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Structural Equation Modeling (SEM) Analyses of Perceived Contextual Factors with Departmental Climate for Teaching Quality Improvement in STEM

Eman Saqr
University of Central Florida

STRUCTURAL EQUATION MODELING (SEM) ANALYSES OF PERCEIVED CONTEXTUAL FACTORS WITH DEPARTMENTAL CLIMATE FOR TEACHING QUALITY IMPROVEMENT IN STEM

By

EMAN AHMAD SAQR
B.A. Hashemite University, 2004
M.A. Hashemite University, 2013

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Major Professor: Richard Hartshorne

ABSTRACT

This study explored the correlation between perceived contextual factors (leadership, collegiality, resources, professional development, autonomy, and respect) and departmental climate for teaching quality improvement in STEM settings across institutional types and faculty's institutional roles. Institutional types include associate's colleges, doctoral-granting universities, master's colleges and universities, and baccalaureate colleges. Faculty's institutional roles included full professor, associate professor, assistant professor, lecturer, and instructor. Gappa et al.'s (2007) framework regarding faculty work was used to explain the explored correlation. Two hundred and seventy-eight faculty members in STEM settings across institutional types participated in the web survey. A partial least squares structural equation modeling (PLS-SEM) approach was utilized to analyze the collected data and test the research hypotheses. The results indicate there were perceived contextual factors positively correlated with departmental climate, for teaching improvement across institutional types except between collegiality and associate's colleges. Moreover, the results revealed that although these factors are positively correlated with departmental climate for teaching improvement among faculty, regardless of their ranks, lecturers are not supported with resources, and instructors are not supported with autonomy. Further, the findings indicate that faculty in STEM are generally satisfied with and supported by their departmental climate. Research implications support the idea that for improved teaching in STEM, policy makers and stakeholders need to focus on providing support, resources, and increased autonomy for lecturers and instructors.

Keywords: leadership, collegiality, resources, professional development, autonomy, respect, STEM faculty, departmental climate, teaching quality, improvement, full professor, associate professor, assistant professor, lecturer, instructor.

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CHAPTER ONE: INTRODUCTION

As a priority policy, faculty are encouraged to adopt teaching methods based on evidence regarding how people learn, particularly in the Science, Technology, Engineering, and Mathematics (STEM) disciplines. However, evidence-based teaching methods are often adopted spottily and slowly (President's Council of Advisors on Science and Technology, 2012). Further, pedagogical reform efforts in STEM disciplines are designed to facilitate the adoption of evidence-based pedagogical approaches. These efforts have been shown to slowly result in the adoption of innovative instructional approaches and are oftentimes insufficiently applied in STEM settings. Moreover, pedagogical change rate is impacted by faculty readiness for that change, and STEM faculty tend to show lower levels of readiness for pedagogical change than those in other areas (Fairweather, 2008). Similarly, STEM faculty are often encouraged to embrace pedagogical change without being provided any input regarding how the suggested pedagogical change(s) could be successfully implemented and fit within their local contextual conditions (Henderson & Dancy, 2008). Therefore, providing such an examination, as well as considering the inclusion of contextual conditions, (e.g. resource availability, autonomy in teaching, and relationships with colleagues) when developing pedagogical reforms, might serve to improve faculty teaching practices. Further, Fishman (2005) added that policies and structures related to pedagogical change might be impeded due to incompatibility between the perceived needs of pedagogical change and other existing constraints in STEM disciplines at a departmental and institutional level, such as limited teaching resources provided. Therefore, encouraging the adoption of new pedagogical approaches could be motivated by clarifying

explicit and valid benefits and concerns (e.g. decreasing the attrition rate of students in STEM disciplines) related to the consequences of pedagogical change or following cultural conventions of professional groups which support pedagogical change (Hora & Holden, 2013).

Research in STEM has indicated that student performance is strongly correlated with teaching quality, including instructional style, content, materials, activities, and time management (Roth et al., 2006). As faculty teaching practices have a greater impact on student achievement than other factors (e.g. financial conditions), the effects of pedagogical change on student achievement could be more effective when high quality instructional practices are supported, by providing STEM faculty with skills and knowledge required for strong teaching practices (Hora & Holden, 2013). Moreover, reinforcing a sense of self for faculty teaching in STEM is correlated with the improvement of work context and improving teaching practices in STEM. Beijaard, Meijer, and Verloop (2004) asserted that improving work context increases an individual's confidence, adaptation, commitment, satisfaction, and motivation to become a teacher. Brown (2006) added that work context is a main indicator of retention and performance in the teaching profession. Additionally, Eick (2009) found that the role of teaching context is critical as teachers develop their instructional practices. Particularly, a strong self-efficacy, satisfaction, commitment, and motivation to teach in STEM disciplines and to become STEM teachers may be correlated with working conditions and teaching context. Thus, exploring conditions of work context would be useful, to fully explain and inform approaches which address issues that negatively impact teaching quality that, consequently, impacts student performance in STEM disciplines (Chi, 2009).

Past research has demonstrated that prior knowledge and expertise have a great impact on faculty teaching practices and teaching quality (Oleson & Hora, 2014). They are important contributors when developing instructors' teaching practices and becoming professional educators over time (Beijaard, Meijer, & Verloop, 2004). Interestingly, instructors' beliefs about the teaching profession are usually shaped by their prior knowledge and skills before entering their classrooms (Oleson & Hora, 2014). Teachers are influenced based on their previous expertise constructed and acquired over time by observing others' behaviors within teaching contexts (Hora & Holden, 2013). Teachers also have different teaching roles and are situated in varied contexts, all of which impacts their points of view and beliefs about teaching. These roles are emotionally attached to their personalities, with which they identify over time (Holland & Lachicotte, 2007). With social learning theory, Bandura (1977) contended that observing others' behaviors within teaching contexts impacts individuals' beliefs, actions, and knowledge structures. Further, prior expertise and skills impact teachers' instructional behaviors, such as interpreting subject matter or selecting pedagogical techniques (Hora & Holden, 2013). Therefore, when considering the reform of faculty pedagogical approaches, prior knowledge and expertise of STEM faculty should be respected and recognized within work contexts. When faculty teaching expertise is recognized, a sense of competence increases and serves as a motivating factor towards faculty readiness to improve their teaching practices. However, STEM faculty often teach the way they were taught, and STEM instruction has historically and primarily been instructor-centered. Therefore, the predominant problem of continuing to use instructor-centered approaches in STEM disciplines is circular, and pedagogical change needs to

be addressed using multi-leveled, comprehensive, and diverse reform efforts (Hora & Holden, 2013).

There have been numerous and continuing reform efforts for teaching, such as pedagogical change programs which support STEM faculty instructional practices. When work context improves, teaching quality is positively impacted, resulting in improved faculty instructional practices (Chi, 2009). However, there is still a lack of reliable evidence which focuses on the sustained impacts of professional reform efforts on STEM faculty pedagogical change (Derting et al., 2016). Consequently, empirical evidence demonstrates how STEM faculty professional development programs and reform efforts, which may affect STEM faculty teaching practices, are both limited and necessary. Understanding the impacts on faculty teaching practices of professional reform efforts focused on pedagogical change allows decision makers and stakeholders to continue to reform interventions needed for future teaching endeavors (Ericsson, 2008). Recognizing the impact of professional reform efforts supporting STEM faculty also allows for identifying the most influential professional development activities related to the changes needed to improve STEM faculty teaching practices. Although many qualitative and quantitative studies have been conducted to explore the impact of professional reform efforts on STEM faculty teaching practices, they lack strong evidence of outcomes (Derting et al., 2016). Stes et al. (2010) reviewed 108 studies regarding the impact of professional reform efforts on teachers' learning of skills in STEM disciplines. They found that 14% of these studies used quantitative or mixed methods approaches, and a few studies used qualitative methods. Utilizing a qualitative approach may provide an in-depth understanding and exploration of people's interactions and experiences in a specific setting and may also explain "why" and "how"

something happens. Therefore, more quantitative, qualitative, and mixed methods research which explore STEM faculty teaching practices and skills is still needed (Creswell, 2013). Stes et al. (2010) concluded that it is still a challenge to assess the success of professional reform efforts within institutions. It is also documented that there is a lack of consistency between what faculty learn during professional reform programs for pedagogical change and their actual teaching practices (Ebert-May, 2011). Overall, faculty do not apply what they learn during professional reform programs to improve their teaching practices. This may be the result of reform efforts which do not adequately address work context conditions that are correlated with teaching quality in STEM.

Teaching professional development (TPD), as a part of reform efforts impacting teaching quality, should address the importance of educational theories to support faculty teaching practices (Kreber, 2001). The quality of TPD can either enhance STEM faculty teaching practices and motivation or impede future faculty participation. TPD programs should consider teachers' needs and recognize their progression regarding their instructional practices. It has been affirmed that faculty prefer short workshops that introduce educational theories and support teaching practices (Bouwma-Gearhart, 2012). However, Levinson-Rose and Menges (1981) indicated that short workshops have limited long-term effects on faculty teaching practices. Therefore, professional development initiatives reflect the importance of providing faculty with the adequate time they need to learn and adopt new pedagogies in practice and facilitate pedagogical change in the disciplines (Buczynski & Hansen, 2010). Moreover, when STEM faculty understand educational theories which explain classroom issues, their readiness and motivation for pedagogical change increases, and their teaching practices improve. Not only will

the understanding of educational theories improve STEM faculty teaching practices, but it will increase the value of academic scholarships which support educational theories in STEM disciplines (Kreber, 2001). STEM faculty indicated they have the interest to improve their teaching practices and connect them with educational theories (Bouwma-Gearhart, 2011). Overall, faculty teaching practices could be supported when teaching knowledge and skills are correlated with educational theories.

Psychological Processes Correlated with Teaching Quality in Higher Education

Based on previous studies, there are several factors which may either strengthen or constrain teaching quality (van Lankveld et al., 2017). van Lankveld et al. (2017), for example, found that professional reform programs may enhance the improvement of teaching practices, while the context of higher education may constrain that improvement. Furthermore, they found that the direct work environment may also constrain or support the improvement of teaching practices, based on whether a discipline or department values teaching. There are also five psychological processes which are involved in forming teacher identity within the higher education context and which impact faculty teaching practices and teaching quality. These processes include a) a sense of appreciation, b) a sense of connectedness, c) a sense of competence, d) a sense of commitment, and e) an imagining of a career trajectory.

Contextual Factors Correlated with Teacher Identity in Higher Education

Beijaard et al. (2004) indicated that developing teacher identity is described as a struggle because teachers need to introduce meaning to different perspectives of teaching roles which might also be conflicting. Holland and Lachicotte (2007) explained that faculty develop and sustain their teacher identity based on the collective regard of others for their role. Moreover,

teacher identity is developed differently between faculty with professional backgrounds and faculty who recently graduated from their Ph.D. programs. Faculty with professional expertise strongly identify themselves as professionals, and their expertise increases their credibility of being university-level teachers. Conversely, faculty who recently graduated from their Ph.D. programs indicated that they felt more insecure about their teaching during the early years of their profession as university teachers. In conclusion, faculty teaching expertise has an impact on the construction of faculty teacher identity and teaching quality within higher education contexts (van Lankveld et al., 2017).

When faculty feel they relate to colleagues and share experiences and resources with them, their confidence to enhance their teaching practices increases (van Lankveld et al., 2017). Faculty teaching roles are often impacted by staff development activities and contact with students. Therefore, when faculty feel confident to perform their roles, considering these impacts, their competence in teaching increases. When faculty are given opportunities to reinforce their values of care for students, their teacher identity is satisfied. Finally, when faculty can imagine their future teaching trajectory, teacher identity is strengthened, and teaching quality increases. To conclude, there is a strong correlation between having a sense of being a teacher and teaching quality within higher education contexts.

The current study focused on the correlation of perceived contextual factors with departmental climate for teaching quality improvement within higher education contexts. Particularly, it concentrated on contexts in STEM across institutional types and faculty's institutional roles at a higher education level. These types included: a) associate's colleges (state/community colleges), b) doctoral-granting universities (research intensive/research

extensive), c) master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and d) baccalaureate colleges (focus on undergraduate degrees). Faculty's institutional roles included a) full professor, b) associate professor, c) assistant professor, d) lecturer, and e) instructor. Knowing the correlation of these factors and faculty's perceptions and beliefs related to teaching quality in STEM are important (Margot & Kettler, 2019). STEM faculty hold their prior knowledge, experiences, and views, which impact their teaching practices and teaching quality in the field. Therefore, their perceptions regarding the correlation of contextual factors with departmental climate for teaching quality in STEM might impact faculty willingness and ability to develop their teaching practices and learn pedagogy as STEM educators.

van Lankveld et al. (2017) assured that, while the context of higher education at an institutional level constrains teaching quality improvement, the direct work context at a departmental level might either enhance or constrain that improvement. As context has a main influence on teaching quality, perceived contextual factors across institutional types and faculty's institutional roles was explored within higher education contexts, particularly in STEM disciplines.

Professional Identity and the Teaching Profession in STEM Disciplines

In general, STEM professional identity refers to the ability to master research and laboratory techniques and learning professional norms needed to be academically successful in STEM disciplines (Henderson, Beach, & Finkelstein, 2011). It also refers to the way faculty view their work and themselves among colleagues and within the context of their disciplines. Both research publication accomplishments and resources gathered for experimental work are

based on a shared professional identity among faculty and positive peer review (Henderson, Beach, & Finkelstein, 2011). In STEM disciplines, faculty could improve their professional identity using a peer review process which is tied to the development of faculty professional identity. Sometimes, faculty feel the adoption of innovative teaching approaches might impact their status as researchers among peers in their disciplines. When this occurs, their professional identity might serve as a critical barrier to allotting the necessary time and effort required for making substantial pedagogical change needed in undergraduate STEM education (Henderson, Beach, & Finkelstein, 2011).

The Tension Lines Between Participating in Pedagogical Change and Improving Teaching Quality in STEM Disciplines

Henderson, Beach, and Finkelstein (2011) indicated that there are three tension lines which faculty encounter to participate in pedagogical change and improve teaching quality in STEM, which state: a) academic preparation primarily focuses on developing a research identity, rather than a teaching identity; b) faculty are afraid to identify themselves as teachers; and c) the professional culture of STEM disciplines tends to prioritize research productivity, while ignoring teaching.

STEM faculty are often trained in a culture that appreciates research productivity more than teaching effectiveness. Therefore, faculty professional identity is described more as a research identity and often minimizes the role of teaching identity. At universities during the past 30 years, doctoral and post-doctoral training has focused on research more than teaching, has immersed students into the research culture, and has typically ignored the development of teaching skills (Kenny et al., 2001). Although doctoral students typically spend most of their time as teaching assistants, they are often not expected to develop their competency in teaching.

Therefore, a clear disconnect exists between the knowledge and skills doctoral students receive during their academic studies and what they apply in their careers (Fuhrmann et al., 2011). Moreover, while most faculty positions require teaching, the focus of academic preparation of most graduate students in STEM disciplines is on the development of research knowledge and skills. Often, in graduate programs, pedagogical-strategy training is voluntarily offered and usually serves only a small number of students (Ebert-May et al., 2011). Additionally, there are currently no federal mandates related to training grants offering pedagogical-strategy training for future STEM faculty. Therefore, most STEM faculty teach, traditionally using lecture as a predominant pedagogical strategy (Mazur, 2009). In addition, peer pressure can act as a barrier to faculty adopting innovative teaching approaches and can result in them conforming to the traditional teaching methods used in STEM disciplines (Gibbs & Coffey, 2004). When teaching is not recognized as a primary component of the faculty profession in STEM, pedagogical change might not be successfully accomplished. Further, the development of teacher identity might be limited, and faculty may have reduced interest in exploring and applying innovative pedagogical approaches to their own teaching methods.

The second tension line is that graduate students often do not embrace a teacher identity as part of their own professional identity, because they are afraid of being marginalized among mentors and peers in STEM disciplines. Many faculty members advise their graduate students who have an interest in teaching to hide that interest because such students may not be taken seriously or viewed as researchers by the rest of academia (Connolly, 2010). Therefore, faculty encourage graduate students to focus on conducting research rather than teaching, even though teaching while conducting research may improve their research skills (Feldon et al., 2011).

Faculty also encourage post-doctoral students, who have interest in teaching and continuing to be professors, to limit the time they spend on teaching and focus more on conducting research (Henderson, Beach, & Finkelstein, 2011). In graduate programs with research-centric norms, graduate students may have internal conflicts regarding the development of their professional identities as teachers alongside their identities as researchers. Graduate students and junior faculty may believe they need to focus exclusively on research to be successful in the academic world of STEM fields. A common view is that graduate students who are interested in teaching may put their status as researchers at risk (Henderson, Beach, & Finkelstein, 2011).

The third tension line for STEM faculty to participate in pedagogical change, maintain their teacher identity, and improve teaching quality in STEM is that conducting research is viewed superiorly, whereas teaching is viewed inferiorly in STEM disciplines (Beth et al., 2012). The inferiority of teaching originated in our society, which doesn't respect and well-compensate teaching professionals as many other professions do (Beth et al., 2012). In addition, many STEM faculty members believe they need to avoid integrating teaching as a part of their professional identity. They believe teaching might undermine their scientific status among colleagues within STEM disciplines and institutions. STEM faculty deemphasize teaching and try to maintain their high professional status as researchers within their institutions and the larger context of STEM disciplines. Henderson, Beach, and Finkelstein (2011) concluded that, unfortunately, being faculty oftentimes means one may choose to be either a researcher or a teacher, rather than being both. Connolly (2012) indicated that some STEM faculty are still interested in careers that involve teaching alongside their commitment to research. The professional culture of STEM disciplines, though, focuses on research rather than teaching (Henderson, Beach, & Finkelstein,

2011). This results in STEM faculty spending more time conducting and honing their research skills, as opposed to pedagogical skills, in an effort to raise their professional status and promote their professional identity as researchers. Thus, teaching reforms or any teaching incentives developed may be marginalized and avoided as being a critical component of the faculty teaching profession in STEM disciplines (Connolly, 2012).

Overall, having a sense of being a teacher in STEM plays an important role in encouraging STEM faculty to remain in the teaching profession and, consequently, improve teaching quality in disciplines. Many studies (Eick, 2009; Luehmann, 2007) indicated that having a sense of being a teacher is a firm foundation of faculty's commitment and motivation to be a teacher in STEM disciplines. In addition, having a strong sense of being a teacher leads to effectiveness and satisfaction in developing faculty teaching practices and improving teaching quality (Henderson & Bradey, 2006). In this respect, a better understanding of perceived contextual factors on departmental climate for teaching quality improvement in STEM is important to understand STEM faculty development in the teaching profession. In addition, relationships between having a sense of being a teacher and teaching quality seem to be correlated (Moore, 2009). Therefore, for STEM faculty who teach, the findings of this study may lead to the identification of the main contextual factors which primarily impact teaching quality improvement and potential success in STEM teaching. Further, the outcomes of this study could promote greater interest among STEM researchers and educators in developing new reform programs to support teaching quality in STEM disciplines and focus on reinforcing a sense of being a teacher there. Finally, the results of this study may provide key insights into solving

challenges to teach, which could increase teaching quality in higher education, particularly in STEM disciplines.

Rationale of the Study

There is a need for more scientifically literate citizens who can explain and mitigate global challenges and make justified and acceptable decisions based on the understanding of science. Therefore, the perspective of the STEM field at a higher education level needs to be changed, and teaching practices need to be more flexible and inclusive for a diverse population of students in the United States (National Research Council, 2003). Many students complain about the poor teaching quality and limited student-instructor dialogues in STEM. Students are also encouraged to be passive learners as teaching methods are heavily lecture-based. The climate for teaching quality improvement in STEM is still hostile. Initiatives for catalyzing widespread teaching reform efforts for STEM at institutional and departmental levels are also limited. Therefore, actions must be taken to improve work contexts for teaching quality. Also, major changes in the policies, practices, and the culture for life-long innovations are required in STEM, inside and outside of higher education (Baldwin, 2009).

Bouwma-Gearhart (2012) indicated that the United States is losing its creative and competitive edge in STEM disciplines, and many undergraduate students leave college and are ill-prepared to be scientifically-literate citizens. Therefore, stakeholders and decision makers hope to improve STEM faculty teaching practices to help undergraduate students succeed in STEM disciplines (U. S. Office of Science and Technology Policy, 2006). Research regarding the effectiveness of professional reform efforts focusing on teaching increased over the last 40 years. However, research on STEM faculty teaching practices and their perceptions of

pedagogical change as well as which pedagogies are considered meaningful in STEM disciplines is still limited (Bouwma-Gearhart, 2012). Further, faculty professional reform efforts often use a "one size fits all" model and are not specified or personalized based on faculty professional realities and diverse backgrounds (Wallin, 2003). Moreover, most STEM faculty earn their advanced degrees from universities that train their graduate students to be effective researchers, not to be effective teachers (Austin & Barnes, 2005). Once STEM faculty are employed at academic institutions, they often receive limited to no training or professional reform which focuses on teaching practices. One way to address these issues is by assessing STEM faculty teaching practices in STEM professional reform efforts. To improve teaching practices, having a sense of being a teacher, as an essential part of the teaching profession, should be strengthened by improving teaching quality within work contexts (O'Connor, 2008).

Nicholl (2005) also added that, although there are a variety of innovative, research-based teaching practices, many faculty still hold preconceived notions of teaching practices and, consequently, resist changing instructional methods. Faculty reluctance to pedagogical change encompasses many reasons, including: the fact that many postsecondary institutions focus on rewarding faculty research efforts over teaching efforts within STEM disciplines (Bouwma-Gearhart, 2012). Fairweather (2008) also added that STEM faculty are reluctant to use innovative pedagogical strategies because their discipline culture values research over teaching. Consequently, STEM faculty are less involved in pedagogical reform and they do not endeavor and spend time to enhance their teaching practices. However, they optimize and invest their time in conducting research. Further, faculty are reluctant of pedagogical change, given the need to improve STEM faculty teaching practices is not recognized, and effective and meaningful

teaching practices and activities which are necessary are not well-identified. Thus, STEM faculty often feel as though teaching is not appreciated, and accomplishments related to teaching roles are not recognized. Having a sense of appreciation, competence, and commitment in the teaching profession is associated with the strength of one's teacher identity, which is correlated with teaching quality (Beijaard et al., 2004; van Lankveld et al., 2017). It is essential for motivating STEM professionals to enter and remain in the teaching profession (Beijaard et al., 2004).

Another issue is STEM faculty reform efforts primarily focus on improving faculty teaching practices at an individual level (Henderson, Beach, & Finkelstein, 2011). Consequently, these practices do not account for broad structures and inhibit the spreading of STEM faculty reform efforts. In addition, individual-oriented strategies do not promote the development of learning communities and faculty networks, which are considered essential to support pedagogical reform efforts. Moreover, STEM faculty are more likely to change their behaviors and attitudes toward teaching based on rewards and work allocation than on evidence of the effectiveness of pedagogical strategies. Further, STEM faculty knowledge and skills related to teaching are limited (Henderson, Beach, & Finkelstein, 2011). Therefore, having a sense of connectedness among faculty, leadership roles, knowledge and skills related to teaching are also factors that may impact teaching quality in STEM disciplines (van Lankveld et al., 2017).

STEM faculty also lack sophisticated knowledge in pedagogy, learning theory, social science, and educational theories, and there is often no explicit connection between faculty teaching practices and educational theories (Beddoes & Borrego, 2011). Further, their teaching practices and experiences tend to be a replication of their mentors' teaching practices (Merriam, Caffarella, & Baumgartner, 2012), rather than being guided by learning theory and educational

research (Borrego & Henderson, 2014). However, there are still limited discussions in STEM literature regarding how educational theories could be sufficiently applied, and what the effects of these theories are on STEM research and practice (Beddoes & Borrego, 2011). Further research is required to investigate how the application of educational theories and principles may promote reforming STEM faculty teaching practices (Gormally, Evans, & Brickman, 2014). Thus, having enough knowledge related to educational theories and how this knowledge could be connected with teaching practices in STEM disciplines may impact teaching quality improvement in STEM (Jermolajeva & Bogdanova, 2017).

Faculty teaching practices are affected by other factors, including: a) experience developed over time to teach certain topics, b) social contexts, c) knowledge of the subject matter (Beijaard, Meijer, & Verloop, 2004), d) institutional culture, and e) individual characteristics that all interact with each other and are correlated with teaching quality and having a sense of being a teacher in STEM (Merriam, Caffarella, & Baumgartner, 2012). There is often a lack of institutional infrastructure required for pedagogical change in STEM disciplines (Borrego & Henderson, 2014). Thus, more research is necessary to explore the role of institutional development in creating an academic culture that promotes pedagogical change in STEM disciplines. There is an existing limitation in the literature to determine which STEM faculty reform efforts are the most beneficial for faculty to promote their teaching practices and for stakeholders who are interested in supporting pedagogical change in STEM (Gormally, Evans, & Brickman, 2014). More research is needed to explore the correlation of participation in professional development with teaching practices of STEM faculty.

Some solutions, such as providing incentives for teaching excellence, are important for the change to occur (Brownell & Tanner, 2012). Moreover, faculty should be provided with appropriate training and adequate time required for pedagogical change to occur. Rewards and compensation for the time and efforts invested to enhance teaching practices and spur pedagogical change are also important. Such rewards might include a) lower teaching loads, b) verbal acknowledgement of teaching achievements from supervisors, c) teaching awards, d) tenure recognition, and e) financial benefits (Anderson, 2007). Currently, though, such rewards for effective teaching are not typically implemented in STEM disciplines (Romano et al., 2004). Additionally, faculty might not improve their teaching practices given a lack of incentives they may have received for research productivity (DeHann, 2005). Therefore, professional publication becomes the main predictor of faculty pay regardless of the type of institution (Fairweather, 2008). Since pay rate is based on research productivity, faculty value their professional status as researchers more than teachers. Consequently, faculty teacher identity is marginalized. Also, correlations between the time faculty spend conducting research and publishing, and the average salary have been found (Fairweather, 2008). Therefore, STEM discipline culture, pedagogical reform efforts, rewards, tenure and promotion decisions are factors that may impact the improvement of teaching quality in STEM (Beijaard et al., 2004). This, coupled with the pressure faculty receive, particularly pre-tenured faculty, to spend most of their work time on conducting research and usually at the expense of teaching-practice quality (Anderson, 2007), often results in hesitation among STEM faculty to participate in pedagogical reform efforts. Furthermore, there is still a lack of support and feedback for teaching at research universities, and faculty are mainly assessed and rewarded based on their research success. Dennin et al.

(2017) found that although faculty indicated the importance of teaching as part of their job duties, there is a disconnection between the claim of supporting teaching quality and the actual teaching practices applied in STEM at departmental and institutional levels.

As previously outlined, Brownell and Tanner (2012) concluded that many factors constrain the improvement of faculty teaching practices including: a) lack of time, b) lack of incentives, c) insufficient training, and d) the tensions between faculty professional identity (how they view themselves and define their professional status) and the call for pedagogical change. Furthermore, there are not formal mechanisms that promote peer-feedback for tenure and promotion evaluations or a reward system that encourages faculty to participate in a peer-feedback process (DeHann, 2005). Moreover, STEM faculty are often not prepared with appropriate pedagogies required for teaching in STEM disciplines. There is often a lack of supporting faculty teaching practices, both in their preparation for academia, as well as in their early years in academia. Although professional reform efforts and other incentives might promote teaching, these efforts still have not shown a direct and significant correlation with STEM faculty teaching practices (Benton, Duchon, & Pallett, 2013). However, these factors in conjunction with having a sense of being a teacher have not been thoroughly examined, which is problematic, as research has shown that work context is a significant determinant of instructional quality in STEM disciplines (Benton, Duchon, & Pallett, 2013). Thus, tensions between having a sense of being a teacher, actual teaching practices, and teaching quality in STEM do exist. Thus, examining perceived contextual factors that influence department climate for teaching quality improvement in STEM would be useful, as it would inform a myriad of approaches to potentially influence faculty teaching practices and instructional climate as well in STEM.

Still, efforts to enhance teaching quality continuously encounter resistance in STEM disciplines (Herro & Quigley, 2017). STEM is not sufficiently capable of preparing workers who are adequately able to discuss important issues related to public policy and engage in decision making and informed dialogue regarding these issues within our technology-based economy. National Research Council (2003) reported that a nation is described within two types, a disadvantage majority and a technology-knowledgeable elite. It is documented that the STEM educators face a great challenge. They noted that teaching and preparing a large number of students, who have a diverse interest and background for a world that is rapidly changing, increasingly needs science and technology (National Research Council, 2003). With a diverse nation in the United States, teaching in STEM needs to be more flexible to maintain the talent needed within a competitive global economy. Therefore, teaching in STEM should break a business-as-usual stance in a world that is increasingly interdependent (Baldwin, 2009).

Work context has an essential role that may support or constrain teaching quality improvement (van Lankv eld et al., 2017). Many initiatives, such as the establishment of teaching centers, teaching awards, and teaching grants may provide new opportunities for faculty to support their role in teaching as a legitimate and distinct identity within the higher education context. Teaching quality in STEM is still not well-valued or well-identified (Margot & Kettler, 2019). Teaching quality is also correlated with teacher identity that is also marginalized in academia. The development of teacher identity is a process that includes someone's interpretation and re-interpretation of what type of person they may consider themselves to be and what type of person they want themselves to be (Beijaard et al., 2004). Rodgers and Scott (2008) assured that identity is constructed within a dynamic, shifting, and social context

(Rodgers & Scott, 2008). Using a socio-cultural point of view, teacher identity is developed in a context where cultural and social forces are present (Holland & Lachicotte, 2007). The teacher has an essential role to improve teaching quality. Therefore, the teacher and context work together to develop and maintain the STEM talent necessary for a competitive economy and an interdependent world. Therefore, exploring the factors that are correlated with teaching quality in STEM is important and allows for improving scale-up change, including departments and institutions that enhance faculty teaching practices. Moreover, understanding the contextual factors involved in the improvement of teaching quality in STEM may also enhance pedagogical change in STEM disciplines (Baldwin, 2009).

Empirical research regarding the impact of different institutional types (e.g. research and teaching) on important outcomes such as teaching quality improvement and research performance at an institutional and individual level is still limited. Terpstra and Honoree (2009) found that faculty activity emphases on research rather than teaching are different within various academic disciplines in an institution. For example, it is found that faculty activity emphases in the business discipline is different than other disciplines such as education and science. Therefore, the current study focused on the correlation of perceived contextual factors with department climate for teaching quality improvement across institutional types and faculty's institutional roles, particularly in STEM disciplines. Terpstra and Honoree (2009) indicated that institutional types are not just correlated with faculty activity emphases, but also institutional outcomes such as research quantity and quality, teaching effectiveness, and student attraction, retention, and satisfaction with teaching. Most faculty assured that their institutions focus on research as a primary activity while fewer faculty indicated that teaching is the utmost emphasis

of their institutions. To conclude, although many state legislatures have recently requested faculty to devote more time to teaching and less time on pursuing research (Milkovich & Newman, 2005), and many institutions claim teaching is the most important activity, the reward structure heavily relies on research performance.

Researchers also indicated that the size of institutions is correlated with faculty emphases (Marsh & Hattie, 2002; Milkovich & Newman, 2005). They assured that smaller institutions are more likely to focus on teaching than larger ones. Furthermore, smaller institutions tend to allocate equal levels of importance for each teaching, research, and service, while larger institutions commonly place the most emphasis on research rather than other activities (e.g. research, and services). Faculty roles may also vary across academic disciplines within an institution based on the need for either teaching, research, or both. Although many institutions claim teaching is highly prioritized, their reward systems and structures (e.g. promotion and tenure) primarily focus on research productivity and accomplishments (Terpstra & Honoree, 2009). Therefore, the public or formal classification of an institution, regarding the relative emphasis on teaching rather than research can be assessed based on the nature of the reward structure of that institution.

