishments. Although it is difficult to build personal relationships in a relatively large college class, faculty can offer office hours and make themselves available and approachable before and after class. Office hours were noted by students in this study as being particularly useful. Not only does it allow students to seek help for questions related to the learning subject, but it also provides a wonderful opportunity for faculty to get to know students and interact with students. Other examples and strategies to develop a positive relationship with students may include: 1) having lunch and socialize with students outside of the classroom, 2)

talking to students and learning their names, 3) staying after class to help students with questions, 4) providing tutoring session, and 5) having high expectation and treating students as equals fairly and with respect.

Fourth, there is a lack of application of cultural engagement practices in college classes. The results of this study indicated that regardless of student race, all students were unable to perceive cultural engagement practices in a college math course. Faculty should prepare and design their class by developing more connections of students' culture into the learning subject. In particular, institutions should help and prepare faculty to implement cultural engagement practices in university classrooms. For example, regular workshops and training sessions that address course design can be offered to faculty. Workshops and training sessions could cover different topics relating to culture and instruction and can be offered and available at different times throughout the semester. In particular, institutions could have some exclusive training sessions demonstrating good examples and practices that integrate students' culture into the curriculum and teaching process. Especially when university classrooms are becoming more diverse where students come from different countries with various cultural backgrounds, institutions should help faculty to be prepared to teach in a diverse classroom that different cultures are represented in the teaching process. Moreover, different offices at the university should actively collaborate to promote inclusive teaching. For example, the office of teaching and learning at the university should collaborate with the office of academic programs for each college. It would be useful if they can have designated instructional consultant responsible for each college to help with a course design that addresses the needs of diverse students. By doing so, faculty members and instructional consultant are more likely to develop an active working relationship due to their focus and familiarity in that particular college. Designated instructional

consultants can then provide individual consultation or group consultation for faculty members in the college. In addition, administrators should also provide opportunities for faculty collaboration on inclusive teaching. Administrators could provide networking session opportunities where faculty members from different departments and disciplines can interact and seek potential collaborations. University can also provide opportunities for faculty, graduate students (i.e., teaching assistants) to attend conferences focusing on teaching and learning to actively involved in the community that contributes to the continued development of inclusive teaching. The office of teaching and learning should also collaborate with the office of diversity and inclusion to make sure the materials and methods used in faculty training and workshops are inclusive and appropriate for audiences from diverse backgrounds.

At the departmental level, department heads should actively share resources and information on inclusive teaching to faculty members. To encourage faculty to attend the workshops and training sessions for effective and inclusive teaching, department heads could send out the inviting emails to encourage attendance and organize some debrief sessions to discuss how these workshops can help to design or redesign the course in the department.

Fifth, institutions should provide and establish a more supportive and friendly campus climate. For predominately white institutions, it is important that institutions provide training and workshops to address various topics regarding race, culture and social equity. Addressing sensitive topics can be challenging, but at the same time, a safe platform is needed where faculty, students, and staff can openly talk and address the issues that penetrate educational equity. For example, workshops that educate faculty and students about diversity and inclusion on campus can be offered. Topics such as microaggression would help faculty and students to reflect on their daily interactions toward students of color and other marginalized groups. This kind of

opportunity will allow faculty, students and staff to recognize and avoid potential behaviors that might lead to negative experiences of faculty and students from marginalized groups. In addition, the institution should also share the endeavors that university are undertaking to promote diversity and inclusion on a regular basis and reinforce the institution's commitment to creating a more inclusive environment.

Finally, building positive interactions between faculty and students requires time and efforts from both parties. It is important to have available resources and service that help address the challenges that students and faculty face when it comes to relationship building. Therefore, institutions should provide resources for both faculty and students in order to facilitate the development of positive teacher-student relationships. For faculty members, institutions could provide consultation service and training sessions to help faculty members to identify and apply effective mentoring strategies. Effective mentoring can be quite challenging for students from different cultural groups, especially regarding the power and privileges of faculty, who are typically representative of the majority culture. These training opportunities can thus help faculty, especially new faculty members, to become better mentors to support their students to be successful. For students, institutions could provide resources for students to guide them through a process to develop professional and positive relationships with their teachers and mentors.

5.9 Limitations of the Research

This research intended to develop and validate an instrument that could measure students' perceptions of culturally responsive teaching in agriculture and STEM disciplines in the context of higher education. Further, this study used a structural equation model to examine the relationship between students' perceptions of culturally responsive teaching and a sense of

belonging and academic self-efficacy. The researcher was aware of the following limitations that were associated with this study and the interpretation of the results.

