STEM PROFESSORS' MOTIVATION TO ENGAGE IN A COLLEGE TEACHING
CERTIFICATE

by

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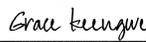For the Degree of
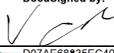
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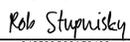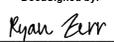Grand Forks, North Dakota

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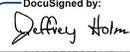
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Abstract

Despite an expanded focus on educating students in STEM disciplines, nearly half of U.S. college students who enroll in these degree programs fail to graduate (Hamm et al., 2020, p. 623). Critics sometimes blame pedagogically untrained faculty (e.g., Kahn, 2022). This Dissertation in Practice (DiP) focused on STEM university faculty's motivation for teaching and whether professors are motivated to enroll in pedagogy courses. Via the lens of self-determination theory (SDT), this DiP examined to what extent STEM faculty at a major research university in the upper Midwest could devote additional time to pedagogy by enrolling in a college teaching graduate certificate program. This DiP utilized a semi-structured interview (n = 6) to address the primary research question of to what extent faculty are motivated to enroll in a college teaching graduate certificate program to address critics who advocate for pedagogically trained faculty. Findings indicated that the behavioral needs of professors were not sufficiently satisfied to engage in a graduate teaching certificate. Rather, the STEM faculty were interested in pursuing a method of pedagogical development that satisfied their behavioral needs more effectively, engaging in book club related discussions. The implications of this study suggest that STEM faculty are motivated for pedagogical improvement under certain circumstances (i.e., when their needs for autonomy, competence, and relatedness are being satisfied), when they have the time to commit to pedagogical endeavors, and when they are early in their teaching careers which can be useful for university administration to improve STEM educational experiences in their institutions.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

STEM Professors' Motivation to Engage in a College Teaching Certificate

Artifact I

Introduction and Overview of the Problem

Across the United States, we have Ph.D. students in history, chemistry, biology, and English who have never taken a class on teaching (Mayhew, 2018). Many doctoral programs do not require courses in pedagogy for STEM (Science, Technology, Engineering, Mathematics) doctoral candidates. However, some of these doctoral candidates take up teaching positions in colleges and universities after graduation. Through no fault of doctoral candidates, they never learned how to teach (Mayhew, 2018). This is a common issue, not an issue that pertains to any particular individual, department, or university. Indeed, some argue that university professors do not teach well as teaching is where instructors receive the least training (Fertig, 2016). The central argument of my DiP is that university STEM professors are generally not trained educators. Therefore, a solution that benefits faculty and students is needed.

STEM faculty lacking pedagogical training harms students nationwide, at all grade levels, including colleges and universities. Despite an expanded focus on educating students in STEM disciplines, nearly half of U.S. college students who enroll in these degree programs fail to graduate (Hamm et al., 2020, p. 623). According to Jawaharlal (2017), nothing in a professor's typical experiences prepares them to be a teacher. A new professor with a Ph.D. is best prepared for a research specialization but minimally prepared for teaching. Regardless, recent Ph.D. graduates must teach with no pedagogical training — akin to letting a teenager drive an automobile without a valid license (Jawaharlal, 2017). Moreover, some even argue that

professors need a permit to teach, (e.g., Kahn, 2022). This is only one side of the issue regarding STEM professors' lack of pedagogical training opportunities.

The other side of the issue is that it would be unreasonable to expect a Ph.D. with a high proficiency in research, contracted by a university well known for research, to devote extensive energy to pedagogy (Hodgson, 2005). Indeed, many people are under the impression that teaching is a significant part of a professor's duties, but 40 percent teaching, 50 percent research, and 10 percent service are typical for a tenure-track university professor (Roney, 2017, para. 5). Being a faculty member at a university can be fulfilling, but it is one of the most stressful jobs (Lashuel, 2020). Adding more responsibilities to professors' already taxing schedules may cause STEM faculty to leave the university to pursue jobs in the private sector. Historically, professors' research output has been used as the primary factor for the quality of education at the university level (Jin & Jin, 2012). As research is the primary focus in research universities (for those faculty members with research responsibilities in their contracts), this encourages STEM professors to focus on research rather than teaching.

The problem is that university faculty are often not trained educators (Ladany, 2024). Conversely, expecting faculty to be experts in pedagogy and their field, advisors, and counselors is an unreasonable expectation for faculty members. Scientists who work in STEM industries are more satisfied and better paid than their university colleagues (Woolston, 2021). This indicates the need for a solution that could benefit both students and faculty without adding to the professors' already packed list of responsibilities. This Dissertation in Practice (DiP) focused on the motivation of university STEM faculty members to teach and their motivation to enroll in pedagogy courses (e.g., a college teaching graduate certificate). Specifically, this study aimed to suggest a solution to the pedagogically under-trained faculty issue by proposing that professors

teach one less course in exchange for taking one education course without any change in compensation and to investigate whether this solution would motivate faculty to enroll in pedagogy courses.

Artifact I provided an overview of the problem of pedagogically under-trained collegiate STEM faculty. A review of relevant research and practitioner-based literature covered the issue of professors having minimal opportunities for pedagogical development. Common exceptions for lack of pedagogical training, including mentoring, peer-reviewed teaching, student perception of instruction, and others, were examined. Finally, Artifact I detailed viable solutions (and barriers) to theoretical foundations by examining STEM professors' challenges when enrolling in a college teaching certificate (e.g., a lack of time).

In Artifact II, a description of the research approach/protocol was presented. I included a narrative that explained the implementation results and key themes from the data analysis. This artifact discussed research design, methodology, and other components integral to understanding the collection and interpretation of interview data. This study analyzed semi-structured interview data from STEM faculty at a major university in the upper Midwest to determine to what extent they were motivated to enroll in a college teaching certificate program. The purpose of interviewing faculty was to ascertain their interest, thoughts, ideas, perceptions, etc., regarding a college teaching certificate program. I sought to determine what factors motivate or prevent them from engaging in a college teaching program. A thematic analysis determined significant recurring themes that prevent faculty members from enrolling.

In Artifact III, the implementation of a solution to the pedagogically under-trained STEM faculty issue was discussed, and a solution based on the data gathered from interviews was presented. After interviewing and analyzing the data, the research team concluded that a graduate

certificate did not satisfactorily meet the three behavioral needs necessary to sustain motivation for pedagogical development: autonomy, competence, and relatedness. Rather, one theme repeated itself in the data: the willingness of STEM faculty to participate in book club activities in which professors meet to discuss methods of pedagogical improvement inspired by various pedagogical texts. To provide professors with an opportunity to obtain these texts, especially if they were not readily accessible from the university or public library, a grant proposal was deemed necessary to help pay for the texts' costs. A grant proposal was included in artifact three that could be generalized to multiple grants, and the next steps were discussed.

The following includes a brief definition of terms that may be helpful for the reader to understand before reading this Dissertation in Practice. In this section, the basics of motivation and self-determination theory are described so that the reader has a basic understanding of these theories before reading the rest of the paper. Further, after the definitions are presented, an analysis of how the key concepts relate to each other and are essential to answering this study's research questions is discussed.

Pedagogy: Pedagogy is widely used in academia and often means "teaching" (Merriam-Webster, n.d.).

Ethnocentrism: Ethnocentrism describes a way of thinking and perceiving the world that centers on one's cultural or ethnic group. Ethnocentrism involves evaluating other cultures and ethnic groups based on the standards and values of one's own group and viewing them as inferior, less important, or effective. Ethnocentrism can lead to negative attitudes and behaviors toward those perceived as different, contributing to conflicts and misunderstandings (Evans, 2022).

Motivation: The term motivation is widely used in education. In motivation theory, there are frequent references to a contrast between intrinsic or internal motivation and extrinsic or instrumental motivation. Intrinsic motivation pertains to activities done for curiosity or pleasure (Deci & Ryan, 2000). Extrinsic motivation encompasses behaviors acted upon for reasons other than their inherent satisfaction (Ryan & Deci, 2020). Intrinsic motivators arise from our passion for the task or the material for personal development. In contrast, extrinsic motivators may include rewards, prizes or awards, distinctions, or even grades (Lang, 2021).

Self-Determination Theory (SDT): The term describes a macro theory of motivation. SDT developed from research on intrinsic and extrinsic motivations. Later, SDT grew to include research on work organizations and other areas outside the workplace (Deci et al., 2017). SDT is an empirically based, organismic theory of human nature that concentrates on motivation, personality development, and overall wellness. SDT assumes that humans are inherently curious, self-motivated, and growth oriented. There are six mini-theories within SDT. One of those theories, which will be used extensively in this DiP, is Basic Psychological Needs Theory (Martela et al., 2020).

Basic Psychological Needs Theory: The theory argues that people require support for basic psychological needs for healthy psychological development (Ryan et al., 2019). These needs include autonomy, competence, and relatedness. The satisfaction or thwarting of these needs significantly influences human maturation and wellness (Martela et al., 2020).

- **Autonomy** refers to the experiences of volition and willingness. When satisfied, SDT theorizes that people experience a sense of integrity when their actions, thoughts, and feelings are self-endorsed and authentic. When thwarted, SDT indicates that one

20

experiences a sense of pressure and often conflict, for example, feeling pushed in an unwanted direction (Vansteenkiste et al., 2020).

- **Competence** describes the experience of effectiveness and mastery. Competence becomes satisfied when people effectively engage in activities and experience opportunities to use and expand their knowledge and skills. When thwarted, people experience a feeling of ineffectiveness, failure, or helplessness (Vansteenkiste et al., 2020).

- **Relatedness** is a term that exemplifies the experiences of warmth, bonding, and care. Relatedness is satisfied by forming bonds with and feeling significant to other people. Relatedness thwarting typically results in feelings of alienation, exclusion, and loneliness (Vansteenkiste et al., 2020).

Necessity of this Research

This research is central to understanding and communicating why STEM professors may or may not be able to enroll in a college teaching certificate. Understanding what motivates professors to take educational courses and potentially choose to focus on their pedagogy and best teaching practices requires a theoretical framework for understanding human motivation – SDT. Stupnisky (2022) explained that several motivational theories have been applied to faculty research. SDT was chosen as Stupnisky's (2022) study framework because of its clear conceptual linkages and previous empirical support Further, Stupnisky's study regarding faculty motivation for research explained that motivation is determined by the level of satisfaction with three basic psychological needs: competence (perceived research expertise or skill), autonomy (freedom to choose research initiatives and strategies), and relatedness (feeling connected with collaborators).

SDT proposes motivation; in this case, STEM faculty motivation for teaching is determined by their level of satisfaction with three basic psychological needs: competence, autonomy, and relatedness. Competence refers to perceived teaching expertise or skill or "when professors have a meaningful impact on their students, such as 'ah-ha moments'" (Stupnisky et al., 2018, p. 16). Next, autonomy includes the freedom to choose pedagogical initiatives and strategies. To satisfy autonomy, instructors must "have freedom to teach lesson content in their own way" (p. 16). Finally, relatedness entails connecting with others. Specifically, "opportunities for professors to relate to colleagues and students" (p. 16) may help relatedness to be satisfied. If there is a barrier to developing pedagogy, I hypothesize, consistent with the tenants of self-determination theory, that at least one basic psychological need is not being satisfied, or there may be some administrative constraints.

Purpose of the DiP

Through the lens of Self Determination Theory, this DiP's purpose is to understand STEM faculties' motivation for teaching and perception of education courses being used to improve collegiate pedagogy. The DiP investigated a potential solution to pedagogically untrained faculty by determining to what extent STEM professors at a flagship research university in the upper Midwest viewed education courses to improve collegiate teaching. As part of the solution this DiP proposed, professors could teach one less class in exchange for taking one pedagogy class in a college teaching graduate certificate program, with no change in compensation. Moreover, this DiP aimed to examine the feasibility of implementing the described solution by interviewing faculty.

Research Questions

Identifying the research questions is an essential component in determining the research direction in any research study. In this section, the research questions will be introduced to establish a clear understanding of the research topic, its relevance, and its significance to collegiate STEM education. The interview questions, available for inspection in the appendix, will address the research questions. The research questions are the following:

I.   What factors motivate STEM professors to enroll in a college teaching certificate? Are there any common professional reasons that help determine this choice?

II.   Do STEM professors have any concerns regarding the value of pedagogical training to promote college students' STEM advancement?

III.   Do STEM professors think studying pedagogy is a feasible and practical method to address a potential lack of pedagogical training opportunities? Why or why not?

IV.   What may hinder STEM faculty from enrolling in pedagogy-related classes?

Rationale for STEM Pedagogical Training

Many methods of improving student comprehension focus on the student. For example, online tutors, on-campus opportunities for students to engage in and compete against one another in math or science competitions, learning labs, office hours, etc. Comparatively, common resources available for faculty are teaching evaluations by students and peers, professional development, and mentorship opportunities. By focusing on faculty, in addition to students, the hope for many of those advocating for STEM faculty to receive pedagogical training is that student graduation rates will improve. Examining faculty motivations regarding the value of educational courses and to what extent faculty think increased pedagogical training would impact student performance is significant for current faculty and students in the STEM disciplines.

This problem of practice has the potential to catalyze some exciting future research projects that may provide benefits to students. For example, faculty who enroll and graduate from a teaching certificate program could participate in a time series study where the grades are analyzed before, during, and after the professors' involvement in the certificate program. Students' grades and retention rates may improve as faculty advance through the certificate program. In that case, this could lead to implementing new policies, requiring policy writing and analysis. Focusing on faculty, in addition to students, to potentially improve STEM learning, student scores, and retention rates might become the norm rather than the primarily student-based approach to improvement that is common in higher education institutions.

The potential impact of this research is vital because it will allow faculty to voice their concerns regarding their training to be professors in the qualitative aspect of the study. In addition, this DiP will provide research consumers with valuable data regarding the perceptions of STEM faculty regarding education courses that may be useful in later research projects.

Understanding the Problem

Students are generally unaware that professors are not trained educators. Ironically, while many students believe that all professors do is teach, teaching is where professors receive the least training (Fertig, 2016). In other words, "If a professor earns a B.S. in Biology, an M.S. in Biology, and a Ph.D. in Biology, where [do they] learn how to be a teacher" (Marshall, 2021, para. 1)? Dr. Marshall of the University of Central Florida's College of Community Innovation and Education suspects that, "one reason is that, other than the only faculty in the university trained as professional educators are in the college of education, most professors just teach the way they were taught [when they were students]" (para. 1). Simply put, most faculty members receive little or no formal pedagogical training before their first teaching jobs (Mulnix, 2016).