Terpstra and Honoree (2009) found that institutions that value teaching and research equally tend to have the most effective teachers. There is much debate regarding the best institutional emphasis or type for teaching effectiveness. Some researchers indicated that an emphasis should primarily be placed on teaching more than research (Marsh, 1987). Conversely, other researchers indicated that a stronger emphasis should be placed on research as it contributes to teaching effectiveness. Faculty in research institutions are aware of current

information which they share with their students (Marsh & Hattie, 2002). Terpstra and Honoree (2009) suggested that giving priority to research and teaching, equally, is best. They concluded that state legislatures would be doing a disservice to students in higher education if they request faculty to devote more of their time and efforts to teaching rather than research.

Limited research exists which explains the in-depth correlation of perceived contextual factors with departmental climate for teaching quality improvement, particularly in STEM disciplines. Therefore, to advance research on teaching quality improvement in STEM, this study focused on exploring the correlation of perceived contextual factors with departmental climate for teaching quality improvement across institutional types and faculty's institutional roles. These types included: a) associate's colleges (state/community colleges), b) doctoral-granting universities (research intensive/research extensive), c) master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and d) baccalaureate colleges (focus on undergraduate degrees). Faculty's institutional roles included full professor, associate professor, assistant professor, lecturer, and instructor. These factors were investigated quantitatively using a survey which was adopted from an existing survey which measured department climate for teaching improvement in higher education. Perceived contextual factors that were explored in the current study included a) leadership, b) collegiality, c) resources, d) professional development, e) autonomy, and f) respect (Walter et al., 2014).

Research Questions

For the current study, the correlation of perceived contextual factors with departmental climate for teaching quality improvement in STEM was explored using the following research questions:

1. To what extent are perceived contextual factors correlated with departmental climate for teaching quality improvement in STEM across institutional types including associate's colleges (state/community colleges), doctoral-granting universities (research intensive/research extensive), master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and baccalaureate colleges (focus on undergraduate degrees)?
2. To what extent are perceived contextual factors correlated with departmental climate for teaching quality improvement in STEM across faculty's institutional roles (professor, associate professor, etc.)?

Definition of Key Terms

As aforementioned this study explored the correlation of perceived contextual factors with departmental climate for teaching quality improvement in STEM. Thus, the main terms used in this study are the following: department climate for teaching quality improvement, teaching quality, STEM faculty, and teacher identity.

Climate for teaching quality improvement. It is defined as processes or actions necessary to make the required changes to teaching for the best learning outcomes. These change processes include the importance of continued use of evidence-based teaching practices, curriculum, or technology (Walter et al., 2014).

Teaching quality. It refers to perspectives that teachers bring to teaching context, teaching practices they use, and institutional and contextual factors that affect opportunities of teachers and institutions for growth and change. Therefore, understanding the institutional context is important to implement any change plan (Massy, Wilger, & Colbeck,1994).

STEM faculty. STEM faculty for the current study refers to all faculty who have teaching responsibilities in science disciplines including natural sciences (e.g. biology), formal sciences (e.g. statistics), and social science (e.g. psychology) (White, 2014). It also includes faculty who teach in technology, engineering, and mathematics disciplines.

Teacher identity. Teacher identity indicates that being a teacher in a society is based on having a personal and collective sense of self (e.g. emotion, behavior, belief, and professional roles) which is constructed individually within self and socially within the social relations of a society (Rodger & Scott, 2008).

Instructor. An instructor normally holds at least a master's degree or equivalent. It is considered an entry level rank and it is appropriate for new faculty who recently completed their Ph.D., M.D., or post-doctoral training (Yun, 2013).

Lecturer. A lecturer is a faculty member who is mainly appointed to provide instruction, and this rank reflects a professional expertise and achievement, and a strong basis of scholarly work and teaching abilities (Yun, 2013).

Assistant professor. An assistant professor holds a doctoral level or equivalent degree, participates in university affairs at an institutional or departmental level, and shows commitment to teaching and professional work (Yun, 2013).

Associate professor. A faculty who meets the requirements of an associate professor rank shows proficiency in teaching and has a national reputation as a professional or scholar.

Full professor. A faculty who meets the requirements of a full professor rank has a scholarly distinguished accomplishment in his or her field (Yun, 2013).

Conclusion

In the current study, the researcher investigated the correlation of perceived contextual factors with departmental climate for teaching quality improvement in STEM. This dissertation, which outlines the procedures, results, and analysis of the results of this study, is organized into five chapters. The next chapter reviews literature related to the conceptual framework that guided the development of this study, issues related to teaching quality improvement, and contextual factors that are correlated with department climate for teaching quality improvement in STEM disciplines. The third chapter presents the research methodology for the study, including study design, rationale of the method used for this study, population and sample, and data analysis methods and procedures. The fourth chapter presents the analysis of data collected. Lastly, a discussion of the implications of the results of this study are presented in the fifth chapter.

CHAPTER TWO: LITERATURE REVIEW

In the United States, many colleges and universities are classified as either teaching institutions or research institutions based on differing academic missions, state mandates, and federal money received for research (Terpstra & Honoree, 2009). Moreover, most of these institutions prominently distinguished themselves as having a teaching classification. Many U.S state legislatures assured the importance of teaching as a marketing strategy designed to attract more students, as future literate citizens are required in the workforce (Terpstra & Honoree, 2009). Therefore, faculty are requested to spend more time on teaching than conducting research.

Many faculty members believe that an adequate amount of time should equally be devoted to teaching effectiveness and research accomplishment. Some researchers also indicated that an emphasis on research can lead to better teaching quality improvement (Marsh & Hattie, 2002). Faculty, as active researchers who have the interest to update their information based on the latest developments in the field, are more likely to pass recent and newest information to their students. Therefore, the reward structures need to be designed to assess and value research as well as teaching (Terpstra & Honoree, 2009). When the reward systems focus on publications and strongly emphasize research productivity, teaching quality can be negatively impacted, and faculty's time and energy devoted to teaching responsibilities can be detracted. To conclude, equal emphases on different roles (e.g. research and teaching) may not just effectively impact outcomes related to teaching, it may also enhance outcomes at an individual level such as pay and job satisfaction. Further, at an institutional level, it may impact research performance, students' recruitment and retention as well as service levels.

Faculty who operate at institutions which emphasize research are likely to be more productive regarding research quality and quantity than faculty who operate at institutions which emphasize teaching. Results also indicated that when research and teaching are equally valued within an institution, faculty's job satisfaction increases (Lin & Lee, 2017). Consequently, that satisfaction positively impacts faculty's motivation, performance, and their belonging behavior to that institution. Moreover, job and pay satisfaction can resolve issues related to faculty absenteeism, turnover and retention (Milkovich & Newman, 2005). Terpstra and Honoree (2009) indicated that faculty are most satisfied within institutions that give an equal emphasis and weight to both, research and teaching. These institutions are also more appealing to faculty, have higher and better levels regarding faculty job and pay satisfaction, and are the best in terms of faculty retention and recruitment. Moreover, the best ratings measuring teaching effectiveness and research performance were found within those institutions that value research and teaching equally, while the worse ratings were found within institutions that primarily focus on teaching rather than research.

Although many faculty members are adequately knowledgeable of evidence-based teaching practices, success to transform postsecondary teaching is still limited. Institutional contexts and structures as one of the underlying barriers constrain pedagogical change (Henderson, Beach, & Finkelstein, 2011). A climate is considered a measure of an institutional environment, and a productive conceptual frame could be applied in research that endeavors to change a practice and inform a policy. As climate is a measure of change, it could inform policy makers and stakeholders with a required change in administrative actions or institutional policy (Schneider, Ehrhart, & Macey, 2013).

Department climate is defined as physical and non-physical conditions perceived by individuals within an institution (Maxwell, 2016). It also refers to individuals' perceptions of various activities and aspects of that institution, observed work, and individual behaviors. Institutional climate includes the characters of the scope work that might affect individuals' behaviors within an institution. The important aspect of institutional climate is its ability to affect individuals' attitudes and behaviors within an institution (Lin & Lee, 2017). Institutional climate is different from one institution to another given the varying environments across institutions. Therefore, each institution has its own atmosphere, environment, and might also have its own impact on behaviors and attitudes of its own individuals. Institutional climate can provide a broad picture of atmosphere, structures, and patterns of relationships within an institution. Schneider et al. (2013) added that though institution climate can operate on different levels of an institution, it is beneficial to focus on a specific level (e.g. climate for something). Therefore, the current study focused on exploring the correlation of perceived contextual factors with departmental climate for teaching quality improvement in STEM across higher education institutions to improve faculty teaching practices and overall teaching quality.

This study focused on teaching quality improvement in STEM and explored the relevant factors that may correlate with faculty teaching practices there, particularly perceived contextual factors. This study also contributed to the conceptualization of teaching quality improvement by conducting an investigation of the extent to which contextual factors may correlate with department climate for teaching quality improvement in STEM disciplines. This chapter, firstly, elaborates on the theoretical background of department climate for teaching quality, particularly

in STEM, and concludes with a discussion of research related to perceived institutional and contextual factors that may correlate with teaching quality in STEM disciplines.

Conceptual Framework of Department Climate for Teaching Quality Improvement

The conceptual framework which guided the current study informed the fundamental understanding of the correlation of primary, perceived, and contextual factors with departmental climate for teaching quality improvement in STEM disciplines across institutional types and faculty's institutional roles. These types included a) associate's colleges (state/community colleges), b) doctoral-granting universities (research intensive/research extensive), c) master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and d) baccalaureate colleges (focus on undergraduate degrees). Faculty's institutional roles included full professor, associate professor, assistant professor, lecturer, and instructor. Therefore, the correlation of these contextual factors on departmental climate for teaching quality improvement was explored using faculty perceptions in STEM within higher education contexts.

The conceptual framework for the current study is based on Gappa's, Austin's, and Trice's (2007) framework of faculty work. Gappa et al. (2007) identified six elements of faculty work, including three aspects of work experience and three characteristics of academic institutions. These aspects are directly correlated with teaching quality improvement. The aspects of work experience are professional growth, collegiality, and academic freedom and autonomy. The characteristics of academic institutions are leadership, rewards, and resources. Walter et al. (2014) indicated that the strength of Gappa et al.'s (2007) framework of faculty work is its alignment with literature related to teaching climate within departments (Knorek, 2012), climate

for change within workplace (Bouckenooghe, Devos, & Van den Broeck, 2009), the nature of workplace and academic work (Massy et al., 1994), and teaching leadership (Ramsden, et al., 2007).

Teaching Climate Within a Department

Knorek (2012) constructed a faculty teaching climate scale that measures faculty teaching practices. This scale can also be used in other research areas (e.g. institutional assessment). The scale is also considered a valuable measure to explore academic cultures and their impact on faculty work. Knorek (2012) added that teaching is not well-recognized and valued within higher education. Therefore, teaching can be improved through the change of teaching climate and enhancing the value of teaching. He also suggested that improving teaching climate can enhance faculty teaching practices at an institutional level doing the following: a) provide adequate and proper resources and spaces for teaching, b) reward faculty for teaching excellence, c) establish an effective system for faculty development, and d) improve graduate students' teaching skills and support their teaching knowledge. Knorek (2012) defined departmental teaching climate as faculty's perceptions of teaching practices, the value of teaching, and teaching policies with their departments.

Climate for Change Within a Workplace

Bouckenooghe, Devos, and Van den Broeck, (2009) indicated that to empower individuals within workplaces for change, interpersonal interaction with their peers should be supported. Providing individuals with a supportive work environment enhances their readiness for change. Individuals in workplaces require trusted relationships, a supportive environment, and cooperation with colleagues to accomplish their work effectively. Thus, facilitating

individuals' participation, loyalty, and commitment are major tasks of environmental management. Moreover, Emery and Trist (1965) indicated that building a supportive environment with cooperative relationships and creating a sense of commitment within workplaces are important for the improvement of human relations. Based on this improvement, institutions should focus on successfully building and managing their individuals' interpersonal relationships for institutional effectiveness.

Research indicated that human relations have the power to mobilize all the energies and forces required for creating confident and capable individuals who can conquer new changes and challenges within workplaces (Zammuto & O'Connor, 1992). Institutions that provide their individuals with supportive and flexible structures are prominent contributors to creating a positive attitude toward change. Further, resistance to change is low within a participative and supportive work environment that is consistent with the philosophy of human relationships. Emery and Trist (1965) added that the psychological dimensions of climate including support, participation, and trust are key environmental contributors for change. Finally, Bouckenooghe, Devos, and Van den Broeck, (2009) defined climate of change as individuals' perceptions of contextual factors under which change may occur.

The Nature of a Workplace and Academic Work

Massy et al. (1994) explored departmental conditions that may support or constrain faculty cooperation regarding undergraduate education and assured that the academic department context has a crucial role in improving undergraduate teaching. Massy et al. (1994) interviewed 300 faculty across different institution types including research institutions, liberal art colleges, and doctorate-granting institutions. The results indicated that faculty encounter many

departmental challenges. These challenges included a) patterns of fragmented communication that isolate faculty from each other and hinder them from contacting and discussing issues related to undergraduate education. One faculty member indicated that "This place is full of people who really can't talk to each other" (Massy et al., 1994, p. 12). Further, b) there is a limited availability of resources that constrain opportunities for faculty relationships. It is indicated that faculty internally compete within their department for scarce resources, which raises more isolation and atomization. Finally, c) rewarding and evaluation methods undermine the attempt of creating a supportive environment for relationships and communication among faculty. Faculty indicated that the current evaluation and rewards overemphasize research rather than teaching. Further, teaching assessments are superficial and lead to increased fragmentation of the professoriate.

Massy et al. (1994) concluded that there are many factors that support effective teaching within departments. These factors include, a) providing faculty with a supportive culture that values teaching, b) enhancing faculty interaction, collegiality, and respect, c) giving all faculty, regardless of rank or status, the opportunity to review each other's research and teaching, d) giving all faculty—junior and senior—equal teaching responsibilities, e) rotating teaching courses among faculty, and f) the most important factor is the role of the chair who has the power to achieve the revolutionary changes needed in teaching practices within departments. Across institutional types, these factors for supportive teaching cultures were found in one liberal college and some departments (e.g. sciences, social sciences, and humanities) within doctorate-granting and research universities. Most importantly, within the same institution, it is found that many departments support teaching, while others do not (Massy et al., 1994).

Teaching Leadership

Ramsden et al. (2007) found that enhancing university teaching requires change in the teaching environment based on faculty perceptions regarding appropriate academic workloads, acceptable sizes of classes, and a supportive leadership structure for teaching within a department. The leadership of a departmental head or a dean has the potential to enhance the quality of university teaching. Leadership for teaching is considered a transformational process which encourages faculty to adopt pedagogical change within a collaborative management context supported with contingent rewards. Ramsden et al. (2007) found that there is a strong correlation between departmental leadership for teaching and the adoption of new teaching innovations and pedagogical change. University teachers reported their commitment to teaching is correlated with leadership for teaching. There is also a direct relationship between leadership for teaching and student learning. When departmental leaders provide a supportive environment for teaching, not only will faculty's approaches to teaching be improved, but also student learning will improve. Moreover, Ramsden et al. (2007) found that an environment with collegial support is also correlated with leadership for teaching within a department. Commitment to teaching increases when university teachers are involved with departments that value teaching. To conclude, leadership for teaching is correlated with commitment to teaching, a collegial environment, an increased use of innovative teaching approaches, and the overall quality of university teaching.

For the current study, six perceived contextual factors correlated with department climate for teaching quality improvement were measured using a survey adopted from Walter et al.'s (2014) study. Departmental climate for teaching quality improvement is a combination of Gappa

et al.'s (2007) framework and related literature (Table 1). These factors included leadership (Bouckenooghe et al., 2009), collegiality (Massy et al., 1994), resources (Knorek, 2012), professional development (Gappa et al., 2007; Knorek, 2012), autonomy (Gappa et al., 2007), and respect (Ramsden et al., 2007).

Table 1. Operational Definitions and Sources of Contextual Factors of Department Climate for Teaching Quality Improvement as Cited in Walter et al. (2014)

Contextual Factors	Definition	Concept Source
Leadership	Refers to department leaders' expectations polices, and actions that value teaching and enhance teaching quality improvement.	Bouckenooghe et al., 2009
Collegiality	Refers to teachers' feeling that they are a part of a community of colleagues who respect and value each other's teaching contributions and concern for each other's well-being.	Massy et al., 1994
Resources	Refer to tools and equipment necessary for improving teaching quality including support services and physical and flexible spaces for teaching.	Gappa et al., 2007
Professional development	Refers to opportunities that enhance teachers' knowledge, skills, and abilities for teaching and addresses their needs, challenges, and concerns for better satisfaction in teaching.	Gappa et al., 2007 Knorek, 2012
Autonomy	Refers to feeling freedom in teaching (e.g. choosing course content or selecting a teaching method) with no undue institutional interferences.	Gappa et al., 2007
Respect	Refers to feeling that teaching is valued as a main aspect of academic work when decisions are made about promotion, teaching improvement, and continued employment.	Ramsden et al., 2007

Contextual Factors Impacting Teaching Quality in Higher Education

Teaching quality is impacted by many contextual factors at a departmental level within higher education contexts which include:

1. Teaching rewards and recognition indicated that when excellence in teaching is recognized through job security or rewards, faculty teaching practices improve and a sense of appreciation and competence increases as well (van Lankveld et al., 2017). Therefore, faculty should be assessed for promotion and tenure decisions based on their teaching performance along with their research productivity, particularly in STEM disciplines.
2. Availability of teaching resources indicated that when all teaching tools and resources required to support teaching are available, such as teaching centers, funding, equipment, and office space, faculty teaching practices and teaching quality improve (Walter et al., 2014).
3. Teaching reform efforts indicated that faculty are more satisfied in the teaching profession when they are offered opportunities that broaden their abilities, knowledge, and skills needed for their work (Walter et al., 2014).
4. Cooperation with colleagues indicated that when faculty feel they belong to a community of colleagues who respect each other’s teaching contributions, are concerned about each other's well-being, and share their teaching expertise, the feeling to remain in the teaching profession is strengthened (Knorek, 2012), and a sense of connectedness increases (van Lankveld et al., 2017). This sense of connectedness is correlated with teaching quality and an increased use of evidence-based teaching approaches (Ramsden et al., 2007).

5. Autonomy and freedom in teaching indicated that when faculty have the right to choose course content and teaching practices without any institutional interference, their confidence to perform their teaching roles increases (Gappa et al., 2007), and a sense of competence in teaching also increases (van Lankveld et al., 2017). Faculty may struggle to enhance their teaching practices when their strong values in teaching conflict with departmental and institutional policies (Beijaard et al., 2004).
6. Sharing perceptions about teaching indicated that when faculty share their perceptions about teaching with colleagues and take each other's point of view in a department, their teaching practices improve (Hurtado, 2012), and a sense of connectedness also increases (van Lankveld et al., 2017).
7. Leadership indicated that when the department leader establishes policies, expectations, and actions that communicate the value of teaching and encourage faculty to improve their teaching practices and perform their teaching roles (Bouckenooghe, Devos, & Van den Broeck, 2009; Walter et al., 2014), a sense of appreciation also increases (van Lankveld et al., 2017).

Moreover, van Lankveld et al. (2017) added that there are key contextual factors that impact teaching quality improvement in higher education including:

1. The work environment that may strengthen or constrain teaching quality (van Lankveld et al., 2017). When the work environment is perceived to be supportive and collegial, it may enhance teaching quality. Within a supportive environment, faculty have a sense of community and feel they are a part of a team who values teaching. Teaching quality might be constrained when the work environment

values research over teaching. In addition, teaching quality might be constrained when the work environment is more hierarchical and competitive (van Lankveld et al., 2017).

2. Contact with students also enhances teaching quality (van Lankveld et al., 2017). When faculty interact with students and elicit their feedback and reactions, faculty may feel they are more appreciated, and their job satisfaction may increase. Moreover, when faculty are appreciated from initiatives (e.g. monetary rewards), teaching quality also improves (Beauchamp & Thomas, 2009).
3. Contact with staff development activities may also enhance teaching quality because these activities increase faculty confidence in their teaching abilities and provide faculty with opportunities to contact like-minded peers and exchange ideas, opinions, and expertise with them. Staff development activities may also create an educational language and a sense of credibility for faculty as educators within their departments. In conclusion, when faculty feel they are valued and their academic work is appreciated, their self-esteem increases and overall teaching quality improves (van Lankveld et al., 2017).
4. Based on several studies conducted in the UK and Australia, the context of higher education constrains teaching quality improvement due to the tensions between teaching and research (van Lankveld et al., 2017). Faculty reported that although their academic institutions claim research and teaching are equally valued, research is still viewed as more important. Faculty also indicated that tenure and promotion decisions are made based on publications and research performance while teaching is viewed as a second-class activity. The lesser appreciation for

teaching compared to research leads to tensions in faculty teaching quality and increases a sense of insecurity, uncertainty and reduced self-esteem (Clarke, Knight, & Jarvis, 2012).

Participating in professional development activities, having a level of autonomy, and encompassing up-to-date knowledge and skills at work are contextual factors which impact a teacher's profession. Autonomy is crucial in the teaching profession. When teachers have a certain level of autonomy, this might impact their levels of satisfaction, motivation, and commitment in teaching. More autonomy at work increases teachers' satisfaction, motivation, and commitment (Van Veen, 2008). Having current knowledge and participating in professional development activities contribute to teaching quality improvement. Nixon (1996) indicated that the teaching profession is an area of expertise that should be totally recognized, promoted, and developed. Teaching quality also increases with experience regarding what faculty want to accomplish as university educators. Professional development also impacts faculty teaching quality at personal and professional levels. Therefore, professional development training should be offered to develop teachers personally and professionally (Kwakman, 1999). Although faculty are offered the same professional development training, teaching quality varies among them, as other beliefs toward the teaching profession contribute to the overall shaping of one's teaching practices (Canrinus, 2011). Impacted by work context in higher education, exploring the correlation of perceived contextual factors with departmental climate for teaching quality improvement is important. However, there are still limited studies regarding this correlation, particularly in STEM.

Institutional Factors Impacting Teaching Quality in Higher Education

The institutional climate has a major impact on teaching quality improvement (Landrum et al., 2017). When campus climate encourages freedom regarding the choice of teaching methods, provides adequate resources, time, training to support teaching, and equally values research and teaching, faculty teaching quality might be improved. Moreover, when campus climate encourages faculty to use evidence-based teaching practices and connect with colleagues inside and outside their departments and institutions to expand teaching-related knowledge and expertise, faculty teaching quality also improves (Landrum et al., 2017). Further, campus climate should encourage faculty to be effective teachers as well as being researchers. Being effective teachers should be a main part of faculty's professional status in addition to being effective researchers.

Landrum et al. (2017) indicated that when the institution allows faculty to choose a teaching technique, encourages them to try new pedagogies, and breeds collaborative teaching discussion among faculty, faculty teaching practices improve. As a result of Landrum et al.'s (2017) research, faculty at Boise State University are encouraged to use new teaching methods and collaborative teaching discussions. Further, when the institution has flexible and physical spaces for teaching and learning, furnishes faculty with adequate mechanisms to evaluate teaching, and provides adequate resources to support teaching, faculty teaching practices will improve. Consequently, teaching quality will also improve. As a result of Landrum et al.'s (2017) research, faculty are provided with adequate resources and support for teaching at Boise State University.

Additionally, Landrum et al. (2017) indicated that when the institutional climate values teaching as highly as research and values teaching in tenure and promotion decisions, teaching quality increases. As a result of Landrum et al.'s (2017) research, teaching and researching are

relatively valued in terms of hiring faculty, promotion, and tenure decisions at Boise State University. Moreover, when the institutional climate values the assessment of student learning outcomes, encourages faculty to use evidence-based teaching practices, faculty teaching practices improve, then their teaching quality increases. As a result of Landrum et al.'s (2017) research, faculty are encouraged to use evidence-based teaching practices at Boise State University. Furthermore, when the institutional climate supports teaching discussions among faculty and connects faculty with each other, faculty teaching practices improve, and their teaching quality increases. As a result of Landrum et al.'s (2017) research, faculty have good conversations and connections with colleagues at Boise State University.

Landrum et al. (2017) found that age is significantly correlated with the freedom of choosing a teaching method. Younger faculty reported that they have greater freedom to select an evidence-based teaching method. Age is also significantly correlated with the value of teaching and research. Although younger faculty have freedom to choose their teaching methods, they still reported that research is more valued than teaching. Teaching workload is also significantly correlated with the value of teaching and research. Faculty who reported higher percentages of teaching workload believe teaching is more valued for tenure and hiring decisions. Tenure track faculty reported they believe teaching is less institutionally supported with resources and their perspectives on research are more valued. Conversely, non-tenure track faculty believe that teaching within their institution is more supported with resources and more valued than research.

Having offices on campus is also significantly correlated with institutional support (Landrum et al., 2017). Faculty who have offices on campus are provided with more institutional support, feel more connectedness with each other, and they also believe they are provided with

more institutional resources for teaching compared to faculty who do not have offices on campus. Faculty with offices reported that teaching within their institution is more valued than research. Finally, there is no significant difference between male and female responses on perceived institutional factors of current instructional climate, including freedom of choosing teaching methods, institutional support, teaching-research balance, encouraging faculty to use evidence-based teaching practices, and teacher connectedness (Landrum et al., 2017).

Teaching Quality Within STEM Disciplines in Higher Education

Many faculty members within academic institutions prominently work to improve faculty teaching practices and teaching quality in STEM disciplines, such as University of British Columbia's Carl Wieman and Harvard University's Eric Mazur (Baldwin, 2009; National Research Council, 2003). These institutions have implemented many innovative pedagogies in undergraduate STEM education, but there is still a main concern regarding teaching quality in STEM. Reports indicated that a large number of STEM faculty received little to no formal training on pedagogical change, innovative teaching practices, and mechanisms regarding how learning could be assessed (National Research Council, 2003). Architecture and seating arrangements also constrain the use of innovative teaching practices (Baldwin, 2009). Undergraduate students indicated that teaching quality in STEM is poor. The use of lecture-based teaching in STEM increases passive learning and limits student-teacher dialogues. Within the current STEM environment, students need to memorize formulas and facts to pass tests without learning basic scientific concepts and genuine understanding of a subject matter essential for studying more advanced courses and working in STEM fields (Baldwin, 2009). Therefore, teaching climate in STEM filters students and weeds out those whose interest in the field is less

involved and certain. Many students feel they are not welcomed within STEM, given inadequate teaching quality, so they choose to change their academic fields.

With no doubts, a diverse nation with rapidly changing needs and a competitive economy in the United States requires workers who are scientifically knowledgeable and have a solid background in science and technology (Herro & Quigley, 2017). Therefore, STEM education should be accessible and welcoming to diverse types of learners and prepare them to participate in a skilled labor force. Many leading professional associations and educational leaders request the need to reform teaching and learning in STEM education and strongly advocate for the change (Baldwin, 2009). Many organizations (e.g. the American Chemical Society [ACS]) endeavor to implement reforming efforts in STEM, requesting their stakeholders and members to support and adopt more welcoming and flexible pedagogical techniques that effectively enhance teaching quality and reach out to more diverse learners. For example, ACS publishes its own journal regarding chemical education. It also sponsors many professional development programs and workshops to enhance teaching practices in the chemistry discipline (National Research Council, 2003). The Accreditation Board for Engineering and Technology (ABET) is another professional organization heavily involved in efforts to enhance teaching practices and learning processes in engineering and technology disciplines. Despite these reform efforts in STEM, they are still erratic, taking place in some disciplines but not others (Margot & Kettler, 2019). Moreover, many initiatives have lost their creative momentum to enhance teaching and learning processes and have replaced this momentum with forces of inertia over time.

Obstacles to Reform in STEM Disciplines

The sporadic and slow pace of reform in STEM refers to many contextual factors in higher education (Margot & Kettler, 2019). These factors consider: a) there is limited training

provided for faculty to enhance their teaching roles, b) STEM faculty lack the knowledge and skills required to perform their teaching roles effectively (Herro & Quigley, 2017), and c) they also lack the knowledge of instructional-strategy types. In many higher education institutions, rewarding and evaluation systems discourage STEM faculty from enhancing their teaching practices and focuses on their research productivity and publication. Therefore, faculty prefer to spend their discretionary time conducting research rather than improving their teaching practices. Overall, the climate of most higher education contexts is majorly conducive to enhancing research over teaching in STEM (Baldwin, 2009; Margot & Kettler, 2019). STEM disciplines also lack the resources required to support pedagogical change in STEM. Absence of incentives and limited rewards for pedagogical improvements hinder teaching quality improvement in STEM. Moreover, the use of evidence-based instructional practices has not shown a widespread impact on teaching quality in STEM across institutions (Herro & Quigley, 2017). Faculty lack the autonomy they desire for selecting teaching practices and course content, and that might also inhibit pedagogical change in STEM. Improving teaching quality still relies on small groups of faculty or individual faculty who have a sense of commitment to enhance teaching and learning processes at a departmental and institutional level in STEM (Wieman, 2007). For example, at the University of Oregon, one professor in the biology department replaced the use of lecturing as a teaching method with the use of evidence-based teaching approaches that enhance the teaching and learning processes in the discipline. Although teaching reform efforts are led by a number of pioneers in STEM, most STEM faculty and scientists have resisted to change their teaching practices (Wieman, 2007). The history of STEM education has shown that reform teaching efforts initiated by individual faculty or small groups of faculty members are insufficient to be implemented for the holistic change prominently needed in STEM disciplines. The role of

individual faculty to enhance teaching practices might be sufficiently and successfully applied within their own departments but not necessarily within others.

Many initiatives call for change to support teaching quality in STEM at departmental and institutional levels (Bradforth et al., 2015). They facilitate efforts and provide mechanisms that reward evidence-based approaches and enhance teaching quality to support student learning. To enhance teaching quality, teaching is categorized as a scholarly activity, and it is also considered a change process for implementation. For example, the Teaching Quality Framework (TQF) assesses teaching quality using perspectives as data sources: faculty, their peers, and their students (Bradforth et al., 2015). The strategy of TQF for change is designed to enhance teaching practices at an institutional level based on theories of organizational change. This strategy focuses on bringing key faculty and leaders within departments to work together to co-create and test an assessment system which may work well in their contexts, based on faculty teaching expertise.

There is an increasing call to focus on teaching quality in higher education at local and national levels (Ross, 2018). Teaching quality has a major impact on improving student outcomes (e.g. graduation rates, diversity, and retention). With the alignment of that call, faculty have also been called to evaluate and improve their teaching practices in a more robust way. Although there is adequate research regarding effective teaching practices based on student learning, there is still a significant gap between this knowledge and the current use of teaching practices (Ross, 2018). Within most universities, this disconnection is highly noticeable, particularly within research intensive institutions. Moreover, teaching reward systems in those institutions have many limitations that might constrain improved teaching quality. For the current study, exploring the correlation of perceived contextual factors with departmental climate

for teaching quality improvement in STEM within higher education contexts might have addressed conflicting values between knowledge and actual teaching practices.