First, the scale that measured students' perceptions of culturally responsive teachings in this study was developed based on the original SMCRT scale developed and validated by Dickson et al. (2016). In total, there were 21 items for SMCRT scale. However, Dickson et al. (2016) suggested that more CRT practices should be included in the scale. In this study, ten new relationship-building items were added and replaced some of the language affirmation items on the original SMCRT scale. However, these 10 new items did not fully represent practices to reflect a teacher-student relationship. For example, in this study, students indicated that offering office hour, faculty personality and faculty being responsive to emails were examples that help to build a positive teacher-student relationship. However, these teaching practices were not represented in the scale for this study.

Second, 67% of participants in this study were white students. As such, the race of study participants was more homogenous largely represented by white students. Lack of sufficient minority students in this study (i.e., African American) prevented the researcher to run structural equation model individually by individual student race. Minority students such as African American students are underrepresented in agriculture and STEM disciplines. Therefore, finding enough minority participants that were willing to participate in this study at a predominately white institution was challenging. As such, the structural equation model in this study combined all students as one group in order to predict the relationships among students' perceptions of culturally responsive teaching, sense of belonging and academic self-efficacy.

Third, this study asked participants to reflect on their first college math course. Although a first college mathematics course can be a gatekeeping course, the instruction in introductory

mathematics courses may not have necessarily been representative of learning experiences students will experience in other colleges or courses. Therefore, generalizing the findings from this study to other university courses should be conducted with caution.

Fourth, this study used a convenience sampling method when selecting participating institutions and only included one PWI and one HBCU as institutional contexts. Therefore, the findings from this study cannot be generalized to other universities.

Fifth, this study mainly focused on agriculture and STEM disciplines in higher education. The participants only include undergraduate students who are enrolled in agriculture, STEM and liberal arts programs. Therefore, the findings from this study may not be representative of other disciplines.

In addition, STEM includes science, technology, engineering, and mathematics. However, the HBCU selected for this study did not have an engineering program. In order to match the STEM contexts between the two institutions, this study only included science and mathematics disciplines to represent STEM. Therefore, the findings from this study may not be representative of other STEM disciplines such as engineering and technology.

Moreover, the researcher was a graduate student, master's and doctoral respectively in colleges of agriculture at the two universities that were included in this study. She did her undergraduate study outside of the U.S. and did not have traditional agriculture and STEM exposure and familiarity in a university setting. Although she used strategies to monitor her potential biases, the interpretations of the data could have been informed by these biases.

Last, this research relied on self-reported data from a newly developed instrument. The data and analyses relied on participants' genuine responses/answers to questions from the instrument. This study did not differentiate between domestic and international students.

Therefore, cultural and social differences could potentially bring in biases with regards to participants' answers/understandings/interpretation of these questions.

5.10 Recommendations for Future Research

The following recommendations for future research are explained below. These recommendations were made to address the limitations associated with this study.

First, the scale that measured students' perceptions of culturally responsive teaching in this study represented a limited number of teaching practices. Future research should include more culturally responsive teaching practices on the scale and retest its validity and measurement fit. For example, in response to the open-ended questions, participants indicated that teachers who tried different ways to explain the content in the class were particularly useful to help students to learn. In addition, the use of technology (i.e., video, I-clicker) and group work were also helpful in student learning. Hence, more examples of the teaching methods should be added to the scale of culturally responsive teaching for future research. In addition, culturally responsive teaching includes teaching practices that support the development of positive teacher-student relationships. In this study, the scale only included 10 items that represent relationship-building practices. However, based on the responses from the two open-ended questions, participants provided their perspectives toward teaching behaviors and teacher characteristics that contributed to a positive teacher-student relationship. Examples of these teaching practices and characteristics included the following: 1) teachers offered office hours, 2) teachers were approachable and personable, 3) teachers encouraged students to ask questions, and 4) teachers were kind, caring, sympathetic and humorous. Future research should add more examples of the teacher-student relationship-building practices into the development of culturally responsive teaching scale.

Second, this study examined culturally responsive teaching from students' perspectives through a quantitative approach via using a questionnaire. A couple of disadvantages of using a quantitative approach include: 1) missing some in-depth and detailed information from participants, and 2) not capturing the thoughts from students regarding their observations and interpretations toward the behaviors demonstrated by their teachers. It will be useful for future research to conduct qualitative research to fully understand how students perceive and interpret culturally responsive teaching behaviors in classrooms. The findings from a qualitative approach will allow researchers to have a bigger picture understanding how culturally responsive teaching is manifested in university classrooms and students' attitude and perceptions toward culturally responsive teaching.