Indeed, most faculty members obtain little to no formal guidance in teaching, as reflected in student attrition and the 96 percent of students who exit a STEM major citing inadequate teaching as a motivating factor (Thiry et al., 2019).

First-generation college students and those from marginalized groups in the United States are less likely than their peers to pursue STEM professions (von Vacano et al., 2022). There is a persistent myth that underrepresented students leave STEM because they cannot meet rigorous standards (Perez, 2020). This notion reflects a reluctance to accept the truth that instructors must change. Once faculty are ready to change, they must recognize they have tremendous power to reset the cultural norms within their classrooms and labs. Such a change requires faculty to engage with pedagogy, educational research, and social psychology experts who can guide them in incorporating evidence-based methods to foster classroom belonging (Cervato, 2020).

Teaching has historically been undervalued on college campuses (Frost & Teodorescu, 2001). Faculty members may have little interest in enrolling in the certificate program. This is not the fault of the STEM faculty. Instead, an ethos is present at universities where research is valued above teaching.

Review of Research and Practitioner-Based Literature

This study focuses on STEM faculty, who are trained researchers but not trained educators. This effort to address the faculty lacking pedagogical training potentially involves telling faculty that what they have been doing for the past 5, 10, or even 30 years may not be the most effective approach, especially for today's students (Brownell & Tanner, 2012). Institutions of higher learning are in desperate need of a solution that addresses the lack of pedagogical training opportunities for STEM faculty while not minimizing the contributions made thus far by hardworking faculty members across the U.S. Academia is currently situated where nearly half

of U.S. college students who enroll in these STEM degree programs fail to graduate (Hamm et al., 2020, p. 623). Moreover, women and ethnic minorities remain underrepresented in STEM fields (Kricorian et al., 2020). This leads to a lack of connectedness between faculty and students, a topic covered in many colleges' teaching graduate certificates. This is an issue of paramount importance as students who enter STEM fields do not see their ethnic groups, genders, etc., being represented in the faculty body. These already marginalized students may feel that they do not belong in STEM. With the common knowledge that individuals learn in varied ways, professors often teach in a traditional Eurocentric pedagogy, which may not be compatible with the needs of diverse learners. Moreover, a difficult point to argue about is that there may be numerous benefits of faculty devoting more attention to pedagogy. On the other hand, it is unreasonable to expect a person with a Ph.D. who has a high proficiency in research and who has been hired by a university well-known for research to devote extensive energy to pedagogy (Hodgson, 2005).

Theoretical Framework

Theoretical research perspectives were the most helpful in understanding my problem of practice because studying whether STEM faculty were willing to enroll in a graduate teaching certificate program had not previously been extensively researched. As such, a theoretical perspective was all that this study could rely on, as there was not a study like this one. Of the many theoretical perspectives on motivation theory, the one that was chosen as the theoretical framework for my study: self-determination theory, seemed the most appropriate. From my readings, conversations with faculty members such as UND's Dr. Stupnisky (University of North Dakota [UND], 2023b), and my overall current understanding surrounding my problem of

practice, SDT seemed to be an appropriate lens to understand what motivated faculty to devote more focus to pedagogy.

Best practices are crucial for teaching students effectively. However, not all faculty members use best practices when teaching despite their well-documented effectiveness" (Stupnisky et al., 2018, p. 15). Indeed, "although much is known about effective STEM teaching practices, many faculty members continue to adhere to traditional methods, such as lectures" (Sansom et al., 2023, p. 1). This is a significant issue because students assume professors know how to teach (Fertig, 2016) and utilize best practices in their classrooms. It must be noted that this research does not offer teaching advice or what constitutes best practices. What this research does seek is to understand to what extent increased knowledge of pedagogy may be helpful, in the STEM professors' view, in better formulating best practices for scientific and mathematical disciplines.

With Dr. Stupnisky's (UND, 2023b) support and the literature I examined as part of my literature review, we decided that self-determination theory was an appropriate theoretical framework to study STEM faculty motivation for teaching, as in order for the motivation for any task to be sufficiently maintained, the behavioral needs for autonomy, relatedness, and competence should be satisfactorily satisfied (Deci et al., 1997; Ryan et al., 2021).

The concept map below (Figure 1) indicates the minimal pedagogical training STEM faculty will likely have compared to their research and content degrees, such as bachelor's, master's, and Ph.D. For example, if a STEM professor earns a B.S. in science, an M.S. in science, and a Ph.D. in science, at what point in their programs have they learned how to be an effective teacher (Marshall, 2021)? Marshall (2021) suspects that one reason is that other than

the education faculty in a university, most professors just teach the way they were taught. Note the theme that STEM professors are not trained educators is demonstrated in the concept map.

Figure 1

STEM Teaching Concept Map

Student Wants To Be a STEM Professor

Must Acquire an

Educational Background

Focusing on — Not Focusing on

STEM B.S. ← First Degree Earned

STEM M.S. ← Second Degree Earned — STEM

STEM Ph.D ← Third Degree Earned

Teaching — Possibly Serves as a → T.A.

Contributes to

Nearly half of U.S. College Students who Enroll in STEM degree Programs Fail to Graduate (Hamm et al., 2020, Abstract section) □

Student Becomes

Student Becomes

Healthy Individuals who are Proactively Interested in their Surroundings and Experiences, Naturally Engaged and Assimilative in an Ongoing way □ (Ryan et al., 2021) **(SDT)**□

STEM Professor

Are — Deserve — Are NOT

Competent Researchers

Respect and Autonomy **(SDT)** to Make their own Choices

Trained Educators

Can Improve By

Making a Decision to Enroll in Teaching Certificate Program - Determine To What Extent STEM Professors Want to Enroll in Certificate Program by Means of a Survey

STEM Professor Decides

To Enroll

Not To Enroll

Conduct — Conduct

Qualitative Inquiry - In the Form of a Case Study to Understand Why Consistent with **SDT**.

Examine

Analyze Emerging Themes as the Data is Coded.

(Note: "To Enroll" is the same node in the above and below image.)

An Opportunity to Build Healthy Relationships (Relatedness) with Other Educators. **(SDT)**

A Decision (Choice) - Autonomous Motivation **(SDT)**

Building Pedagogical Competence **(SDT)**

Promoting Autonomy **(SDT)** - Autonomous Persons are those who can Reflectively Evaluate their Actions, Self-Endorse those that Fit with their Values and Needs, and in so doing Actively Develop a Life Worth Living (Ryan et al., 2021).

Autonomous STEM Professors are those who can Effectively Evaluate their Actions, Self-Endorse those that Fit with their Values and Needs, and in so doing Actively Develop their Pedagogy.

Should Be

At No Cost —Because of— Employee Tuition Waiver

Recognized and Appreciated

To Enroll

Controlled Motivation which is Comprised of External Regulation—A Type of Motivation where an Individual Acts out of the Desire for External Rewards or Fear of Punishment **(SDT)** (Ackerman, 2018).

STEM Professor Takes

Educational Courses —Should Never Be— Forced / Mandatory / Result in Lower Pay For STEM Professors

Educational Courses

Increases

STEM Professor Workload —Add→ One Teaching Class From the Graduate College Teaching Certificate —Implementation Leads To→ New Teaching Ideas and Strategies Used in STEM Courses

Subtract— One STEM Course from Professor's Teaching Load

Promotes

Work/Life Balance

Promotes

Supports

STEM Students

Possibly Achieve

Higher Scores (Opportunity for Further Research)

Allows

STEM Professors to Form a Support Network

Promotes / Prevents

Positive Growth Mindset

Burnout

Note. Made with Cmap Tools.

Another important aspect of this research, captured in the concept map, is the theoretical framework, a critical aspect of the research endeavor and a component often minimally covered in doctoral classes (Grant & Osanloo, 2014). The theoretical framework informs multiple aspects of this problem of practice, specifically that enrolling in a college teaching certificate or

participating in pedagogical development should always be a choice to sustain motivation for continued teaching advancement. Further, note that the proposed solution embodies many core SDT principles that maintain the professors' autonomy, competence, and relatedness.

The concept map helps describe the typical collegiate STEM faculty member at a doctoral research university (American Council on Education [ACE], 2023) Frequently, as has been documented throughout this research, there are minimal pedagogical training opportunities for these staff members. In the concept map, research questions I, II, and III are embodied by the branching points below "STEM Professor Decides." Note that there is a qualitative inquiry to understand why the faculty may be motivated to enroll in the certificate program or have any concerns about the process (Interview Question VIII a) and whether the interviewees believe studying pedagogy is a feasible and practical way to improve teaching (Interview Question VIII a). The branching "Should be" and "Should Never Be" address research question IV by pointing out that enrolling in a teaching certificate program should be a choice (autonomous motivation) and not forced upon faculty. Note that the hallmarks of SDT theory, specifically behavioral needs theory, are interspersed throughout the concept map and are placed in bold.

Connections Between Topics & Themes – Conceptual Framework

To use mathematics as an example, Anderson (2018) asserts, "The idea that some of us are 'math people' and some are not is a myth that pervades Western society" (p. 1). Furthermore, algebra is one of the biggest challenges to getting a high school or college degree — especially for students of color and first-generation undergraduates. It is also the most failed course in community colleges nationwide (Lattimore & Depenbrock, 2017). Even so, college mathematics professors are often trained researchers, not educators (Fertig, 2012; Hodgson, 2005; Jawaharlal, 2017; Marshall, 2021). Note the belief that people think math is challenging, and mathematics

professors are generally not trained educators. This may be because of the mindset's math professors hold regarding pedagogy. Such a complex discipline taught by those with minimal training in pedagogy is a considerable problem. This DiP aims to provide an understanding of STEM professors' perceptions of the value of educational courses being used to facilitate a deeper understanding of concepts to college students and propose a solution to the pedagogically untrained faculty issue via the lens of Self Determination Theory.

Another theme is the faculties' teaching mindset, which is an opportunity for future research endeavors. This mindset may be fixed because, historically, the culture of universities has undervalued teaching in favor of research (Frost & Teodorescu, 2001). This informs an understanding of why faculty do not generally invest in teaching because, historically, professors' research work is used as a metric for the quality of education at universities (Jin & Jin, 2012). This existing system makes the issue of improving student understanding difficult because teaching is not the focus of faculty. Instead, research is. Professors' mindset regarding pedagogy overlaps with the idea that STEM fields are challenging (Kennedy et al., 2018) because those at the top have minimal pedagogical training and little reason or personal motivation to focus on pedagogy.

STEM Faculties' Motivation for Teaching

Many scholars have devised and experimented with different methodologies to boost student performance in STEM e.g., (Amstelveen, 2018; Bernacki et al., 2021; Chingos et al., 2017; Scott-Clayton et al., 2014), although few articles focused on the professors' lack of pedagogical knowledge. Typically, faculty mindset is linked to student effectiveness (e.g., Shoshani, 2021). For example, the professional well-being of instructors was inversely proportional to student dropout rates and was correlated with an increase in students' grades.

Although Cervato (2020) and a few others have asked if faculty pedagogical knowledge matters, the literature is overshadowed by articles about improving the students' learning rather than the professors' teaching.

It is essential to understand that this problem of practice examines an often-neglected component of the STEM success equation: the pedagogical training of the instructor. The first step is to ascertain to what extent professors are motivated to focus more on pedagogy, followed by understanding what the professors need to advance their teaching, and then making recommendations so that administrators and faculty can take advantage of the findings. However, for all of this to be accomplished, we must look at what motivates STEM professors to improve their teaching, and the literature provides some insight into this matter.

Of interest to this study is Hanson et al.'s (2022) research on faculty motivation to teach in a medical setting, which utilized SDT as a theoretical framework. The results of the study indicated that the faculty reported that teaching often met their basic psychological needs. In addition, the study found that full professors were more likely than their peers to report that teaching satisfied their need for autonomy. This is interesting, as when choosing a sample of STEM faculty to interview, the professor's rank may determine whether they would be motivated to enroll in the teaching certificate. Interestingly, "the majority of motivating factors tie to the faculty's need for relatedness to both students and the teaching institution" (p. 7), and not extrinsic motivating factors such as time and money.

Another article of particular interest in this research is Sansom et al.'s (2023) study. In this study, they note that "Traditional teaching practices in undergraduate science, technology, engineering, and mathematics courses have failed to support student success, causing many students to leave STEM fields and disproportionately affecting women and students of color" (p.

33

1). Further, "although much is known about effective STEM teaching practices, many faculty continue to adhere to traditional methods, such as lectures" (p. 1). This is an indication that although faculty have access to a variety of pedagogical training opportunities, once at university, they are often not utilized to their full potential. The authors discovered that multiple factors contributed to pedagogical decision-making, including personal, social, and contextual factors. The authors explained that personal factors included "beliefs about teaching and learning, [and] attitudes" (p. 1). Next, social factors included "expectations from colleagues, students, and administrators" (p. 1). Finally, "contextual factors included time, resources, and student characteristics" (p. 1). If the results from the study can be generalized to this research, then we can expect to see much the same motivating factors contributing to the STEM faculty member's decision to be motivated to engage in pedagogical training by enrolling in a graduate certificate.

Common Approaches to Addressing the Problem of Practice

The following section will detail common approaches to addressing the problem of practice. Note that there are advantages and disadvantages to each method used to address the problem of pedagogically undertrained professors. Although this section includes major approaches, this section should not be considered to be an all-encompassing and exhaustive list of the approaches previously used in addressing a traditional lack of pedagogical preparedness of STEM faculty.

Peer Review and Professional Development

According to Rifkin et al. (2023), many essays, social media posts, and books have addressed the lack of formal teaching training that professors receive. Despite limited data on the subject, peer review of teaching is a significant way to address a lack of pedagogical training on

behalf of STEM faculty. Additionally, professional development programs have been used to supplement pedagogical knowledge and practice.

In the beginning of organized university institutions, there were no teaching evaluations. Faculty inferred pedagogical quality from the acclaim professors received from peers and students, based predominantly on testimony and gossip (Bernstein, 2008). University surveys of perceived teaching effectiveness emerged from the turmoil of the late 1960s. Bernstein's study found that student evaluations were never intended to serve as professional evaluations. Instead, the surveys were the only evidence of teaching effectiveness until some professors opened their classrooms for peer observation. Historically, the peer review of teaching has typically meant only that a peer has watched a colleague teach a class or lab. During the 1980s, some faculty members began making teaching portfolios consisting of teaching philosophies, syllabi, course intent and content descriptions, student survey results, summaries of colleagues' classroom observations, mentorship advice, etc. Since then, assessment professionals have researched how faculty can best evaluate a colleague's teaching. Despite the ubiquity of teaching evaluations, recent studies have demonstrated student evaluations of teaching are deeply flawed measures of teaching effectiveness, even when we assume they are unbiased and reliable (Esarey & Valdes, 2020; Flaherty, 2020) Therefore, teaching evaluations have failed to address the lack of pedagogical training STEM faculty receive. Despite shortcomings, faculty observation and reflection on classes have been a significant source of pedagogical training outside the classroom (e.g., Bandy, 2015).