Therefore, the current study explored how the correlation of perceived contextual factors with department climate for teaching quality, particularly in STEM disciplines, may vary across institutional types and faculty's institutional roles at a higher education level. These types included: a) associate's colleges (state/community colleges), b) doctoral-granting universities (research intensive/research extensive), c) master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and d) baccalaureate colleges (focus on undergraduate degrees). Faculty's institutional roles included full professor, associate professor, assistant professor, lecturer, and instructor. The Survey of Climate for Instructional Improvement (SCII) as an interdisciplinary and reliable survey was adopted to collect data from STEM faculty within higher education contexts (Walter et al., 2014).

Teacher Identity and Teaching Quality

There are several research studies which address the relationship between teacher identity and teaching quality. Teacher identity is a concept that addresses the nature of personal and professional sides of the teaching profession (Akkerman & Meijer, 2011). This includes teacher professional learning that is both externally and internally directed, teacher professional learning that is influenced by individuals' perceptions of being teachers, and desired persona of teachers (Beijaard, 2009).

Teacher Identity

Although various fields such as medicine, law, and information technology have interest in the concept of professional identity and how this identity might impact individuals' professions (Hammam et al., 2010), research regarding professional identity is mostly achieved within the field of teacher education. Further, teacher identity is a distinct research area that has emerged in teacher education within the last few decades (Chi, 2009). Beijaard et al. (2004) indicated that teacher identity plays an important role in promoting teachers' performance and their professional development, and there have been numerous studies exhaustively focused on critical professional issues of teacher identity. These critical issues have included teachers' commitments, efficacy, motivation, confidence, and satisfaction. Additionally, teacher identity is divided into two main categories, including sociological (collective) identity and psychological (personal) identity (Meadian identity vs. Ericksonian identity). Chi (2009) added that teacher identity is a combination of personal and social aspects. Therefore, teacher identity requires both personal and collective senses of self to become a teacher. A personal sense of self is individually constructed, while a collective sense of self is constructed through social relations within a society.

Teaching Quality

Recent research mainly focuses on the factors that impact teaching quality and how it could be improved (Hammam et al., 2010). Research has indicated that teaching quality is strongly correlated to and influenced by work conditions (e.g. teaching resources) (Moore & Hofman, 1988). Teaching quality is also correlated with how teachers may react towards professional reform efforts (Day, 2002). When faculty positively interact with professional teaching activities as part of teaching reform efforts, teaching quality overall might be improved. Day (2002) also added that there is a lack of attention paid to the teaching profession in professional teaching reform efforts worldwide, so there are still professional challenges among teachers. Teacher education focuses on the interaction between a teacher as a professional and a teacher as a person (Kelchtermans, 2009). Darling-Hammond and Snyder (2000) indicated that the mutual relationship between teacher identity, teaching context, and teaching quality emerged by understanding the complexity of teaching, being a teacher, and the role of a teacher's personal and practical knowledge to learn how to teach within a professional landscape. Therefore, teaching quality is one of the important concepts that arise in research regarding teacher education and it is, consequently, a key concept to consider when addressing pedagogical reform efforts (Darling-Hammond & Snyder, 2000).

Contextual Factors and Teachers' Personal Attributes Impacting Teaching Quality

Contextual factors also influence teaching quality. Contextual factors are the type and workload of teacher appointments in the extent of other additional tasks (e.g. research and service) that teachers perform beside teaching and in the length of time that teachers work with current colleagues (Canrinus, 2011). Teachers' teaching quality improves over time. Therefore, the longer teachers work in the teaching profession, the more experience they gain and what they professionally want and who they want to be are also achieved (Dobrow & Higgins, 2005).

Contextual factors also include having autonomy and being provided with professional development opportunities that contribute to teachers' professionalism and impact teaching quality (Van Veen, 2008). Nixon (1996) indicated that teaching is an "important area of professional expertise in its own right" (p. 14). Therefore, professional development opportunities strengthen teaching expertise (Nixon, 1996) and develop teachers personally and professionally (Kwakman, 1999). Overall, the recognition of teaching as a profession is considered a key contextual factor which may impact teaching quality (Van Veen, 2008).

Chi (2009) indicated there are many attributes that impact teachers' teaching quality at personal and sociological levels. Personal attributes (e.g. experience, emotion, behavior, knowledge, motivation, satisfaction, commitment, and efficacy) impact teachers' teaching quality at an individual level, while sociological attributes (e.g. contexts and collective interaction) impact teachers' teaching quality at a social level. Personal aspects (e.g. motivation) measure the clinical state of being teachers and determine whether it is stably developed or not. On the other hand, teaching quality is also impacted by social interaction that determines how teachers decide to be teachers and how they are perceived as teachers by others within work contexts (Isbell, 2006).

Research indicated the importance of the teaching role in enhancing teachers' professional development, teaching performance, and teaching quality (Starr et al., 2006). Hung (2008) added that teachers' teaching quality is impacted by three motivational factors which are intrinsic, altruistic, and extrinsic factors. There are also four commitment factors that impact teachers' teaching quality include the following beliefs: teaching is a choice, teaching is for student learning, teaching is a demand, and the attitude and interaction among teachers and students impact teaching quality (Hung, 2008). In addition, Choi (2007) presented that teaching

quality is impacted by classroom context, teacher beliefs, and discourses about teaching in a society. Day, Flores, and Viana (2007) indicated that teaching quality, teachers' motivation, and commitment to teaching are also impacted by school leadership. O'Connor (2008) further added that teaching quality is heavily impacted by work context and beliefs about teaching. McCormack, Gore, and Thormas (2006) then indicated the importance of perceiving values and praise, rewarding recognition, and gaining support from supervisors and students to improve teaching quality. They also found that peer conversations, collegial relationships, and collaboration increase teachers' confidence in teaching practices and skills with a positive impact (McCormack et al., 2006). In conclusion, work context has its impact on teachers' development and commitment in the teaching profession and on teaching quality (Isbell, 2006). Work context plays an essential role in facilitating interest in becoming a teacher, as well as remaining in the teaching profession (Beijaard et al., 2004). Work context also plays a critical role in developing teaching practices. Thus, the improvement of teaching quality is reflected by the improvement of teaching conditions and work environment (O'Connor, 2008).

The Relationship Between Teacher Identity and Teaching Quality

Based on Grier and Johnston (2009), teaching quality is strongly correlated with teacher identity and also relies on one's beliefs that teaching is a profession that is constantly evolving and changing based on teachers' personal and professional experiences. Wenger (1998) explained that teachers' imagination, engagement, and alignment processes impact their teaching quality. Teaching quality is also impacted by engaging faculty within a community of practice and assuming that one's teaching quality is related to the work conditions and relations with colleagues (Wenger, 1998). Teaching quality could be demonstrated in practice in three ways: the use of professional vocabulary, the use of a skill that is socially valued, and the work

responsibility of others that can be shared (Van Maaren & Barley, 1984). Fullan and Hargreaves (1992) concluded that pedagogical change is not an easy process and might be wrought with conflict of one's knowledge, beliefs, identity, and relationships. Therefore, teaching quality is related to and determined by an individual's role within a community and their ability to be immersed within that community.

Beijaard, Meijer, and Verloop (2004) defined teaching identity as teachers' perceptions and interpretations of and interactions with their workplace. Elaborating on this concept, Kelchtermans (2009) added that teachers shape an interpretative framework of their teaching practices based on their interaction with context and work conditions including social, structural, and cultural conditions. Day et al. (2006) found that a professional dimension (which is based on policy and social expectations regarding what shapes a teacher's educational ideals and makes a good teacher), a personal dimension (which is based on a teacher's life outside school), and a situational dimension (which is based on work context) are the main dimensions that teachers try to balance in their daily work. To conclude, teaching quality is influenced by working conditions, individuals' teaching beliefs, and social relations with others.

Psychological Processes that Shape Teacher Identity and Correlated with Teaching Quality

Teachers' perceptions of the teaching profession are impacted by many internal and external influences, including the interaction between teacher and context (Olsen, 2008), resulting in teacher identity. Teacher identity often manifests through the following psychological processes: professional commitment, satisfaction, self-efficacy, and motivation towards the teaching profession. These psychological processes are considered the main indicators of teacher identity and they also impact teaching quality in higher education (Canrinus, 2011). Psychological processes are also considered important antecedents to identify

and determine teaching behaviors (Watt & Richardson, 2008). Teachers may have different levels of commitment, satisfaction, self-efficacy, and motivation towards the teaching profession based on their personal perspectives and beliefs regarding work context. Teacher identity is constructed through practices and discourse, and it is considered a result of teachers' interactions within teaching contexts. Teachers may also have different teacher identities as a result of having different beliefs about teaching (Beijaard, Meijer, & Verloop, 2004). Kelchtermans (2009) also assured that these four constructs are important in teachers' lives and work. Ololube (2006) found that teacher identity indicators are correlated with teaching quality and the effectiveness of teaching behaviors. Similarly, Wat and Richardson (2008) agreed with this correlation. These constructs are defined as the following:

1. A teacher's commitment is defined as their strong values and interests to teach students and care about teaching the next generation (Lee, Carswell, & Allen, 2000). Professional commitment is also a psychological connection between individuals and their profession, based on their affective reaction to that profession (Lee, Carswell, & Allen, 2000). It describes how teachers feel about their profession. The feeling towards the teaching profession may affect teachers' willingness to continue teaching and stay in the teaching profession (Lee, Carswell, & Allen, 2000). Lee et al. (2000) defined professional commitment as "a psychological link between a person and his or her occupation that is based on an affective reaction to that occupation" (p. 800).
2. Professional satisfaction is an affective feeling that indicates whether individuals like certain aspects of their profession or not. It is also an accomplishment of one's desires and needs within a profession and its context (Medlock, 2004;

Ololube, 2006). In addition, professional satisfaction has varying definitions divided into three types, including an affective feeling of liking your profession or not (Ololube, 2006), a degree of achievement regarding one's desire and needs in a profession (Oshagbemi, 2003), and a comparison between the current profession and other professions (Davis & Wilson, 2000). Van der Ploeg and Scholte (2003) defined profession satisfaction as "an attitude based on an evaluation of relevant aspects of the work and work situation" (p. 227). Their definition focuses on evaluating work and work-context aspects, and the importance of someone's evaluation of the work and context where the work takes place.

3. Professional motivation is defined as individuals' internal desires to change and shape profession-related behaviors (Latham & Pinder, 2005). Latham and Pinder (2005) defined motivation as "a psychological process resulting from the interaction between the individual and the environment" (p. 486). They also defined work motivation as "a set of energetic forces that originate both within as well as beyond an individual's being, to initiate work-related behavior and to determine its form, direction, intensity, and duration" (p.484). Latham and Pinder's (2005) definition of motivation considers the importance of individuals' psychological and environmental factors that may impact their work. Motivation might impact teaching quality and manifest how having interest and a strong desire to teach is correlated with work context. As a result, motivation to teach might improve teaching quality in STEM.

4. Teachers' self-efficacy is defined as their ability to influence students' outcomes, perform professional and organizational tasks, and regulate relations in the

teaching and learning processes, considering the context where teachers work (Friedman & Kass, 2002; Olivier & Ellett, 2007). Friedman and Kass (2002) also defined teacher self-efficacy as “A teacher’s perception of his or her ability to (a) perform required professional tasks and to regulate relations involved in the process of teaching and educating students and (b) perform organizational tasks, become part of the organization and its political and social processes” (p. 684). Friedman and Kass’s (2002) definition of self-efficacy focuses on teachers’ abilities to improve their teaching practices within an institutional context.

It is important that faculty feel a sense of appreciation for teaching (Holland & Lachicotte, 2007). Teaching appreciation from initiatives (e.g. grants and teaching or monetary rewards) or from students might support faculty teacher identity as it is also correlated with teaching quality (van Lankveld et al., 2017). When faculty feel their academic work is questioned, their self-esteem might be negatively impacted, which is problematic, as self-esteem is directly associated with teaching quality. Further, when faculty self-esteem is undermined, faculty’s teaching quality decreases. Faculty connectedness with peers is also important and enhances their teaching practices. Confidence in teaching may increase when faculty feel a sense of connectedness to colleagues by sharing experiences and creating a sense of trusted relationships. Therefore, when faculty feel they are confident in their role as teachers, their teaching practices improve. Faculty also consider teaching resources as important to identify themselves as teachers through these resources. Teaching quality might also be improved when faculty connect with others outside their departments during professional reform programs and through faculty social networks. Having connections with colleagues and professional networks develop a sense of connectedness and enhances faculty teaching practices (van Lankveld et al.,

2017). For this reason, in the current study, a sense of connectedness with colleagues, as a contextual factor correlated with departmental climate for teaching quality improvement, was studied at a higher education level, particularly in STEM.

Feeling a sense of commitment and a personal interest in teaching may also enhance one's teaching practices (van Lankveld et al., 2017). Having a strong personal interest in teaching students and caring about the next generation may positively impact the improvement of teaching practices. Faculty might struggle to improve their teaching practices when their strong values conflict with institutional policies or when there is no appreciation for university teaching. Professional reform activities may provide faculty with opportunities that reinforce their teaching values of caring for students and enhance their teaching satisfaction. Moreover, having a sense of competence is also important to enhance one's teaching practices (Beauchamp & Thomas, 2009).

A sense of competence is considered a key indicator of teaching quality improvement. Faculty might be reluctant to perceive themselves as teachers in the early years of teaching. When their work is recognized and they are confident to perform their teaching roles, their teaching quality improves and is supported. Faculty may feel insulted when their teaching competence is not recognized. Then, they might struggle to improve their teaching practices (Beijaard et al., 2004). Therefore, a recognition of competence by others is important to improve one's teaching quality. Additionally, when faculty can imagine the trajectory of their career as teachers, their teaching quality will be supported (van Lankveld et al., 2017). Senior faculty might have their own teaching records that could be presented as models for younger faculty to enhance their teaching practices, support their teaching quality, and reaffirm their teaching

satisfaction. Therefore, faculty will not perceive themselves as senior teachers unless they find possibilities and opportunities of career development in the teaching profession.

The psychological processes previously explained are associated with contextual factors that may support or constrain teaching quality improvement within a university context including the work environment, faculty contact with students, contact with staff development programs, and the context of higher education (Beauchamp & Thomas, 2009). While faculty interaction with students and staff development programs may enhance their teaching practices, the context of higher education may constrain them.

Conclusion

In conclusion, research regarding department climate for teaching quality improvement is important (Hong, 2010). It helps us understand how teachers may react to professional reform efforts, how department climate for teaching quality improvement could sufficiently be addressed based on the teacher education field, and how teacher commitment in the teaching profession could be explained (Hong, 2010). Henard and Roseveare (2012) indicated that more research is needed on the explicit appreciation of teaching in higher education, how the value of teaching can be supported, and how departmental leaders could change the value of teaching using implicit messages about teaching at a department level.

As outlined in this chapter, department climate for teaching quality improvement has been a primary concern in many recent studies, particularly in higher education (van Lankveld et al., 2017). In the next chapter, the researcher outlines the methodological approach for exploring the correlation of perceived contextual factors with departmental climate for teaching quality improvement in STEM across institutional types and faculty's institutional roles in higher education. These types included a) associate's colleges (state/community colleges), b) doctoral-

granting universities (research intensive/research extensive), c) master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and d) baccalaureate colleges (focus on undergraduate degrees). Faculty's institutional roles included full professor, associate professor, assistant professor, lecturer, and instructor. Perceived contextual factors were explored for the current study including leadership, collegiality, resources, professional development, autonomy, and respect (Walter et al., 2014).

Although research has been conducted regarding the factors correlated with teaching quality improvement at an elementary and secondary level, there is still limited research related to the factors correlated with teaching quality at a higher education level, particularly in STEM. There has also been specific research addressing issues regarding the correlation of perceived contextual factors with teaching quality improvement in all higher education contexts. However, there has not been research conducted regarding how those factors might similarly or differently correlate with and impact departmental climate for teaching quality improvement in STEM. Therefore, the current study explored the correlation of perceived contextual factors with department climate for teaching quality improvement in STEM across institutional types and faculty's institution roles in higher education institutions. Exploring the correlation of perceived contextual factors with departmental climate for teaching quality improvement in STEM could shed a light on student attrition, help us understand faculty commitment in teaching, explain faculty response to pedagogical change, and may aid in explaining how to address teaching quality for STEM in teacher education.

CHAPTER THREE: METHODOLOGY

There are many studies on departmental climate for teaching quality improvement in primary and secondary education, but studies are limited in the context of higher education, particularly in STEM disciplines (Beauchamp & Thomas, 2009; van Lankveld et al., 2017). Therefore, departmental climate for teaching quality improvement within the context of higher education has been a primary focus for many recent studies and reform efforts (van Lankveld et al., 2017). There are many factors that impact departmental climate for teaching improvement including: a) the context of higher education, b) direct work environment, c) contact with students, and d) staff development activities. The context of higher education and direct environment where faculty work have a great impact on faculty teaching practices and may constrain or strengthen teaching quality improvement. This effect on the teaching quality improvement can be dependent upon the extent to which teaching is valued at both the institutional and departmental levels. Other factors that may improve teaching quality include the number and quality of student-faculty interactions, as well as the opportunity to participate in professional reform and development activities (van Lankveld et al., 2017).

Teaching quality is improved when faculty experience job satisfaction and feel appreciated, whether through students' feedback and reactions or initiatives such as grants or teaching rewards (van Landkveld et al., 2017). A sense of connectedness among colleagues also increases when faculty share their experiences with colleagues who have similar experiences, to improve their teaching practices and enhance teaching quality improvement. A sense of competence increases when faculty teaching skill is recognized (Akkerman & Meijer, 2011). A sense of commitment, developed when faculty have a deep interest in teaching students, also impacts and improves

teaching quality (van Landkveld et al., 2017). Finally, when faculty have a future career trajectory in the teaching profession, their teaching quality is enhanced.

Although many institutions claim that research and teaching are equally valued, faculty are often primarily assessed for promotion and tenure based on their research performance, particularly in STEM (Clarke, Knight, & Jarvis, 2012). Thus, STEM faculty might encounter tensions to change their pedagogies and identify themselves as teachers. Further, faculty may struggle to improve their teaching practices and having to reconcile the idea that priority is given to research over teaching (Henderson, Beach, & Finkelstein, 2011). Additionally, often, advisors in STEM encourage their students to primarily focus on being effective researchers, rather than effective teachers, which perpetuates the view that teaching is inferior to conducting research (Feldon et al., 2011). Many teaching reform efforts and teaching incentives developed are often marginalized and are not considered as important as research efforts and incentives (Connolly, 2012). Understanding that faculty professional status stems from research and knowing about themselves as teachers could be a driver of or a barrier for pedagogical change (Weaver et al., 2015). Therefore, in this dissertation, the correlation of perceived contextual factors with departmental climate for teaching quality improvement in STEM disciplines were explored as well as how they may vary across institutional types and faculty's institutional roles in higher education. Institutional types include associate's colleges (state/community colleges), doctoral-granting universities (research intensive/research extensive), master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and baccalaureate colleges (focus on undergraduate degrees). Institutional roles include full professor, associate professor, assistant professor, lecturer, and instructor.

Research Questions

In this dissertation, the researcher aimed to investigate the correlation of perceived contextual factors on departmental climate for teaching quality improvement in STEM disciplines. Therefore, the research questions included:

1) To what extent are perceived contextual factors correlated with departmental climate for teaching quality improvement in STEM across institutional types associate's colleges (state/community colleges), doctoral-granting universities (research intensive/research extensive), master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and baccalaureate colleges (focus on undergraduate degrees)?
2) To what extent are perceived contextual factors correlated with departmental climate for teaching quality improvement in STEM across institutional roles (full professor, associate professor, etc.)?

Methods

Study Design

In this research, a descriptive quantitative design was used to explore department climate for teaching quality in STEM. Survey data was collected for the current descriptive design study. The researcher used a quantitative approach, because quantitative methods are useful to examine, represent, and analyze the relationships among variables mathematically using statistical analysis (Creswell, 2013). Ary et al. (1985) indicated that "quantitative research is inquiry employing operational definitions to generate numeric data to answer predetermined hypotheses or questions" (p. 260). Quantitative methods are generally used for scientific research problems and also allow for collecting data from a large sample size. Quantitative methods have many positive aspects, including that the results of statistical analysis used have greater objectivity and are

independent from the researcher. Quantitative data can also be displayed in different formats such as charts, graphs, and tables, allowing for better interpretation. Furthermore, data analysis conducted is less-time consuming, and it is usually done using statistical software. Sample sizes used for quantitative studies are usually substantial; therefore, results can be generalized. Finally, quantitative data are considered more reliable and credible, particularly for stakeholders, policy makers, and administrators (Creswell, 2013).

To answer the research questions for the current study, the researcher used structural equation modeling (SEM). The researcher used SEM which examined the relationships hypothesized between perceived contextual factors as low-order constructs and department climate for teaching quality improvement as a higher order construct across institutional types and faculty's institutional roles. Using the repeated indicators approach, all indicators of the subdimensions (the lower-order constructs) are also repeated to identify the main dimension (the higher-order construct). Therefore, the variance of the higher-order construct is explained by the lower-order constructs (Sarstedt et al., 2019).

Lohmoller (1989) indicated that higher order constructs in the context of PLS-SEM are also called hierarchical component models. A higher order construct is modeled on an abstract dimension (known as a higher-order component) that is correlated with its concrete subdimensions (known as lower-order components). For the current study, all perceived contextual factors including leadership, collegiality, resources, professional development, autonomy, and respect are considered lower order constructs. On the other hand, department climate for teaching quality improvement is considered a higher order construct. Department climate for teaching quality improvement is considered a reflection of perceived contextual factors (Figure 7). Therefore, the direction of relationships is from perceived contextual factors

to department climate for teaching improvement. When hierarchical component models are reflective-reflective or formative-reflective, loadings should be represented. Conversely, when the models are formative-formative or reflective-formative, weights should be presented.

SEM software, such as confirmatory factor analysis, allows for examining complex models and relationships among one or more endogenous variables (dependent variables) and one or more exogenous variables (independent variables). SEM provides a clear understanding of structural relations graphically for the theory under the study. SEM as a quantitative method used for the current study allows for the modeling of structural relations of unobservable factors (latent variables). Factors are considered broad concepts that may describe numbers of observed (manifest) variables or a phenomenon (Creswell, 2013). SEM is mainly used in behavioral and social sciences and examines two types of theoretical constructs. These constructs include observed variables, which can be measured directly such as blood sugar, and unobservable (latent) variables that cannot be observed directly such as identity. Latent variables can be measured using observable variables. The observations are measured scores such as coded responses to an interview self-report to attitude scales. In the current study, the researcher used the reduced number of perceived contextual factors that were extracted from a large number of the observed variables, have a commonality, and might be correlated with teaching quality in STEM based on Gappa et al.'s (2007) conceptual framework.

Methodology Rationale

The researcher used SEM as a multivariate statistical analysis method to examine the structural relations among factors that influence departmental climate for teaching quality improvement in STEM. SEM is a tool used to investigate variable relationships for complex concepts that are not measured easily and directly. Through SEM, the multiple and interrelated

dependence can be estimated in a single analysis. Therefore, it is a preferred technique by researchers. Two types of variables are used in SEM, including endogenous variables that are also called dependent variables, and exogenous variables that are also called independent variables. SEM combines two types of analyses including multiple regression and factor analysis. Factor analysis is used to simplify data and reduce the number of variables that exist (Pett, Lackey, & Sullivan, 2003). When factor analysis is used, large numbers of observed variables are reduced to reflect a smaller number of latent variables (Pett, Lackey, & Sullivan, 2003).

The researcher utilized structural equation modeling (SEM), adopting the repeated indicators approach, to examine the relationships hypothesized across institutional types and faculty's institutional roles. There are many advantageous features of higher order constructs such as achieving model parsimony through reducing the number of path model relationships (Polites et al., 2012). In this case, researchers can include the independent constructs in a higher-order construct and shift the relationships from the independent constructs (lower-order components) to the dependent constructs (higher-order constructs). Cronbach and Gleser (1965) also indicated that higher-order constructs can resolve the bandwidth fidelity dilemma and reduce collinearity among formative indicators. To receive the benefits, the conceptualization and specification of higher order constructs needs to be based on a well-developed measurement theory. Therefore, researchers need to specify the lower-order components of the measurement model and the relationships between the higher order dimension and its lower-order subdimensions. Hierarchical component models could be reflective-reflective, reflective-formative, formative-formative, and formative-reflective (Cheah et al., 2019). The reliability and validity of lower-order components should be assessed as they are elements of higher-order

constructs of a measurement model (Sarstedt et al., 2019). Researchers should analyze the discriminant validity of lower-order components and higher order components as well. The measurement model of the higher order construct is defined by the relationship between the higher-order dimension and its lower-order subdimensions. When higher order models are evaluated, the measurement models of lower-order components as well as the measurement model of the higher-order construct should be considered.

Population and Sample

The population for this study was comprised of all STEM faculty who teach STEM courses in higher education contexts. All STEM faculty with teaching responsibilities from several colleges (e.g. Seminole State College), universities (e.g. UCF) or professional organizations (e.g. ASEE) were recruited as participants for the current study.

The current study used the following criteria to qualify a STEM faculty with teaching responsibilities: a) the faculty needs to be teaching at least one course and listed in the Registrar's database, b) the course that the faculty teaches has an enrollment greater than ten, and c) faculty must be at the rank of full professor, associate professor, assistant professor, lecturer, or instructor. The sample included online faculty, off-campus faculty, tenured/tenure-track, and full-time faculty. Given the researcher is a doctoral student at UCF and aimed to use a convenience sampling technique (outlined below), UCF as a university was chosen as a site from which to collect data from STEM faculty. More STEM faculty were also recruited from other institutions, or via professional organization listservs (e.g. APS, ASEE, and AMS) as a convenient way to increase the number of participants for the study.

Sampling

The researcher used a convenience, or accidental/haphazard, sampling technique. Convenience sampling is a nonrandom or nonprobability sampling type where participants of the target population are easily accessible to the researcher, meet practical and certain criteria identified by the researcher for the study, are available at a given time, and have the willingness to participate for the purpose of the study (Dornyei, 2007). Convenience sampling assumes that all participants of the target population are homogeneous (Battaglia, 2008). The researcher aimed to use convenience sampling techniques so that adequate participants might be recruited to thoroughly explore the correlation of perceived contextual factors with departmental climate for teaching quality improvement, particularly in STEM. Further, the researcher aimed to determine how these factors may vary across institutional types including associate's colleges (state/community colleges), doctoral-granting universities (research intensive/research extensive), master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and baccalaureate colleges (focus on undergraduate degrees) and faculty's institutional roles (e.g. assistant professor, associate professor, and lecturer) at a higher education level.

Recruitment / Data Collection

Before conducting the study, the researcher obtained the Institutional Review Board (IRB) approval of the current study and informed consent documentation for the instrument selected. The survey was constructed using the Qualtrics service and had two sections. The first section includes demographic items, such as gender, age, faculty rank, total years of teaching experience in higher education, primary academic discipline, and an approximation of one's normal teaching and research workload (Landrum et al., 2017). The second section addresses

perceived contextual factors that might be correlated with department climate for teaching quality improvement. These factors include leadership, collegiality, resources, professional development, autonomy, and respect (Walter et al., 2014).

For the current study, STEM faculty with teaching responsibilities were recruited from a number of higher education institutions (e.g. UCF) and professional organizations, including, but not limited to, the American Physical Society (APS), the American Society for Engineering Education (ASEE), and the American Mathematical Society (AMS).

During the Spring 2020 semester, all STEM faculty with teaching responsibilities from professional organizations (e.g. APS, ASEE, and AMS) or higher education institutions were invited via an organizational listserv or another mass e-mail functionality, to complete the survey, which includes 26 items related to department climate for instructional improvement (SCII) (Walter et al., 2014). After initial e-mails, two follow-up reminders were sent only to those who received the invitation for participation but did not respond. The survey remained open to responses for two months after its initial dissemination.

Instrumentation

All perceived contextual factors mentioned previously were collected in an online survey to explore the extent of their correlation with department climate for teaching quality improvement in STEM and how that correlation may vary across institutional types and with faculty’s institutional roles. These types included a) associate's colleges (state/community colleges), b) doctoral-granting universities (research intensive/research extensive), c) master's colleges and universities (at least 50 master’s degrees and fewer than 20 doctoral degree programs), and d) baccalaureate colleges (focus on undergraduate degrees). Faculty’s

institutional roles included full professor, associate professor, assistant professor, lecturer, and instructor.

Based on Walter et al.'s (2014) study, all the items of department climate for teaching quality were answered using the six-point Likert response format from 6= strongly agree to 1= strongly disagree (strongly agree, agree, somewhat agree, somewhat disagree, disagree, strongly disagree). For the current study, Walter et al.'s (2014) survey was adopted with the same use of Likert response format. To increase participants' responses for agreement or disagreement on items and avoid the claiming of no opinion, the neutral point was not added to the scale (Johns, 2005). Walter et al. (2014) indicated that the items generated for the SCII refer to an organization level rather than an individual level. For example, they used "the instructors in my department think" rather than "I think."

Survey selection

For the current study, the survey selected includes six items to measure their correlation with department climate for teaching quality improvement in STEM and how that correlation may vary across institutional types (e.g. research extensive, teaching universities, and state colleges) and faculty's institutional roles (e.g. assistant professor, associate professor, and lecturer) at a higher education level. Perceived contextual factors of department climate for teaching quality included leadership, collegiality, resources, professional development, autonomy, and respect. The reliable factors selected were included within an online survey in an effort to measure how these factors correlated with departmental climate for teaching quality improvement in STEM disciplines at a higher education level.

Table 2. Perceived Contextual Factors Correlated with Departmental Climate for Teaching Quality Improvement

Perceived Contextual Factors	Items		Source
1.Leadership	. "The department chair has a clear vision of how to improve teaching in the department."[a] . "The department chair implements teaching-related policies in a consistent and transparent manner."[a] . "The department chair inspires respect for his/her ability as a teacher."[a] . "The department chair is receptive to ideas about how to improve teaching in the department."[a] . "The department chair is tolerant of fluctuations in student evaluations when instructors are trying to improve their teaching."[a] . "The department chair is willing to seek creative solutions to budgetary constraints in order to maintain adequate support for teaching improvements."[a]	> 0.8	Walter et al. (2014)
2.Collegiality	. "Instructors in my department frequently talk with one another."[a] . "Instructors in my department discuss the challenges they face in the classroom with colleagues."[a]	> 0.8	

Perceived Contextual Factors	Items		Source
	. “Instructors in my department share resources (ideas, materials, sources, technology, etc.) about how to improve teaching with colleagues.”[a] . “Instructors in my department use teaching observations to improve their teaching.”[a] . “Instructors in my department are “ahead of the curve” when it comes to implementing innovative teaching strategies.”[a] . “Instructors in my department have someone they can go to for advice about teaching.”[a]		
3.Resources	. “Instructors in my department have adequate departmental funding to support teaching.”[a] . “Instructors in my department have adequate space to meet with students outside of class.”[a] . “Instructors in my department have adequate time to reflect upon and make changes to their instruction.”[a]	> 0.8	
4.Professional Development	. “Instructors in my department are assigned a mentor for advice about teaching.”[a] . “In my department, teaching development events (i.e. talks, workshops) are hosted specifically for Department instructors.”[a] . “In my department, new instructors are provided with teaching development opportunities and resources.”[a]	> 0.8	

Perceived Contextual Factors	Items		Source
5.Autonomy	. "Instructors in my department have considerable flexibility in the content they teach in their courses."[a] . "Instructors in my department have considerable flexibility in the way they teach their courses."[a] . "In my department, there are structured groups organized around the support and pursuit of teaching improvement."[a]	> 0.8	
6.Respect	. "Evidence of effective teaching is valued when making decisions about continued employment and/or promotion."[a] . "Differences of opinion are valued in decision-making related to teaching improvement."[a] . "Courses are fairly distributed among instructors."[a] . "Teaching is respected as an important aspect of academic work."[a] . "All of the instructors are sufficiently competent to teach effectively."[a]	> 0.8	

[a]Walter et al. (2014, p. 16-17).