Third, this study measured culturally responsive teaching through students' self-reflection of their first college math teacher. The math course was purposively selected because it is a basic course that undergraduates have to take at some point in their college life. However, due to the nature of the math subject, it can be challenging to make the math classroom to be culturally relevant, engaging and personalized. Therefore, it might be useful that future research can study culturally responsive teaching using different courses. For example, courses that have more focus on culture and humanity might provide a different context to compare students' perceptions of culturally responsive teaching. Additionally, capstone courses that have applications to address industry and/or societal problems might elicit different perceptions of culturally responsive teaching. It is possible that students have very different experiences and interactions with teachers from humanity courses (i.e., art, history, philosophy), therefore, their interpretation of teachers' behaviors and teaching methods could be different. Moreover, it might be useful that future studies could measure culturally responsive teaching through students' self-reflection on

different teachers instead of one teacher. Reflecting on different teachers' instructional methods and interaction with the class will allow students to compare their learning experiences with different teachers in different classrooms. This comparison will allow students to have a better understanding, interpretation, and perceptions toward various teaching behaviors and teacher characteristics.

Fourth, this study only focused on undergraduate students from the agriculture, STEM and liberal arts disciplines. Future research should extend the scope of the research context to different disciplines in higher education. In particular, this study only selected science and mathematics disciplines to represent STEM fields. It will be useful to replicate the study with undergraduate students from engineering and technology disciplines. By doing so, it will provide additional information and comparison among students from different areas of STEM. The results would help us better understand students' math learning experiences across different STEM programs.

Fifth, this study only included one PWI and one HBCU. Future research should include more institutions to increase generalizability. Every institution is unique in its student and faculty demographics, student enrollment, course design, campus culture, leadership, and other contextual factors. Even though math is a basic course that is offered almost in every university, the structure and instruction of the math course could be quite different. It will be useful to include more universities representing different types of institution (i.e., public institutions, private institutions, four-year institutions, two-year institutions, associate's colleges, tribal colleges and etc.) (Carnegie Classification of Institutions of Higher Education, n.d.) in order to compare students' learning experiences in a college math class. By identify the effective teaching practices that help to engage the diverse students in different contexts, institutions could learn

from each other and collaborate as a larger unit to promote inclusive teaching practices in higher education.

Moreover, future research should include more institutions and more diverse institutions to increase the sampling pool for minority students such as African American students. The majority of participants in this study were white students. Within the context of agriculture and STEM, African American students are underrepresented; it was challenging to attract a sufficient number of African American students to participate in this study. Therefore, increasing the number of participating institutions will allow future research to be able to include and attract more African American students from different universities.

Sixth, this study indicated that freshmen students have a higher level of perception toward culturally responsive teaching behaviors than senior students do. The researcher did not quite understand the factors that could influence freshman vs. senior students' different perceptions. Future research should identify these factors and examine to what extent and how these factors impact students' different interpretation of teaching behaviors and their interaction and general experience with their first college math teachers.

Seventh, this study indicated that African American students at an HBCU have a significantly higher level of perceptions toward culturally responsive teaching than their peers from a PWI. The type of institution played a significant role in African American students' overall perceptions of culturally responsive teaching. Future research should further examine the intersectional effects between the institution type and students' race on students' perceptions of culturally responsive teaching with different participants with more universities. For instance, future research could examine whether Hispanic students in the Hispanic serving institutions will

be different from their peers enrolled in PWI in terms of their perceptions of teacher's culturally responsive teaching, sense of belonging and academic self-efficacy.

In addition, several paths in the SEM model were not statistically significant in this study. For example, diverse teaching did not predict a sense of belonging, culture engagement predicted neither sense of belonging nor academic self-efficacy, and relationship building did not predict academic self-efficacy. Future study should reexamine theses non-significant paths with different participants in different contexts. Future study should also reexamine these non-significant paths with different courses (e.g., humanity courses). Humanity courses have more focuses on human culture, therefore, the instruction of humanity course might encourage class interactions to a higher level through different forms of class structure. Class discussion, group project, and community learning emphasized in humanity courses could promote a higher level of learning engagement and interactions between teachers and students. Therefore, humanity course may provide different learning experiences for students. Hence, students' perceptions of cultural engagement teaching practices in humanity course might be different from this study and thus might produce different statistical pathways.