Professional development programs encourage STEM faculty to implement new teaching methods and challenge the status quo of research-dominated metrics that represent the primary measure of a STEM program's quality in undergraduate teaching (Weston et al., 2023).

Professional development in teaching is an essential component of continuing efforts to improve student learning outcomes in STEM higher education. While many large-scale professional development programs exist, few have thoroughly evaluated the results to determine whether faculty members have adopted new techniques and implemented what they learned in their classrooms and labs. Despite the ubiquity of professional development opportunities for STEM faculty, without assessing long-term professional development outcomes, we are left with minimal evidence of professional development effectiveness (Emery et al., 2019).

Longer teaching professional development workshops were more effective for STEM faculty members at major research universities than shorter ones because they allowed them to build an environment of mutual understanding and constructive collaboration (Bouwma-Gearhart, 2011). The desire for longer teaching professional development programs is promising for this research as many faculty members may want a longer form of professional development, like what a graduate teaching certificate can provide.

Men were a third less likely to participate than their female counterparts (Bouwma-Gearhart, 2011), and "those from the fields of life science and engineering were more willing to participate" than other STEM disciplines" (p. 561) As such, we might expect that there will be an overwhelming majority of women in this study, but the research team tried to recruit male faculty members into the study without regard to gender as a basis of research participant selection. However, statistically, more women would likely participate in the study, as per the author's research. Finally, in this research, advocates must appeal to the behavioral needs of faculty members to motivate them to engage in teaching professional development (Bouwma-Gearhart, 2011). Likewise, if the research team appeals to the behavioral needs of the faculty

members, we may be able to communicate the pedagogical and personal rewards of enrolling in a graduate certificate.

STEM faculty must feel that their relatedness, competency, and autonomy are sufficiently satisfied to change their pedagogical views and approaches (Bouwma-Gearhart et al., 2020). Likewise, for this research team to expect their participation in this research and motivation to enroll in a graduate certificate program in teaching, we must ensure that the professor is convinced that their basic psychological needs will remain satisfied by enrolling in a teaching certificate program. Moreover, if this research can communicate that by investing time now, STEM faculty can potentially save more time and effort by saving on "trying things out in the classroom" and sticking with research-based pedagogy likely to be learned in teaching certificate programs, more STEM faculty might be willing to engage in a graduate teaching certificate in the future, and the issue of the pedagogically untrained STEM faculty can be satisfactorily addressed.

Broadening the Goals and Content of Doctoral Programs

Change is challenging in any setting, particularly in STEM pedagogy, and changing academic teaching appears especially problematic (Brownell & Tanner, 2012). This effort potentially involves colleges and universities telling the faculty that what they have been doing for the past five, ten, or even thirty years may not be the most effective approach, especially for today's students. A lack of pedagogical training opportunities has additional classical solutions, such as broadening the goals and content of doctoral and postdoctoral training to include training in pedagogy (Brownell & Tanner, 2012). Regrettably, progress in this avenue has been slow (Rifkin et al., 2023). Moreover, efforts are likely better spent elsewhere than training professors to teach in graduate school because, for example, in the engineering disciplines in the United

States, a professor of engineering graduates approximately 7.8 new doctoral engineering students in their career (Larson et al., 2013). If we assume that only one of these graduates replaces the professor's position, we are left with many graduates who do not accept academic positions. Unfortunately, without a significant influx of more students, only 12.8% of Ph.D. graduates can retain their positions. The fact that the supply of Ph.D. graduates far exceeds the demand in many places leads to a highly competitive environment for STEM faculty. As such, to distinguish themselves from their peers, doctoral STEM graduates should excel in their research, publications, and teaching skills to maximize their possibilities of a faculty position at a university (Fertig, 2012) Soon-to-graduate doctoral students might also consider a teaching certificate to distinguish themselves from other candidates.

Successful Approaches

While collegiate STEM programs across the United States produce graduates who positively contribute to academia and industry, there is not much data regarding the lack of formal training that professors receive in pedagogy or its benefits (Rifkin et al., 2023). Regardless of pedagogical training for faculty, "college is working" (Mayhew, 2018, 56:43), in the sense that competent graduates are produced. Faculty without pedagogical training educate students who become proficient in their discipline. In particular, STEM education works despite minimal pedagogical training opportunities for professors. Mayhew (2018) argues if the system is not broken, why modify it? To answer this question, consider that despite various existing support structures, only half of U.S. STEM college students complete their college degrees (Hamm et al., 2020, p. 623). We do not have an optimal collegiate STEM education system in the United States. Instead, we have a working system (Mayhew, 2018).

Insufficient Approaches

38

For many people, the fact that physicians teach tomorrow's physicians without acquiring pedagogical training before becoming a professor is a cause of concern (Varga et al., 2020). Similarly, many traditional methods to address the pedagogically untrained STEM faculty issue have been mainly insufficient across all areas of STEM, medicine, and other areas (Hamm et al., 2020). Some techniques researchers have investigated for gaining pedagogical skills and knowledge outside formal university training programs include engaging in reflective practice (Evans, 2022), mentoring (Thomas et al., 2014), professional development (Hott & Tietjen-Smith, 2018; Winberg et al., 2018) and seeking a perception of teaching effectiveness from students and fellow faculty (Esarey & Valdes, 2020). Overall, research indicates a positive correlation between utilizing these methods and students' success. Lamentably, these methods lack the benefits that enrolling in a college teaching graduate certificate can provide.

While reflection on teaching successes and mistakes has advantages (Yale, 2016, one disadvantage of relying on reflection is the risk of biased thinking. One example is ethnocentrism, which is a way of thinking and perceiving the world that centers on one's own cultural or ethnic group as superior to the beliefs of other groups (Evans, 2022). Unfortunately, "Ethnocentrism is a universal tendency, and each of us is ethnocentric to some degree" (Northouse, 2019, p. 623). When professors solely reflect on their observations and judgments to make pedagogical decisions rather than research-driven methods that one would learn about in a graduate teaching certificate program, faculty may unintentionally misjudge the students' abilities to understand and apply scientific principles effectively.

Thomas et al. (2014) explains that little data exists on faculty mentoring each other. However, peer mentors can catalyze positive changes in doctoral research universities. Whether that mentorship is formal or informal, there has been a long history of professors helping each

other with classroom lectures or labs when activities were not as successful as planned. This may include meeting off campus to discuss plans for future classes, suggesting a book about teaching, sharing a YouTube video with teaching tips, etc. Even in favorable circumstances, mentorship has been limited in effectiveness, often resulting in decreased productivity, increased stress, and the loss of valuable research and faculty (Hund et al., 2018).

Faculty professional development is critical to supporting effective teaching, research, and service contributions (Hott & Tietjen-Smith, 2018). There are many barriers to accessing quality professional development, including time, monetary support, and competing interests (Brownell & Tanner, 2012) Sadly, professional development has been an inadequate substitute for pedagogical training because these opportunities generally relate to STEM content, not pedagogy. To elaborate, in a critical review of the literature on learning to teach the STEM disciplines in higher education there was little focus on the STEM disciplines themselves. Most of the research did not address the key issue of what makes STEM disciplines difficult to learn and challenging to teach (Winberg et al., 2018). Instead, professional development should focus on pedagogy that addresses the concerns of what makes STEM challenging to teach (Winberg et al., 2018). In this sense, there is a slight distinction between professional development and pedagogical training. However, for the most part, they are just synonymous terms where pedagogical training is ideally a component of professional development. Synthesizing from Winberg et al. (2018), the distinction is that pedagogical training often encompasses a broad range of activities designed for improving the skills, knowledge, and effectiveness of professors in their current roles which includes aspects other than pedagogically orientated components such as career advancement, leadership skills, research training, overall professional growth (not necessarily pedagogical growth). Finally, professional development often involves workshops,

mentoring, and other activities that may not necessarily have a pedagogical focus. Whereas pedagogical training focuses on improving teaching and learning, is designed to enhance the professor's ability to deliver lesson content effectively, may focus on managing classrooms, designing curricula, focus on ways to access students more effectively, may include a focus of pedagogical theories or techniques directly related to teaching, and any other activity that focuses exclusively on teaching. Pedagogical development and professional development are often used interchangeably, for good reasons as there are professional development opportunities that incorporate pedagogical components. However, the argument is that for with professional development or pedagogical training to be effective, they must "address the key issue of what makes the STEM disciplines difficult to learn and challenging to teach" (Winberg et al., 2018, p. 940).

Further, Professor Linda Darling-Hammond (2009) asserts that to learn a new skill to the extent that it will positively impact student learning, approximately 50 hours of professional development is required (Aguilar, 2016, p. 192; Darling-Hammond et al., 2009), making professional development an unlikely candidate to catalyze positive changes in the STEM fields, given the already demanding schedules of faculty members. Professional development has been a poor substitute for formal pedagogical theory and practice, which is common in graduate certificate programs.

Recent studies explain that student evaluations of teaching are deeply flawed measures of teaching effectiveness, even when we assume they are unbiased and reliable (Esarey & Valdes, 2020; Flaherty, 2020) When university departments review a professor's teaching by assigning faculty members to evaluate fellow faculty, the evaluator is likely not trained in pedagogy, as many professors lack pedagogical training (Fertig, 2012) The entire process of student and peer

feedback has been a false indicator of teaching effectiveness because neither the students nor the faculty are trained in pedagogy (Flaherty, 2020) Additionally, feedback from students and peers is often ineffective at improving pedagogy, as opinions are often highly varied in these reviews. As college graduate certificates are highly structured and standardized, there is a clear advantage to seeking a formalized understanding of pedagogy rather than relying on varied feedback from students and peers.

An important aspect to consider is that, regardless of the approaches previously used to address the pedagogically untrained faculty issue, a common concern is a lack of diversity in STEM education and industries, such as race and ethnicity (McGee & Bentley, 2017). Despite considerable efforts from universities, the involvement of diverse scholars in STEM remains stagnant (Miriti, 2020). Despite many attempts to improve college education, minorities do not reap the same benefits as their majority peers (Asai, 2020) By taking courses in pedagogy, professors can learn about addressing the needs of diverse learners and the barriers and challenges students face in classrooms and labs. By reaching diverse students, colleges and universities can improve STEM education for all, and vast improvements are possible. As cultural-specific pedagogical training opportunities are uncommon in pure STEM degrees, many faculty members may have little knowledge of how to tailor their instruction to the needs of diverse learners or make adjustments in their teaching methodology to suit such unique learning needs (Miriti, 2020).

Linking Barriers and Solutions to Theoretical Foundations

In the following section, the advantages, and disadvantages of SDT are explored, specifically in terms of understanding the motivation of professors to engage in pedagogical development. An exploration of how SDT informs the problem of practice, the limitations,

barriers, and disadvantages of understanding STEM professors' motivation to engage in pedagogical development through this lens is discussed.

SDT Informs the Problem of Practice

Utilizing Self-Determination Theory (SDT) will help me understand what motivates STEM faculty to enroll in a college teaching certificate program because SDT has been used to study faculty motivation for research, (e.g., Stupnisky et al., 2022) and is an appropriate framework for understanding faculty motivation for teaching. The SDT framework has been linked to collegiate teaching, but empirical research testing the validity of the assertions is rare (Deci et al., 1997; Stupnisky et al., 2018). Further, teaching could satisfy a professor's need for competence. For example, the "ah-ha" teaching moments. Autonomy is satisfied when professors have freedom to teach their courses the way they choose. Finally, relatedness is satisfied when there are opportunities for faculty and students to work together (Stupnisky et al., 2018). Therefore, SDT will provide a sound theoretical framework for studying STEM faculty motivation for teaching.

SDT represents "a generative and philosophically coherent framework based on a convergent network of empirical evidence with relevance across domains and cultures and to our basic experiences and concerns as humans" (Stupnisky et al., 2018, p. 97). As SDT has relevance across "domains and cultures," SDT is appropriate for studying the teaching motivation of faculty members from different academic fields and cultures. Moreover, SDT's validity is not dependent on a singular or select few studies or narrow results; instead, it has prevailed across multiple forms of evidence across varying domains of human interest and endeavors. As STEM faculty are from various academic disciplines and cultures, SDT is an appropriate theoretical framework.

SDT theory helps inform this problem of practice by providing a framework to understand STEM faculties' motivation to enroll in a college teaching certificate program. For example, if this DiP finds through the interview analysis that most professors are not motivated to enroll in a college teaching certificate, in that case, SDT indicates that a reason may be that the professors' basic psychological needs are not being met. In other words, there is some lack in professors' autonomy, competence, or relatedness (Martela et al., 2020). For example, professors may lack sufficient freedom to teach lesson content in their own way (Stupnisky et al., 2018), resulting in the basic psychological need for autonomy not being satisfied.

Limitations of SDT

Tierney Wisniewski (2018) of the University of British Columbia - Vancouver said it best when she explained she is skeptical of SDT. Wisniewski (2018) indicates that theorists have done a fantastic job supporting their claims with evidence. Critiques of SDT are hard to come by. Moreover, the SDT framework has been linked to faculty teaching, but few empirical studies test these assertions (Stupnisky et al., 2018). However, there are many parallels in studying motivation for faculty research in the preliminary stages of my literature review, (e.g., Stupnisky et al., 2022), which leads me to believe that despite this criticism, the SDT framework is still appropriate for my study.

Additionally, SDT has "low predictive power" (Kooij & Wicherts, 2021, para. 14). This is unfortunate as predicting the motivation of faculty via SDT was integral to my hypothesis. Although SDT is low in predictive power, it provides a helpful lens for understanding why faculty are motivated for specific tasks. With the understanding that no theory is perfect and that we use theories because they provide helpful lenses to view our research, we remind the reader that SDT theory is imperfect but valuable.