The six reliable factors of the Survey of Climate for Instructional Improvement (SCII) were adopted for the current study, as they are perceived contextual factors correlated with department climate for teaching quality improvement in STEM and how that correlation varies across institutional types (e.g. research-intensive, and research-extensive universities) and faculty's institutional roles (e.g. assistant professor, and associate professor). These factors are leadership, collegiality, resources, professional development, autonomy, and respect (Walter et al., 2014). Kozlowski and Klein (2000) assured that climate can be measured as a psychological construct at an individual level or as a property of an organization when its individuals' perceptions are collected, and a consensus is reached at a group level. Walter et al. (2014) focused on the correlation of perceived contextual factors with departmental climate for teaching quality improvement at a higher education level. Elements of departmental climate for teaching improvement include atmosphere, structures, and relationships that might be correlated with individuals' behaviors and attitudes (Schneider et al., 2013). Since departmental climate for teaching quality improvement might be correlated with faculty teaching attitudes and behaviors, Walter et al.'s (2014) survey was adopted. The framework of SCII focuses on three aspects of faculty expertise, including professional development, collegiality, and autonomy (Gappa et al., 2007; Walter et al., 2014). It also focuses on three characteristics of an academic institution, including leadership, rewards, and resources.

Validity and reliability

Brownlow, McMurray, and Cozens (2004) indicated that Cronbach's alpha ranges from 0.7 to 0.9 show high reliability, while Cronbach's alpha ranges from 0.5 to 0.7 show moderate reliability. Furthermore, Griethuijsen et al. (2015) indicated that Cronbach's alpha ranges from

0.6 to 0.7 are considered acceptable. For perceived contextual factors based on Walter et al.'s (2014) study, *leadership* (six items), *collegiality* (six items), *resources* (three items), *professional development* (three items), *autonomy* (three items), and *respect* (five items) show high inter-reliability ($\alpha = 0.944$).

Based on factor-related reliability and validity, the six reliable factors from the SCII were adopted for the current study, including leadership, collegiality, resources, professional development, autonomy, and respect (Walter et al., 2014). The SCII was designed by researchers at Western Michigan University to collect data about the climate for teaching improvement within academic departments. It was field tested with individual faculty and a group of experts from multiple institutions before pilot testing, illustrating a clear evaluation and revision of items. The initial items of SCII were reduced based on confirmatory and exploratory factor analyses as a validation process. The survey ended up having 26 items with high internal reliability ($\alpha > 0.8$) (Walter et al., 2014). The SCII items were constructed based on the framework of faculty work that combines three aspects of work experience, including professional growth, collegiality, and academic freedom and autonomy, and three characteristics of academic institutions including leadership, rewards, and resources (Gappa et al., 2007). The framework of faculty work aligned with literature related to the climate and nature of workplace and academic work, the climate of departmental teaching, and leadership for teaching (Knorek, 2012; Ramsden et al., 2007).

Data analysis methods/procedures

The data collected for the current study was stored and analyzed using SmartPLS software. SmartPLS is an analysis tool that is used for Partial Least Square Model (PLS)-Structural Equation Model (SEM) for theory development and exploratory research. SmartPLS

allows for modeling numbers of variables and indicators, describing the relationships among them, and providing an understandable picture to demonstrate the results. SmartPLS provides the opportunity to tests a model by drawing the path between the indicators and variables. Hair, Ringle, and Sarstedt (2013) indicated that SmartPLS has its advantages. Researchers can use this technique when they have a lack of distributional assumptions and a small sample size. The measurement scales of the variables used for SmartPLS could be ordinal, nominal, or interval (i.e. Likert scale). Shackman (2013) indicated that the sample size required for the analysis via SmartPLS is between 51 and 274. SmartPLS could test models, provide valid and accurate results, and explain causal relationships among variables if the sample size is below 250. SmartPLS also requires no distributional assumptions, which provides more flexibility (Shackman, 2013). Ringle et al. (2013) added that the main contribution SmartPLS provides is the ability to predict and the use of non-normal data. Moreover, SmartPLS can test models that include reflective and formative scales, easily. Formative and reflective models can be used in one construct with no restriction (Hair et al., 2013). Therefore, the ability to use reflective and formative elements makes SmartPLS more distinct than LISREL or other SEM software programs.

Descriptive statistics were also explored (means and standard deviations for all survey factors). Given the survey had 28 items that need to be explored based on STEM faculty responses, descriptive statistics allow the researcher to present the data in a simple and meaningful way. It also makes the data interpretation easier, turns a collection of data into a clear and meaningful piece of information that can be understood, and keeps the original information without distorting its meaning (Spriestersbach et al., 2009). After descriptive statistics were conducted, all items were explored via SEM. The advantage of SmartPLS within other kinds of

models is providing greater statistical power to detect significant relationships in exploratory research. On the other hand, SmartPLS has fewer methods to identify reliability and validity compared to covariance constructs, but this disadvantage is not apparent when a sample size is increased (Hair et al., 2013).

There are two types of the PLS path model, the measurement model and the structural model. Within the measurement model, the indicators are measurable and able to describe the variables. Categorical, ordinal, quasi-metric, or metric scales can be used through SmartPLS which provides a large degree of flexibility. SmartPLS can test complex models with a wide range of manifest and latent variables with different scales, and there has to exist a correlation between these variables.

The researcher used SEM because all the six constructs selected as perceived contextual factors are a combination of multiple items that are not easily measured separately. SEM is a causal modeling that includes a set of statistical, mathematical methods and computer algorithms to fit numbers of constructs to data. SEM defines latent (unobservable) variables through one or more manifest (observable) variables within a measurement model and imputes relationships among latent variables within a structural model (MacCallum & Austin, 2000). In addition, a researcher should be skillful enough in statistics to run the analysis through SEM software programs effectively and manage these kinds of advanced statistical programs. SEM is commonly used in social sciences due to its ability to define relationships between unobservable variables through observable variables. In SEM diagrams, observable variables are shown as rectangles and latent variables as ovals. SEM estimates numerically how each observable variable is strongly correlated to and a good indicator of the latent variables. Using SEM allowed for combining many observed variables within unobserved and interpretable variables (Kim &

Mueller, 1978) and exploring their relationship with department climate for teaching quality improvement in STEM.

Summary

In conclusion, the purpose of this study was to observe the correlation of perceived contextual factors with teaching quality in STEM across institutional types and faculty's institutional roles. These types included associate's colleges (state/community colleges), doctoral-granting universities (research intensive/research extensive), master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and baccalaureate colleges (focus on undergraduate degrees). Faculty's institutional roles included full professor, associate professor, assistant professor, lecturer, and instructor. Perceived contextual factors regarding department climate for teaching quality included leadership, collegiality, resources, professional development, autonomy, and respect. To answer the current research questions, the researcher used SEM as a quantitative approach. SEM is an advanced statistical method which includes many complex concepts and layers. Researchers should be knowledgeable with factor analyses and regression as they are basic statistics to understand SEM well. The researcher used a convenience sample as a sampling technique.

The researcher adopted Walter et al.'s (2014) SCII survey and applied it as web-based survey via Qualtrics for data collection. The survey consists of six factors including leadership, collegiality, resources, professional development, autonomy, and respect. After data was collected via the survey adopted, SEM was applied to explore the correlation of perceived contextual factors with departmental climate for teaching quality improvement in STEM.

In the next chapter, the researcher will discuss the results of the SEM for the data collected and will explain the main factors that are mainly correlated with departmental climate

for teaching quality improvement in STEM across institutional types and faculty's institutional roles at a higher education level.

CHAPTER FOUR: RESULTS

Introduction

The purpose of this study was to determine the correlation of perceived contextual factors with departmental climate for teaching quality improvement within higher education contexts, particularly in STEM disciplines across institutional types and faculty roles. Institution types included associate's colleges (state/community colleges), doctoral-granting universities (research intensive/research extensive), master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and baccalaureate colleges (focus on undergraduate degrees). Faculty's roles included full professor, associate professor, assistant professor, lecturer, and instructor. Perceived contextual factors explored for the current study included leadership, collegiality, resources, professional development, autonomy, and respect (Walter et al., 2014).

This chapter discusses the statistical analyses of the collected data in the study. The results of the descriptive statistics are presented to examine the participants' demographics and their perceptions of the correlation of contextual factors with departmental climate for teaching quality improvement across institutional types and faculty roles. The results of hierarchical component models are presented according to the research hypotheses.

Research Questions

This study explored the following questions:

Research Question 1: To what extent are perceived contextual factors correlated with departmental climate for teaching quality improvement in STEM settings across institutional types including associate's colleges (state/community colleges), doctoral-granting universities (research intensive/research extensive), master's colleges and universities (at least 50 masters

degrees and fewer than 20 doctoral degree programs), and baccalaureate colleges (focus on undergraduate degrees)?

Research Question 2: To what extent are perceived contextual factors correlated with departmental climate for teaching quality improvement in STEM settings across faculty's institutional roles (professor, associate professor, etc.)?

Research Hypotheses

To answer the above questions, the Gappa et al.'s (2007) framework of faculty work elements was used to examine the extent of perceived contextual factors correlated with departmental climate for teaching quality improvement in STEM settings across institutional types and faculty's institutional roles. Gappa et al. (2007) identified six elements of faculty work including three aspects of work experience and three characteristics of academic institutions, all of which directly impact teaching quality. The aspects of work experience are professional growth, collegiality, and academic freedom and autonomy. The characteristics of academic institutions are leadership, rewards, and resources. Walter et al. (2014) indicated that the strength of Gappa et al.'s (2007) framework of faculty work is its alignment with literature related to teaching climate within departments (Knorek, 2012), climate for change within the workplace (Bouckenooghe, Devos, & Van den Broeck, 2009), the nature of workplace and academic work (Massy et al., 1994), and teaching leadership (Ramsden et al., 2007).

Knorek (2012) suggested that improving teaching climate can enhance faculty teaching practices at an institutional level by: a) providing adequate and proper resources and spaces for teaching, b) rewarding faculty for teaching excellence, c) establishing an effective system for faculty development, and d) improving graduate students' teaching skills and support their teaching knowledge. Moreover, Emery and Trist (1965) indicated that building a supportive

environment with cooperative relationships and creating a sense of commitment within workplaces are important for the improvement of human relations. Based on this improvement, institutions should focus on successfully building and managing their individuals' interpersonal relationships for institutional effectiveness. Massy et al. (1994) added that there are many factors that support effective teaching within departments. These factors include, a) providing faculty with a supportive culture that values teaching, b) enhancing faculty interaction, collegiality, and respect, c) giving all faculty, regardless of rank or status, the opportunity to review each other's research and teaching, d) giving all faculty—junior and senior—equal teaching responsibilities, e) rotating teaching courses among faculty, and f) the most important factor is the role of the chair who has the power to achieve revolutionary changes needed in teaching practices within departments.

Based on the above questions, and the review of previous literature related to this topic, the researcher developed the following alternative hypotheses:

A) Perceived contextual factors are positively correlated with departmental climate for teaching quality improvement in STEM settings across institutional types including associate's colleges (state/community colleges), doctoral-granting universities (research intensive/research extensive), master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and baccalaureate colleges (focus on undergraduate degrees). The hypotheses include the following:

H1. Perceived contextual factors are positively correlated with department climate for teaching improvement in STEM at associate's colleges (state/community colleges);

H2. Perceived contextual factors are positively correlated with department climate for teaching improvement in STEM at doctoral-granting universities (research intensive/research extensive);

H3. Perceived contextual factors are positively correlated with department climate for teaching improvement in STEM at master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs);

H4. Perceived contextual factors are positively correlated with department climate for teaching improvement in STEM at baccalaureate colleges (focus on undergraduate degrees);

B) Perceived contextual factors are positively correlated with departmental climate for teaching quality improvement in STEM settings across faculty' institutional roles including full professor, associate professor, assistant professor, lecturer, and instructor. The hypotheses include the following:

H5. Perceived contextual factors are positively correlated with department climate for teaching improvement in STEM among full professors;

H6. Perceived contextual factors are positively correlated with department climate for teaching improvement in STEM among associate professors;

H7. Perceived contextual factors are positively correlated with department climate for teaching improvement in STEM among assistant professors;

H8. Perceived contextual factors are positively correlated with department climate for teaching improvement in STEM among lecturers;

H9. Perceived contextual factors are positively correlated with department climate for teaching improvement in STEM among instructors.

<u>Descriptive Statistics</u>

Participants

The participants in this study included STEM faculty who were teaching at an institution of higher education in the United States (US). Thus, an invitation to complete *The Impact of Perceived Contextual Factors on Departmental Climate for Teaching Quality Improvement* web survey was emailed to STEM faculty at different institutional types using the web directory of these institutions. There were three associate colleges, four doctoral-granting universities, five baccalaureate colleges, and five master's colleges and universities (Table 3).

Table 3. Numbers and Types of Higher Education Institutions

Number of Higher Education Institution	Type of the Institution
Four	Doctoral-granting universities (research intensive/research extensive)
Three	Associate's colleges (state/community colleges)
Five	Baccalaureate colleges (focus on undergraduate degrees)
Five	Master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs)

The survey was available from February 1, 2020 until March 31, 2020. The response rate was moderate (about 301 responses out of 6000) from the invitation. The researcher, firstly, assessed the data for correctness and completeness prior to analysis using the PLS-SEM approach. Sekaran (2005) indicated that missing data should be removed if it is more than 15% of the original data, and more than 5% of values per indicator. A total of 301 participants completed at least part of the survey. The total number of survey respondents included in the study was 278, while all partial survey responses were removed. Table 4 provides a summary of the participants' demographics.

Table 4. Profile of Respondents

Rank		Frequency	Percentage
Academic status	Tenured	77	27.7
	Tenure-track	64	23.0
	Non-tenure track	137	49.3
Gender	Male	130	46.8
	Female	146	52.5
	Other	2	.7
Age	Under 25	1	.4
	26 to 50	155	55.8
	51 and above	122	43.9
Total years of teaching experience in higher education	0 to 5 years	27	9.7
	6 to 10 years	65	23.4
	11 to 15 years	105	37.8
	16 to 20 years	23	8.3
	21 years and above	58	20.9
An approximation of your normal workload that involves teaching (percentage of full-time equivalent percentage)	0 to 0.25 FTE	37	13.3
	0.26 to 0.50 FTE	67	24.1
	0.51 to 0.75 FTE	70	25.2
	0.76 to 1 FTE	104	37.4
Faculty institutional role	Full Professor	62	22.3
	Associate Professor	51	18.3
	Assistant Professor	63	22.7
	Lecturer	50	18
	Instructor	52	18.7
Institution type	Associate's colleges (state/community colleges)	64	23

	Frequency	Percentage
Doctoral-granting universities (research intensive/research extensive)	98	35.3
Master's colleges and universities (at least 50 master’s degrees and fewer than 20 doctoral degree programs)	59	21.2
Baccalaureate colleges (focus on undergraduate degrees)	57	20.5

The respondent group consisted of 77 tenured faculty (27.7%), 64 tenure-track faculty (22%), and 137 non-tenure track faculty (49.3%). There were 130 males (46.8%) and 146 females (52.5%). Most participants, 155 (55.8%), were between 26 and 50 years of age, followed by 122 participants (43.9%) who were above 51 years of age. The number of participants whose normal workload which involves teaching (percentage of full-time equivalent) was 37 (13.3%) between 0 and 0.25 FTE, 67 (24.1%) between 0.26 and 0.50 FTE, 70 (25.2%) between 0.51 and 0.75 FTE, and 104 (37.4%) between 0.76 to 1 FTE. The institutional role of the participants included 62 (22.3%)full professors, 51 (18.3%)associate professors, 63 (22.7%)assistant professors, 50 (18%)lecturers, and 52 (18.7%)instructors. The majority of participants, 98 (35.3%), were at doctoral-granting universities (research intensive/research extensive), while 64 (23%) were at associate's colleges (state/ community colleges), 59 (21.2%) were at master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and 57 (20.5%) were at baccalaureate colleges (focus on undergraduate degrees).

Faculty Perceptions of Contextual Factors Correlated with Department Climate for Teaching Quality Improvement

Participants rated contextual factors in relationship to departmental climate for teaching quality improvement. In terms of leadership, the results indicated that 19%, 39%, and 21% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that the program coordinator has a clear vision of how to improve teaching in the department or program. Moreover, 28%, 34%, and 20% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that the program coordinator implements teaching-related policies in a consistent and transparent manner. About 35%, 33%, 19% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that the program coordinator inspires respect for his or her ability as a teacher. Furthermore, 41%, 37%, and 14%, of the participants strongly agreed, agreed, or

somewhat agreed, respectively, that the program coordinator is receptive to ideas about how to improve teaching in the department or program. About 36%, 44%, and 9% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that the program coordinator is tolerant of fluctuations in student evaluations when instructors are trying to improve their teaching. Finally, 28%, 39%, and 21% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that the program coordinator is willing to seek creative solutions to budgetary constraints to maintain adequate support for teaching improvements (Table 5) (Figure 1).

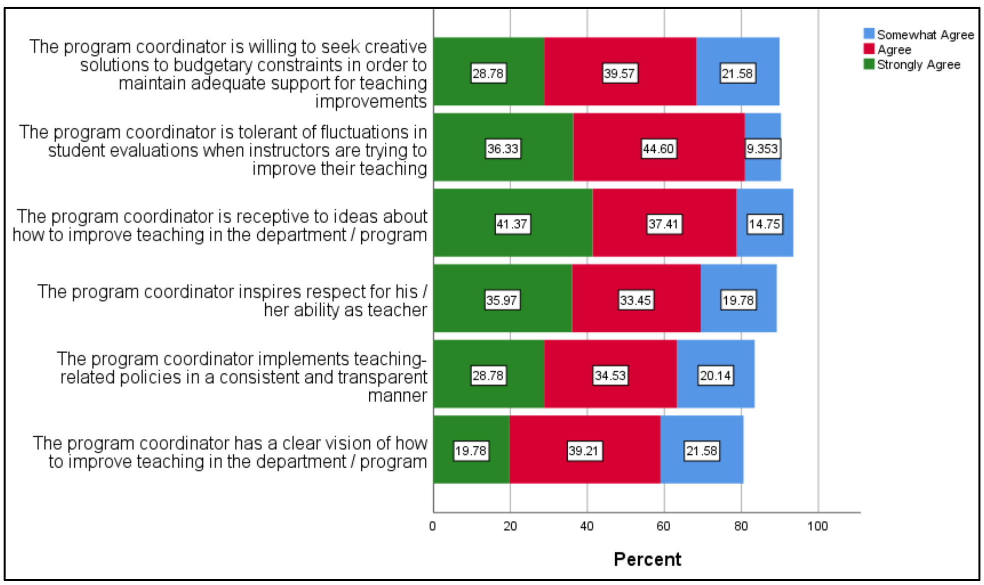

Figure 1. STEM Faculty Perceptions of the Correlation of Leadership with Department Climate for Teaching Improvement

Regarding collegiality, 41%, 26%, and 21% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that instructors in their department or program frequently talk with one another. About 37%, 26%, and 25% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that instructors in their department or program discuss the challenges they face in the classroom with colleagues. Approximately 43%, 26%, and 21% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that instructors in their

department or program share resources (ideas, materials, sources, technology, etc.) about how to improve teaching with colleagues. About 17%, 24%, and 28% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that instructors in their department or program use teaching observations to improve their teaching. About 14%, 27%, and 34% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that instructors in their department or program are "ahead of the curve" when it comes to implementing innovative teaching strategies. Lastly, about 37% ,30%, and 17% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that instructors in their department or program have someone they can go to for advice about teaching (Table 5) (Figure 2).

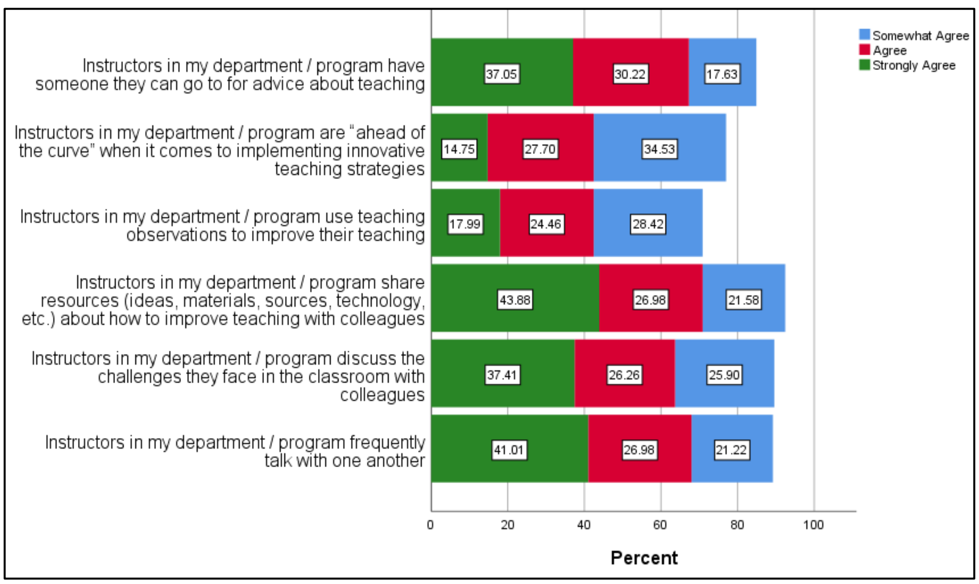

Figure 2. STEM Faculty Perceptions of the Correlation of Collegiality with Department Climate for Teaching Improvement

Regarding resources, about 16%, 39%, and 25% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that instructors in their department or program have adequate departmental funding to support teaching. About 29%, 36%, and 20% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that instructors in their department or program have adequate space to meet with students outside of class.

Approximately 15%, 31%, and 33% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that instructors in their department/program have adequate time to reflect upon and make changes to their instruction (Table 5) (Figure 3).

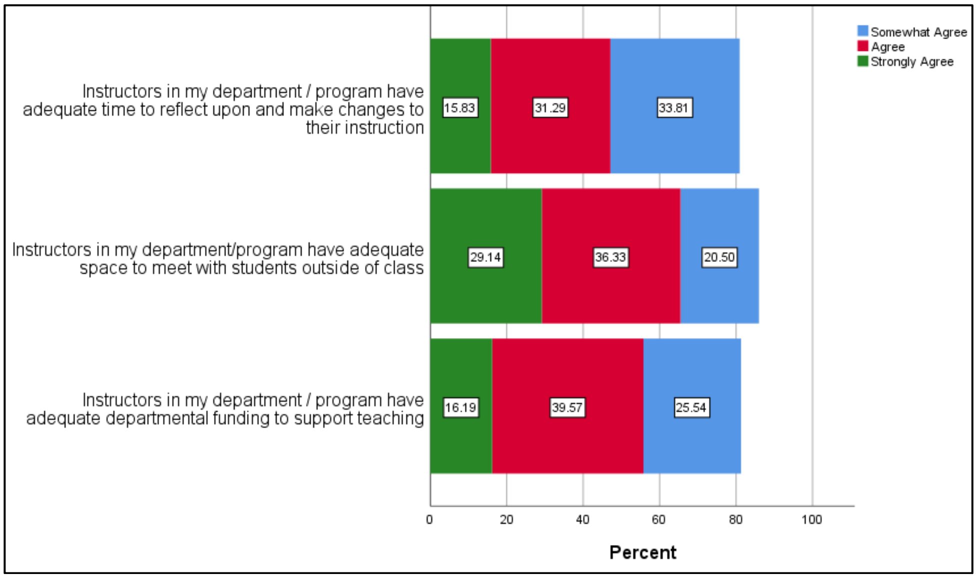

Figure 3. STEM Faculty Perceptions of the Correlation of Resources with Department Climate for Teaching Improvement

Regarding professional development, about 11%, 21%, and 23% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that instructors in their department or program are assigned a mentor for advice about teaching. About 15%, 20%, and 20% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that in their department or program, teaching development events (i.e. talks, workshops) are hosted specifically for department or program instructors. Lastly, about 18%, 37%, and 21% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that in their department or program new instructors are provided teaching development opportunities and resources (Table 5) (Figure 4).

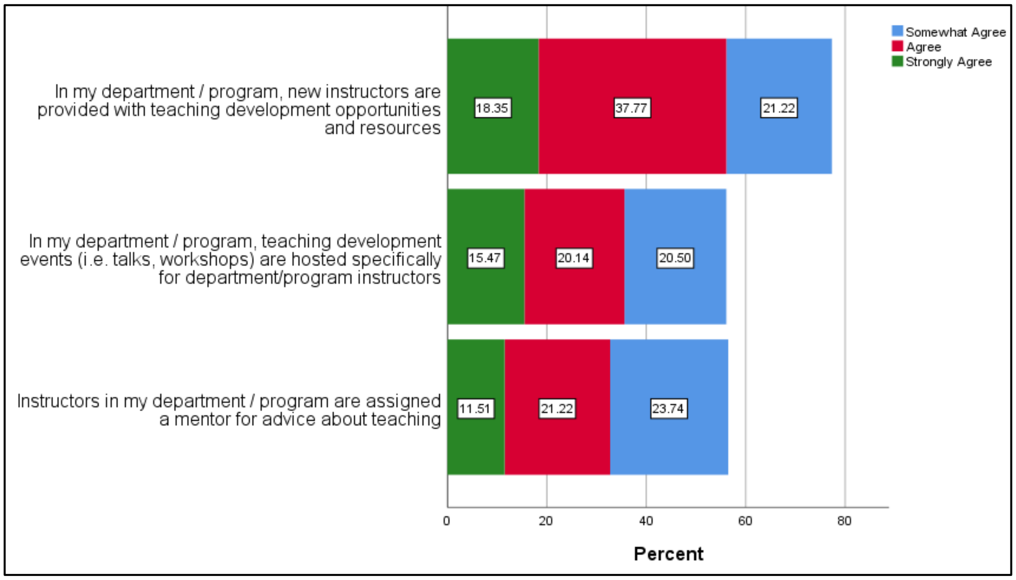

Figure 4. STEM Faculty Perceptions of the Correlation of Professional Development with Department Climate for Teaching Improvement

Regarding autonomy, about 33%, 35%, and 16% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that instructors in their department or program have considerable flexibility in the content they teach in their courses. About 54%, 31%, and 10% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that instructors in their department or program have considerable flexibility in the way they teach their courses. Lastly, about 11%, 17%, and 27% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that in their department or program, there are structured groups organized around the support and pursuit of teaching improvement (Table 5) (Figure 5).

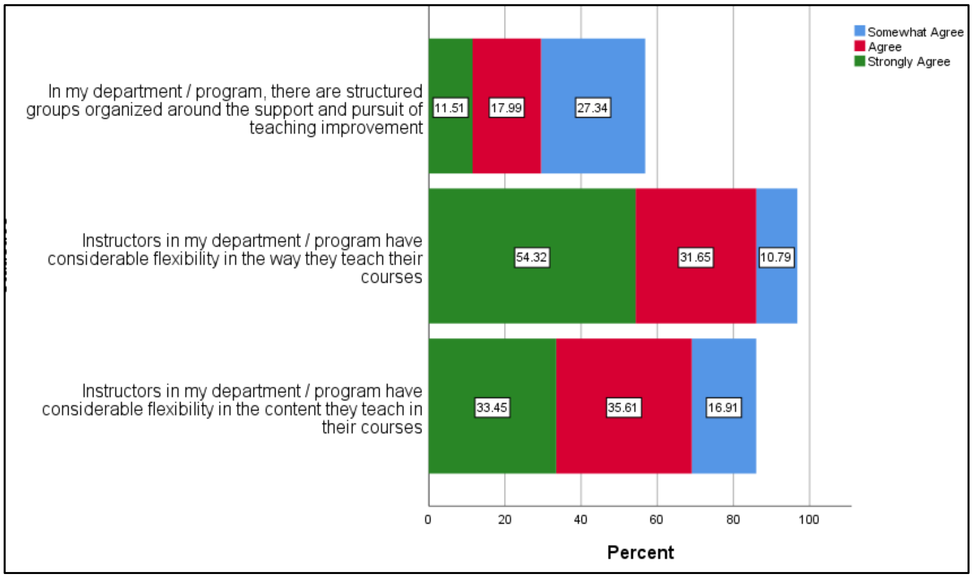

Figure 5. STEM Faculty Perceptions of the Correlation of Autonomy with Department Climate for Teaching Improvement

Regarding respect, about 32%, 36%, and 17% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that evidence of effective teaching is valued when making decisions about continued employment and/or promotion. About 20%, 34%, and 28% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that differences of opinion are valued in decision-making related to teaching improvement. About 21%, 44%, and 17% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that courses are fairly distributed among instructors. About 44%, 29%, and 17% of the participants strongly agreed, agreed, or somewhat agreed, respectively, that teaching is respected as an important aspect of academic work, and about 25%, 36%, and 20% of the participants assured that all of the instructors are sufficiently competent to teach effectively (Table 5) (Figure 6).