Moreover, this study only included two dependent factors in the model: students' sense of belonging and academic self-efficacy. As culturally responsive teaching intrinsically motivates students and leads to many benefits based on a review of literature, future studies should include more dependent variable and explore the motivational paths between the factors. For example, a future study could include the dependent variables such as academic performance, academic engagement, outcome expectation, and matriculation. Adding more variables and exploring their relationships in the model would provide a better understanding of how culturally responsive

teaching positively motivates students to learn and succeed both academically and professionally.

Finally, future studies on culturally responsive teaching should also include faculty participants. Faculty members from different disciplines have different understanding and practices toward culturally responsive teaching. It will be useful to understand how faculty conceptualize and apply culturally responsive teaching in their classrooms. It is possible that culturally responsive teaching practices that faculty are actually doing are not necessarily included and recognized in the current literature. In addition, by having faculty participate in participatory action research studies, insights from faculty members could be better understood regarding the barriers and challenges that they have encountered to implement culturally responsive teaching. Future research, including faculty members, could contribute to our current knowledge and understanding of culturally responsive teaching in university classrooms. Ultimately, efforts and commitment from faculty members could help promote the application of culturally responsive teaching in a university setting.

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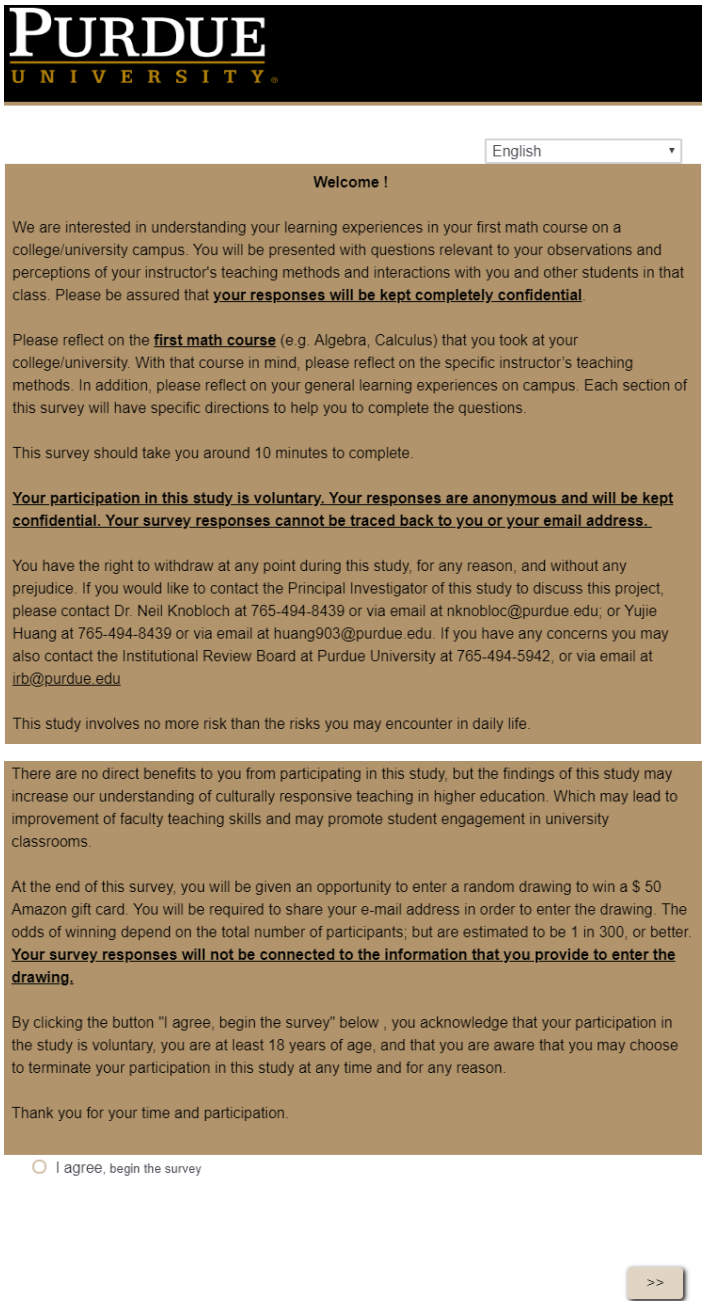
APPENDIX A. QUESTIONNAIRE



PURDUE
UNIVERSITY

English

Welcome !