Moreover, SDT has not been tested outside traditional settings. This means that it may be challenging to apply SDT in specific situations. Further, SDT describes the situation, not what it could be. For example, if you study how people already primarily act, you will reproduce the same biases and inequalities (Wisniewski, 2018, 1a section). Unfortunately, my study concerns "what could be" (1a section). In other words, what could be the results for students having STEM professors trained in pedagogy? This criticism is not too much of a hindrance to my research. As SDT is weak in this regard, similar studies like the one I am proposing may be needed to bolster my research's generalizability (Robson & McCartan, 2016).

Artifact II

Research Design

A qualitative approach was chosen to address the research questions because "there is a need to collect in-depth information on people's opinions, thoughts, experiences, and feelings" (Easwaramoorthy & Zarinpoush, 2006, p. 1). Hence, a qualitative research approach, such as interviews, rather than more quantitative approaches, such as Likert-type survey questions, is appropriate for addressing this study's research questions. Further, a qualitative approach was deemed necessary to address the study's research questions as qualitative research "addresses the 'how' and 'why' research questions and enables [a] deeper understanding of experiences, phenomena, and context" (Cleland, 2017, p. 69) Finally, it may turn out that the idea this research proposes for addressing the educational problem of practice of a lack of pedagogical training on behalf of collegiate faculty may be received negatively. After all, a college teaching certificate represents a serious commitment over four semesters, and there could be many barriers to faculty enrolling in such a certificate, depending on the faculty members' unique

circumstances. Hence, a qualitative approach would be necessary to explore other options to address the problem of practice (i.e., the 'how') that quantitative approaches cannot provide.

This study used qualitative methodology, specifically interviews, to collect data from STEM professors at a Midwestern doctoral research university. The interviews were conducted online using Zoom and over the telephone. Sessions were recorded in audio and video and later transcribed. There were six (6) interviews with professors from chemistry, mathematics, engineering, physics, medicine, and statistics. Six interviewees were chosen to be part of this study as saturation has historically been documented as occurring "within the first twelve interviews, although basic elements for metathemes [are] present as early as six interviews" (Guest et al., 2006, p. 59). Additionally, the author elected six interviewees to prioritize depth over breadth, especially as the interviews occurred over the summer, when most faculty have a reduction of teaching responsibilities. Finally, time and resources were also a concern, given that with more interviewees would require more time for collecting data, analyzing data, participating in the respondent validation process and other aspects of the research process.

To recruit interviewees, I utilized the university's online directory, which was organized by academic discipline. I examined the individuals in the directory for each of the six STEM disciplines of interest. Those individuals appearing in the directory who were support staff, such as administrative secretaries, were excluded from being interviewed, as they had no teaching responsibilities. I then sent an email (see Appendix W) to those in the department with teaching responsibilities, ensuring that the IRB approval form (See Appendix V) was included with the email. I utilized the Blind Carbon Copy (BCC) feature of the email client to ensure that when I began communicating with interested interviewees, no names of others invited to participate in the study would be visible to potential interview participants. I selected participants via

convenience sampling, meaning those who volunteered for the study first were chosen to participate. This sampling method resulted in the exclusion of potential interviewees. This decision was made to ensure that there was not a disproportionate number of interviewees representing a single scientific discipline, such as having two interviewees from the mathematics department but only one from the engineering department. During the recruitment process, several academic disciplines had only one STEM professor respond to the recruitment email. Therefore, it would not have been possible to interview more than one person per academic discipline to achieve equal representation among the academic disciplines for the study.

At the beginning of the interview, participants completed a consent form approved by the IRB body that approved of this research. Then, during the interview session, participants were asked pre-determined questions regarding their past pedagogical experiences and interest in pursuing a college teaching certificate (See Appendix A). Finally, data was analyzed with NVivo software to identify significant statements, common codes, patterns, and prominent themes.

Research Questions

I.   What factors motivate STEM professors to enroll in a college teaching certificate? Are there any common professional reasons that help determine this choice?

II.   Do STEM professors have any concerns regarding the value of pedagogical training to promote college students' STEM advancement?

III.   Do STEM professors think studying pedagogy is a feasible and practical method to address a potential lack of pedagogical training opportunities? Why or why not?

IV.   What may hinder STEM faculty from enrolling in pedagogy-related classes?

Description of Participants

The target population for the study is STEM professors at a doctoral research university in the upper Midwest; thus, the researchers will sample STEM professors with teaching responsibilities at a mid-western research university. The research team will recruit six (6) professors from chemistry, mathematics, engineering, physics, medicine, and statistics who are interested and available to speak about their experiences by utilizing the institution's online faculty directory. If this selection method is not possible, for example, collecting data in the summer months, then data selection will be based on the availability of appropriate research participants.

Data Collection Procedures

Recruitment will be done through email using an online directory of faculty profiles provided by the institution. The participants will complete a Doodle poll to indicate their availability for interviews. Participants will then be emailed an invitation to a specific Zoom session. A reminder email for the interview will be sent out one day before the session. Data collection will begin with participants completing a Zoom / phone interview.

As is typical, "Beyond the doctoral level institutions, most faculty would not have research on their contracts but would focus almost entirely on teaching" (R. Stupnisky, personal communication, October 24, 2023). As such, purposive sampling will be used to select faculty with teaching responsibilities at a major research university in the upper Midwest. Purposive sampling would be ideal for this research endeavor as the research questions concern only STEM faculty and no other academic disciplines. Further, purposive sampling is necessary as faculty are often at different career stages. For example, it would not be feasible for a faculty member close to retirement to be interviewed as they would not likely be interested in taking courses in pedagogy because they would no longer be teaching. As such, purposive sampling seems to be

an ideal way to filter the study participants to ensure that participants will be in the STEM field and have plenty of opportunities to teach students in the future.

No participant was paid for their interview, and neither was there any compensation provided to the participants in this study. The interview process took about an hour. Before the interview, participants were emailed a consent form approved by the university's IRB (Institutional Review Board) office. The interviewees responded via email and confirmed their interest in participating in the study. Additionally, we discussed the consent form in detail when we met via Zoom before continuing the interview. I provided and read the consent form to participants and ensured they understood, and if they consented, their permission was documented by their signature. Those who chose to participate were provided with a copy of their consent form, and I kept a copy for my records.

Data Collection Tools

The primary data collection tool will be interviews that are conducted over Zoom, with Dr. Statistics opting for a telephone interview. Interviews are commonly used data collection tools, especially for qualitative inquiries. Further, interviews provide an opportunity for the research team to ask open-ended questions, like the research questions for this DiP, that data collection tools such as the survey would be ill-equipped to address as "there is a need to collect in-depth information on people's opinions, thoughts, experiences, and feelings" (Easwaramoorthy & Zarinpoush, 2006, p. 1).

The interview questions were developed with the assistance of faculty in the education department at the same university where this data was collected. The interview questions were designed with the key aspects of behavioral needs theory, a sub-theory of SDT: specifically, autonomy, competence, and relatedness. There are nine questions with multiple parts, which are

49

available for inspection in Appendix A. There are also brief paragraphs explaining how the interview questions were essential to the study and what research questions the questions addressed, which are also included in Appendix A.

Data Analysis

My qualitative data analysis for the interviews involved several steps. First, I transcribed the Zoom / phone interviews into text documents. Then, I read through the transcripts to identify any themes and patterns. I identified themes and patterns with the help of a software program, NVivo, designed for qualitative analysis. Once I identified the themes and patterns, I began to code the data by assigning labels to specific sections of the text that correspond to each theme or pattern. Assigning these labels allowed me to organize the data and identify relationships between different themes. After coding the data, I analyzed it by looking for similarities and differences between different themes. This helped me to identify trends and patterns in the data and to draw conclusions about the research questions. Before finalizing my findings, I contacted the interviewees from September 14, 2024, until Wednesday, January 29, 2025, for respondent validation purposes, shared the transcripts and conclusions I made as part of the respondent validation process, and made any necessary adjustments. I was transparent about my methods and provided full details of my analysis process so that my interviewees and others could understand my findings. I modified my findings upon any clarifications during the respondent validation process. Finally, I wrote up the findings, maintaining the confidentiality of my interviewees by using pseudonyms and ensuring there was no way for them to be identified before sharing my data with those on my committee or others not involved in the research process.

Limitations

The generalizability of this research was something that was limited because, unfortunately, research derived out of studies based on purposive or convenience sampling cannot be generalized to wider populations, only subpopulations from which the data was gathered. Still, research is generally conducted utilizing purposive samples (Andrade, 2020). To clarify, "there is nothing wrong with convenience and purposive sampling as long as readers are aware of the (sub)population to which the findings are relevant" (p. 88), but the reader must be aware that the results of this study will apply only to STEM faculty, faculty in doctoral research universities and STEM faculty in similar teaching, research, and life situations. Specifically, choosing only six faculty members, one for each academic discipline chosen, was not ideal. However, given that this research occurred over the summer, one interview participant was often all that responded to multiple requests for interview. As such, the disciplines of chemistry, mathematics, engineering, physics, medicine, and statistics were chosen as these disciplines were deemed highly common in colleges and universities and would be opportunities for future scholars to engage in research with those individual disciplines.

Another limitation of my research approach was that not all faculty participants would be equally articulate or perceptive (Deakin University, 2023). As "no two brains are the same" (Rohman, 2018, para. 1; Valizadeh et al., 2018), there will be variability in the articulation and perceptiveness of individual STEM faculty in response to my interview questions. As such, I may get more beneficial data from some faculty than others. This is one reason why a semi-structured interview was selected so that some follow-up questions could be asked rather than following the interview's script as written.

Unfortunately, the flexibility of semi-structured interviews has been known to lessen their validity and scope. Moreover, it can be challenging to compare the responses of two interview

participants depending upon how the researcher deviated from the pre-established interview questions. Additionally, the openness and conversational characteristics of a semi-structured interview can lead to the interviewer asking programming questions that may be biased. Conversely, faculty may also seek to give answers in interviews that they think will make them look better or that the researcher may want to hear, contributing to social desirability bias. Finally, a limitation of semi-structured interviews is that they can be challenging to conduct with their relaxed standards when compared to structured interviews (George, 2022).

Unfortunately, due to the structure of the DiP classes required for doctorate students, the data collected for this DiP was conducted over the summer 2024 semester, during which most of the faculty members were away from the university and unavailable for interviews. Consequently, one major limitation was that the population was not drawn from a representative sample of professors but only those who needed or wanted to teach over the summer. In addition, no female faculty members were able to be interviewed.

Respondent Validation

The research team allowed more than one full semester for respondent validation from Saturday, September 14, 2024, to Wednesday, January 29, 2025. Four out of six interviewees participated in the respondent validation process. The only research participants that did not participate in the respondent validation process were Dr. Engineering and Dr. Chemistry.

Dr. Medicine participated in the respondent validation process, saying "I have reviewed the attached document, and I do not take issue with anything you have written. What you have written faithfully reflects our conversation" (Dr. Medicine, personal communication, September 16, 2024).

Additionally, Professor Aviation participated in the respondent validation process and indicated that

> After reading through your DiP, I think you accurately captured my thoughts … I looked into the requirements of the certificate and decided to enroll in the first course to see if it was worthwhile … and it was awesome. We spent a total of 5 days over 3 weekends, and it was fun to be in a classroom of motivated peers and to take a course from someone clearly passionate about the topic they were teaching. We read Lang and Major, and I was even able to incorporate a few of the strategies we discussed into my courses during the fall semester … [I]f I can survive this [next] course, I'll be halfway to obtaining a certificate that will be meaningless to my department, but potentially improve my teaching ability and help me better understand higher education. (Professor Aviation, personal communication, January 9, 2025)

Dr. Statistics was the most vocal in his feedback. Most of the comments from Dr. Statistics made in the respondent validation process were in reference to him believing that he represented another academic discipline instead of statistics. This is because the statistics department was so small at the university where this research was conducted and a professor who taught only statistics was unavailable for this research. There was one comment that the statistics professor made about his uncle suggesting that he not take education courses, and I mistakenly attributed that comment to being said by Dr. Statistics. I have updated with clarifications in this report.

Dr. Mathematics, the last to submit their comments in the respondent validation process, indicated that

I appreciate the work you've put into this research and am happy to assist in ensuring the accuracy of your representation of my experiences. In general, I don't have any major concerns about how my contributions have been captured. That said, I did notice a few minor inaccuracies (mostly in the form of typos or grammatical errors) in the transcriptions of my interview responses—though I imagine you've likely spotted these yourself already. These are small details, but I wanted to mention them in case they were overlooked. (Dr. Mathematics, personal communication, January 26, 2025)

To summarize, overall, the respondent validation indicated that there were only minor issues and no major misrepresentations with the draft of this dissertation.

Reliability, Credibility, and Trustworthiness

To ensure "the trustworthiness of the findings, accounting for personal biases that may have influenced findings" (Noble & Smith, 2015, p. 35) is paramount. To combat biases that may be present in my research, member checking (also known as participant or respondent validation) was utilized. Member checking involves returning data "to participants to check for accuracy and resonance with their experiences" (Birt et al., 2016, p. 1802). Via member checking, the credibility of the interpretations made from interview data can be made, and, if necessary, modifications can be made to the research data interpretations if there are any misunderstandings or instances of research bias. Further, member checking aids in the trustworthiness of the interview data (Birt et al., 2016) and will be available and offered to all research participants in this study.

Additionally, I developed "a rigorous semi-structured interview guide [that] enhance[d] the trustworthiness of qualitative research" (Kallio et al., 2016, p. 2962). Specifically, when establishing the interview questions, we followed the steps of Kallio et al. (2016), which are

summarized in the following list:

1. Identifying the prerequisites for semi-structured interviews;

2. Retrieving and using previous knowledge;

3. Formulating the preliminary semi-structured interview guide;

4. Pilot testing the guide; and

5. Presenting the complete semi-structured interview guide (Kallio et al., 2016, p. 2954).

Finally, the reliability and validity of my research were bolstered via triangulation. Specifically, theory triangulation, which involves "the use of multiple perspectives to interpret the results of a study" (Hales, 2010, p. 13) was utilized. The multiple perspectives used to interpret the study results were from those on my committee who hold valid IRB certifications. Triangulation enhanced the overall study by ensuring that the biases of a single researcher could be challenged when analyzing data for this research. I examined multiple data sources, including professors from varying disciplines, and utilized investigator triangulation- using more than one investigator to explore phenomena. Various forms of triangulation are essential in research, and add to the reliability, credibility, and trustworthiness of the findings (Stavros & Westberg, 2009; Fusch et al., 2018). These factors were all considered as potential interviewees were selected, and later, findings were interpreted.