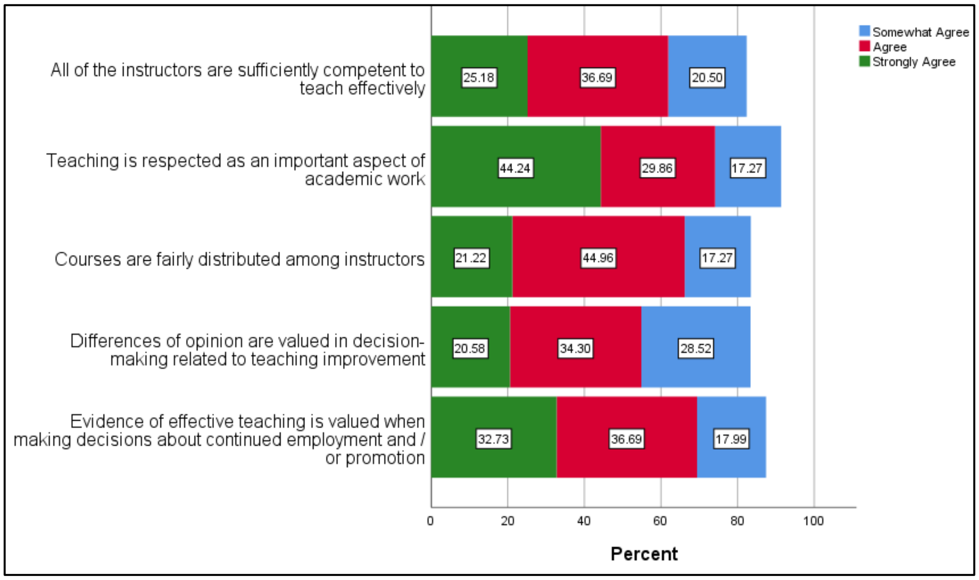

Figure 6. STEM Faculty Perceptions of the Correlation of Respect with Department Climate for Teaching Improvement

Table 5. Frequency and Percentage of Participants

Perceived Contextual Factors		Strongly Agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
Leadership	The program coordinator has a clear vision of how to improve teaching in the department/ program	55 (19%)	109 (39%)	60 (21%)	35 (12%)	13 (4%)	6 (2%)
	The program coordinator implements teaching-related policies in a consistent and transparent manner	80 (28%)	96 (34%)	56 (20%)	30 (10%)	12 (4%)	4 (1%)
	The program coordinator inspires respect for his/her ability as teacher	100 (36%)	39 (33%)	55(19%)	16(5%)	10 (3%)	4 (1%)
	The program coordinator is receptive to ideas about how to improve teaching in the department/program	115(41 %)	194(3 7%)	41(14%)	10(3%)	5 (1%)	3 (1%)
	The program coordinator is tolerant of fluctuations in student evaluations when instructors are trying to improve their teaching	101 (36%)	124 (44%)	26 (9%)	13 (4%)	9 (3%)	5 (1%)

Perceived Contextual Factors		Strongly Agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
	The program coordinator is willing to seek creative solutions to budgetary constraints in order to maintain adequate support for teaching improvements	80 (28%)	110 (39%)	60 (21%)	20 (7%)	4 (1%)	4 (1%)
Collegiality	Instructors in my department/ program frequently talk with one another	114 (41%)	75 (27%)	59 (21%)	21 (7%)	3 (1%)	6 (2%)
	Instructors in my department/ program discuss the challenges they face in the classroom with colleagues	104 (37%)	73 (26 %)	72 (25%)	21 (7%)	5 (1%)	3 (1%)
	Instructors in my department/program share resources (ideas, materials, sources, technology, etc.) about how to improve teaching with colleagues	122 (43%)	75 (27%)	60 (21%)	15 (5%)	4 (1%)	2 (.7%)
	Instructors in my department/program use teaching observations to improve their teaching	50 (28%)	68 (24%)	79 (28%)	39 (14%)	33 (11%)	9 (3%)

Perceived Contextual Factors		Strongly Agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
	Instructors in my department/program are "ahead of the curve" when it comes to implementing innovative teaching strategies	41 (14%)	77 (27%)	96 (34%)	41 (14%)	15 (5%)	8 (2%)
	Instructors in my department/program have someone they can go to for advice about teaching	103 (37%)	84 (30%)	49 (17%)	28 (10%)	8 (2%)	6 (2%)
Resources	Instructors in my department/program have adequate departmental funding to support teaching	45 (16%)	110 (39%)	71 (25%)	31 (11%)	12 (4%)	9 (3%)
	Instructors in my department/program have adequate space to meet with students outside of class	81 (29%)	101 (36%)	57 (20%)	25 (9%)	8 (2%)	6 (2%)
	Instructors in my department/program have adequate time to reflect upon and make changes to their instruction	44 (15%)	87 (31%)	94 (33%)	28 (10%)	15 (5%)	10 (3%)

Perceived Contextual Factors		Strongly Agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
Professional Development	Instructors in my department/program are assigned a mentor for advice about teaching	32 (11%)	59 (21%)	66 (23%)	47 (16%)	57 (20%)	17 (6%)
	In my department/program, teaching development events (i.e. talks, workshops) are hosted specifically for department/program instructors	43 (15%)	56 (20%)	57(20%)	50(18%)	45 (16%)	27 (9%)
	In my department/program, new instructors are provided with teaching development opportunities and resources	51(18 %)	105 (37%)	59 (21%)	26 (9%)	28 (10%)	9 (3%)
Autonomy	Instructors in my department/program have considerable flexibility in the content they teach in their courses	93 (33%)	99 (35%)	47 (16%)	24 (8%)	14 (5%)	1 (0.4%)
	Instructors in my department/program have considerable flexibility in the way they teach their courses	151 (54%)	88 (31%)	30 (10%)	6 (2%)	2 (0.7%)	1 (0.4%)

Perceived Contextual Factors		Strongly Agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
Respect	In my department/program, there are structured groups organized around the support and pursuit of teaching improvement	32 (11%)	50 (18%)	76 (27%)	72 (25%)	36 (12%)	12 (4%)
	Evidence of effective teaching is valued when making decisions about continued employment and/or promotion	91 (32%)	102 (36%)	50 (18%)	26 (9%)	4 (1%)	5 (1%)
	Differences of opinion are valued in decision-making related to teaching improvement	57 (20%)	95 (34%)	79 (29%)	28 (10%)	15 (5%)	3 (1%)
	Courses are fairly distributed among instructors	59 (21%)	125 (45%)	48 (17%)	25 (9%)	13 (4%)	8 (3%)
	Teaching is respected as an important aspect of academic work	123 (44%)	83 (29%)	48 (17%)	11 (4%)	8 (3%)	5 (1%)
	All of the instructors are sufficiently competent to teach effectively	70 (25%)	102 (36%)	57 (20%)	29 (10%)	10 (3%)	10 (3%)

Measures of central tendency (Table 6) were computed to summarize data for faculty perceptions of contextual factors correlated with department climate for teaching quality improvement. The results showed that the majority of faculty reported that teaching is supported within their institutions in terms of leadership, collegiality, and resources. Regarding professional development, the results showed that the majority of faculty reported that they were occasionally provided with opportunities to improve their teaching practices and approaches. In terms of autonomy, the results showed that the majority of faculty assured that they have considerable flexibility in the content and the way they teach their courses. On the other hand, most faculty reported that they are not supported with structured groups organized around the support and pursuit of teaching improvement. Lastly, the results showed that the majority of faculty reported that teaching is respected as an important aspect of academic work and valued when making decisions about continued employment and/or promotion. Table 5 shows the results in percentages for the faculty perceptions of contextual factors correlated with department climate for teaching quality improvement.

Table 6. Measures of Central Tendency for STEM Faculty Perceptions of Contextual Factors

Perceived Contextual Factors		Mean	Median	Mode
Leadership	The program coordinator has a clear vision of how to improve teaching in the department/ program	4.5	5	5
	The program coordinator implements teaching-related policies in a consistent and transparent manner	4.68	5	5
	The program coordinator inspires respect for his/her ability as teacher	4.88	5	5
	The program coordinator is receptive to ideas about how to improve teaching in the department/program	5.10	5	6
	The program coordinator is tolerant of fluctuations in student evaluations when instructors are trying to improve their teaching	5.01	5	5
	The program coordinator is willing to seek creative solutions to budgetary constraints in order to maintain adequate support for teaching improvements	4.83	5	5
Collegiality	Instructors in my department/program frequently talk with one another	4.93	5	6
	Instructors in my department/program discuss the challenges they face in the classroom with colleagues	4.87	5	6
	Instructors in my department/program share resources (ideas, materials, sources, technology, etc.) about how to improve teaching with colleagues	5.04	5	6

Perceived Contextual Factors		Mean	Median	Mode
	Instructors in my department/program use teaching observations to improve their teaching	4.13	4	4
	Instructors in my department/program are "ahead of the curve" when it comes to implementing innovative teaching strategies	4.23	4	4
	Instructors in my department/program have someone they can go to for advice about teaching	4.82	5	6
Resources	Instructors in my department/program have adequate departmental funding to support teaching	4.42	5	5
	Instructors in my department/program have adequate space to meet with students outside of class	4.42	5	5
	Instructors in my department/program have adequate time to reflect upon and make changes to their instruction	4.73	4	5
Professional Development	Instructors in my department/program are assigned a mentor for advice about teaching	3.68	4	4
	In my department/program, teaching development events (i.e. talks, workshops) are hosted specifically for department/program instructors	3.72	4	4
	In my department/program, new instructors are provided with teaching development opportunities and resources	4.35	5	5
Autonomy	Instructors in my department/program have considerable flexibility in the content they teach in their courses	5.36	6	6

Perceived Contextual Factors		Mean	Median	Mode
	Instructors in my department/program have considerable flexibility in the way they teach their courses	5.76	4	4
	In my department/program, there are structured groups organized around the support and pursuit of teaching improvement	3.76	4	4
Respect	Evidence of effective teaching is valued when making decisions about continued employment and/or promotion	4.85	5	5
	Differences of opinion are valued in decision-making related to teaching improvement	4.51	5	5
	Courses are fairly distributed among instructors	4.6	5	5
	Teaching is respected as an important aspect of academic work	5.03	5	6
	All of the instructors are sufficiently competent to teach effectively	4.59	5	5

Note: the corresponding values for the Mode: 1 Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, and 6 = Strongly agree.

The Extent of the Perceived Contextual Factors Correlated Departmental Climate for Teaching Quality Improvement Across Institutional Types and Faculty's Institutional Roles

This section discusses the results based on partial least squares structural equation modeling (PLS-SEM). The repeated indicators approach was utilized to build the hierarchical component model in this study. PLS-SEM examined the relationships hypothesized between perceived contextual factors as low-order constructs and departmental climate for teaching quality improvement as a higher order construct across institutional types and faculty's institutional roles. Within the repeated indicators approach, all indicators of the subdimensions (the lower-order constructs) were also repeated to identify the main dimension (the higher-order construct). Therefore, the variance of the higher-order construct is explained by the lower-order constructs (Sarstedt et al., 2019). As an advantage, Beacker et al. (2012) asserted that the repeated indicators approach might produce smaller biases than other approaches such as the two-stage approach.

Lohmoller (1989) indicated that higher order constructs in the context of PLS-SEM are also called hierarchical component models. A higher order construct is modeled on an abstract dimension (known as a higher-order component) that is correlated with its concrete subdimensions (known as lower-order components). For the current study, all perceived contextual factors including leadership, collegiality, resources, professional development, autonomy, and respect are considered lower order constructs. On the other hand, department climate for teaching quality improvement is considered a higher order construct. Department climate for teaching quality improvement is considered a reflection of perceived contextual factors (Figure 7). Therefore, the direction of relationships is from perceived contextual factors to department climate for teaching improvement. When hierarchical component models are

reflective-reflective or formative-reflective, loadings should be represented. Conversely, when the models are formative-formative or reflective-formative, weights should be presented.

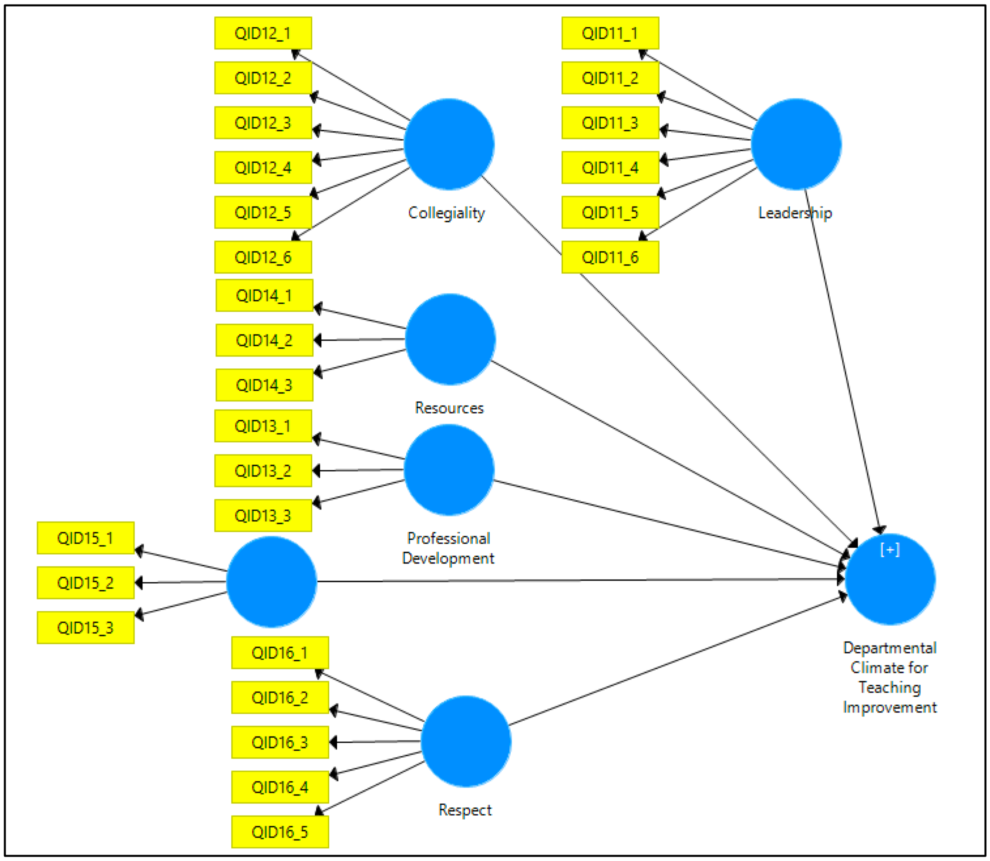

Figure 7. The PLS Hierarchical Component Model

The PLS-SEM, which utilized the repeated indicators approach, was selected as the study focus to explain the variance of the higher order construct (departmental climate for teaching improvement) by its lower-order constructs (i.e. leadership) across institutional types and faculty's institutional roles. The PLS approach also estimates a model with minimum restrictions in terms of sample size, data distributions, and measurement scales. Moreover, a "generate data groups" option in SmartPLS was applied to create data groups for institutional types and faculty's institutional roles. Bootstrapping was also applied to examine if there were significant

relationships between perceived contextual factors and departmental climate for teaching quality improvement across institutional types and faculty's institutional roles.

Measurement Model Assessment

To measure the reliability of the indicators, the factor loading should be considered. To confirm the reliability, the value of each indicator loading should be equal or greater than 0.6 or 0.7 (Hair et al., 2017). Furthermore, the values of Cronbach's Alpha and composite reliability for exploratory research should be equal or greater than 0.6. In this study, all the indicators satisfied the aforementioned criteria and were determined reliable, considering the results from PLS-SEM, except for the value of Cronbach's Alpha of autonomy construct (0.285) (Table 7), whereas the value of composite reliability of autonomy construct is 0.607 and acceptable.

To confirm the convergent validity, the average variance extracted (AVE) should be a value of 0.5 or greater. In this study, the value of AVE for all the constructs was greater than 0.5 except for the autonomy construct which was 0.364 as shown in Table 7. Fornell and Larcker (1981) indicated that AVE should be higher than 0.5 but 0.4 is accepted. They also added that when composite reliability is higher than 0.6 and AVE is less than 0.5, the convergent validity of the construct is still adequate. Based on that, the convergent validity of the constructs was confirmed.

Table 7. Measurement Model Results

Constructs	Indicators	Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Leadership	QID11-1	0.804	0.902	0.925	0.673
	QID11-2	0.817			
	QID11-3	0.860			
	QID11-4	0.852			
	QID11-5	0.787			
	QID11-6	0.800			
Collegiality	QID12-1	0.823	0.858	0.895	0.588
	QID12-2	0.846			
	QID12-3	0.789			
	QID12-4	0.643			
	QID12-5	0.722			
	QID12-6	0.760			
Professional Development	QID13-1	0.688	0.667	0.819	0.603
	QID13-2	0.819			
	QID13-3	0.816			
Resources	QID14-1	0.806	0.650	0.806	0.582
	QID14-2	0.675			
	QID14-3	0.800			
Autonomy	QID15-1	0.340	0.285	0.607	**0.364**
	QID15-2	0.567			
	QID15-3	0.809			
Respect	QID16-1	0.775	0.841	0.887	0.611
	QID16-2	0.821			
	QID16-3	0.761			
	QID16-4	0.800			
	QID16-5	0.748			
Departmental Climate			0.919	0.929	0.347

To confirm the discriminant validity, HTMT, Fornell-Larcker criterion, and cross-loadings were examined. Regarding HTMT, a value of less than 0.85 should be confirmed. As shown in Table 7, HTMT is not confirmed. However, the discriminant validity can still be confirmed and measured by examining Fornell-Larcker criterion and the cross-loadings (Hair et al., 2017). Based on the aforementioned analyses, Table 8 and Table 9 demonstrate that the specified criterion is met. Tabachnick and Fidell (2001) indicated that 0.32 is a threshold for the minimum loading of an item. Thus, the discriminant validity is confirmed.

Table 8. Heterotrait-Monotrait Ratio (HTMT) Results

	A	C	DCTI	L	PD	RESP	RESO
A							
C	0.574						
DCTI	**0.920**	0.893					
L	0.588	0.571	0.884				
PD	0.726	0.624	0.821	0.441			
RESP	0.647	0.667	**0.947**	0.702	0.600		
RESO	0.687	0.475	0.817	0.520	0.600	0.666	

A=Autonomy, C=Collegiality, DCTI=Departmental Climate for Teaching Improvement, L=Leadership, PD=Professional Development, RESO=Resources, RESP=Respect.

Table 9. Fornell-Larcker Criterion Results

	A	C	DCTI	L	PD	RESP	RESO
A	**0.603**						
C	0.496	**0.767**					
DCTI	0.626	0.813	**0.600**				
L	0.424	0.516	0.830	**0.820**			
PD	0.465	0.487	0.614	0.341	**0.777**		
RESP	0.461	0.586	0.849	0.619	0.451	**0.781**	
RESO	0.43	0.387	0.624	0.409	0.427	0.520	**0.763**

A=Autonomy, C=Collegiality, DCTI=Departmental Climate for Teaching Improvement, L=Leadership, PD=Professional Development, RESO=Resources, RESP=Respect.

Table 10. Cross-Loadings Results

Indicators	A	C	L	PD	RESO	RESP
QID11-1			0.804			
QID11-2			0.817			
QID11-3			0.860			
QID11-4			0.852			
QID11-5			0.787			
QID11-6			0.800			
QID12-1		0.823				
QID12-2		0.846				
QID12-3		0.789				
QID12-4		0.643				
QID12-5		0.722				
QID12-6		0.760				
QID13-1				0.688		
QID13-2				0.819		
QID13-3				0.816		
QID14-1					0.806	
QID14-2					0.675	
QID14-3					0.800	
QID15-1	0.340					
QID15-2	0.567					
QID15-3	0.809					
QID16-1						0.775
QID16-2						0.821
QID16-3						0.761
QID16-4						0.800
QID16-5						0.748

A=Autonomy, C=Collegiality, L=Leadership, PD=Professional Development, RESO=Resources, RESP=Respect.

To evaluate the formative measurement (departmental climate for teaching quality improvement), multicollinearity statistics (inner VIF) should be addressed. Table 11 indicates that all the constructs associated with departmental climate have VIF less than 5. Therefore, the model doesn't suffer from multicollinearity.

Table 11. VIF, Outer Loadings, and Outer Weight Results

Constructs	Indicators	Inner VIF Values	Outer VIF Values	Outer Loadings	Outer Weights
A	QID15-1	1.583	1.301	0.340	0.263
	QID15-2		1.275	0.567	0.419
	QID15-3		1.032	0.809	0.832
C	QID12-1	1.850	3.222	0.823	0.205
	QID12-2		3.803	0.846	0.207
	QID12-3		2.294	0.789	0.220
	QID12-4		1.507	0.643	0.180
	QID12-5		1.654	0.722	0.227
	QID12-6		1.639	0.760	0.267
L	QID11-1	1.764	2.389	0.804	0.204
	QID11-2		2.352	0.817	0.200
	QID11-3		2.850	0.860	0.216
	QID11-4		2.692	0.852	0.198
	QID11-5		2.076	0.787	0.195
	QID11-6		2.219	0.800	0.206
PD	QID13-1	1.529	1.137	0.688	0.425
	QID13-2		1.603	0.819	0.411
	QID13-3		1.552	0.816	0.455
RESP	QID16-1	2.183	1.785	0.775	0.247
	QID16-2		1.909	0.821	0.289
	QID16-3		1.612	0.761	0.264
	QID16-4		1.888	0.800	0.262
	QID16-5		1.704	0.748	0.215
RESO	QID14-1	1.528	1.552	0.806	0.487
	QID14-2		1.312	0.675	0.297
	QID14-3		1.270	0.800	0.509

A=Autonomy, C=Collegiality, L=Leadership, PD=Professional Development, RESO=Resources, RESP=Respect.

Structural Model Assessment Across Institutional Types

The structural model was assessed to identify the relationships between perceived contextual factors and departmental climate for teaching quality improvement across institutional types as hypothesized (see Table 12 and Table 13). Path coefficients are crucial to indicate how

well the analyzed data support the research hypotheses. In the following sections, the results from the path model are discussed for each research hypothesis.

<u>Associate's Colleges</u>

Research hypothesis H1 stated that perceived contextual factors were positively correlated with departmental climate for teaching quality improvement in STEM at associate's colleges (state/community colleges) (Figure 8);

- H1a: Leadership was positively correlated with departmental climate for teaching quality improvement in STEM at associate's colleges (state/community colleges);

The path model results indicated that leadership ($t = 7.537$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at associate's colleges (state/community colleges). The direct effect of leadership on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.435. Thus, the research hypothesis H1a was supported.

- H1b: Collegiality was positively correlated with department climate for teaching improvement in STEM at associate's colleges (state/community colleges);

The path model results indicated that collegiality ($t = 1.22$, $p > 0.05$) was not significantly correlated with departmental climate for teaching quality improvement at associate's colleges (state/community colleges). Thus, the research hypothesis H1b was not supported.

- H1c: Resources were positively correlated with departmental climate for teaching improvement in STEM at associate's colleges (state/community colleges);

The path model results indicated that resources ($t = 3.852$, $p < 0.05$) were significantly correlated with departmental climate for teaching quality improvement at associate's colleges

(state/community colleges). The direct effect of resources on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.148. Thus, the research hypothesis H1c was supported.

- H1d: Professional development was positively correlated with departmental climate for teaching quality improvement in STEM at associate's colleges (state/community colleges);

The path model results indicated that professional development ($t = 9.852$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at associate's colleges (state/community colleges). The direct effect of professional development on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.148. Thus, the research hypothesis H1d was supported.

- H1e: Autonomy was positively correlated with department climate for teaching improvement in STEM at associate's colleges (state/community colleges);

The path model results indicated that autonomy ($t = 7.537$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at associate's colleges (state/community colleges). The direct effect of autonomy on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.112. Thus, the research hypothesis H1e was supported.

- H1f: Respect was positively correlated with departmental climate for teaching quality improvement in STEM at associate's colleges (state/community colleges).

The path model results indicated that respect ($t = 9.23$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at associate's colleges

(state/community colleges). The direct effect of respect on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.422. Thus, the research hypothesis H1f was supported.

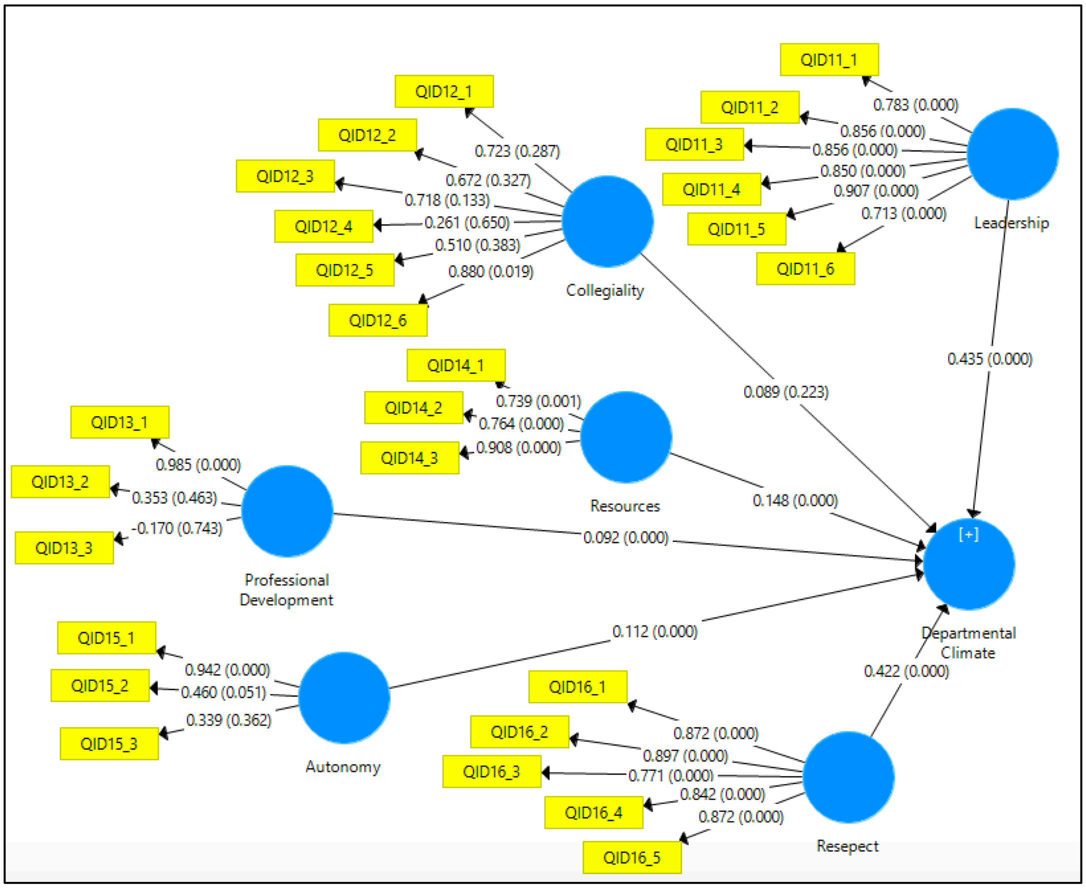

Figure 8. The PLS Hierarchical Component Model at Associate's Colleges

<u>Doctoral-Granting Universities</u>

Research hypothesis H2 stated that perceived contextual factors were positively correlated with department climate for teaching quality improvement in STEM at doctoral-granting universities (research intensive/research extensive) (Figure 9);

- H2a: Leadership was positively correlated with departmental climate for teaching quality improvement in STEM at doctoral-granting universities (research intensive/research extensive);

The path model results indicated that leadership ($t = 14.34$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at doctoral-granting universities (research intensive/research extensive). The direct effect of leadership on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.365. Thus, the research hypothesis H2a was supported.

- H2b: Collegiality was positively correlated with departmental climate for teaching quality improvement in STEM at doctoral-granting universities (research intensive/research extensive);

The path model results indicated that collegiality ($t = 9.307$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at doctoral-granting universities (research intensive/research extensive). The direct effect of collegiality on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.305. Thus, the research hypothesis H2b was supported.

- H2c: Resources were positively correlated with department climate for teaching improvement at doctoral-granting universities (research intensive/research extensive);

The path model results indicated that resources ($t = 4.485$, $p < 0.05$) were significantly correlated with departmental climate for teaching quality improvement at doctoral-granting universities (research intensive/research extensive). The direct effect of resources on

departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.093. Thus, the research hypothesis H2c was supported.

- H2d: Professional development was positively correlated with department climate for teaching improvement in STEM at doctoral-granting universities (research intensive/research extensive);

The path model results indicated that professional development ($t = 7.696$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at associate's colleges (state/community colleges). The direct effect of professional development on departmental climate for teaching quality improvement was positive showing a computed path coefficient value of 0.142. Thus, the research hypothesis H2d is supported.

- H2e: Autonomy was positively correlated with departmental climate for teaching quality improvement in STEM at doctoral-granting universities (research intensive/research extensive);

The path model results indicated that autonomy ($t =4.33$, $p < 0.05$) had a significant correlation with departmental climate for teaching quality improvement at doctoral-granting universities (research intensive/research extensive). The direct effect of autonomy on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.074. Thus, the research hypothesis H2e was supported.

- H2f: Respect was positively correlated with department climate for teaching improvement in STEM at doctoral-granting universities (research intensive/research extensive).

The path model results indicated that respect (t = 10.963, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at doctoral-granting universities (research intensive/research extensive). The direct effect of respect on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.281. Thus, the research hypothesis H2f was supported.

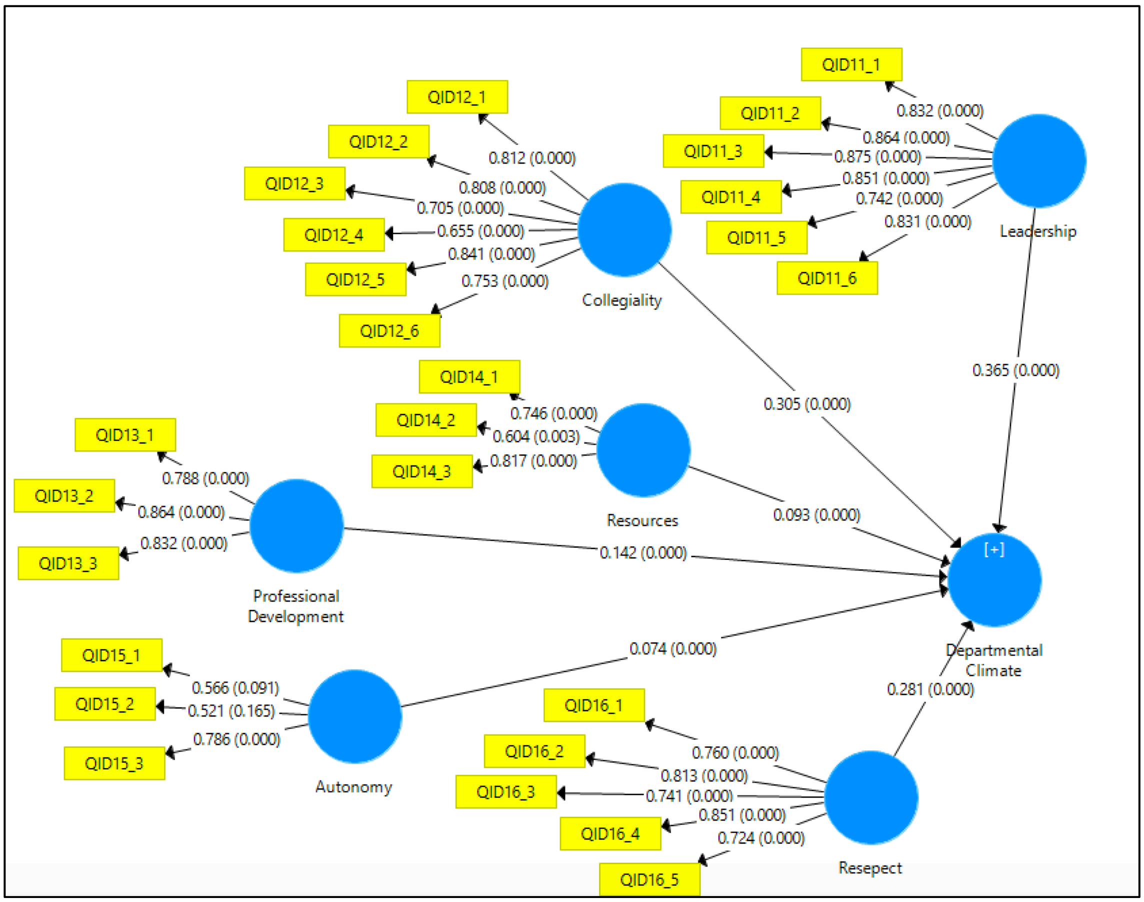

Figure 9. The PLS Hierarchical Component Model at Doctoral-Granting Universities

Master's Colleges and Universities

Research hypothesis H3 stated that perceived contextual factors were positively correlated with departmental climate for teaching improvement in STEM at master's colleges and

universities (at least 50 master's degrees and fewer than 20 doctoral degree programs) (Figure 10);

- H3a: Leadership was positively correlated with department climate for teaching improvement in STEM at master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs);

The path model results indicated that leadership ($t = 4.503$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality at master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs). The direct effect of leadership on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.346. Thus, the research hypothesis H3a was supported.

- H3b: Collegiality was positively correlated with departmental climate for teaching quality improvement in STEM at master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs);

The path model results indicated that collegiality ($t = 8.214$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs). The direct effect of collegiality on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.062. Thus, the research hypothesis H3b was supported.