We are interested in understanding your learning experiences in your first math course on a college/university campus. You will be presented with questions relevant to your observations and perceptions of your instructor's teaching methods and interactions with you and other students in that class. Please be assured that **your responses will be kept completely confidential**.

Please reflect on the **first math course** (e.g. Algebra, Calculus) that you took at your college/university. With that course in mind, please reflect on the specific instructor's teaching methods. In addition, please reflect on your general learning experiences on campus. Each section of this survey will have specific directions to help you to complete the questions.

This survey should take you around 10 minutes to complete.

Your participation in this study is voluntary. Your responses are anonymous and will be kept confidential. Your survey responses cannot be traced back to you or your email address.

You have the right to withdraw at any point during this study, for any reason, and without any prejudice. If you would like to contact the Principal Investigator of this study to discuss this project, please contact Dr. Neil Knobloch at 765-494-8439 or via email at nknobloc@purdue.edu; or Yujie Huang at 765-494-8439 or via email at huang903@purdue.edu. If you have any concerns you may also contact the Institutional Review Board at Purdue University at 765-494-5942, or via email at irb@purdue.edu

This study involves no more risk than the risks you may encounter in daily life.

There are no direct benefits to you from participating in this study, but the findings of this study may increase our understanding of culturally responsive teaching in higher education. Which may lead to improvement of faculty teaching skills and may promote student engagement in university classrooms.

At the end of this survey, you will be given an opportunity to enter a random drawing to win a $ 50 Amazon gift card. You will be required to share your e-mail address in order to enter the drawing. The odds of winning depend on the total number of participants; but are estimated to be 1 in 300, or better. **Your survey responses will not be connected to the information that you provide to enter the drawing.**

By clicking the button "I agree, begin the survey" below , you acknowledge that your participation in the study is voluntary, you are at least 18 years of age, and that you are aware that you may choose to terminate your participation in this study at any time and for any reason.

Thank you for your time and participation.

I agree, begin the survey

>>

Please check the box below to indicate which college math course you are reflecting on.

- ○ Algebra
- ○ Calculus
- ○ Other

Please check the box below to indicate your affiliation.

- ○ Purdue University
- ○ University of Arkansas at Pine Bluff
- ○ Langston University

Please check the box below to indicate where you took this course.

- ○ Purdue University
- ○ University of Arkansas at Pine Bluff
- ○ Langston University
- ○ Other

>>

Part 1.

Directions: Reflect on your first math course at your college/university. With that specific math teacher in mind, how frequently did they demonstrate the behaviors listed below? Please check the box that best represents your opinion.

	1= Never	2= Rarely	3=Sometimes	4=Often	5=Always
1. My math teacher explained what we were learning in different ways to help us learn.	○	○	○	○	○
2. My math teacher used different things (e.g. videos, pictures, slides) to help us understand the subject.	○	○	○	○	○
3. My math teacher used what I already knew to help me understand new ideas.	○	○	○	○	○
4. My math teacher tried to find out what interested me.	○	○	○	○	○
5. My math teacher used real-life examples to help explain the subject.	○	○	○	○	○
6. My math teacher provided timely feedback on my assignments.	○	○	○	○	○
7. My math teacher encouraged collaborative learning with other students.	○	○	○	○	○
8. My math teacher used different types of assessments (e.g. group project, presentation) to assess what I learned.	○	○	○	○	○

>>

Continued....

Directions: Reflect on your first math course at your college/university. With that specific math teacher in mind, how frequently did they demonstrate the behaviors listed below? Please check the box that best represents your opinion.

	1=Never	2=Rarely	3=Sometimes	4=Often	5=Always
9. My math teacher recognized that school culture was different from my home culture.	○	○	○	○	○
10. My math teacher was very interested in my culture.	○	○	○	○	○
11. My math teacher was interested in knowing my family and home life.	○	○	○	○	○
12. My math teacher encouraged all students to learn about others and their cultures.	○	○	○	○	○
13. My math teacher spoke about contributions that my culture had made to science.	○	○	○	○	○
14. My math teacher designed lessons that showed how other cultural groups had made use of mathematics.	○	○	○	○	○
15. My math teacher used examples from my culture when teaching.	○	○	○	○	○

>>

Continued.....

Directions: Reflect on your first math course at your college/university. With that specific math teacher in mind, how frequently did they demonstrate the behaviors listed below? Please check the box that best represents your opinion.