Peer Debriefing

Shenton (2004) explains, "Opportunities for scrutiny of the project by colleagues, peers, and academics should be welcomed" (p. 67). As such, I engaged in peer debriefing, which allowed my data to be examined and interpreted by my committee members, professors, and mentors. Multiple peer debriefers, knowledgeable in qualitative methodologies, were consulted to provide additional viewpoints, avoid misinterpretations and biased conclusions, and avoid

overgeneralizations and simplifications of the themes found (Adebayo, 2022). Specifically, data that had no identifying characteristics, themes, codes, and my interpretations were shared with peers. The peers then challenged the assumptions that were made, conclusions drawn from the data, and any fallacious arguments to arrive at the final product.

Audit Trail

I stored all the data collected for this study with great care and diligence in password-protected servers. Every piece of information was meticulously organized and properly documented to ensure credibility, validity, and trustworthiness. Even the field notes and memos used during the interview transcripts and recordings were stored carefully and securely in OneDrive. Specifically, for each participant, I included a folder in my OneDrive that included a video of our conversation, transcript, and any notes that I had taken during the interview. Moreover, in my NVivo folder, I stored coded transcripts, quantitative data including word frequency analysis, and word cloud files on my password-protected computer. As a result of my careful implementation of the data collected and thorough analysis, the audit trials were deemed highly credible (Adebayo, 2022).

Interview Questions Rationale and Specifics

Interview questions were developed with the help of the research committee to address the research questions. This section presents research questions with interview questions afterward. The rationale for each interview question is described, as well as the research question the interview question addresses. These interview questions should help the research team gauge how well the interviewed faculty members' needs for relatedness, competency, and autonomy are satisfied and addressed the research questions.

Research Questions

I. What factors motivate STEM professors to enroll in a college teaching certificate? Are there any common professional reasons that help determine this choice?

II. Do STEM professors have any concerns regarding the value of pedagogical training to promote college students' STEM advancement?

III. Do STEM professors think studying pedagogy is a feasible and practical method to address a potential lack of pedagogical training opportunities? Why or why not?

IV. What may hinder STEM faculty from enrolling in pedagogy-related classes?

Interview Questions

It is important to note that this was a semi-structured interview and every interview question was not asked of all participants. Some participants were more elaborate with the answers they gave, while others answered concisely. Because of the variation in responses, some of the interview questions were not asked and a decision was made to ask questions that were necessary to address the research questions. For example, probing questions were not prioritized in this instance. At a minimum, all interviewees were asked the main questions (without letter labels. e.g., part a, b, c, …).

I. What are your percentages for teaching, research, service (and any others)?

Rationale: This interview question addresses research question IV, as we are examining the time constraints on the STEM faculty to determine whether existing commitments will hinder devotion to a graduate certificate. The research team (advisor, committee members, and myself) will interpret whether the graduate certificate is a feasible way to address the pedagogically untrained STEM faculty issue partially based on the data analysis from this question, which also addressed research question III by examining the feasibility and practicality of STEM faculty enrolling in a graduate teaching certificate.

II.   Tell me about teaching your discipline.

(a) What field are you in?

(b) Which classes do you currently teach?

(c) What is the most challenging thing about teaching in your discipline? Why is this so challenging?

(d) What pedagogical training were you provided, or have you had?

Rationale: This interview question was designed to build rapport and trust between the interviewer and interviewee. Part (a) was a formality, as this was evident from the research selection process based on the university's online faculty directory. Part (b) was designed to get a feeling about how many courses the STEM professor taught, helping address research questions I, III, and IV by determining whether the professor seemed overwhelmed with their current teaching load or was comfortable with their existing teaching responsibilities. Interview questions (c) and (d) were designed to get the faculty members to "open up" about the challenges they faced in the classroom. These questions allowed the faculty member to "vent" and establish trust in the interviewer. This interview question helped to address research questions I and IV by gauging the faculty member's attitude toward teaching. For example, whether it was an obstacle to their research or something they wanted to devote significant energy and time to. If the former, the faculty member may have had negative perceptions of pedagogy and may elect to continue to "teach as they were taught" (Bouwma-Gearhart, 2011, p. 559), which may hinder their motivation to enroll in a college teaching certificate. If the latter, we may have someone likely to be motivated to enroll in a college teaching certificate.

III.   What pedagogical training have you had in the past?

(a) To what extent did you feel this training was adequate?

(b) Tell me about what has helped (or hindered) your teaching skills.

(c) Tell me more about how competent you feel in your pedagogical skills.

(d) Do you feel you have sufficient opportunities to teach in your own way?

(e) Have you taken courses in pedagogy before? Why or why not?

(f) What do you think the purpose of collegiate pedagogy courses is?

(g) How do you feel that taking courses in pedagogy would impact teaching your STEM courses?

(h) What do you think about STEM faculty, such as yourself, taking pedagogy classes? What are your thoughts on this, and do you think these pedagogy classes would improve your teaching skills? Why or why not?

Rationale: As no assumptions were made about whether the STEM faculty member had received any pedagogical training, this question was designed to inform the interviewer about the interviewee's existing pedagogical training. Part (a) was meant to better understand the STEM faculty members' pedagogical training and whether they considered pedagogical training effective. Part (b) asked how the interviewee had developed their teaching skills, which was integral to addressing research question III, because if they had already developed those skills, then it would be unreasonable to enroll in a college teaching certificate. Conversely, if they have not developed those teaching skills, then a teaching certificate may be open to being considered by the interviewee. Part (c) addressed the competence aspect of behavioral needs theory, whereas part (d) addressed autonomy. Part (e) helped to determine the interviewee's

regard as to the value that pedagogical training had for their respective discipline and hence addressed research question II. Part (f) examined research question III as the question attempted to determine the interviewees' perspective on the purpose of collegiate pedagogy courses. Part (g) was helpful in answering research question II by inquiring how the interviewee thought pedagogy courses would impact the students in their classes. Part (h) addressed research questions I and II, as the question inquired about the value of pedagogical courses (addressing research question II), and depending on their response, I could gauge their potential motivation to enroll in a graduate certificate teaching program (addressing research question I).

IV.   If you could change one aspect of how you were prepared to teach your discipline, what would you change and why?

   Rationale: This question allowed the interviewees to recognize what they need regarding pedagogical training. If faculty members recognize their pedagogical training needs, they may be more motivated to engage in pedagogical development (Bouwma-Gearhart, 2011). Or, in this case, if faculty become more aware of their needs, allowing the research team to inquire about the feasibility and practicality (RQ III) of a college teaching certificate. This question addressed research question II because it gauged the interviewees' opinion on whether studying pedagogy or receiving pedagogical training had value over what the professor currently does in the classroom to ensure students' STEM advancement.

V.   What are some ways you could suggest that STEM professors could use or do to improve their teaching?

   (a) Do you feel that teaching well can be learned, or is it something you are born able to

do? In other words, is teaching good a skill that can be developed or a trait, like red hair?

(b) Do you, or others you know, have a natural ability for teaching?

(c) How often do you execute a lesson perfectly as planned?

(d) What do you do when a student makes a mistake or has trouble?

(e) How do you feel when a student has trouble learning something? In other words, is this a teaching or learning issue?

(f) What is one change you made recently to become a better teacher? How did you decide to make this change? In other words, did you get advice from another educator, read about the idea, etc.?

(g) How much progress have you made in your teaching ability since you first started teaching?

Rationale: The question was critical to this research as it allowed the interviewee to express their views on what could make for a better learning experience for their discipline. Part (a) inquired about the faculty member's views on pedagogy as a trait or skill. It addressed research question I as if teaching were a trait, like red hair, one would hardly be motivated to improve it. Conversely, if teaching were a skill that could be developed, then it may make sense to develop those skills. For part (b), it may seem to some professors that some of their peers have a natural talent for teaching, which may lead to the impression that some individuals are inherently better at teaching than others. This question helped to answer the research question I because it helped to establish the interviewees' mindset. Part (c) encouraged the professor to talk about the challenges in the classroom. Depending on responses, the interview team was able to understand the motivations for enrolling in a teaching certificate program, helping to answer research

question I**.** For parts (d) and (e), these questions probed the interviewee about their specific teaching approach, what they do, and how they felt when a student has difficulty in their classroom. The question further probed the interviewee's mindset and inquired whether these are learning issues, teaching issues, or something else. Part (f) asks about the interviewees' change in their teaching practices and where they got teaching ideas from. This question was integral in understanding how the professor viewed teaching certificates, and their motivation to learn more about them. Part (g) inquired about the progress the interviewees made since they started teaching and asked if they believed they could effectively teach without further pedagogical training. This question helped the research team to understand the pedagogical decision-making process, and explored to what extent a teaching certificate may have had on the decision-making process, helping to determine the interviewees' opinions regarding the feasibility and practicality of the graduate certificate, and thus helping to answer research question III.

VI. Have your peers engaged in professional development, focusing on pedagogy?

(a) How do you think your peers would respond to your taking courses in pedagogy?

(b) Have any of your peers taken pedagogy courses?

Rationale: This question inquired about the culture of the interviewee's department and helped to determine the extent the relatedness component of behavioral needs theory was being satisfied. Further, inquiring about the culture of the interviewees' department was useful as it helped inform an understanding of the professors' motivation to enroll in a teaching certificate. This was integral to understanding the barriers, feasibility, and practicality of a graduate certificate being studied, and the likely response of the professors' peers, addressing research questions III and IV.

VII. What impact do you think taking courses in pedagogy would have on your students?

(a) How do you think STEM professors can best help students learn?

(b) How do you feel the quality of teaching contributes to promotion, tenure, and retention in your department?

Rationale: This interview question addressed research question II in that it attempted to establish to what extent the interviewee thought pedagogy courses would benefit their students. Part (a) allowed the interviewee to examine to what extent pedagogy courses were feasible and explore a practical solution to address the lack of pedagogical training professors likely received (helping to answer research question III). Part (b) addressed research question I, as the interviewees were able to express their opinions regarding the value they feel studying pedagogy would have for their career security.

VIII. A graduate certificate in college teaching is designed to assist prospective and current college and university faculty to acquire and further develop skills and knowledge essential for effective teaching in higher education. Graduate certificates in college teaching typically consist of four classes (12 credits). If you taught one less class, with no change in pay, would you be willing and able to enroll in a college teaching graduate certificate and take one class at a time until certificate completion?

(a) Why or why not? Is this feasible and practical for your unique circumstances?

(b) What barriers do you see to enrolling in a college teaching certificate?

(c) What benefits do you see from engaging in a college teaching certificate?

Rationale: This interview question inquired to what extent the professor would be motivated to enroll in a teaching certificate and the rationale as to why, answering research question I. Further, the question helped to answer research question IV by

inquiring about the barriers to enrolling in a graduate certificate in part (b). Part (c) addressed the value aspect of pedagogy courses by asking about the benefits of a teaching certificate, addressing research question II. Finally, by combining parts (b) and (c), the benefits and barriers were discovered when inquiring as to the extent the interviewees believed pedagogy course to be a feasible and practical method to address the lack of pedagogical training often provided to STEM faculty, helping to answer research question III.

IX.   Is there anything else you could share with me today regarding your work and teachings in STEM and elements related to pedagogy?

Rationale: This question did not explicitly address any of the research questions but instead served to end the interview on the interviewees' terms. This question allowed the interviewee to clarify any statements they made before, to suggest an alternative approach for addressing the pedagogically untrained STEM faculty issue, or to serve as a concluding question to the interview.

Narrative that Explains the Results of the Inquiry

Saldaña (2015) asserts that "No one, including myself, can claim final authority on the utility of coding or the 'best' way to analyze qualitative data" (p. 2). Keeping this in mind, it must be mentioned that there is some subjectivity in the qualitative data analysis process. In this analysis, I chose to engage in a thematic analysis using coding to answer the research questions, allowing me to meticulously comb through interview transcripts and assign codes from the data into categories. Then, I examined those categories and looked for themes that emerged from my data. There were several categories, along with their descriptions, which are included in Table 1.

Table 1

Code Frequencies & Descriptions

| Code Name	Description	The number of Interviewees Code is Present in	Total Frequency of Code
Attitude	Any attitude towards teaching, learning, and administration. Strong feelings are the hallmarks of this code.	5	44
Autonomy	This code includes any restrictions the professor mentions regarding how they are asked to teach.	6	24
Balance	Included in this code is a commitment to the necessity of balancing research and teaching.	3	8
Born/Learned Skills	This code encapsulates the belief that teaching is something that can be learned and improved upon.	6	19
Changes	This code includes mentions of what changes professors would make or think would benefit them. This code also includes remarks about what the professors would change about their pedagogical learning or want to know more about.	4	23
Competence	This code relates to the professor expressing confidence in their teaching ability.	6	30
Existing Pedagogical Training or Knowledge	This code includes mention of existing pedagogical training or knowledge that professors have had.	6	82
Tada	Mention of a professor's interaction with a university office focused on pedagogical improvement.	3	4
Taxonomies	Includes mentions any taxonomies that the instructor has expertise or experience with. For example, Bloom's Taxonomy.	3	4
UDL	Any component of UDL (Universal Design for Learning) is included in this code. This may include multiple means of representation, backward course design, etc.	2	12

Feelings Regarding Pedagogy	This code contains references to professors' thoughts and feelings regarding pedagogy. This may include, but is not limited to, thoughts on pedagogy classes/workshops, the value of pedagogy, feelings regarding the need for pedagogical advancement, etc.	6	116
Importance of Teaching Quality	This code encapsulates any comments on the significance, or lack thereof, regarding quality of teaching.	6	21
Lack of Resources	The criteria for this code included anything that related to the professor speaking about a lack of resources.	3	7
New Learning Opportunities	This code included professors' responses to questions about whether they would choose to advance their pedagogy, or anything concerned with a new pedagogical learning opportunity.	5	38
Meeting	This code included teachers who met up with each other to discuss teaching. For example, a book club or monthly meetings with staff members to discuss what went well and what did not go well.	4	18
Profanity	This code included instances of cursing, profanity, etc.	1	2
Promotion	This code included comments regarding the promotion of faculty. For example, any talk or mention of tenure, promotion, and retention.	5	14
Relatedness	This code consisted of how the professors felt about their peers. Anything that mentions the culture of their department, or how others in their department perceive them, etc. This code also included relationships with other stakeholders, such as students and administrators.	4	12
Responsibility	This code consisted of instructors' comments about responsibility to students and pedagogy. Moreover, the code included comments about not accepting specific responsibilities when offered. This code also included mentions of what the professor's job might include.	2	9
Self-Blame or Regret	This code consisted of any comments the instructor made in which they engaged in self-blaming for lack of learning, teaching	2	5

	proficiency, or any other self-blame language. This code also included regret from previous teaching encounters.		
Teaching Certificate Feelings	This code contained a reference to any thoughts or feelings regarding teaching certificates as a means of further developing pedagogy.	4	26
Concern for Other Teachers	This code included mentions of other professors having to pick up the slack while taking pedagogy courses.	2	4
Teaching Challenges	This code includes any challenges the professors may have faced or felt in relation to any aspect of their teaching, but is not related to external factors such as administrative challenges, lack of resources, etc.	6	101
COVID	This code included mentions of COVID as being a particularly challenging teaching aspect to contend with.	4	6
Teaching Feedback	This code included new teaching knowledge or experiences the professors detailed about having people observe their class or learning from the feedback of students.	3	8
Timing	The criteria for this code were anything that described the professors' schedule or timing-related commitments.	6	44

Saldaña (2015) provided guidance for coding, assigning codes to categories, and extracting themes from the data. Saldaña's (2015) model served as a guide for data analysis throughout the process. In Figure 2, an infographic shows the overall process of reading the data and assigning codes from the data, then placing multiple codes into categories. From these categories, I was able to identify several themes and concepts to help make assertions regarding the research questions.