- H3c: Resources were positively correlated with departmental climate for teaching improvement in STEM at master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs);

The path model results indicated that resources ($t = 5.884$, $p < 0.05$) were significantly correlated with departmental climate for teaching quality improvement at master's colleges and universities. The direct effect of resources on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.153. Thus, the research hypothesis H3c was supported.

- H3d: Professional development was positively correlated with departmental climate for teaching quality improvement in STEM at master's colleges and universities;

The path model results indicated that professional development ($t = 2.790$, $p > 0.05$) was significantly correlated with departmental climate for teaching quality improvement at master's colleges and universities (at least 50 master’s degrees and fewer than 20 doctoral degree programs). The direct effect of professional development on departmental climate for teaching quality improvement was positive showing a computed path coefficient value of 0.091. Thus, the research hypothesis H3d was supported.

- H3e: Autonomy was positively correlated with departmental climate for teaching quality improvement in STEM at master's colleges and universities;

The path model results indicated that autonomy ($t = 3.373$, $p > 0.05$) was significantly correlated with departmental climate for teaching quality improvement at master's colleges and universities. The direct effect of autonomy on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.062. Thus, the research hypothesis H3e was supported.

- H3f: Respect was positively correlated with departmental climate for teaching quality improvement in STEM at master's colleges and universities.

The path model results indicated that respect (t = 6.046, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at master's colleges and universities. The direct effect of respect on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.153. Thus, the research hypothesis H3f was supported.

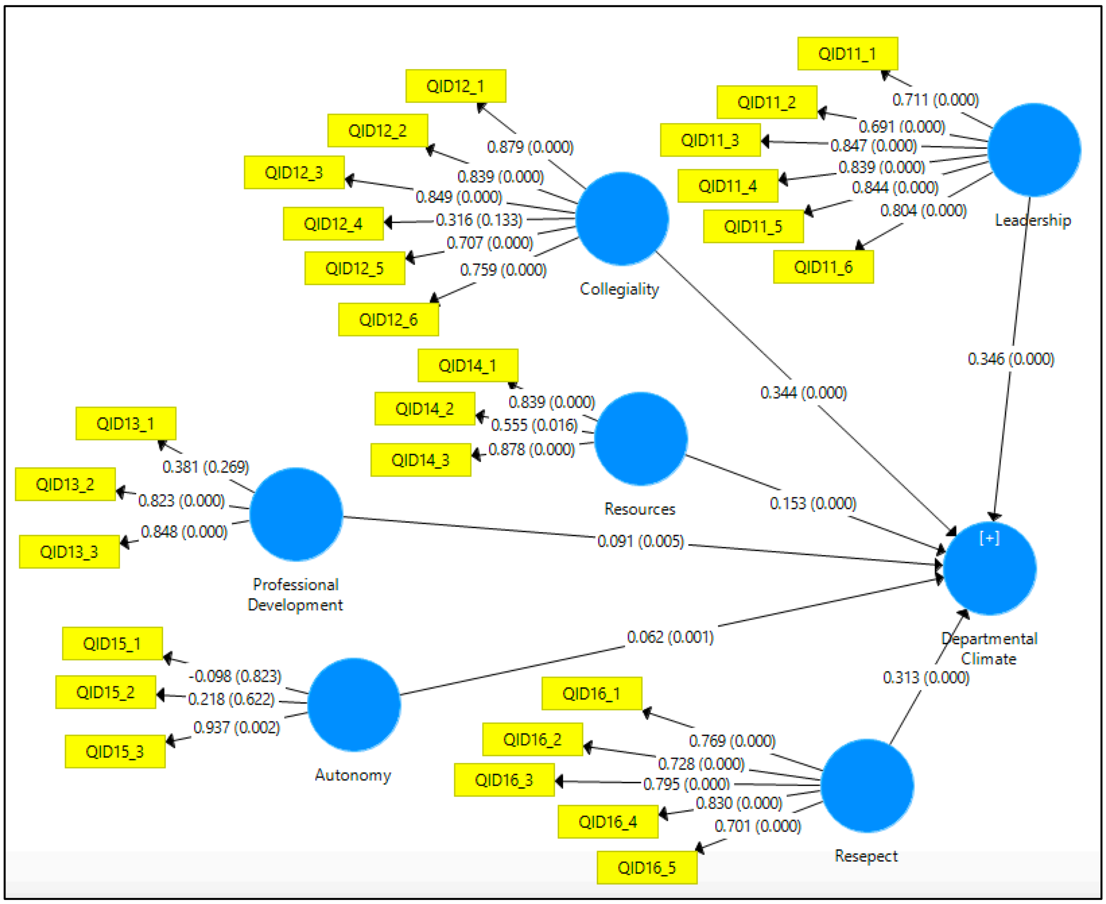

Figure 10. The PLS Hierarchical Component Model at Master's Colleges and Universities

<u>Baccalaureate Colleges</u>

Research hypothesis H4 stated that perceived contextual factors were positively correlated with department climate for teaching improvement in STEM at baccalaureate colleges (focus on undergraduate degrees) (Figure 11);

- H4a: Leadership was positively correlated with departmental climate for teaching quality improvement in STEM at baccalaureate colleges (focus on undergraduate degrees);

The path model results indicated that leadership ($t = 12.21$, $p = p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at baccalaureate colleges (focus on undergraduate degrees). The direct effect of leadership on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.373. Thus, the research hypothesis H4a was supported.

- H4b: Collegiality was positively correlated with departmental climate for teaching quality improvement in STEM at baccalaureate colleges (focus on undergraduate degrees);

The path model results indicated that collegiality ($t = 14.84$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at baccalaureate colleges (focus on undergraduate degrees). The direct effect of collegiality on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.373. Thus, the research hypothesis H3b was supported.

- H4c: Resources were positively correlated with department climate for teaching improvement in STEM at baccalaureate colleges (focus on undergraduate degrees);

The path model results indicated that resources ($t = 4.41$, $p < 0.05$) were significantly correlated with departmental climate for teaching quality improvement at baccalaureate colleges (focus on undergraduate degrees). The direct effect of resources on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.075. Thus, the research hypothesis H4c was supported.

- H4d: Professional development was positively correlated with departmental climate for teaching quality improvement in STEM at baccalaureate colleges (focus on undergraduate degrees);

The path model results indicated professional development ($t = 4.314$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at baccalaureate colleges (focus on undergraduate degrees). The direct effect of professional development on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.082. Thus, the research hypothesis H4d was supported.

- H4e: Autonomy was positively correlated with department climate for teaching improvement in STEM at baccalaureate colleges (focus on undergraduate degrees);

The path model results indicated that autonomy ($t = 6.11$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at baccalaureate colleges (focus on undergraduate degrees). The direct effect of autonomy on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.097. Thus, the research hypothesis H4e was supported.

- H4f: Respect was positively correlated with departmental climate for teaching quality improvement in STEM at baccalaureate colleges (focus on undergraduate degrees);

The path model results indicated that respect ($t = 10.768$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement at baccalaureate colleges (focus on undergraduate degrees). The direct effect of respect on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of. 0.218. Thus, the research hypothesis H4f was supported.

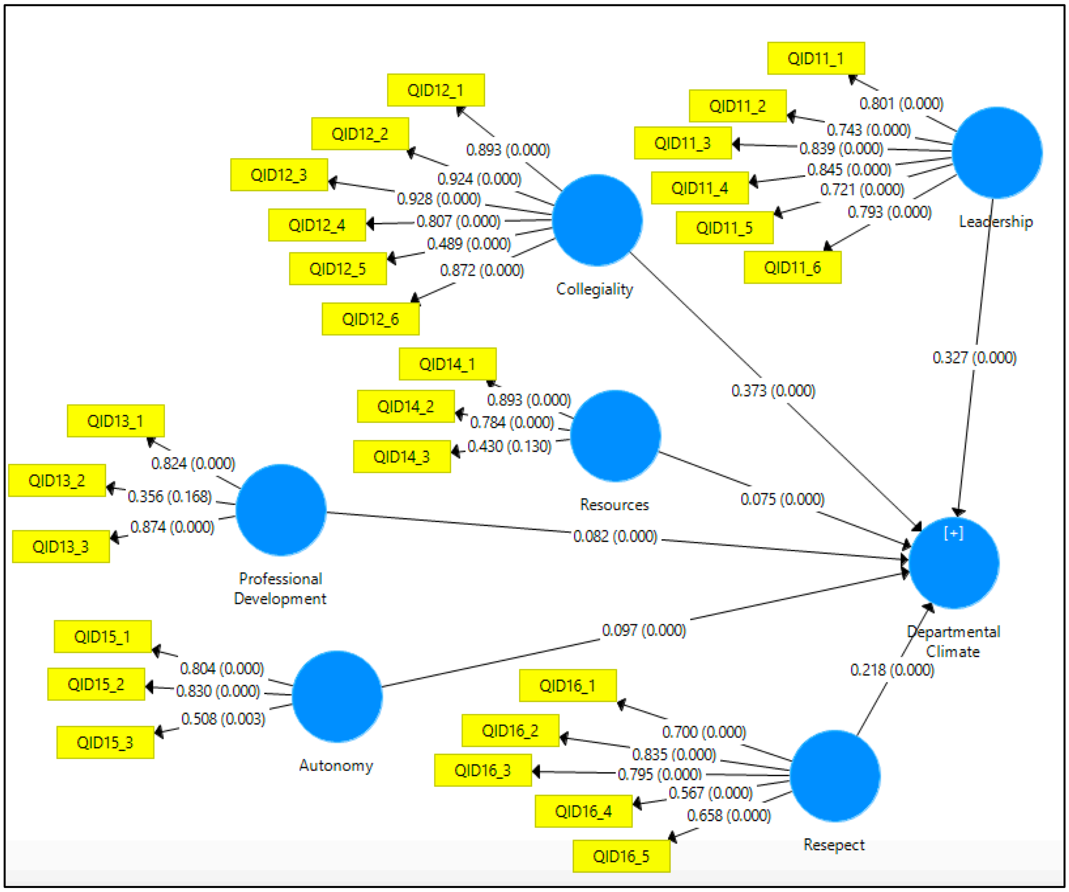

Figure 11. The PLS Hierarchical Component Model at Baccalaureate Colleges

Structural Model Assessment Across Faculty Institutional Roles

Full Professor

Research hypothesis H5 stated that perceived contextual factors were positively correlated with departmental climate for teaching quality improvement in STEM among full professors (Figure 12);

- H5a: Leadership was positively correlated with department climate for teaching improvement in STEM among full professors;

The path model results indicated that leadership ($t = 8.93$, $p = p < 0.05$) was significantly correlated with departmental climate for teaching quality among full professors. The direct effect of leadership on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.331. Thus, the research hypothesis H5a was supported.

- H5b: Collegiality was positively correlated with departmental climate for teaching quality improvement in STEM among full professors;

The path model results indicated that collegiality ($t = 7.29$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among full professors. The direct effect of collegiality on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.291. Thus, the research hypothesis H5b was supported.

- H5c: Resources were positively correlated with department climate for teaching improvement in STEM among full professors;

The path model results indicated resources ($t = 6.138$, $p < 0.05$) were significantly correlated with departmental climate for teaching quality improvement among full professors. The direct effect of resources on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.124. Thus, the research hypothesis H5c was supported.

- H5d: Professional development was positively correlated with department climate for teaching improvement in STEM among full professors;

The path model results indicated professional development ($t = 8.85$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among full

professors. The direct effect of professional development on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.150. Thus, the research hypothesis H5d was supported.

- H5e: Autonomy was positively correlated with departmental climate for teaching quality improvement in STEM among full professors;

The path model results indicated autonomy ($t = 6.578$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among full professors. The direct effect of autonomy on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.096. Thus, the research hypothesis H5e was supported.

- H5f: Respect was positively correlated with departmental climate for teaching quality improvement in STEM among full professors;

The path model results indicated that respect ($t = 7.477$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among full professors. The direct effect of respect on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.247. Thus, the research hypothesis H5f was supported.

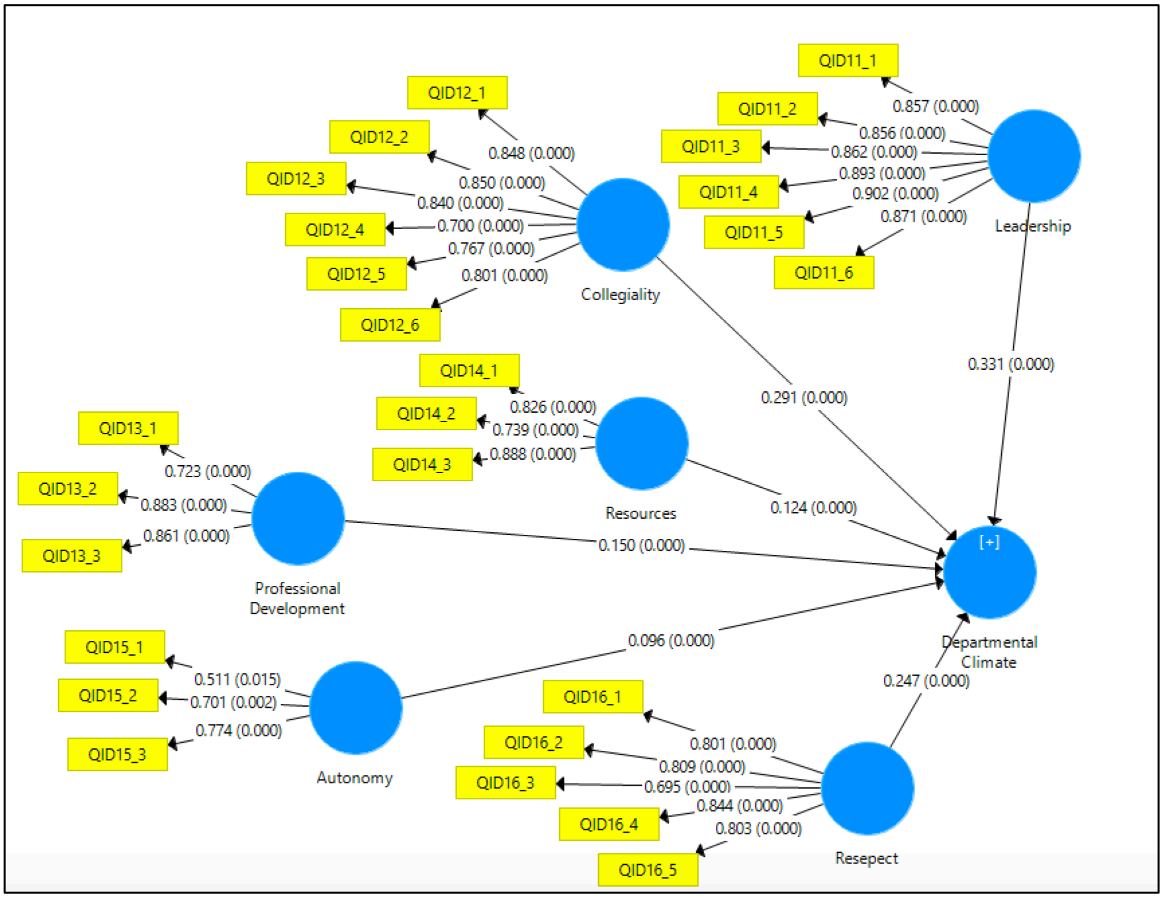

Figure 12. The PLS Hierarchical Component Model Among Full Professors

Associate Professor

Research hypothesis H6 stated that perceived contextual factors were positively correlated with departmental climate for teaching quality improvement in STEM among associate professors (Figure 13);

- H6a: Leadership was positively correlated with departmental climate for teaching quality improvement in STEM among associate professors;

The path model results indicated that leadership ($t = 9.944$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among associate professors. The direct effect of leadership on departmental climate for teaching quality

improvement was positive, showing a computed path coefficient value of 0.332. Thus, the research hypothesis H6a was supported.

- H6b: Collegiality was positively correlated with departmental climate for teaching quality improvement in STEM among associate professors;

The path model results indicated that collegiality ($t = 9.944$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among associate professors. The direct effect of collegiality on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.321. Thus, the research hypothesis H6b was supported.

- H6c: Resources were positively correlated with department climate for teaching improvement in STEM among associate professors;

The path model results indicated that resources ($t = 6.123$, $p < 0.05$) were significantly correlated with departmental climate for teaching quality improvement among associate professors. The direct effect of resources on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.117. Thus, the research hypothesis H6c was supported.

- H6d: Professional development was positively correlated with department climate for teaching improvement in STEM among associate professors;

The path model results indicated professional development ($t = 4.675$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among associate professors. The direct effect of professional development on departmental climate for

teaching improvement was positive, showing a computed path coefficient value of 0.142. Thus, the research hypothesis H6d was supported.

- H6e: Autonomy was positively correlated with departmental climate for teaching quality improvement in STEM among associate professors;

The path model results indicated autonomy ($t = 3.303$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among associate professors. The direct effect of autonomy on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.064. Thus, the research hypothesis H6e was supported.

- H6f: Respect was positively correlated with department climate for teaching improvement in STEM among associate professors;

The path model results indicated that respect ($t = 10.191$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among associate professors. The direct effect of respect on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.237. Thus, the research hypothesis H6f was supported.

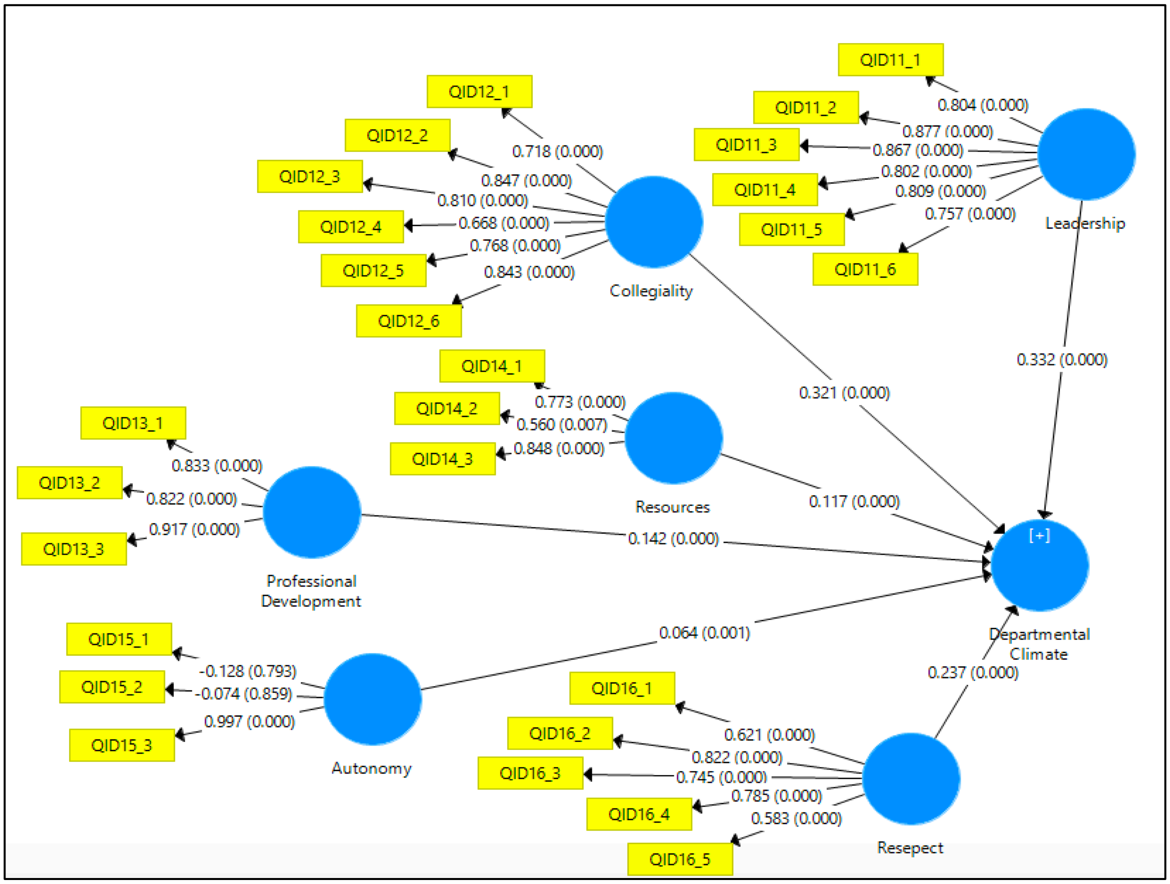

Figure 13. The PLS Hierarchical Component Model Among Associate Professors

<u>Assistant Professor</u>

Research hypothesis H7 stated that perceived contextual factors were positively correlated with department climate for teaching improvement in STEM among assistant professors (Figure 14);

- H7a: Leadership was positively correlated with departmental climate for teaching quality improvement in STEM among assistant professors;

The path model results indicated leadership ($t = 9.442$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among assistant professors. The direct effect of leadership on departmental climate for teaching quality

improvement was positive, showing a computed path coefficient value of 0.379. Thus, the research hypothesis H7a was supported.

- H7b: Collegiality was positively correlated with department climate for teaching improvement in STEM among assistant professors;

The path model results indicated collegiality ($t = 7.998$, $p < 0.05$) had a significant correlation with departmental climate for teaching quality improvement among assistant professors. The direct effect of collegiality on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.351. Thus, the research hypothesis H7b was supported.

- H7c: Resources were positively correlated with departmental climate for teaching improvement in STEM among assistant professors;

The path model results indicated resources ($t = 3.481$, $p < 0.05$) were significantly correlated with departmental climate for teaching quality improvement among assistant professors. The direct effect of resources on departmental climate for teaching quality improvement was positive showing a computed path coefficient value of 0.092. Thus, the research hypothesis H7c was supported.

- H7d: Professional development was positively correlated with departmental climate for teaching quality improvement in STEM among assistant professors;

The path model results indicated professional development ($t = 3.053$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among assistant professors. The direct effect of professional development on departmental climate for

teaching quality improvement was positive, showing a computed path coefficient value of 0.088. Thus, the research hypothesis H7d was supported.

- H7e: Autonomy was positively correlated with departmental climate for teaching quality improvement in STEM among assistant professors;

The path model results indicated that autonomy ($t = 5.026$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among assistant professors. The direct effect of autonomy on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.099. Thus, the research hypothesis H7e was supported.

- H7f: Respect was positively correlated with departmental climate for teaching quality improvement in STEM among assistant professors;

The path model results indicated respect ($t = 8.978$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among assistant professors. The direct effect of respect on departmental climate for teaching improvement was positive showing a computed path coefficient value of 0.304. Thus, the research hypothesis H7f was supported.

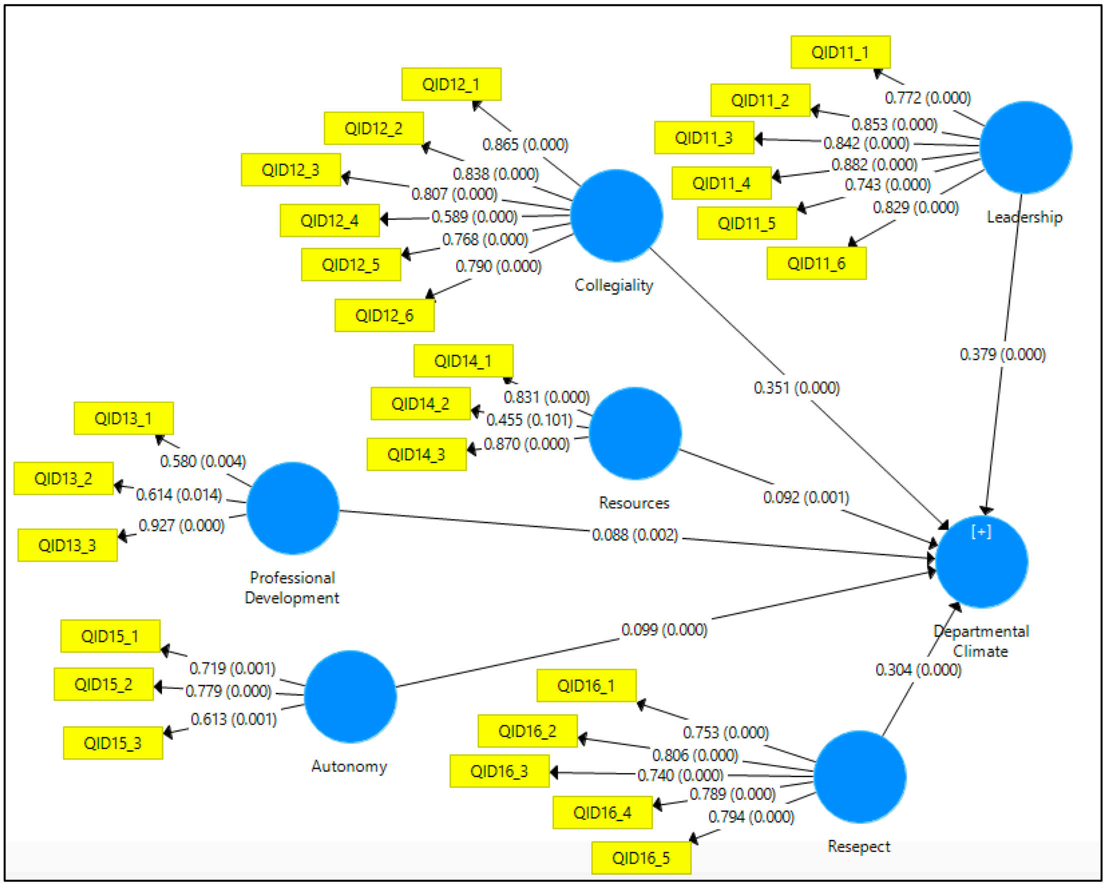

Figure 14. The PLS Hierarchical Component Model Among Assistant Professors

Lecturer

Research hypothesis H8 stated that perceived contextual factors are positively correlated with department climate for teaching improvement in STEM among lecturers (Figure 15);

- H8a: Leadership was positively correlated with departmental climate for teaching quality improvement in STEM among lecturers;

The path model results indicated that leadership (t = 9.36, p = $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among lecturers. The direct effect of leadership on departmental climate for teaching quality improvement was

positive, showing a computed path coefficient value of 0.321. Thus, the research hypothesis H8a was supported.

- H8b: Collegiality was positively correlated with departmental climate for teaching quality improvement in STEM among lecturers;

The path model results indicated that collegiality ($t = 10.939$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among lecturers. The direct effect of collegiality on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.336. Thus, the research hypothesis H8b was supported.

- H8c: Resources were positively correlated with departmental climate for teaching improvement in STEM among lecturers;

The path model results indicated resources ($t = 1.788$, $p = 0.074$) were not significantly correlated with departmental climate for teaching quality improvement among lecturers. Thus, the research hypothesis H8c was not supported.

- H8d: Professional development was positively correlated with departmental climate for teaching quality improvement in STEM among lecturers;

The path model results indicated professional development ($t = 4.191$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among lecturers. The direct effect of professional development on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.102. Thus, the research hypothesis H8d was supported.

- H8e: Autonomy was positively correlated with department climate for teaching quality improvement in STEM among lecturers;

The path model results indicated that autonomy ($t = 1.35$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among lecturers. The direct effect of autonomy on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.044. Thus, the research hypothesis H8e was supported.

- H8f: Respect was positively correlated with departmental climate for teaching quality improvement in STEM among lecturers;

The path model results indicated respect ($t = 14.498$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among lecturers. The direct effect of respect on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.333. Thus, the research hypothesis H8f was supported.

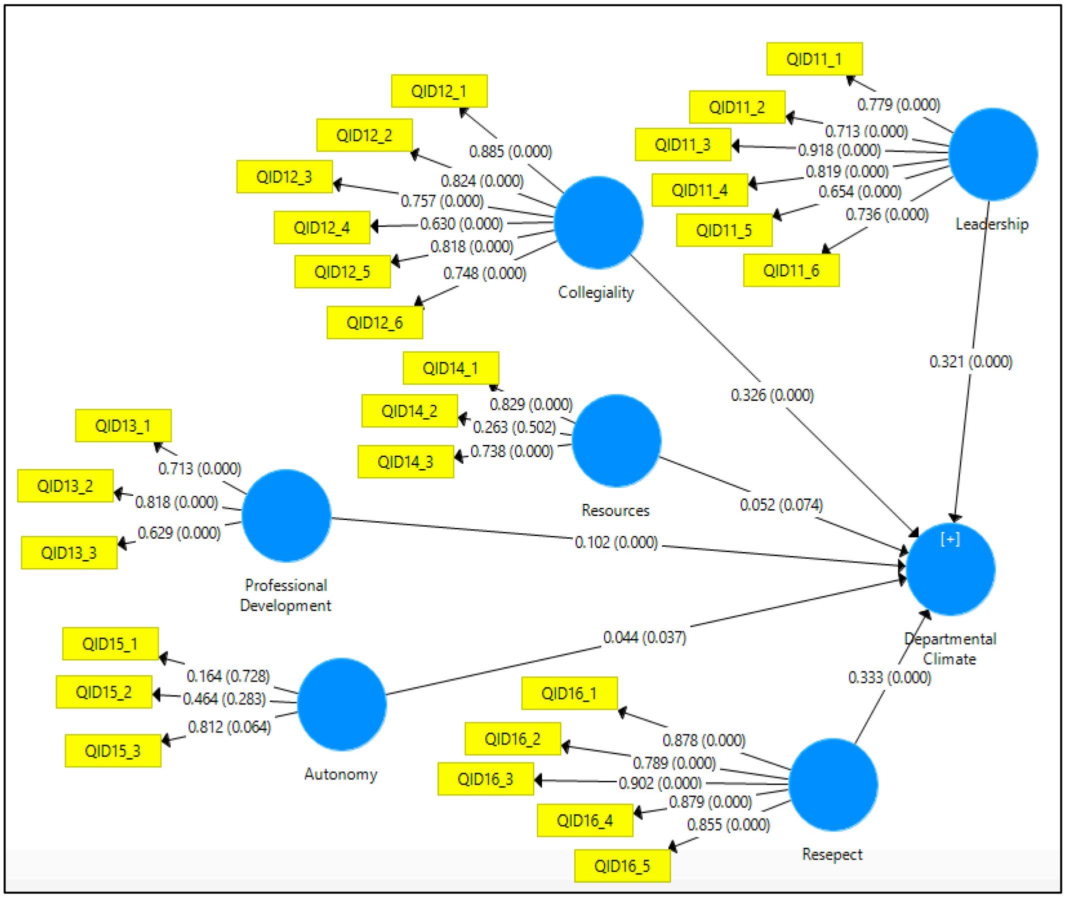

Figure 15. The PLS Hierarchical Component Model Among Lecturers

Instructor

Research hypothesis H9 stated that perceived contextual factors are positively correlated with department climate for teaching improvement in STEM among instructors (Figure 16);

- H9a: Leadership was positively correlated with department climate for teaching improvement in STEM among instructors;

The path model results indicated that leadership ($t = 8.287$, $p = p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among instructors. The direct effect of leadership on departmental climate for teaching quality

improvement was positive, showing a computed path coefficient value of 0.412. Thus, the research hypothesis H9a was supported.

- H9b: Collegiality was positively correlated with department climate for teaching improvement in STEM among instructors;

The path model results indicated that collegiality ($t = 4.236$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among instructors. The direct effect of collegiality on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.180. Thus, the research hypothesis H9b was supported.

- H9c: Resources were positively correlated with departmental climate for teaching improvement in STEM among instructors;

The path model results indicated that resources ($t = 6.539$, $p < 0.05$) were significantly correlated with departmental climate for teaching quality improvement among instructors. The direct effect of resources on departmental climate for teaching improvement was positive, showing a computed path coefficient value of 0.186. Thus, the research hypothesis H9c was supported.