	1=Never	2=Rarely	3=Sometimes	4=Often	5=Always
16. My math teacher treated all students as important members of the classroom.	○	○	○	○	○
17. My math teacher created a learning environment where I was comfortable to voice my opinions.	○	○	○	○	○
18. My math teacher was approachable after class.	○	○	○	○	○
19. My math teacher helped me when I did not understand the content.	○	○	○	○	○
20. My math teacher really cared about how much I learned.	○	○	○	○	○
21. My math teacher cared about my point of view when we discussed questions.	○	○	○	○	○
22. My math teacher expected me to do well in their class.	○	○	○	○	○
23. My math teacher showed high expectations for all students.	○	○	○	○	○

>>

Part 2.

Directions: Reflect on your experiences on campus. To what extent would you agree or disagree with each of the statements listed below? Check the box that best represents your level of agreement.

	1=Strongly Disagree	2=Disagree	3=Neutral	4=Agree	5=Strongly Agree
1. I feel comfortable contributing to class discussions.	○	○	○	○	○
2. I made new friends as a result of my enrollment in the math course.	○	○	○	○	○
3. I participate in study groups with other students.	○	○	○	○	○
4. I feel the university is committed to establishing a welcoming and positive environment for students.	○	○	○	○	○
5. I am included in many activities at this university.	○	○	○	○	○
6. I feel people of my race/ethnicity are more likely to experience discrimination on campus than others.	○	○	○	○	○
7. Faculty and staff at this university treat me with respect.	○	○	○	○	○
8. Faculty and staff have made me doubt whether I belong in this program.	○	○	○	○	○
9. I am treated with as much respect as other students.	○	○	○	○	○
10. People at this university are friendly to me.	○	○	○	○	○
11. I can really be myself at this university.	○	○	○	○	○

>>

Part 3.

Directions: Reflect on your current study on campus. How much confidence do you have about each of the behaviors listed below? Check the box that best represents your level of confidence.

	1=Not at all	2=Little	3=Somewhat	4=A lot	5=Absolutely
1. I can take well-organized notes during lectures.	○	○	○	○	○
2. I feel comfortable participating in class discussions regularly.	○	○	○	○	○
3. I listen carefully during lectures on difficult topics.	○	○	○	○	○
4. I can explain a concept to another student.	○	○	○	○	○
5. I feel comfortable asking professors to review the concept I do not understand.	○	○	○	○	○
6. I am confident that I can earn good grades in most classes.	○	○	○	○	○
7. I can understand most ideas presented in class.	○	○	○	○	○
8. I can understand difficult content in textbooks.	○	○	○	○	○
9. I can master most content in a math course.	○	○	○	○	○
10. I am good at applying lecture content to laboratory sessions.	○	○	○	○	○

Only a few questions left!

Part 4.

Background information

Direction: Please indicate your response by checking the appropriate box that best describes you.

1. Which gender do you most identify with:

- ○ Female
- ○ Male
- ○ Non-Binary
- ○ Prefer not to disclose

2. What is your ethnicity/race"?

- ○ African-American
- ○ Asian
- ○ Pacific Islander
- ○ White
- ○ Native American
- ○ Multiracial
- ○ Hispanic/Latino

3. What it is your classification in college?

- ○ Freshman
- ○ Junior
- ○ Graduate student
- ○ Sophmore
- ○ Senior

4. What college are you in?

- ○ Agriculture
- ○ Science
- ○ Liberal Arts
- ○ Arts & Science

5. How many credits are you taking for this semester?

6. Do you plan to apply to graduate school after completion of your undergraduate degree?

- ○ Yes
- ○ No
- ○ I am already a graduate student

7. What graduate degree would you like to pursue?

- ○ Master's
- ○ Ph.D
- ○ Professional Degree (e.g. DVM, MD, JD)

8. What was the ethnicity/race of your math teacher ? (the math teacher you are reflecting on for this survey)?

- ○ African-American
- ○ Asian
- ○ Multiracial
- ○ White
- ○ Native American
- ○ Not sure
- ○ Hispanic/Latino
- ○ Pacific Islander

9. What was the gender of your math teacher (the math teacher you are reflecting on for this survey)?

- ○ Female
- ○ Non-Binary
- ○ Male
- ○ I am not sure

>>

Part 5
Additional Comments

1. What did your math teacher do that engaged you most in their class?

2. In what ways did your math teacher do to make you feel that you could develop a good teacher-student relationship with them?