Figure 2

Saldaña's (2015) Streamlined Codes-to-Theory Model for Qualitative Inquiry
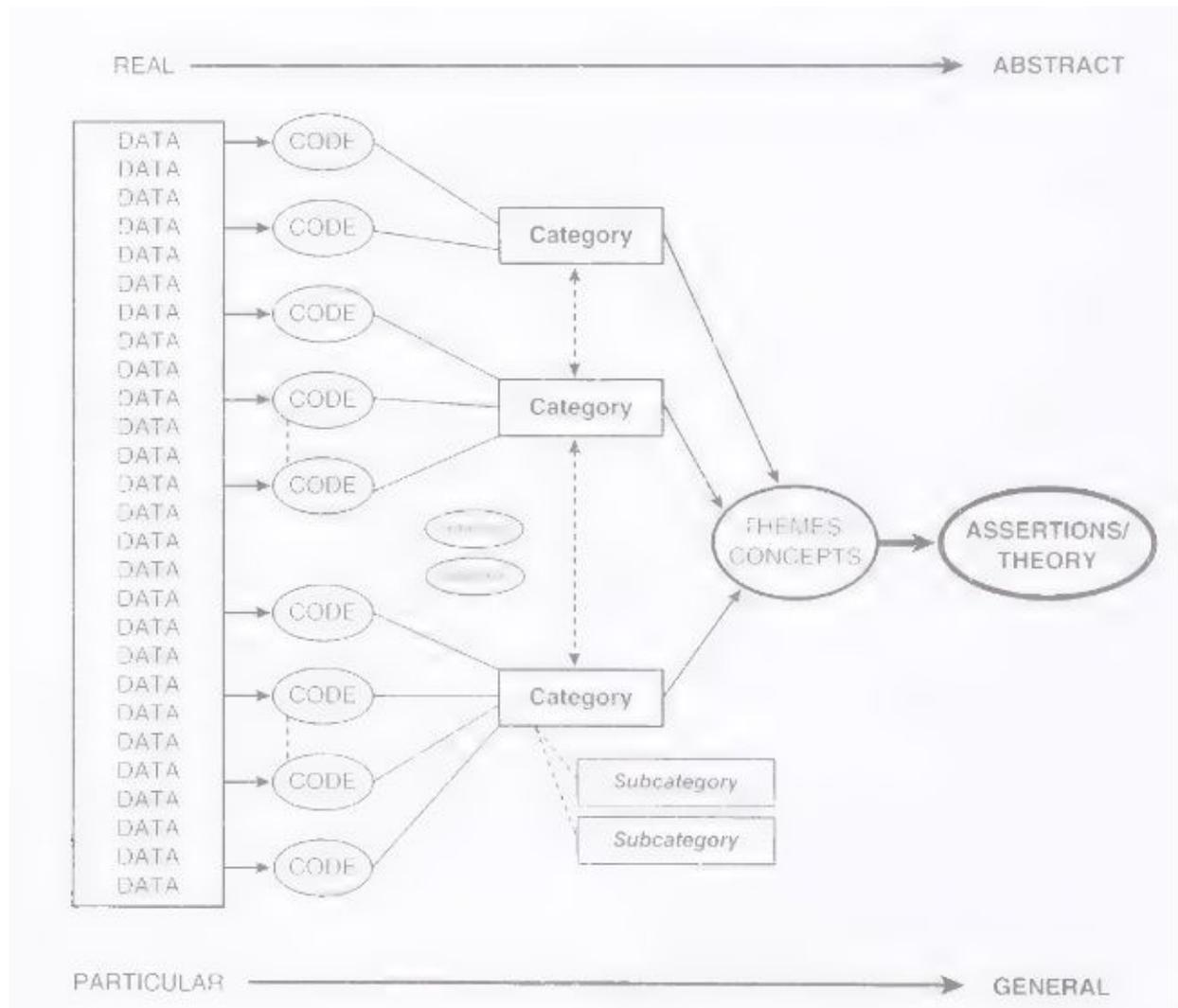
Unfortunately, due to the wide variations between participants, including academic fields, number of available interview participants, years of teaching, and degrees held, saturation was not reached in this research project; that is, I did not collect enough data to draw the necessary conclusions to the research questions to the point where any further data would not produce any insights. One of the interviewees pointed out that I was unlikely to achieve saturation in this study because "the culture has to permeate in the college" (Dr. Engineering), and the culture of every academic department is unique.

Consistent with existing literature, one theme I noticed is that every professor I interviewed detailed a different culture in their department. Indeed, my research helped to demonstrate that "the culture and climate in a department play major roles in the effect and impact on the group members, that is the faculty" (Brown, 2023, para. 2). For example, Dr. Math indicated, "The math department is, like, virtually dead in so many ways." Whereas, considering a differing cultural norm, Dr. Medicine indicated that getting upset (in general) "doesn't benefit anybody. To get frustrated with students who are having difficulty ... I have done that, and I have regretted it." The differing cultures in the varying departments have led to a lack of saturation in this research, but did not preclude useful insights (to follow).

Considering the experiences I had interviewing the faculty members; it was clear that some interviews were more fruitful than others. The following tree map, Figure 3, indicates that the Aviation transcript yielded the most data to be analyzed (the largest rectangle), which is interesting as the one professor without a Ph.D. was the one who had the longest interview. The least fruitful interview was the statistics interview (smallest rectangle). While every interview contributed new data and added to my understanding of the motivations of STEM faculty members to engage in pedagogical development, there were, of course, certain interviewees who I was able to build a stronger relationship with and were more forthcoming and less guarded in their responses.

Figure 3

Data Fruitfulness Tree Map
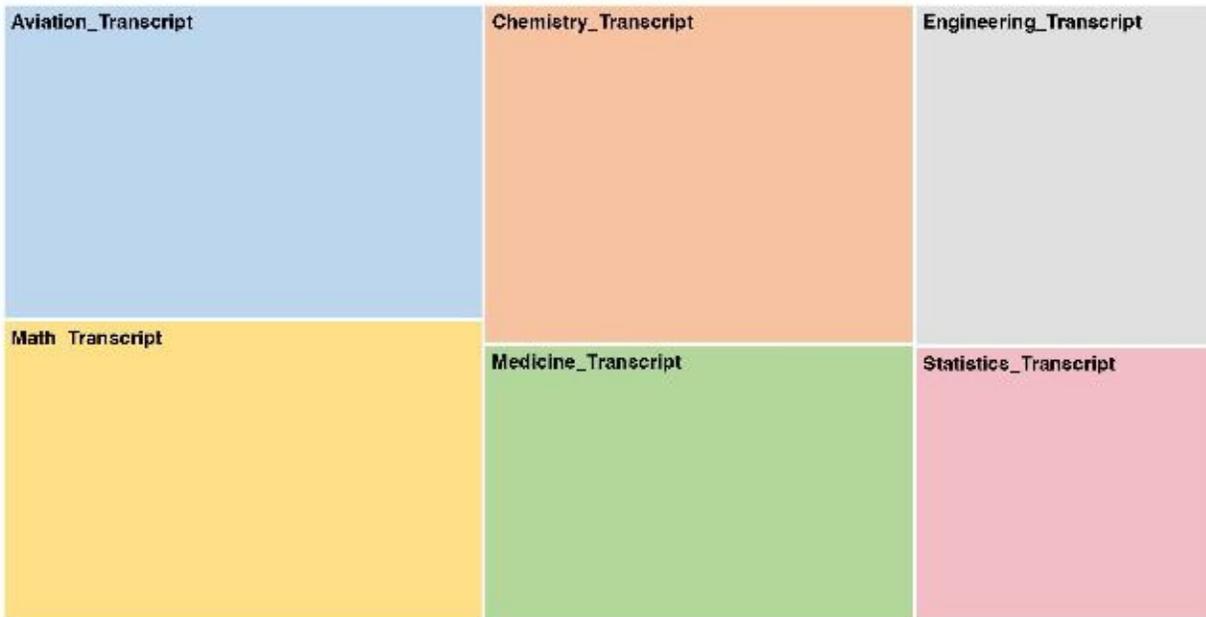
Note. A tree map is a diagram that shows hierarchical data as a set of nested rectangles of varying sizes. A node with many coding references would display as a large rectangle. The tree map is scaled to fit the available space best, so the sizes of the rectangles should be considered concerning each other rather than as an absolute size (QSR International, n.d., What is a tree map section).

In the following we will explore the codes that are partitioned among the interviewed faculty members. There will be bar graphs demonstrating how many times the interviewee contributed to the categories I had formed. The specifics of which codes the interviewees were assigned are available in the appendix but are too extensive to appear in this section.

Figure 4

Case Frequencies for Aviation Interview

Aviation
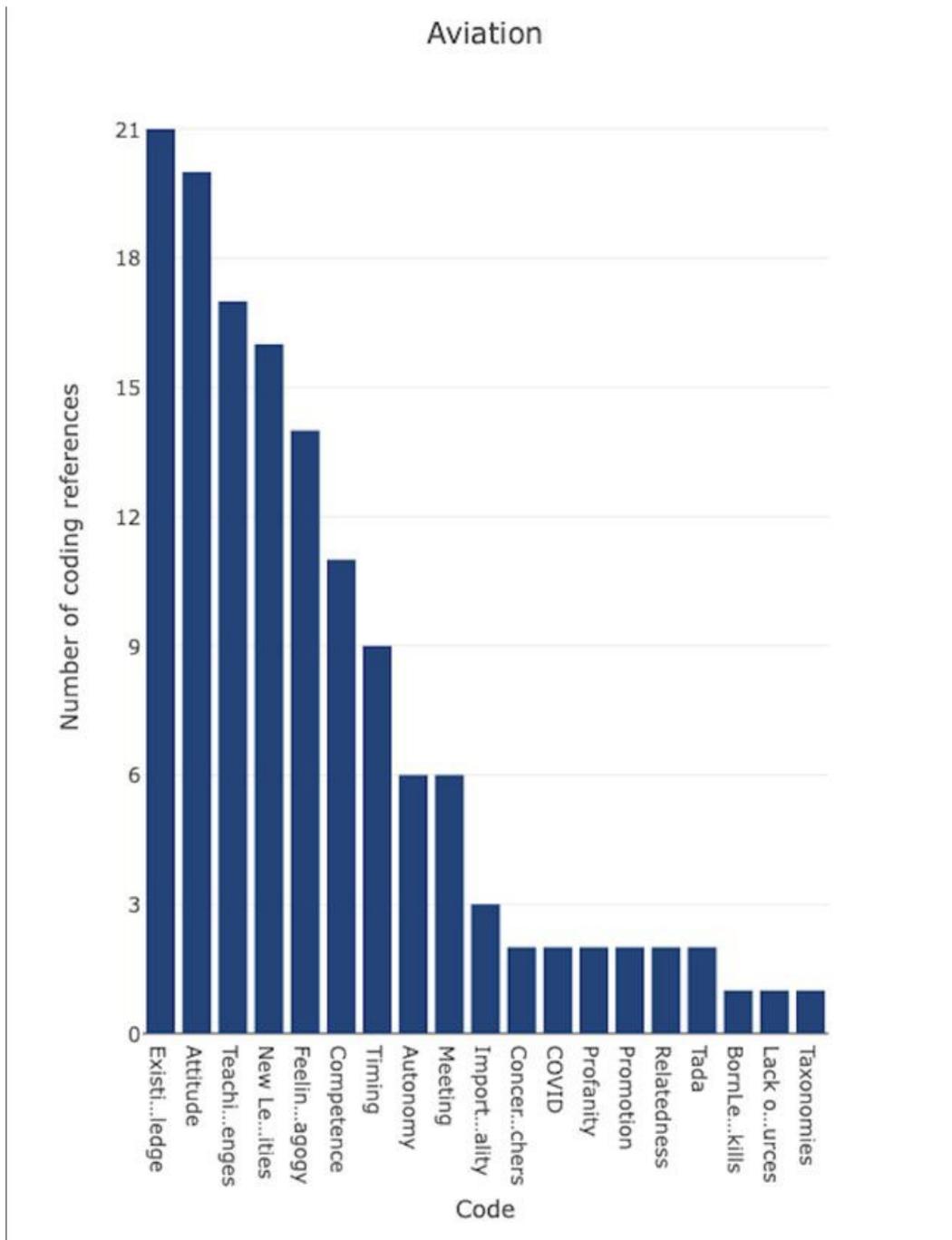
Note. A complete list of cases and their descriptions is available in Table 1.