- H9d: Professional development was positively correlated with department climate for teaching improvement in STEM among instructors;

The path model results indicated that professional development ($t = 3.371$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among instructors. The direct effect of professional development on departmental climate for teaching

improvement was positive showing a computed path coefficient value of 0.088. Thus, the research hypothesis H9d was supported.

- H9e: Autonomy was positively correlated with departmental climate for teaching quality improvement in STEM among instructors;

The path model results indicated that autonomy ($t = 0.893$, $p > 0.05$) was not significantly correlated with departmental climate for teaching quality improvement among instructors. Thus, the research hypothesis H9e was not supported.

- H9f: Respect was positively correlated with department climate for teaching improvement in STEM among instructors;

The path model results indicated that respect ($t = 5.085$, $p < 0.05$) was significantly correlated with departmental climate for teaching quality improvement among instructors. The direct effect of respect on departmental climate for teaching quality improvement was positive, showing a computed path coefficient value of 0.317. Thus, the research hypothesis H9f was supported.

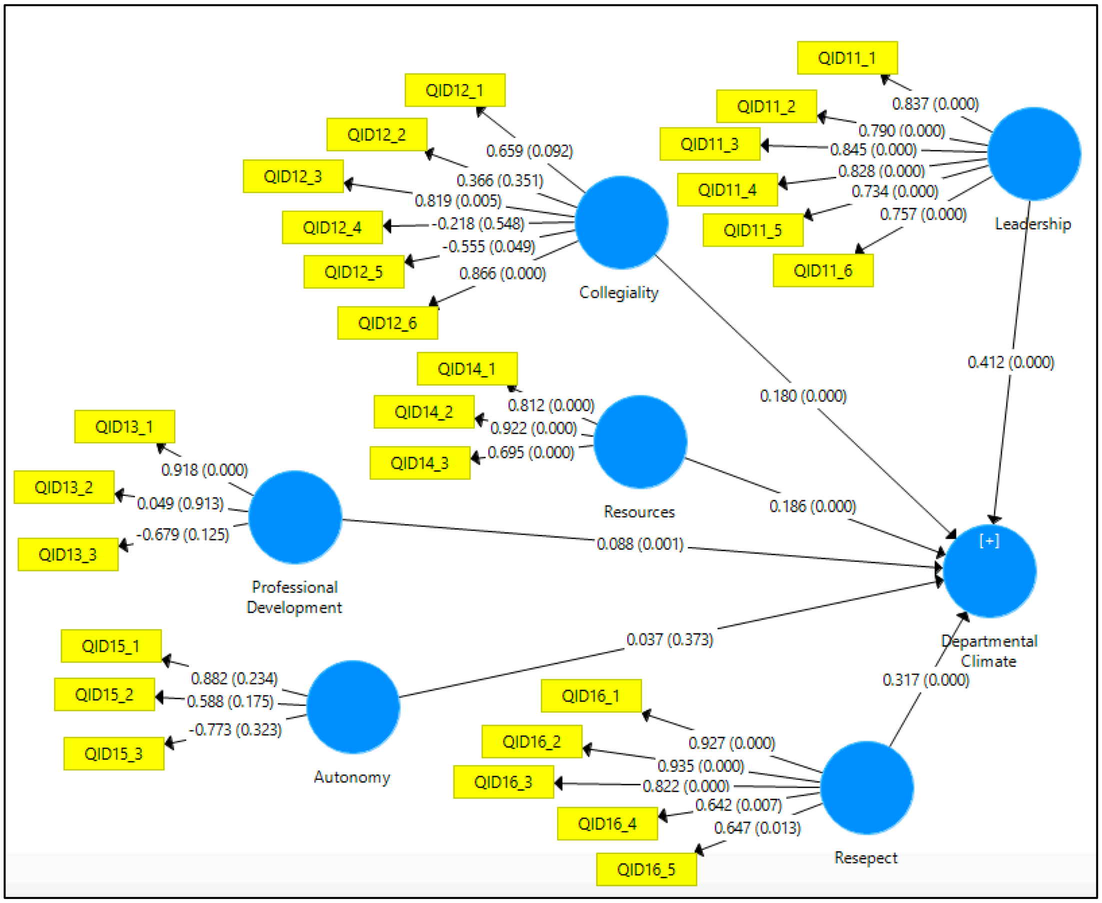

Figure 16. The PLS Hierarchical Component Model Among Instructors

Table 12. Structural Model Results Across Institutional Types

Institutional Type	Constructs	β	t	p
Associate's Colleges	Leadership	0.435	7.957	p< 0.05
	Collegiality	0.089	1.22	**P= 0.223**
	Resources	0.148	3.852	P< 0.05
	Professional Development	0.092	3.534	p< 0.05
	Autonomy	0.112	7.537	p< 0.05
	Respect	0.422	9.23	p< 0.05
Doctoral-Granting Universities	Leadership	0.365	9.716	p< 0.05
	Collegiality	0.305	9.307	p< 0.05
	Resources	0.093	4.485	p< 0.05
	Professional Development	0.142	7.696	p< 0.05
	Autonomy	0.074	4.339	p< 0.05
	Respect	0.281	10.963	p< 0.05
Master's Colleges and Universities	Leadership	0.346	4.503	P< 0.05
	Collegiality	0.344	8.214	p< 0.05
	Resources	0.135	5.884	p< 0.05
	Professional Development	0.091	2.790	p< 0.05
	Autonomy	0.062	3.273	p< 0.05
	Respect	0.313	6.046	p< 0.05
Baccalaureate Colleges	Leadership	0.327	12.210	p< 0.05

Institutional Type	Constructs	β	t	p
	Collegiality	0.373	14.844	$p < 0.05$
	Resources	0.075	4.412	$p < 0.05$
	Professional Development	0.082	4.310	$p < 0.05$
	Autonomy	0.097	6.116	$p < 0.05$
	Respect	0.218	10.768	$p < 0.05$

Table 13. Structural Model Results Across Faculty's Institutional Roles

Faculty's Institutional Role	Constructs	β	t	p
Full Professor	Leadership	0.331	8.930	$p < 0.05$
	Collegiality	0.291	7.291	$p < 0.05$
	Resources	0.124	6.138	$p < 0.05$
	Professional Development	0.150	8.850	$p < 0.05$
	Autonomy	0.096	6.578	$p < 0.05$
	Respect	0.247	7.477	$p < 0.05$
Associate Professor	Leadership	0.332	9.906	$p < 0.05$
	Collegiality	0.321	9.944	$p < 0.05$
	Resources	0.117	6.123	$p < 0.05$
	Professional Development	0.142	4.675	$p < 0.05$
	Autonomy	0.064	3.303	$p < 0.05$
	Respect	0.237	10.191	$p < 0.05$
Assistant Professor	Leadership	0.379	9.442	$p < 0.05$
	Collegiality	0.351	7.998	$p < 0.05$
	Resources	0.092	3.481	$p < 0.05$
	Professional Development	0.088	3.053	$p < 0.05$
	Autonomy	0.099	5.026	$p < 0.05$
	Respect	0.304	8.978	$p < 0.05$
Lecturer	Leadership	0.337	9.369	$p < 0.05$
	Collegiality	0.326	10.939	$p < 0.05$
	Resources	0.052	**1.788**	**$p = 0.074$**
	Professional Development	0.102	4.191	$p < 0.05$

Faculty's Institutional Role	Constructs	β	t	p
	Autonomy	0.044	2.091	$p < 0.05$
	Respect	0.333	14.498	$p < 0.05$
Instructor	Leadership	0.412	8.287	$p < 0.05$
	Collegiality	0.180	4.236	$p < 0.05$
	Resources	0.186	6.539	$p < 0.05$
	Professional Development	0.088	3.371	$p < 0.05$
	Autonomy	**0.037**	**0.893**	**p= 0.373**
	Respect	0.317	5.085	$p < 0.05$

Comparison of Results Across Institutional Types and Faculty's Institutional Roles

Partial least squares Multi-Group Analysis (PLS-MGA) was applied as a non-parametric significance test to examine the differences among the groups based on PLS-SEM bootstrapping results. A result is considered significant when p-value is smaller than 0.05 or larger than 0.95 at 5% probability of error level and a certain difference of path coefficient among groups (Hair et al., 2018). Table 14 and Table 15 showed the results of PLS-MGA among institutional type groups and faculty's institutional role groups.

In terms of the significant differences among institutional types, the results showed that that there was a significant difference in collegiality ($\beta = 0.216$, $p = 0.992$) and respect ($\beta = 0.141$, $p = 0.002$) between associate colleges and doctoral granting universities ($\beta = 0.216$, $p = 0.992$). Moreover, there was a significant difference in autonomy ($\beta = 0.050$, $p = 0.025$) and collegiality ($\beta = 0.255$, $p = 0.002$) between associate colleges and master's colleges and universities. There was a significant difference in respect ($\beta = 0.204$, $p < 0.05$) and collegiality ($\beta = 0.284$, $p = 0.999$) between associate colleges and baccalaureate colleges. There was a significant difference in respect (β = 0,063, $p = 0.021$) and professional development ($\beta = 0.060$, $p = 0.018$) between doctoral granting universities and baccalaureate colleges. There was a significant difference in respect ($\beta = 0.095$, $p = 0.030$) and resources ($\beta = 0.078$, $p = 0.008$) between master's colleges and universities and baccalaureate colleges.

Regarding the significant differences among faculty's institutional roles, the results showed that there was a significant difference in autonomy ($\beta = 0.052$, $p = 0.035$), respect ($\beta = 0.086$, $p = 0.973$), and resources ($\beta = 0.072$, $p = 0.026$) between full professors and lecturers. Moreover, there was a significant difference in professional development ($\beta = 0.063$, $p = 0.032$)

and resources ($\beta = 0.062$, $p < 0.05$) between full professors and instructors. There also was a significant difference in respect ($\beta = 0.067$, $p = 0.952$) between associate professors and assistant professors. Furthermore, there was a significant difference in resources ($\beta = 0.065$, $p = 0.039$) and respect ($\beta = 0.095$, $p = 0.997$) between associate professors and lecturers. There was a significant difference in collegiality ($\beta = 0.141$, $p = 0.015$) and resources ($\beta = 0.070$, $p = 0.962$) between associate professors and instructors. There was a significant difference in autonomy ($\beta = 0.055$, $p = 0.036$) between assistant professors and lecturers. There was a significant difference in collegiality ($\beta = 0.171$, $p = 0.009$) and resources ($\beta = 0.095$, $p = 0.978$) between assistant professors and instructors. There was a significant difference in autonomy ($\beta = 0.055$, $p = 0.036$) between assistant professors and lecturers. Lastly, there was a significant difference in collegiality ($\beta = 0.146$, $p = 0.012$) and resources ($\beta = 0.134$, $p = 0.997$) between lecturers and instructors.

Table 14. Multigroup Analysis Results Across Institutional Type Groups

Institutional Type Groups	Constructs	β1 – β2	t-value Groups	p-Value PLS-MGA	p-Value Parametric Test	p-Value Welch-Satterthwait Test
Associate colleges vs Doctoral-granting universities	Autonomy	0.038	6.959/4.473	p > 0.05	p > 0.05	p > 0.05
	Collegiality	0.216	1.231/9.218	**0.992**	**0.003**	**0.008**
	Leadership	0.069	8.25/13.700	p > 0.05	p > 0.05	p > 0.05
	Professional Development	0.051	3.974/7.152	p > 0.05	p > 0.05	p > 0.05
	Resources	0.056	4.365/4.612	p > 0.05	p > 0.05	p > 0.05
	Respect	0.141	11.159/11.326	**0.002**	**0.001**	**0.002**
Associate colleges vs Master's colleges and universities	Autonomy	0.050	6.983/3.214	**0.025**	**0.044**	**0.048**
	Collegiality	0.255	1.316/7.741	**0.995**	**0.002**	**0.002**
	Leadership	0.089	8.244/4.729	p > 0.05	p > 0.05	p > 0.05
	Professional Development	0.001	3.943/2.904	p > 0.05	p > 0.05	p > 0.05
	Resources	0.004	4.027/5.666	p > 0.05	p > 0.05	p > 0.05

Institutional Type Groups	Constructs	β1 – β2	t-value Groups	p-Value PLS-MGA	p-Value Parametric Test	p-Value Welch-Satterthwait Test
	Respect	0.109	10.125/6.068	$p > 0.05$	$p > 0.05$	$p > 0.05$
Associate colleges vs Baccalaureate colleges	Autonomy	0.016	6.899/5.949	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Collegiality	0.284	1.238/15.042	**0.999**	**p < 0.05**	**p < 0.05**
	Leadership	0.108	7.929/12.020	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Professional Development	0.010	3.707/3.977	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Resources	0.073	3.895/4.360	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Respect	0.204	10.627/11.594	**P < 0.05**	**p < 0.05**	**p < 0.05**
Doctoral-granting universities vs Master's colleges and universities	Autonomy	0.012	4.383/3.526	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Collegiality	0.039	9.194/7.984	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Leadership	0.019	14.014/4.800	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Professional Development	0.052	7.675/2.813	$P >0.05$	$P >0.05$	$P >0.05$
	Resources	0.06	4.697/5.972	$p > 0.05$	$p > 0.05$	$p > 0.05$

Institutional Type Groups	Constructs	β1 – β2	t-value Groups	p-Value PLS-MGA	p-Value Parametric Test	p-Value Welch-Satterthwait Test
	Respect	0.032	11.003/6.172	p > 0.05	p > 0.05	p > 0.05
Doctoral-granting universities vs Baccalaureate colleges	Autonomy	0.022	4.408/6.235	p > 0.05	p > 0.05	p > 0.05
	Collegiality	0.068	9.193/14.648	p > 0.05	p > 0.05	p > 0.05
	Leadership	0.038	13.800/12.027	p > 0.05	p > 0.05	p > 0.05
	Professional Development	0.060	7.373/3.948	**p =0.018**	**p =0.045**	**P =0.037**
	Resources	0.018	4.533/4.230	p > 0.05	p > 0.05	p > 0.05
	Respect	0.063	11.512/10.842	**p = 0.021**	p > 0.05	**p = 0.048**
Master's colleges and universities vs Baccalaureate colleges	Autonomy	0.035	3.173/6.213	p > 0.05	p > 0.05	p > 0.05
	Collegiality	0.029	7.586/14.943	p > 0.05	p > 0.05	p > 0.05
	Leadership	0.019	4.870/11.981	p > 0.05	p > 0.05	p > 0.05
	Professional Development	0.008	3.030/4.102	p > 0.05	p > 0.05	p > 0.05

Institutional Type Groups	Constructs	β1 – β2	t-value Groups	p-Value PLS-MGA	p-Value Parametric Test	p-Value Welch-Satterthwait Test
	Resources	0.078	5.878/4.359	**p = 0.008**	**p =0.014**	**p = 0.015**
	Respect	0.095	6.545/11.106	**p = 0.030**	p > 0.05	p > 0.05

Table 15. Multigroup Analysis Results Across Faculty's Institutional Role Groups

Faculty Institutional Role Groups	Constructs	β1 – β2	t-value Groups	p-Value PLS-MGA	p-Value Parametric Test	p-Value Welch-Satterthwait Test
Full professor vs Associate professors	Autonomy	0.033	6.415/2.796	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Collegiality	0.030	7.347/10.280	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Leadership	0.001	8.469/9.915	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Professional Development	0.008	9.314/5.033	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Resources	0.007	6.159/6.642	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Respect	0.010	7.170/10.023	$p > 0.05$	$p > 0.05$	$p > 0.05$
Full professor vs Assistant professor	Autonomy	0.003	6.600/4.824	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Collegiality	0.060	7.802/7.990	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Leadership	0.048	9.450/9.694	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Professional Development	0.062	9.181/3.004	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Resources	0.032	6.197/3.656	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Respect	0.057	7.864/9.324	$p > 0.05$	$p > 0.05$	$p > 0.05$

Faculty Institutional Role Groups	Constructs	β1 – β2	t-value Groups	p-Value PLS-MGA	p-Value Parametric Test	p-Value Welch-Satterthwait Test
Full professor vs Lecturer	Autonomy	0.052	7.031/2.052	**p = 0.035**	**p = 0.036**	**p = 0.046**
	Collegiality	0.035	7.535/9.900	p > 0.05	p > 0.05	p > 0.05
	Leadership	0.010	9.592/9.384	p > 0.05	p > 0.05	p > 0.05
	Professional Development	0.048	9.324/3.948	p > 0.05	p > 0.05	p > 0.05
	Resources	0.072	6.315/1.812	**p = 0.026**	**p = 0.034**	**p = 0.042**
	Respect	0.086	7.530/13.262	**p = 0.973**	**p = 0.047**	**p = 0.041**
Full professor vs Instructor	Autonomy	0.059	6.972/0.947	p > 0.05	p > 0.05	p > 0.05
	Collegiality	0.111	7.566/3.928	p > 0.05	p > 0.05	p > 0.05
	Leadership	0.080	9.515/9.836	p > 0.05	p > 0.05	p > 0.05
	Professional Development	0.063	8.764/3.604	**p = 0.022**	**p = 0.032**	**p = 0.039**
	Resources	0.062	6.081/7.794	**p = 0.964**	**p = 0.048**	p > 0.05
	Respect	0.070	7.347/5.033	p > 0.05	p > 0.05	p > 0.05
Associate professor vs	Autonomy	0.035	2.467/4.866	p > 0.05	p > 0.05	p > 0.05

Faculty Institutional Role Groups	Constructs	β1 – β2	t-value Groups	p-Value PLS-MGA	p-Value Parametric Test	p-Value Welch-Satterthwait Test
Assistant professor						
	Collegiality	0.030	10.684/7.700	p > 0.05	p > 0.05	p > 0.05
	Leadership	0.047	11.201/9.271	p > 0.05	p > 0.05	p > 0.05
	Professional Development	0.054	5.111/2.935	p > 0.05	p > 0.05	p > 0.05
	Resources	0.025	6.717/3.695	p > 0.05	p > 0.05	p > 0.05
	Respect	0.067	9.811/8.540	**p = 0.952**	p > 0.05	p > 0.05
Associate professor vs Lecturer	Autonomy	0.019	3.117/2.264	p > 0.05	p > 0.05	p > 0.05
	Collegiality	0.005	10.058/10.248	p > 0.05	p > 0.05	p > 0.05
	Leadership	0.011	10.431/9.398	p > 0.05	p > 0.05	p > 0.05
	Professional Development	0.040	4.729/4.209	p > 0.05	p > 0.05	p > 0.05
	Resources	0.065	6.285/1.772	**p = 0.039**	p > 0.05	p > 0.05
	Respect	0.095	9.551/13.205	**p = 0.997**	**p = 0.008**	**p = 0.008**
Associate professor vs Instructor	Autonomy	0.027	2.189/0.848	p > 0.05	p > 0.05	p > 0.05

Faculty Institutional Role Groups	Constructs	β1 – β2	t-value Groups	p-Value PLS-MGA	p-Value Parametric Test	p-Value Welch-Satterthwait Test
	Collegiality	0.141	9.854/4.087	**p = 0.015**	**p = 0.011**	**p = 0.012**
	Leadership	0.080	9.581/8.174	p > 0.05	p > 0.05	p > 0.05
	Professional Development	0.054	4.663/2.883	p > 0.05	p > 0.05	p > 0.05
	Resources	0.070	6.132/6.823	**p = 0.962**	**p = 0.038**	**p = 0.040**
	Respect	0.079	9.391/5.155	p > 0.05	p > 0.05	p > 0.05
Assistant professor vs Lecturer	Autonomy	0.055	5.005/2.164	**p = 0.036**	p > 0.05	p > 0.05
	Collegiality	0.025	7.757/9.908	p > 0.05	p > 0.05	p > 0.05
	Leadership	0.058	10.276/8.967	p > 0.05	p > 0.05	p > 0.05
	Professional Development	0.014	3.040/3.867	p > 0.05	p > 0.05	p > 0.05
	Resources	0.040	3.664/1.791	p > 0.05	p > 0.05	p > 0.05
	Respect	0.028	9.491/15385	p > 0.05	p > 0.05	p > 0.05
Assistant professor vs Instructor	Autonomy	0.062	4.940/0.844	p > 0.05	p > 0.05	p > 0.05
	Collegiality	0.171	7.810/4.248	**p = 0.009**	**p =0.007**	**p =0.007**

Faculty Institutional Role Groups	Constructs	β1 – β2	t-value Groups	p-Value PLS-MGA	p-Value Parametric Test	p-Value Welch-Satterthwait Test
	Leadership	0.032	9.633/8.556	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Professional Development	0.00	2.829/2.704	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Resources	0.095	3.498/6.528	**p = 0.978**	**p =0.016**	**p = 0.017**
	Respect	0.012	7.914/5.253	$p > 0.05$	$p > 0.05$	$p > 0.05$
Lecturer vs Instructor	Autonomy	0.008	1.984/0.964	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Collegiality	0.146	9.929/4.249	**p = 0.012**	**p = 0.007**	**p = 0.008**
	Leadership	0.091	8.917/9.525	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Professional Development	0.014	3.969/2.980	$p > 0.05$	$p > 0.05$	$p > 0.05$
	Resources	0.134	1.766/7.555	**p = 0.997**	**p =0.001**	**p = 0.001**
	Respect	0.016	14.099/5.275	$p > 0.05$	$p > 0.05$	$p > 0.05$

Summary

The statistical analyses, which was applied to analyze the data, describe the sample and answer the research questions, and address the research hypotheses were presented in this chapter. All hypotheses proposed in this study were supported except the correlation of collegiality ($t = 0.089$, $p > 0.05$) with department climate for teaching improvement at associate colleges, the correlation of resources ($t = 1.788$, $p > 0.05$) among lecturers, and the correlation of autonomy ($t = 1.037$, $p > 0.05$) among instructors. Perceived contextual factors including leadership, collegiality, resources, professional development, autonomy, and respect were strongly correlated with departmental climate for teaching quality improvement across institutional types and faculty's institutional roles were supported. The exception was that collegiality was not supported at associate colleges. Moreover, resources were not supported among lecturers, and autonomy was not supported among instructors. The next chapter includes the discussion of the findings, implications for practice, and recommendations for future research.

CHAPTER FIVE: DISCUSSION, IMPLICATIONS, RECOMMENDATIONS

The present study explored the correlation between perceived contextual factors (leadership, collegiality, resources, professional development, autonomy, and respect) and departmental climate for teaching quality improvement in STEM settings across institutional types and faculty's institutional roles. Institutional types included associate's colleges, doctoral-granting universities, master's colleges and universities, and baccalaureate colleges. Faculty's institutional roles included full professor, associate professor, assistant professor, lecturer, and instructor. Gappa et al.'s (2007) framework of faculty work was used to explain the explored correlation. Two hundred and seventy-eight faculty in STEM settings across institutional types participated in the web survey. The partial least squares structural equation modeling (PLS-SEM) approach was utilized to analyze the data collected and test the research hypotheses.

This chapter presents the discussion of the findings based on the analyses completed to answer the research questions for this study. This chapter also includes a discussion of prior research, implications for practice in higher education institutions, limitations, and recommendations for future research.

Discussion of Findings

This study explored the correlation of perceived contextual factors with departmental climate for teaching quality improvement in STEM settings across institutional types and faculty's institutional roles. In this section, the results of the analyses are discussed based on institutional types, faculty roles, and the comparison of perceived contextual factors across these types and roles.

Institutional Types

The first research question explored the correlation of perceived contextual factors with departmental climate for teaching quality improvement in STEM across institutional types including associate's colleges (state/community colleges), doctoral-granting universities (research intensive/research extensive), master's colleges and universities (at least 50 masters degrees and fewer than 20 doctoral degree programs), and baccalaureate colleges (focus on undergraduate degrees.

Associate's Colleges

The results of the study indicated that perceived contextual factors including leadership, resources, professional development, autonomy and respect had a strong correlation with departmental climate for teaching quality improvement in STEM settings at associate's colleges. Collegiality was still not supported at associate's colleges. The hierarchical component model (Figure 8) at associate's colleges assured that contextual factors, except collegiality, were significantly correlated with departmental climate for teaching quality improvement. Collegiality had a non-significant correlation with departmental climate for teaching quality improvement.

Doctoral-Granting Universities

The results of the study indicated that perceived contextual factors including leadership, collegiality, resources, professional development, autonomy and respect had a strong correlation with departmental climate for teaching quality improvement in STEM settings at doctoral-granting universities. The hierarchical component model (Figure 9) at doctoral-granting universities assured that contextual factors were significantly correlated with departmental climate for teaching quality improvement.

Master's Colleges and Universities

The results of the study indicated that perceived contextual factors including leadership, collegiality, resources, professional development, autonomy and respect had a strong correlation with departmental climate for teaching quality improvement in STEM settings at master's colleges and universities. The hierarchical component model (Figure 10) at master's colleges and universities assured that contextual factors were significantly correlated with departmental climate for teaching quality improvement.

Baccalaureate Colleges

The results of the study indicated that perceived contextual factors including leadership, collegiality, resources, professional development, autonomy and respect had a strong correlation with departmental climate for teaching quality improvement in STEM settings at baccalaureate colleges. The hierarchical component model (Figure 11) at baccalaureate universities assured that contextual factors were significantly correlated with departmental climate for teaching quality improvement.

Faculty Roles

The second research question explored the correlation of perceived contextual factors with departmental climate for teaching quality improvement in STEM across faculty's institutional roles (professor, associate professor, etc.).

Full Professor

The results of the study indicated that perceived contextual factors including leadership, collegiality, resources, professional development, autonomy and respect had a strong correlation with departmental climate for teaching quality improvement in STEM settings among full professors. The hierarchical component model (Figure 12) among full professors assured that

contextual factors were significantly correlated with departmental climate for teaching quality improvement.

Associate Professor

The results of the study indicated that perceived contextual factors including leadership, collegiality, resources, professional development, autonomy and respect had a strong correlation with departmental climate for teaching quality improvement in STEM settings among associate professors. The hierarchical component model (Figure 13) among associate professors assured that contextual factors were significantly correlated with departmental climate for teaching quality improvement.

Assistant Professor

The results of the study indicated that perceived contextual factors including leadership, collegiality, resources, professional development, autonomy and respect had a strong correlation with departmental climate for teaching quality improvement in STEM settings among assistant professors. The hierarchical component model (Figure 14) among assistant professors assured that contextual factors were significantly correlated with departmental climate for teaching quality improvement.

Lecturer

The results of the study indicated that perceived contextual factors including leadership, collegiality, professional development, autonomy and respect had a strong correlation with departmental climate for teaching quality improvement in STEM settings among lecturers. Resources were not supported among lecturers. The hierarchical component model (Figure 15) among lecturers assured that contextual factors, except resources, were significantly correlated

with departmental climate for teaching quality improvement. Resources had a non-significant correlation with departmental climate for teaching quality improvement among lecturers.

Instructor

The results of the study indicated that perceived contextual factors including leadership, collegiality, resources, professional development, autonomy and respect had a strong correlation with departmental climate for teaching quality improvement in STEM settings among instructors. Autonomy was not supported among instructors. The hierarchical component model (Figure 16) among instructors assured that contextual factors, except autonomy, were significantly correlated with departmental climate for teaching quality improvement. Autonomy had a non-significant correlation with departmental climate for teaching quality improvement among instructors.

To conclude, the results of this study indicated that not only was departmental climate for teaching quality improvement supported across institutional types, but it was also supported across faculty's roles including full professor, associate professor, and assistant professor. However, that departmental climate was not fully supported among instructors and lecturers. Hierarchical component models presented previously across faculty roles assured that perceived contextual factors had a statistically significant correlation with departmental climate for teaching quality improvement among full professors, associate professors, and assistant professors. Whereas, resources had a non-significant correlation with departmental climate among lecturers. Autonomy also had a non-significant correlation with departmental climate among instructors.

Comparison of Perceived Contextual Factors Across Institutional Types and Faculty Roles

Leadership

Regarding leadership, the majority of STEM faculty, regardless of their institutional roles included full professor, associate professor, assistant professor, lecturer, and instructor across institutional types. The institutional types included associate's colleges (state/community colleges), doctoral-granting universities (research intensive/research extensive), master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and baccalaureate colleges (focus on undergraduate degrees) which indicated that program coordinators have a clear vision of how to improve teaching, and implement teaching related polices in a consistent and transparent manner. They also indicated that program coordinators inspire respect for their abilities as teachers, are receptive to ideas about how to improve teaching in their departments, and they are tolerant of fluctuations in students' evaluations when faculty try to improve their teaching. In addition, STEM faculty indicated that program coordinators are willing to seek creative solutions to budgetary constraints in order to maintain adequate support for teaching improvements. Results showed that leadership is supported across institutional types and faculty's institutional roles.

Collegiality

Regarding collegiality, the majority of STEM faculty across institutional types indicated that, in their departments they frequently talk with one another, discuss the challenges they face in the classroom with colleagues, share resources about how to improve with colleagues, are "ahead of the curve" when it comes to implementing innovative teaching strategies, and have someone they can go to for advice about teaching. Results showed that collegiality is better supported at doctoral granting universities and master's colleges and universities than at

associate's and baccalaureate colleges. Results also showed that collegiality is better supported among associate professors and lecturers than instructors.

<u>Resources</u>

Regarding resources, the majority of STEM faculty indicated that they have adequate departmental funding to support teaching, have adequate space to meet with students outside of class, and adequate time to reflect upon and make changes to their instruction. Results showed that resources are better supported at doctoral granting universities and master's universities than baccalaureate colleges. Results also showed that resources are better supported among full professors, associate professors, and instructors than lecturers and assistant professors.

<u>Professional Development</u>

Regarding professional development, the majority of STEM faculty indicated that they are assigned a mentor for advice about teaching in their departments. In addition, they assured that teaching development events are hosted specifically for department instructors, and new instructors are provided teaching development opportunities and resources. Results showed that professional development is better supported at doctoral granting universities than associate's and baccalaureate colleges. Results showed that professional development is better supported among full professors and associate professors than assistant professors and lecturers.

<u>Autonomy</u>

Regarding autonomy, the majority of STEM faculty indicated that they have considerable flexibility with the content they teach in their courses and the way they teach their courses. They also added that there are structured groups organized around the support and pursuit of teaching improvement. Results showed that autonomy is better supported at master's colleges and

universities than at associate’s colleges. Results showed that autonomy is better supported among full professors and assistant professors than lecturers and instructors.

Respect

Regarding respect, the majority of STEM faculty indicated that evidence of effective teaching is valued when making decisions about continued employment and/or promotion, differences of opinion are valued in decision-making related to teaching improvement, courses are fairly distributed among instructors, teaching is respected as an important aspect of academic work, and all of the instructors are sufficiently competent to teach effectively. Results showed that respect is better supported at doctoral granting universities and baccalaureate colleges than associate’s colleges. Results showed that respect is better supported among lecturers than full professors and associate professors.

Discussion of Prior Research

This study was the first to explore the correlation of perceived contextual factors with departmental climate for teaching quality improvement in STEM settings across institutional types and faculty’s institutional roles. As such, the results of this study will be compared to related areas of prior research in this section.