PURDUE UNIVERSITY

Thank you for your participation in this survey, your responses have been recorded. Your responses are anonymous and will be kept confidential.

If you would like to enter a drawing for a $50 Amazon gift card, please click here

APPENDIX B. INSTITUTIONAL REVIEW BOARD APPROVAL LETTER FROM PURDUE UNIVERSITY

PURDUE
UNIVERSITY

HUMAN RESEARCH PROTECTION PROGRAM
INSTITUTIONAL REVIEW BOARDS

To:	KNOBLOCH, NEIL A
From:	DICLEMENTI, JEANNIE D, Chair Social Science IRB
Date:	02/07/2019
Committee Action:(2)	Determined Exempt, Category (2)
IRB Action Date:	02 / 07 / 2019
IRB Protocol #:	1902021678
Study Title:	Students' academic motivation and perceptions of culturally responsive teaching in higher education

The Institutional Review Board (IRB) has reviewed the above-referenced study application and has determined that it meets the criteria for exemption under 45 CFR 46.101(b).

Before making changes to the study procedures, please submit an Amendment to ensure that the regulatory status of the study has not changed. Changes in key research personnel should also be submitted to the IRB through an amendment.

General

- To recruit from Purdue University classrooms, the instructor and all others associated with conduct of the course (e.g., teaching assistants) must not be present during announcement of the research opportunity or any recruitment activity. This may be accomplished by announcing, in advance, that class will either start later than usual or end earlier than usual so this activity may occur. It should be emphasized that attendance at the announcement and recruitment are voluntary and the student's attendance and enrollment decision will not be shared with those administering the course.
- If students earn extra credit towards their course grade through participation in a research project conducted by someone other than the course instructor(s), such as in the example above, the students participation should only be shared with the course instructor(s) at the end of the semester. Additionally, instructors who allow extra credit to be earned through participation in research must also provide an opportunity for students to earn comparable extra credit through a non-research activity requiring an amount of time and effort comparable to the research option.
- When conducting human subjects research at a non-Purdue college/university, investigators are urged to contact that institution's IRB to determine requirements for conducting research at that institution.
- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the

written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). Submit this documentation as an FYI through Coeus. This is an institutional requirement.

Categories 2 and 3

- Surveys and questionnaires should indicate
  - only participants 18 years of age and over are eligible to participate in the research; and
  - that participation is voluntary; and
  - that any questions may be skipped; and
  - include the investigator's name and contact information.
- Investigators should explain to participants the amount of time required to participate. Additionally, they should explain to participants how confidentiality will be maintained or if it will not be maintained.
- When conducting focus group research, investigators cannot guarantee that all participants in the focus group will maintain the confidentiality of other group participants. The investigator should make participants aware of this potential for breach of confidentiality.

Category 6

- Surveys and data collection instruments should note that participation is voluntary.
- Surveys and data collection instruments should note that participants may skip any questions.
- When taste testing foods which are highly allergenic (e.g., peanuts, milk, etc.) investigators should disclose the possibility of a reaction to potential subjects.

You are required to retain a copy of this letter for your records. We appreciate your commitment towards ensuring the ethical conduct of human subjects research and wish you luck with your study.