Figure 5

Case Frequencies for Chemistry Interviews

Chemistry
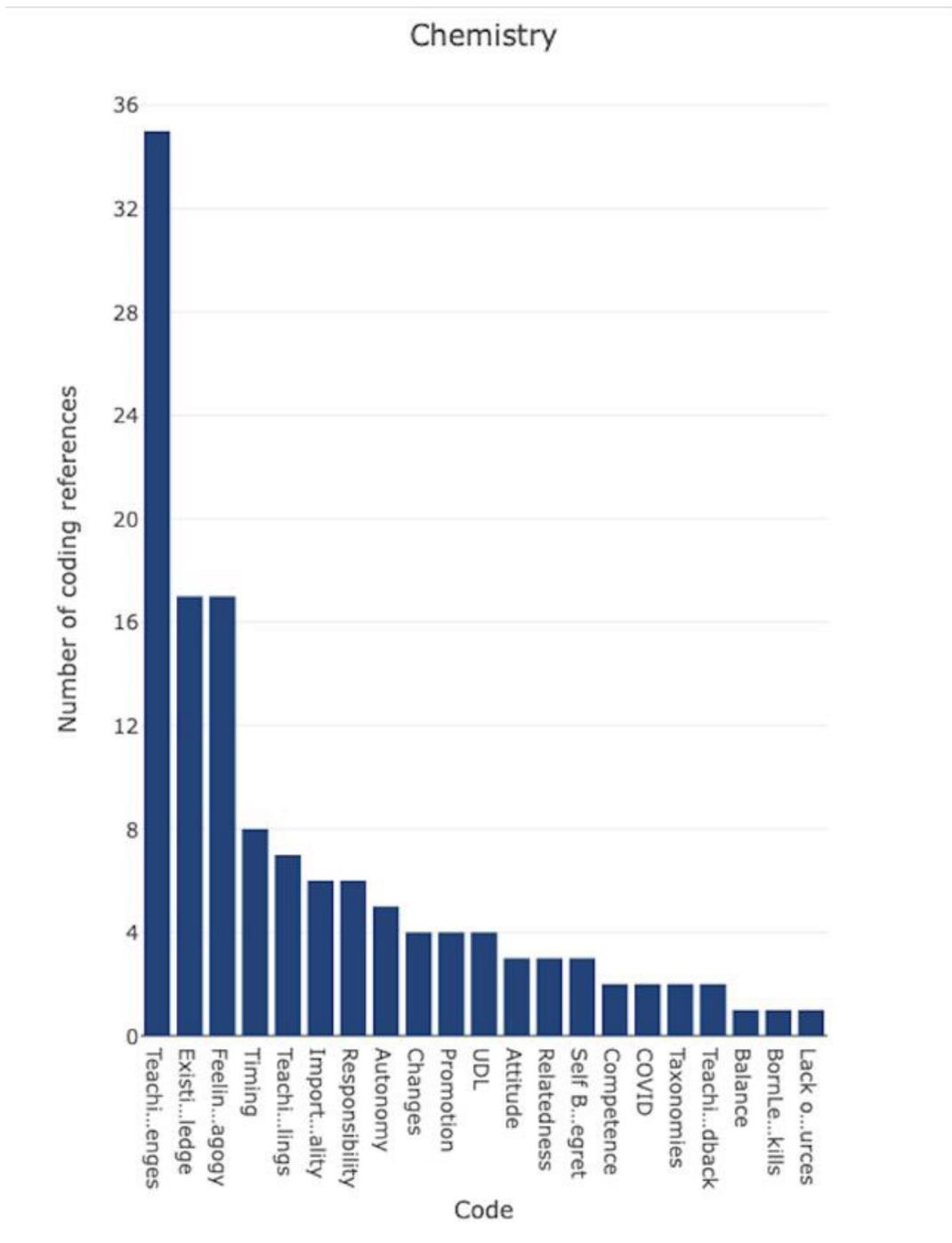
Note. A complete list of cases and their descriptions is available in Table 1.

Figure 6

Case Frequencies for Engineering Interview

Engineering
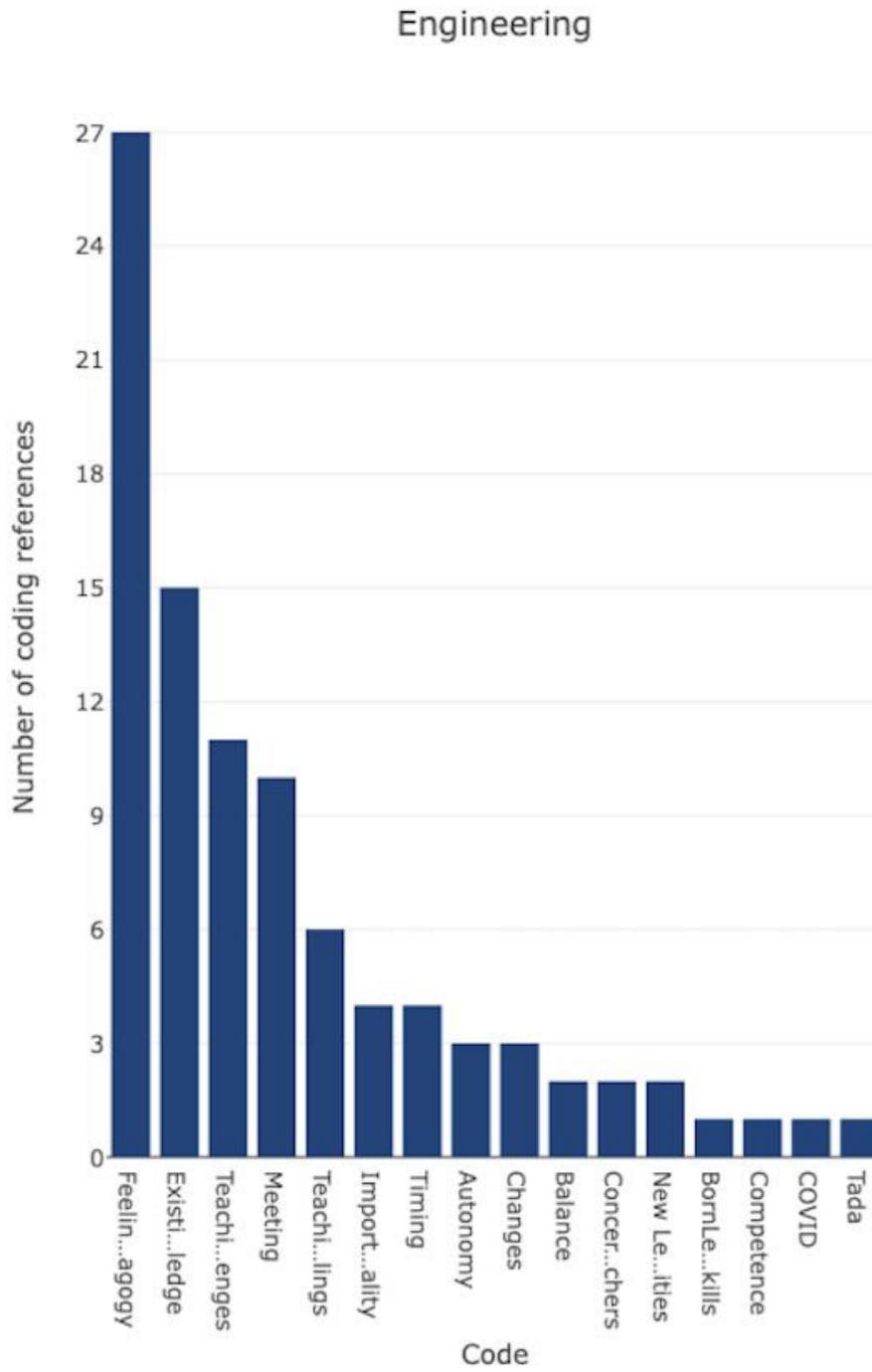
Note. A complete list of cases and their descriptions is available in Table 1.

Figure 7

Case Frequencies for Math Interview

Figure 7 - Case Frequencies for Math Interview
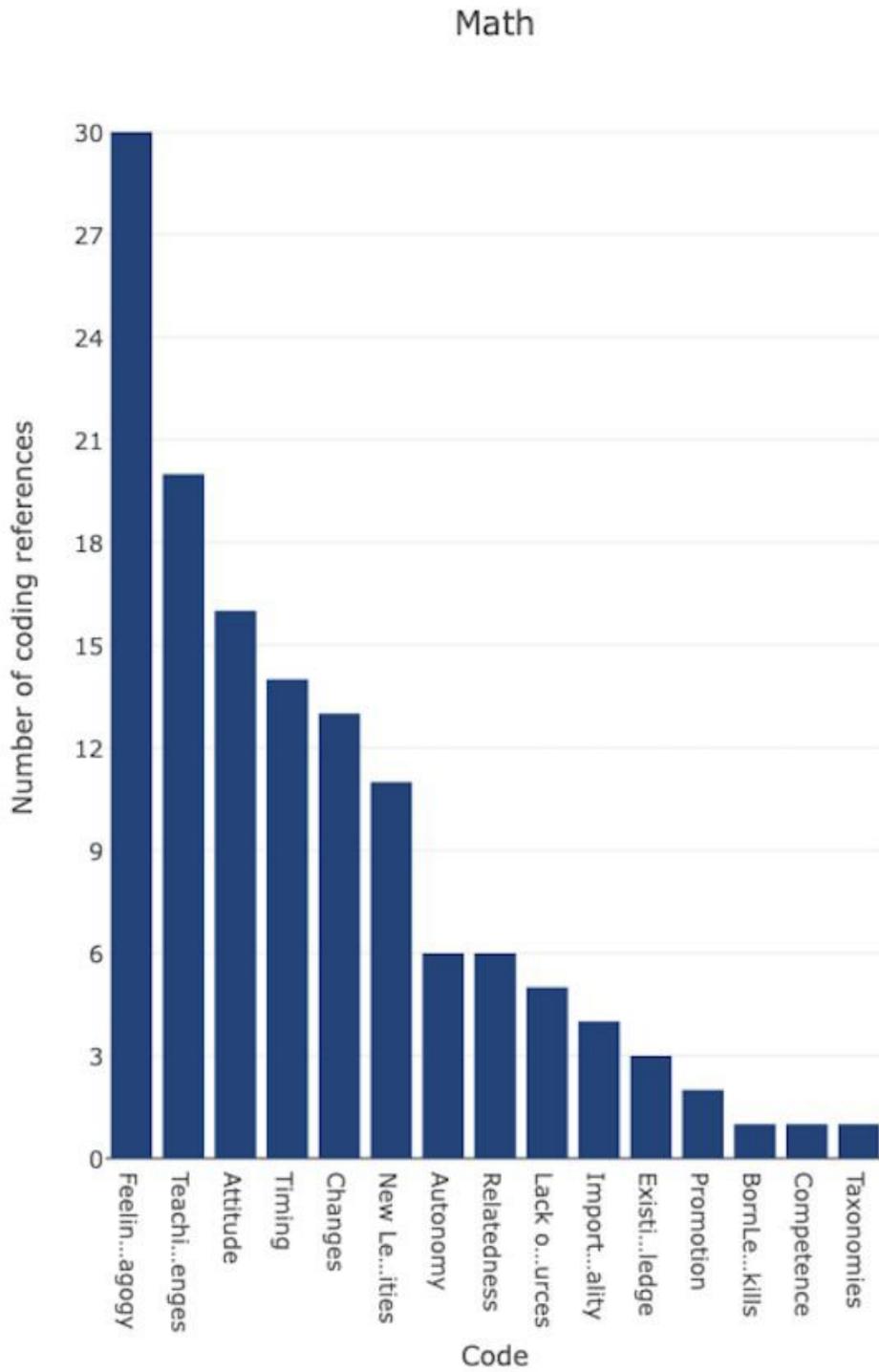
Note. A complete list of cases and their descriptions is available in Table 1.

Figure 8

Case Frequencies for Medicine Interview

Medicine
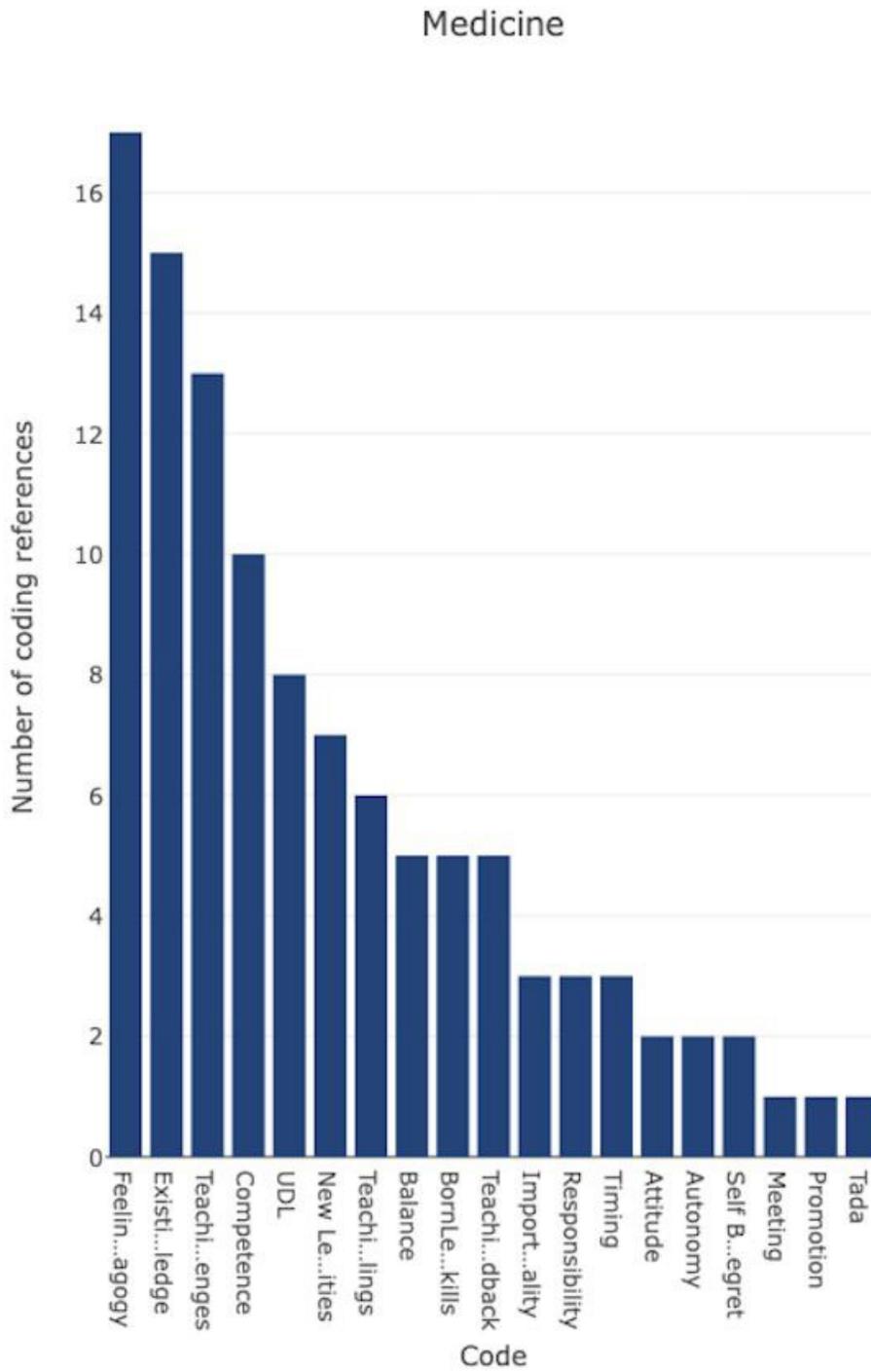
Note. A complete list of cases and their descriptions is available in Table 1.