The findings of this study were consistent with several prior studies. For example, Hurtado et al. (2012) indicated that teaching is considered an area of advancement and promotion. Teaching is also considered an area of continual development in STEM as well as in other disciplines. Hurtado et al. (2012) indicated that 47% of full professors, 60.7 % of associate professors, 66.6% of assistant professors, 65.3% of lecturers, and 65.6% of instructors recently participated in teaching development programs. In general, 50.1% of faculty were supported with resources to engage in community-based research or teaching at public (26.9%) and private

(25%) universities. Moreover, prior research indicated that teaching can be improved by a change of teaching climate and by enhancing the value of teaching (Knorek, 2012). Therefore, improving teaching climate can enhance faculty teaching practices at an institutional level by doing the following: a) providing adequate and proper resources and spaces for teaching, b) rewarding faculty for teaching excellence, and c) establishing an effective system for faculty development (Knorek, 2012). Bouckenooghe, Devos, and Van den Broeck (2009) also indicated that individuals' interpersonal interactions with peers should be supported, to empower them within workplaces for change. Providing individuals with a supportive work environment enhances their readiness for change. Individuals at workplaces require trusted relationships, a supportive environment, and cooperation with colleagues to accomplish their work effectively. Thus, facilitating individuals' participation, loyalty, and commitment is a major task of environmental management.

According to Massy et al. (1994), there are many factors that support effective teaching within departments. These factors include: a) providing faculty with a supportive culture that values teaching, b) enhancing faculty interaction, collegiality, and respect, c) giving all faculty, regardless of rank or status, the opportunity to review each other's research and teaching, d) giving all faculty—junior and senior—equal teaching responsibilities, e) rotating teaching courses among faculty, and the most important factor is f) the role of the chair who has the power to achieve the revolutionary changes needed in teaching practices within departments. The results of this study showed that departmental climate for teaching quality improvement is also supported through collegiality, respect, and leadership across institutional types and faculty's institutional roles in STEM settings. However, Milkovich and Newman (2005) indicated that smaller institutions are more likely to focus on teaching than the larger ones. The results of this

study showed that teaching is supported across institutional types, regardless of the institution's size.

Ramsden et al. (2007) also found that there is a strong correlation between departmental leadership for teaching and the adoption of new teaching innovations and pedagogical change. University teachers reported their commitment to teaching is correlated with leadership for teaching. When departmental leaders provide a supportive environment for teaching, not only will faculty's approaches to teaching be improved, but student learning will also be improved. Moreover, an environment with collegial support is correlated with leadership for teaching within a department. Commitment in teaching also enhances when university teachers are members of departments that value teaching. In consistence with that, the findings of this study indicated that departmental climate for teaching quality improvement is supported through leadership and collegiality factors (van Lankveld et al., 2017).

On the other hand, the results of this study contradicted other prior research. For example, Suchman (2014) indicated that only 25% of tenured and tenure-track faculty provide instruction. As tenure-track faculty were pressured to maintain being active in conducting research, they spent less time updating their knowledge related to STEM education. As a result, they were not able to successfully implement new pedagogies and were unlikely to be the impetus for pedagogical change. Furthermore, faculty are rarely assessed for promotion and tenure packages based on teaching performance. Therefore, Suchman (2014) recommended that metrics for teaching recognition should be developed and integrated into traditional tenure and promotion packages to evaluate faculty performance. The current study showed that most STEM faculty, regardless of rank or status, are provided with resources, time, and promotion to enhance their teaching practices.

Prior studies also indicated that there is limited training provided to STEM faculty to enhance their teaching roles, STEM disciplines lack the resources required to support pedagogical change, the use of evidence-based instructional practices has not shown a widespread impact on teaching quality in STEM across institutions, and STEM faculty lack the autonomy they prefer for selecting teaching practices and course content (Herro & Quigley, 2017; Margot & Kettler, 2019). On the other hand, the results of the current study indicated that departmental climate for teaching quality improvement is supported with resources, autonomy, professional development, and respect.

Landrum et al., (2017) assured that when departmental climate allows for freedom regarding the choice of teaching methods, provides adequate resources, time, training to support teaching, and equally values research and teaching, faculty teaching quality might be improved. Moreover, when departmental climate encourages faculty to use evidence-based teaching practices and connect with colleagues inside and outside their departments and institutions to expand teaching-related knowledge and expertise, faculty teaching quality also improves.

Ross (2018) found there was a tremendous disconnect between having adequate knowledge on effective teaching practices and the current use of these practices within most universities, particularly within research intensive ones. Moreover, teaching reward systems in those institutions have many limitations that might constrain improved teaching quality. As the current study focuses on teaching within STEM, the results indicated that departmental climate for teaching quality improvement is supported across institutional types including associate's colleges, doctoral-granting universities, master's colleges and universities, and baccalaureate colleges.

This study contributes to the literature by confirming the findings from previous research, which indicated that perceived leadership, collegiality, resources, professional development, autonomy, and respect are critical factors in supporting departmental climate for teaching quality improvement. The uniqueness of this study is that it is the first comprehensive analysis of departmental climate for teaching quality improvement across institutional types and faculty's institutional roles in STEM settings at the higher education level. Moreover, this study revealed that departmental climate for teaching quality improvement is supported in STEM settings through leadership, collegiality, resources, professional development, autonomy, and respect. However, departmental climate for teaching improvement is not supported with collegiality within associate's colleges. Collegiality had a non-significant correlation with departmental climate for teaching improvement at associate's colleges while it had a significant correlation at master's colleges and universities, doctoral-granting universities, and baccalaureate colleges. Prior research assured that collegiality has a strong relationship with teaching improvement (van Lankveld et al., 2017; Walter et al., 2014), particularly in STEM (Bouwma-Gearhart, 2012).

Implications for Practice

The results of this study have implications for stakeholders and policy and decision makers to provide faculty in STEM with training in effective pedagogies and evidence-based teaching approaches. The findings of this study demonstrated that there are strong correlations between contextual factors and departmental climate for teaching quality improvement in STEM settings across institutional types and faculty's institutional roles. The results showed that departmental climate for teaching quality improvement was mostly supported across institutional types and faculty roles in STEM at higher education institutions. The results of the study also assured that faculty need to be provided with: resources required to update their teaching

approaches, rewards for teaching improvement, and autonomy for widespread pedagogical changes. Thus, many educational leaders advocate for reform efforts for teaching and learning in STEM (Trenshaw et al., 2016). Moreover, many professional organizations (e.g. the American Chemical Society) could encourage their stakeholders and members to adopt more welcoming and collaborative teaching practices that effectively reach out to more diverse learners not only in STEM but also in other disciplines as well. When faculty also discuss teaching challenges with colleagues and encourage each other to experiment with various pedagogies, a receptive climate for teaching reform efforts will be supported (Baldwin, 2009). Reward polices (e.g. tenure and promotion criteria) need to be revised for teaching recognitions and improve departmental climate for teaching quality particularly in STEM. Faculty could also be rewarded with scholarships for teaching, to enhance their teaching quality. Therefore, when meaningful professional credit is given to faculty for their efforts in teaching, their teaching practices can be improved. Faculty should also be rewarded for their efforts when applying new pedagogies, even if these pedagogies do not successfully achieve their original promise.

To create a climate that enhances teaching quality in STEM, a collaborative effort is required at many levels (National Research Council, 2003). Institutional leaders (e.g. deans and provosts) play critical roles to enhance departmental climate for teaching quality and provide faculty with a stimulus for the status quo that prevails in most STEM departments (Wieman, 2007). They could support STEM faculty with resources essential for enhancing teaching reform efforts. Institutional leaders could additionally make a connection among faculty across institutions for useful dialogues and discussions as well as use evaluation criteria, budgetary resources, teaching assignments, and reward systems to enhance change and innovation particularly in STEM (Baldwin, 2009). Moreover, individual departments including chair and

colleagues have the responsibility to increase teaching quality within their own environment as genuine reform of STEM education initiates at a department level (Baldwin, 2009). In general, faculty who share their expertise in teaching with colleagues help improve their department climate for teaching quality improvement and create a culture for change at department and institutional levels (Baldwin, 2009). Faculty who also share their expertise in teaching with colleagues and connect with each other regularly to discuss teaching and learning issues help to build a climate for change and enhance teaching quality. To conclude, departmental climate for teaching improvement could be improved by concerned stakeholders (e.g. educational leaders, professional organizations, and professors) who could take effective actions to strengthen that climate. Margot and Kettler (2019) assured that

> Provision of opportunities for professional learning and development, and obtaining relevant teaching qualifications, and establishing requirements that professional development and qualifications are undertaken are indicators of an institutional climate that recognizes the importance of the preparation of staff for teaching (p. 9).

Decision-makers and stakeholders also need to connect with STEM educators from institutions and professional organizations, to examine to which extent their pedagogical change efforts are effective. Many STEM organizations (e.g. the National Science Foundation and STEM accrediting agencies) are considered influential agents for pedagogical change and focus on the importance of teaching improvement for retrieving the vitality in STEM departments.

Therefore, federal mandates related to training grants offering pedagogical-strategy training for future STEM faculty are needed. In graduate programs with research-centric norms, graduate students should be provided with opportunities to develop their professional identities as teachers alongside their identities as researchers (Henderson, Beach, & Finkelstein, 2011).

Graduate students and junior faculty need to focus not exclusively on research but also on teaching to be successful in the academic world of STEM fields. Relationships between the sense of being a teacher and teaching quality seem to be correlated (Moore, 2009). Therefore, for STEM faculty who teach, the findings of this study confirmed the main contextual factors that were primarily correlated with teaching quality improvement and potential success in STEM teaching. Further, the outcomes of this study could promote greater interest among STEM researchers and educators to continually develop more reform programs to support teaching quality particularly in STEM disciplines and focus on reinforcing a sense of being a teacher there. Finally, the result of this study provides key insights for solving challenges to teach and increasing teaching quality in higher education, particularly in STEM disciplines.

Active learning pedagogies have effective impacts on student learning. As a result, students, particularly who come from underrepresented backgrounds, persist and complete their undergraduate degree. Consequently, graduation rates for students obtaining a bachelor's degree increase (Trenshaw et al., 2016). Based on that, Singer (2015) indicated that many higher education institutions increase their efforts to improve department climate for teaching quality and transform STEM undergraduate education. Despite these efforts towards improving teaching quality at a higher education level, the majority of faculty at research universities remain inattentive to pedagogical change in STEM. The desired magnitude of pedagogical change is still limited, and the vast use of evidence-based teaching practices has not materialized yet in STEM (Singer, 2015).

The Association of American Universities and Cottrell Scholars indicated that to enhance department climate for teaching quality improvement in STEM, faculty should be provided

support, the effectiveness of teaching should accurately be reflected through the use of proper metrics, and incentive should be aligned with teaching quality expectations (Wieman, 2015). For example, beginning with the hiring process, the importance of teaching should be articulated and identified (Dennin et al., 2017). Candidates' attitudes about teaching should be assessed using multiple questions related to knowledge, skills, and research contributions about teaching as an essential part of their job duties. Moreover, departments should provide faculty with professional development activities, support them to participate in learning communities where faculty can share opinions and expertise about teaching, and be mentored by expert teachers (Dennin et al., 2017). Faculty teaching innovations should be evaluated by utilizing mechanisms that communicate and satisfy department expectations and institution criteria for teaching. In addition, teaching innovations should be recognized through reward systems (e.g. promotion and tenure) that value and respect effective and best practices of teaching.

Establishing department climate should be consistent with an institutional climate that recognizes teaching as a scholarly activity associated with efforts and time to enhance teaching quality particularly in STEM (Singer, 2015). To reward teaching, both department and institution should use clearly empirical evidence that validates the importance of teaching quality improvement in STEM when considering promotion, tenure, and teaching awards. Advocating discussions about scholarly teaching activities by key institutional leaders and academic administrators promotes teaching quality in STEM (Singer, 2015). Increasing awareness about the available scholarship and efforts to improve teaching quality has the potential to clarify to which extent an institution's educational objectives correspond with its research mission.

The enrollment of diverse learners grows continuously in higher education institutions. This pressure places more work demands on faculty and requires them to enhance their abilities

and skills to meet new expectations correspondent with these demands. Gappa et al. (2007) assured that institutional administrators and leaders play an important role in fostering a context where faculty have a level of commitment and quality of work as they endeavor to find an area of academic scholarship. Faculty with intellectual capabilities and dedication are a key asset to an institution. Therefore, institutions must provide faculty with an academic workplace that satisfies their changing needs and increases the overall desirability of their academic job (Aragón & Garcia, 2015). Administrators must prioritize faculty concerns to improve the quality of their work context. Still, institutional leaders fail to create a climate of engagement and satisfaction within the workplace. Consequently, qualified faculty are driven to seek employment elsewhere (Aragón & Garcia, 2015).

Within consumer-driven societies, fostering faculty satisfaction helps institutions recruit and maintain the most professional faculty, attract more students, garner support from outside agencies, and outpace their competitors. Gappa et al. (2007) attested that respect for faculty is a core component of pedagogical change. A respectful climate should encompass structural, human resource, symbolic, and political components. The structural component encompasses respect within the institution’s procedure and policy to support faculty. The human resource component focuses on faculty’s commitment, attitudes, and skills which are considered essential resources for the institution to flourish. The symbolic component assures the importance of the institution’s actions and events to support respect within the climate. The political component centers on the ability of faculty to impact decisions and goals of the institution. Respect could also be a shared responsibility of faculty and administrators in their goals, commitments, and decisions to change and support their work environment.

Gappa et al. (2007) indicated that there are five essential elements by which a climate of respect is characterized including autonomy in academic work, collegiality, professional development, flexible polices in academic appointments, and equity regarding academic appointments. These elements increase faculty satisfaction and productivity. Consequently, the intellectual capital of the institution increases (Ruddy, Thomas-Hemak, & Meade, 2016). When faculty are provided with autonomy to manage their work (e.g. planning a course, deciding a teaching technique, and selecting a material), faculty satisfaction increases. That satisfaction is considered the hallmark of faculty success and creativity in academic work. Ensuring flexible polices (e.g. job sharing and parental leave) enhances faculty retention and commitment and increases the institution's recruitment of high-quality faculty.

Flexible policies should focus on the value of the outcome instead of the time consumed on a task (Ruddy et al., 2016). Such policies require the most institutional support to keep the intellectual capital of faculty within the workplace and provide a healthier balance between work and family. Providing faculty with professional development opportunities enhances their skills and intellectual vitality. As a result, the enrollment of diverse students and their learning increases. Collegiality (e.g. having a teaching team across disciplines) may also expand faculty's teaching knowledge, stimulate new teaching approaches, and bring diverse and new teaching perspectives (Gappa et al., 2007). Collegiality is important for the health of an institution as it increases a sense of connectedness to a community of scholars where faculty's opinions and contributions are valued. A feeling of belonging may also increase when faculty are concerned about each other's well-being within their community. Higher education institutions should foster a vigorous sharing of opinions, ideas, and perspectives among faculty who are also in

charge of collegiality and supporting each other's professional behaviors. As a result, faculty job satisfaction increases as well as commitment to their institutions.

Limitations

In this study, there were several limitations. SEM has a number of weaknesses, including requiring a large sample size to be used in this statistical technique (a sample size of 150 or greater). As this study compared the correlation of perceived contextual factors with departmental climate for teaching quality improvement across institutional types and faculty roles, there were limited sample sizes among these types and roles. For example, there were 62 full professors, 51 associate professors, 63 assistant professors, 50 lecturers, and 52 instructors. There also were only 64 participants from associate colleges, 98 participants from doctoral-granting universities, 59 participants from master's colleges and universities, and 57 participants from baccalaureate colleges. Moreover, SEM also requires a well-specified conceptual model and measurement to run the analysis. In this study, the measurement model indicated that all the constructs were considered reliable considering the results from PLS-SEM, except the values of Cronbach's Alpha (0.285) and composite reliability (0.607) of the autonomy construct which were acceptable with a debate. Further, the use of convenience sampling might have bias and outliers. It also might not be considered representative of the population. Participants of the target population were not afforded equal opportunities to be chosen (Battaglia, 2008). Therefore, the examination of department climate for teaching quality improvement in STEM was based on a limited sample of the population.

All perceived contextual factors of departmental climate for teaching quality improvement were examined in a single specific context (e.g. United States) for STEM faculty who have teaching responsibilities aside from research. The survey selected for this study was

also self-reported, which may have caused issues regarding validity, as respondents may have exaggerated their answers due to an embarrassment to reveal their reality (Robins, Fraley, & Krueger, 2009). Respondents may have also under-reported their situations and may have provided biased answers for many reasons, such as trying to make themselves look good, confirm the researcher's conjecture, or make themselves seem distressed to gain promised services.

Recommendations for Future Research

The aim of this study was to gain understanding regarding the extent to which perceived contextual factors correlated with departmental climate for teaching quality improvement in STEM settings across institutional types and faculty's institutional roles using Gappa et al.'s (2007) framework for faculty work. The results of this study were encouraging and might also provide a foundation for future research. The results of this study may lead to new concerns and questions. For example, future research could examine perceived contextual factors more in depth across STEM disciplines at a higher education level in one institution. Moreover, the current study could also be extended to include STEM education at a K-12 level.

Future research could also shed the light on teacher identity among STEM faculty and how they perceive themselves as teachers, particularly at a higher education level. Based on Grier and Johnston (2009), teaching quality is strongly correlated with teacher identity and also relies on one's beliefs that teaching is a profession that is constantly evolving and changing based on teachers' personal and professional experiences. Teacher identity often manifests through the following psychological processes: professional commitment, satisfaction, self-efficacy, and motivation towards the teaching profession, and these psychological processes are considered the main indicators of teacher identity and are also correlated with teaching quality in

higher education (Canrinus, 2011). Teacher identity is constructed through practices and discourse, and it is considered a result of teachers' interaction within teaching contexts (Beijaard, Meijer, & Verloop, 2004).

Determining specific interventions to enhance STEM departmental climate for teaching quality improvement and support STEM faculty teaching skills and knowledge could also be another future research interest. Researchers may have interest to explore perceived contextual factors that are correlated with departmental climate for teaching quality improvement based on gender differences considering the fact that women in STEM still encounter challenges regarding tenure and promotion criteria, career progression, maternity polices, and childcare facilities (Howe-Walsh & Turnbull, 2016). Thus, it would be interesting to examine how gender contributes to the variance in perceived contextual factors on departmental climate for teaching quality improvement across institutional types and faculty institutional roles. Further, the results could be evaluated based on longevity of teaching and commitment and progression in the teaching profession of the respondents.

Moreover, researchers might have an interest in understanding STEM faculty's lived experiences with a specific contextual factor such as leadership, collegiality, resources, professional development, autonomy, or respect in departments using a qualitative research approach. Qualitative methods may provide in-depth understanding and explore people's interactions and experiences in a particular setting and explain "why" and "how" something happens (Creswell, 2013). Using qualitative research, the findings might vary, warranting more in-depth and detailed results regarding faculty perceptions regarding each of the contextual factors that are correlated with departmental climate for teaching quality improvement in STEM.

Conclusion

To enhance a university culture that values and recognizes high-quality teaching as important as conducting high-quality research, higher education institutions require the establishment of criteria which considers teaching as a collaborative activity that cannot be achieved individually (Bradforth et al., 2015). The roles of faculty, department, and institution should also be identified and evaluated to see to which extent faculty work is aligned with the expectations of their local context (e.g. department) as well as with institutional policies, mission, and vision for teaching. In this regard, while academic freedom for faculty in their classrooms is preserved at an individual level, collective responsibilities of faculty for teaching should also be supported at an institutional level (Bradforth et al., 2015). Institutional leaders (e.g. deans and department chairs) also have the power to reinforce teaching practices and assure that teaching is not an isolated activity, but it is part of their roles as university members and scholars within their disciplinary-based community (Dennin et al., 2017). Institutional leaders have the responsibility to encourage faculty, regardless of their rank or status, to develop their teaching practices and increase a mindset of continuous improvement for teaching as one of their educational responsibilities within their department and discipline context.

Aragón and Garcia (2015) indicated that when faculty are not respected, and their talents are not utilized, both faculty and their institutions will negatively be impacted. This reciprocal relationship between faculty and their institutions assures the importance of the alignment and appreciation between faculty's roles and responsibilities and institutional leaders' decisions and procedures. Administrators should also respect and appreciate faculty for their accomplishments, efforts and time dedicated to their departments, colleges, and their institutions for teaching. Although an entire institution has the responsibility to embrace a climate of respect and

continuously monitor that climate, the guidance and supervision should mainly come from leadership. As institutional leaders often connect with faculty on a regular basis, those leaders have the potential to foster a climate of respect and advocate a workplace with no impediments for faculty.

To conclude, faculty are becoming more diverse, and their work demands are unprecedentedly increasing within higher education institutions responding to new and increased expectations inside and outside the academy (Aragón & Garcia, 2015). The desirability to work in academia is decreasing, and the need to attract and maintain the brightest scholars is increasing (Ruddy, Thomas-Hemak, & Meade, 2016). When faculty who are the intellectual capital of higher education are invested, their performance increases in teaching, research and service, and leads to institutional success. Faculty commitment to their institutions also increases when their needs and concerns are addressed. Gappa et al. (2007) assured that supporting department climate for teaching quality improvement might not require funding, rather it requires commitment and creative thinking to reform and reshape it. Campus-wide change of department climate requires the willingness and commitment of institutional leaders and administrators for teaching quality and faculty work (Dennin et al., 2017).

APPENDIX A: CONSENT FORM

UNIVERSITY OF CENTRAL FLORIDA

EXPLANATION OF RESEARCH

Title of the project: The Impact of Perceived Contextual Factors on Departmental Climate for Teaching Quality Improvement in STEM Across Institutional Types and Faculty's Institutional Roles in Higher Education
Principal Investigator: Eman Saqr
Other Investigators: N/A
Faculty Supervisor: Dr. Richard Hartshorne

You are being invited to take part in a research study. Whether you take part is up to you.

This study will be focused on exploring the impact of perceived contextual factors on department climate for teaching quality improvement in STEM across institutional types and with different institutional roles. Institutional types include 1) associate's colleges (state/community colleges), 2) doctoral-granting universities (research intensive/research extensive), 3) master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and 4) baccalaureate colleges (focus on undergraduate degrees). Institutional roles include full professor, associate professor, assistant professor, lecturer, and instructor. The impact of perceived contextual factors on departmental teaching quality improvement will be measured quantitatively through an online survey that has been adopted from an existing survey and will be responded by faculty in STEM. These factors include leadership, collegiality, resources, professional development, autonomy, and respect. The survey includes two sections: 1) demographic questions, and 2) perceived contextual factors of department climate for teaching improvement quality.

You are being asked to participate in an anonymous survey. You will be asked a series of question related to teaching quality in STEM disciplines. Please be assured that your answers will be kept completely anonymous.

Completing the survey will take approximately 5-10 minutes. You may choose the time and place you complete the survey.

Your participation in this research is voluntary. You have the right to withdraw at any point during the study, for any reason. Not participating will not hurt you in any way.

You must be 18 years of age or older to take part in this research study.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, please e-mail Eman Saqr via emansaqr@knights.ucf.edu, Doctoral Student, Education, Instructional Design &Technology Track, College of Community Innovation and Education, (407) 342-1915 or Dr. Richard Hartshorne, Faculty Supervisor, Department of Learning Sciences & Educational Research at (407) 823-1861 or by email at richard.hartshorne@ucf.edu.

IRB contact about your rights in this study or to report a complaint: If you have questions about your rights as a research participant, or have concerns about the conduct of this study, please contact Institutional Review Board (IRB), University of Central Florida, Office of Research, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901, or email irb@ucf.edu.

UCF HRP-254 Form v.1.21.2019

APPENDIX B: IRB LETTER OF APPROVAL

UNIVERSITY OF CENTRAL FLORIDA

Institutional Review Board
FWA00000351
IRB00001138
Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

EXEMPTION DETERMINATION

January 9, 2020

Dear Eman Saqr:

On 1/9/2020, the IRB determined the following submission to be human subjects research that is exempt from regulation:

Type of Review:	Initial Study, Category 2
Title:	The Impact of Perceived Contextual Factors on Departmental Climate for Teaching Quality Improvement in STEM Across Institutional Types and Faculty's Institutional Roles in Higher Education
Investigator:	Eman Saqr
IRB ID:	STUDY00000523
Funding:	None
Grant ID:	None

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made, and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request so that IRB records will be accurate.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Racine Jacques, Ph.D.
Designated Reviewer

Page 1 of 1

APPENDIX C: SURVEY QUESTIONS

Dissertation Survey

Title of Project: **The Correlation of Perceived Contextual Factors with Department Climate in STEM Across Institutional Types and Faculty Roles**

Principal Investigator: **Eman Saqr**
Faculty Supervisor: **Dr. Richard Hartshorne**

You are being invited to take part in a research study designed to explore the correlation of perceived contextual factors with department climate in STEM settings across institutional types and faculty institutional roles. Institutional types that will be examined include associate's colleges (state/community colleges), doctoral-granting universities (research intensive/research extensive), master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs), and baccalaureate colleges (focus on undergraduate degrees). Faculty institutional roles examined include full professor, associate professor, assistant professor, lecturer, and instructor.

The correlation of perceived contextual factors (leadership, collegiality, resources, professional development, autonomy, and respect) with departmental climate in STEM settings in higher education level will be measured quantitatively through an online survey that has been adapted from an existing survey. The survey includes two sections: demographics and perceptions of contextual factors correlated with departmental climate.

Your participation will include completing an anonymous online survey and should take approximately five minutes, of which you may choose the time and place to complete the survey. Your participation in this research is voluntary, and you have the right to withdraw at any point during the study, for any reason.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, please e-mail Eman Saqr at emansaqr@knights.ucf.edu, Doctoral Candidate, Education, Instructional Design &Technology Track, College of Community Innovation and Education, or Dr. Richard Hartshorne, Faculty Supervisor, Department of Learning Sciences & Educational Research at (407) 823-1861 or by email at richard.hartshorne@ucf.edu.

IRB contact about your rights in this study or to report a complaint: If you have questions about your rights as a research participant, or have concerns about the conduct of this study, please contact Institutional Review Board (IRB), University of Central Florida, Office of Research, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901, or email at irb@ucf.edu.

You must be aged 18 or older to participate in this study. By clicking the "I consent" button below, you are agreeing that you:

- wish to participate in this voluntary study,
- are 18 years of age or older, and

- are aware that you may choose to stop your participation in the study at any time and for any reason.

Please note that this survey will be best displayed on a laptop or desktop computer. Some features may be less compatible for use on a mobile device.

○ I consent, begin the study

○ I do not consent, I do not wish to participate

Please note that this survey will be best displayed on a laptop or desktop computer. Some features may be less compatible for use on a mobile device.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, please e-mail Eman Saqr via Emansaqr@knights.ucf.edu, Instructional Technology Track, College of Community Innovation and Education,(407) 342-1915 or Dr. Richard Hartshorne, Faculty Supervisor, Department of Learning Sciences & Educational Research at (407) 823-1861 or by email at Richard.hartshorne@ucf.edu.

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been determined to be exempted from IRB review unless changes are made. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

A) Demographic questions:

1. Academic status

- ◯ Tenured
- ◯ Tenure-track
- ◯ Non-tenure-track

2. Gender:

- ◯ Male
- ◯ Female
- ◯ Other

3. Age:

- ◯ Up to 25
- ◯ 26 to 50
- ◯ 51 and above

4. Faculty institutional role:

- ◯ Full professor
- ◯ Associate professor
- ◯ Assistant professor
- ◯ Lecturer
- ◯ Instructor

5. Total years of teaching experience in higher education:

◯ Up to 5 years

◯ 6 to 10 years

◯ 11 to 15 years

◯ 16 to 20 years

◯ 21 years and above

6. Your primary academic discipline (open-ended):

7. An approximation of your normal workload that involves teaching (percentage of full-time equivalent percentage):

◯ Up to 0.25 FTE

◯ 0.26 to 0.50 FTE

◯ 0.51 to 0.75 FTE

◯ 0.76 to 1 FTE

8. Institution type:

◯ Associate's Colleges (State/Community Colleges)

◯ Doctoral-granting universities (research intensive/research extensive)

◯ Master's colleges and universities (at least 50 master's degrees and fewer than 20 doctoral degree programs)

◯ Baccalaureate colleges (focus on undergraduate degrees)

B) Perceived Contextual Factors

For each item, please select the Likert scale point that best represent your opinion from 5= Strongly agree to 1= Strongly disagree. Each statement begins with “I believe that

a) Leadership

	Strongly Agree=6	Agree=5	Somewhat agree =4	Somewhat disagree=3	Disagree= 2	Strongly disagree= 1
1-The program coordinator has a clear vision of how to improve teaching in the department/ program	○	○	○	○	○	○
2-The program coordinator implements teaching-related policies in a consistent and transparent manner	○	○	○	○	○	○
3-The program coordinator inspires respect for his/her ability as teacher	○	○	○	○	○	○
4-The program coordinator is receptive to ideas about how to improve teaching in the department/program	○	○	○	○	○	○
5-The program coordinator is tolerant of fluctuations in student evaluations when instructors are trying to improve their teaching	○	○	○	○	○	○
6-The program coordinator is willing to seek creative solutions to budgetary constraints in order to maintain adequate support for teaching improvements	○	○	○	○	○	○

b) Collegiality

	Stron gly Agree =6	Agree= 5	Somewha t agree =4	Somewhat disagree= 3	Disagree=2	Strongly disagree= 1
1- Instructors in my department/ program frequently talk with one another	○	○	○	○	○	○
2-Instructors in my department/ program discuss the challenges they face in the classroom with colleagues	○	○	○	○	○	○
3-Instructors in my department/program share resources (ideas, materials, sources, technology, etc.) about how to improve teaching with colleagues	○	○	○	○	○	○

4-Instructors in my department/program use teaching observations to improve their teaching	○	○	○	○	○	○
5-Instructors in my department/program are "ahead of the curve" when it comes to implementing innovative teaching strategies	○	○	○	○	○	○
6-Instructors in my department/program have someone they can go to for advice about teaching	○	○	○	○	○	○

c) Resources

	Strongly Agree=6	Agree=5	Somewhat agree =4	Somewhat disagree=3	Disagree= 2	Strongly disagree= 1
1-Instructors in my department/program have adequate departmental funding to support teaching	○	○	○	○	○	○
2-Instructors in my department/program have adequate space to meet with students outside of class	○	○	○	○	○	○
3-Instructors in my department/program have adequate time to reflect upon and make changes to their instruction	○	○	○	○	○	○

d) Professional Development

	Strongly Agree=6	Agree=5	Somewhat agree =4	Somewhat disagree=3	Disagree= 2	Strongly disagree= 1
1-Instructors in my department/program are assigned a mentor for advice about teaching	○	○	○	○	○	○
2-In my department/program, teaching development events (i.e. talks, workshops) are hosted specifically for department/program instructors	○	○	○	○	○	○
3-In my department/program, new instructors are provided with teaching development opportunities and resources	○	○	○	○	○	○

e) Autonomy

	Strongly Agree=6	Agree=5	Somewhat agree =4	Somewhat disagree=3	Disagree= 2	Strongly disagree= 1
1-Instructors in my department/program have considerable flexibility in the content they teach in their courses	○	○	○	○	○	○
2-Instructors in my department/program have considerable flexibility in the way they teach their courses	○	○	○	○	○	○
3-In my department/program, there are structured groups organized around the support and pursuit of teaching improvement	○	○	○	○	○	○

f) Respect

	Strongly agree=6	Agree=5	Somewhat agree =4	Somewhat disagree=3	Disagree= 2	Strongly disagree= 1
1-Evidence of effective teaching is valued when making decisions about continued employment and/or promotion	○	○	○	○	○	○
2-Differences of opinion are valued in decision-making related to teaching improvement	○	○	○	○	○	○
3-Courses are fairly distributed among instructors	○	○	○	○	○	○
4-Teaching is respected as an important aspect of academic work	○	○	○	○	○	○
5-All of the instructors are sufficiently competent to teach effectively	○	○	○	○	○	○

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