APPENDIX C. INSTITUTIONAL REVIEW BOARD APPROVAL LETTER FROM THE UNIVERSITY OF ARKANSAS AT PINE BLUFF

University of Arkansas – Pine Bluff

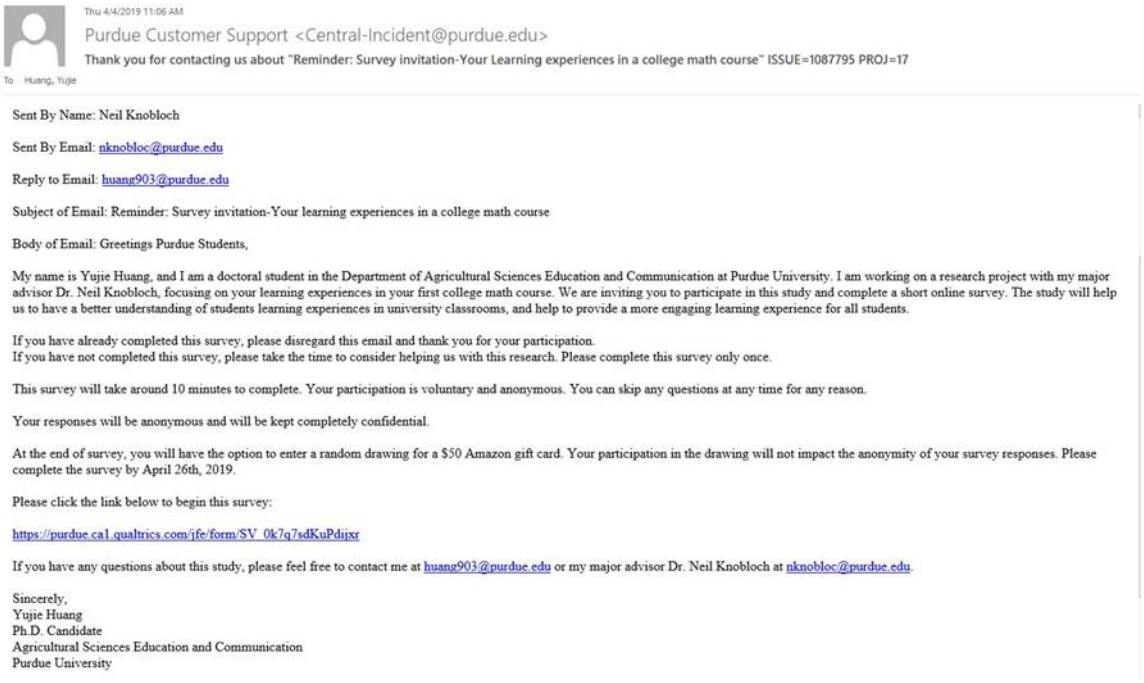
Institutional Review Board
Response to Request for Review

UA Pine Bluff IRB IORG0002614	Registration 031119A Date 03/11/19	
Principal Investigator	Name Neil Knobloch Telephone 765-494-8439	E--mail nknobloc@purdue.edu
Project Title or Description	Students' academic motivation and perception of culturally responsive teaching in higher education	

The items checked need to be completed for further review		
	Cover letter	Statement that participants may withdraw
	Contact information	Methods of maintaining confidentiality
	Abstract	Compensation mechanisms
	Human protocols	IRB approval of collaborating institutions
	Duration of study	Survey instruments
	Consent form	Justification for significant risk
	Assent form if needed	Other (explain)
	Confidentiality statement	
	Potential risk statement	

Type of Review	Decision Made
Exempt from review	Unconditional Approval X
Expedited Review X	*Conditional Approval
Full Board Review	Non-Approval
Date 03/11/19	
Signature of IRB Chair	*Conditions to be met see note under "other"
Richard B. Walker	

APPENDIX D. SURVEY INVITATION



Thu 4/4/2019 11:06 AM

Purdue Customer Support <Central-Incident@purdue.edu>

Thank you for contacting us about "Reminder: Survey invitation-Your Learning experiences in a college math course" ISSUE=1087795 PROJ=17

To Huang, Yujie

Sent By Name: Neil Knobloch

Sent By Email: nknobloc@purdue.edu

Reply to Email: huang903@purdue.edu

Subject of Email: Reminder: Survey invitation-Your learning experiences in a college math course

Body of Email: Greetings Purdue Students,

My name is Yujie Huang, and I am a doctoral student in the Department of Agricultural Sciences Education and Communication at Purdue University. I am working on a research project with my major advisor Dr. Neil Knobloch, focusing on your learning experiences in your first college math course. We are inviting you to participate in this study and complete a short online survey. The study will help us to have a better understanding of students learning experiences in university classrooms, and help to provide a more engaging learning experience for all students.

If you have already completed this survey, please disregard this email and thank you for your participation.
If you have not completed this survey, please take the time to consider helping us with this research. Please complete this survey only once.

This survey will take around 10 minutes to complete. Your participation is voluntary and anonymous. You can skip any questions at any time for any reason.

Your responses will be anonymous and will be kept completely confidential.

At the end of survey, you will have the option to enter a random drawing for a $50 Amazon gift card. Your participation in the drawing will not impact the anonymity of your survey responses. Please complete the survey by April 26th, 2019.

Please click the link below to begin this survey:

https://purdue.ca1.qualtrics.com/jfe/form/SV_0k7q7sdKuPdijxr

If you have any questions about this study, please feel free to contact me at huang903@purdue.edu or my major advisor Dr. Neil Knobloch at nknobloc@purdue.edu.

Sincerely,
Yujie Huang
Ph.D. Candidate
Agricultural Sciences Education and Communication
Purdue University