Figure 9

Case Frequencies for Statistics Interview
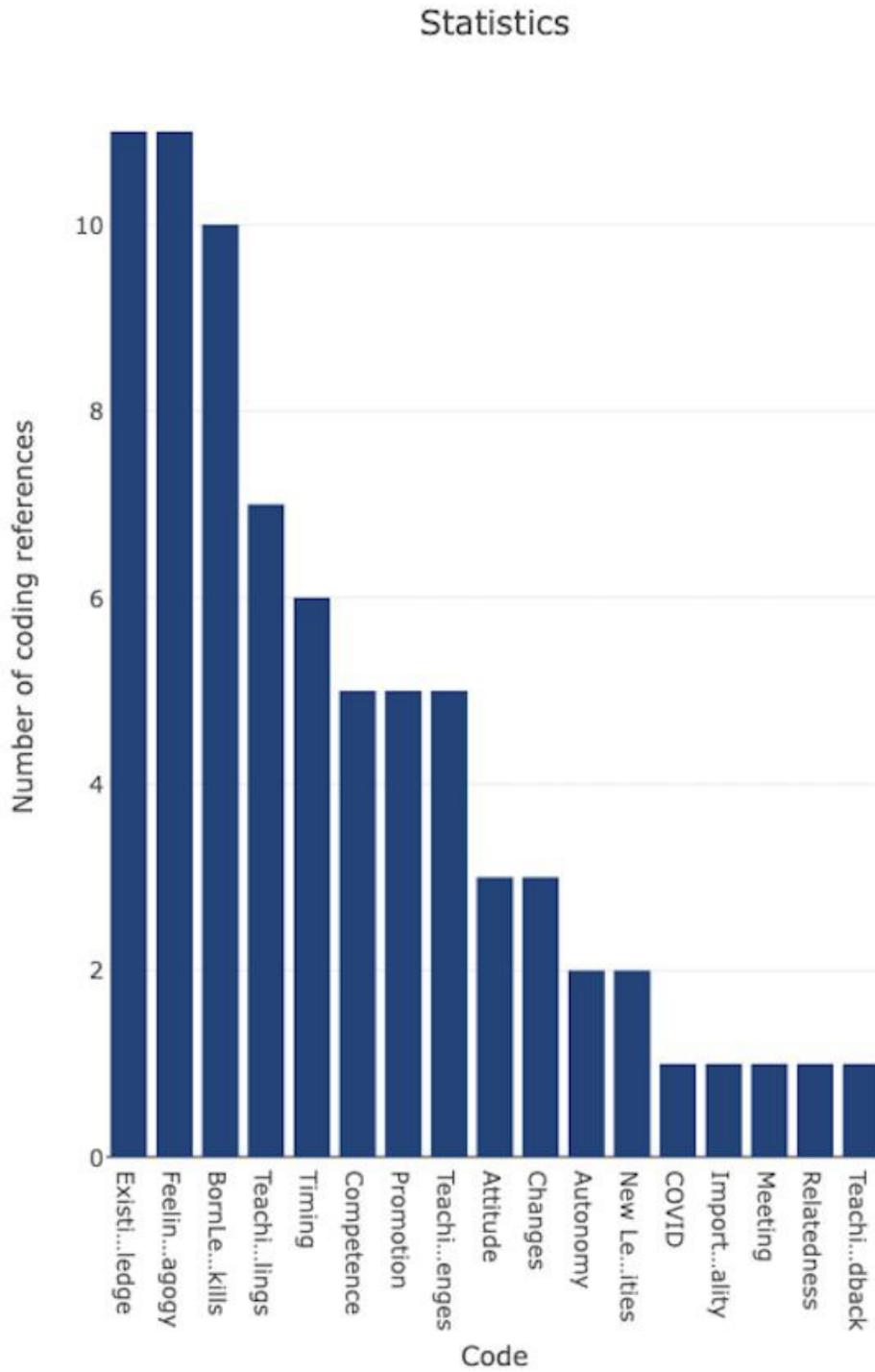
Note. A complete list of cases and their descriptions is available in Table 1.

As can be seen from the above bar graphs, the codes and corresponding categories for each interviewee are variable. As a reminder, the codes and corresponding categories for each interviewee are available in the appendix, and a complete list of cases and their descriptions is available in Table 1. Much like the department's culture, the data collected from each interviewee was different, again contributing to a lack of saturation. In the following table, there is detailed information about the frequencies of codes that were analyzed in the interviews.

The following table presents the number of coding references that were coded across the six interviews. There was an enormous concentration of references to "teaching challenges." This table will allow for some additional insights as to the "gist" of how the interviews progressed and the frequency of common ideas, thoughts, and feelings common among all the interviewees.

Table 2

Number of Coding References

Codes	Number of Coding References	Aggregate Number of Coding References	Number of Interviewees Coded	Aggregate Number of Interviewees Coded
Attitude	44	44	5	5
Autonomy	24	24	6	6
Balance	8	8	3	3
Born/Learned Skills	19	19	6	6
Changes	23	23	4	4
Competence	30	30	6	6
Existing Pedagogical Training or Knowledge	82	102	6	6
Existing Pedagogical Training or Knowledge / Mention of Participating in a University's Offices Pedagogical Improvement Efforts	4	4	3	3
Existing Pedagogical Training or Knowledge/Taxonomies	4	4	3	3

Existing Pedagogical Training or Knowledge/UDL	12	12	2	2
Feelings Regarding Pedagogy	116	116	6	6
Importance of Teaching Quality	21	21	6	6
Lack of Resources	7	7	3	3
New Learning Opportunities	38	56	5	5
New Learning Opportunities\Meeting	18	18	4	4
Profanity	2	2	1	1
Promotion	14	14	5	5
Relatedness	12	12	4	4
Responsibility	9	9	2	2
Self-Blame or Regret	5	5	2	2
Teaching Certificate Feelings	26	30	4	5
Teaching Certificate Feelings/Concern for Other Teachers	4	4	2	2
Teaching Challenges	101	107	6	6
Teaching Challenges/COVID	6	6	4	4
Teaching Feedback	8	8	3	3
Timing	44	44	6	6

It is important to note that when NVivo counts the references in an aggregated node, it includes all the references coded directly at the node and the references in first-level child nodes. If the same reference is coded at multiple levels, it will be counted multiple times" (Lumivero, 2023, Note section). Additionally, for the interested reader, all the coding references are available in the appendix.

In the following table, we examine some exemplary quotes that contribute to an understanding of the interviewees' thoughts, feelings, and beliefs regarding pedagogy. Note that these quotes have not been edited in any way, and the names of the interviewees correspond to the disciplines that they teach. For example, "Dr. Chemistry," is a professor who teaches chemistry courses.

Table 3

Exemplar Quotes for Feelings Regarding Pedagogy Case

Interviewee	Exemplar Quote
Professor Aviation	"Teaching courses, I think, are a positive impact, and they should help enhance some of these delivery techniques because I can be a technical expert as an engineer. But that doesn't mean I can explain to my wife how that works." "I enjoy the pedagogical aspect of teaching. If I were to do a doctorate, it would be educational leadership." "I teach here in the aviation department because I like to teach."
Dr. Chemistry	"Hey, they really drilled it into us at these workshops." "I would actually almost prefer to be in a 100% teaching position, in which case I would be investing a foot, not only in pedagogy for the students' benefit, but also, for our own sanity, just like learning management systems and, you know, dealing with huge amounts of stuff can be a chore and grading can be a chore." "I would strongly recommend, to people like that, that, you know, training would be really useful."
Dr. Engineering	"Once you've been here a long time, you kind of get into a kind of rut of the way of thinking, of thinking about things. So, I just wanted to make sure I'm keeping things fresh." "I don't think it'll [teaching courses] alter the way in which I deliver the content, but it might help, or it might help reinforce some of the things in the classroom." "It takes a lot of courage and, you know, having 20 years of experience to come and say, I tried something I did fail."
Dr. Math	"Even if it, like, fully convinced me that I should do something different, like, there is essentially no reason for me to like if that required taking, like, a large amount of time. There's essentially, like, no reason for me to engage in it, right? It would just be mostly to my detriment to spend a ton of time redoing any [thing] ... There are other things to do." "You don't get like any more credit for teaching the class better than worse." "We're just doing like a lot of, like armchair psychoanalysis of our students. They got essentially zero information. And it seems silly to me."

Dr. Medicine	• "The education courses I did take, I took in college, and it was just a couple of courses that really just kind of turned me on to wanting to be an educator." • "Lot of interest among faculty here at the medical school in professional development." • "I think I could have really benefited from, from some [more] teaching and learning courses, understanding what my trajectory was for the career that I wanted."
Dr. Statistics	• "Having a course in teaching would have been a luxury." • "These people who've been through the College of Education, you know, they're better teachers." • "Don't take any of those education courses," he said. He said, "It doesn't help." **Respondent Validation Comment from Dr. Statistics:** "The words in quotation marks are the words of my uncle. I don't necessarily agree with him."

As can be seen from Table 3, there are vast differences in the individuals I interviewed. Most professors, specifically, Aviation, Chemistry, Engineering, and Medicine, seemed to view pedagogy training possibilities favorably. However, the Math and Statistics professors were exciting outliers in this situation. Note that the math and statistics departments are grouped into the same department at the university where this research was conducted. Therefore, the "Statistics" professor was broadened to include anyone who had taught statistics. For example, statistics in the education department, statistics for engineers, accounting statistics, etc.

While some may think the math professor had a negative view of pedagogy, this is, in fact, not the case. The math professor just wants to spend his time optimally, and he thinks that his time would be better spent helping students in other ways rather than enrolling in a college teaching certificate. For example, the mathematics professor contributed an unparalleled understanding by explaining that "if you're, like, an extremely terrible [teacher], I imagine that might cause some question into like a tenure decision. But, unless it's exceptionally strong in either direction, I don't expect it to be terrifically important." As such, the math professor

explained that studying pedagogy would be unlikely to have a benefit as it would not have a significant impact on their career or be likely to positively contribute to their students' mathematical understanding.

The statistics professor seemed to hold a positive view of pedagogical courses, but the statistics professor was more of the opinion that pedagogical training would have been something to have towards the beginning of their career and might be less appropriate than engaging in pedagogy after teaching for some time already.

Visual Representation of Interviews with Word Clouds

One way of visualizing qualitative data is via the use of word clouds. To elaborate, word clouds are used in many disciplines to analyze and communicate main ideas (Hicke et al., 2022, p. 1). Despite many disadvantages and drawbacks of word clouds, "word clouds are effective at conveying a general 'gist' of their contents" (p. 1), which is our goal in this section: to present a visual overview of each interview, to allow the reader to understand the 'gist' of how the interview went, and the possible themes that may emerge out of the interviews. It is important to note that while "word clouds remain a popular data visualization among journalists and DH [Digital Humanities] academics" (p. 5), among other scholars, word clouds do not provide a complete understanding of the interview; the only way to do that is to be there.

Figure 10

Aviation Word Cloud

Figure 11

Chemistry Word Cloud

Figure 12

Engineering Word Cloud

Figure 13

Math Word Cloud

Figure 14

Medicine Word Cloud

Figure 15

Statistics Word Cloud

Self Determination Theory

The three behavioral needs, autonomy, competence, and relatedness took various forms in the STEM faculty members' responses during the interviews. They were analyzed in Table 4 and discussed below.

Table 4

Behavioral Needs Satisfaction Among Interviewees

Interviewee	Behavioral Need
Professor Aviation	**Autonomy:** • "We could teach our course however we saw fit." • "I have the same freedom in all four levels except for the OSHA classes that I'll teach because those are some very specified requirements." • "I get complete academic freedom in my classes." **Competence:** • "I'm an assistant professor. Yes, but I do not have a PhD. Nor does anyone here." • "A doctorate means that that person has written and defended a dissertation, and they did research on something that does not mean that they either like or are capable of teaching an undergrad course, because I've had people who had engineering doctorates who were really smart, but could not explain that concept to somebody else in a manner in which they understood because they didn't understand fundamentals of instruction." • "Fairly confident." **Relatedness:** • "[Another instructor] was doing a performance. He was up on a stage, and he was doing a performance. He couldn't really respond very well to student questions that came from out of nowhere." • "I prefer an interactive guided discussion classroom versus I stand up in front and lecture and impart my knowledge."
Dr. Chemistry	**Autonomy:** • "A lot of academic freedom." • "We have almost full control over the course, the syllabus, and all that. And, actually, under this current administration is really pretty good." • "Even our colleagues don't really bug us that much about [it]." **Competence:** • "I certainly know the material very well." • "I am certainly getting better and better at explaining things." **Relatedness:** • "I didn't really interact much with students." • "If the students have a good relationship with you, which they do with me, I think that's generally a good sign." • "I'm sure a lot of people are probably really jaded by students."

Dr. Engineering	**Autonomy:**
	• "I've been given complete liberty."
	• "In graduate courses, I have a lot more flexibility."
	• "We have a very cooperative department."
	Competence:
	• "Nothing challenging."
	Relatedness:
	• N/A

Dr. Math	**Autonomy:**
	• "Your freedom definitely increases with the difficulty and also, you know, increases as the enrollment decreases."
	• "Generally, I don't feel constrained."
	• "Math has become like math in college courses; it has become far less rigorous than it once was because they would fail. Too many students and the administrators won't like that and won't let them."
	Competence:
	• "You don't get, like, any more credit for teaching the class better than worse."
	Relatedness:
	• "Math has become like math in college courses; it has become far less rigorous than it once was because they would fail. Too many students and the administrators won't like that and won't let them."
	• "Mostly, I just don't really care that much. Like, I don't know whatever class you want to teach that class, okay. I don't care what you call it."
	• "Most of the math department is in the ground already."

Dr. Medicine	**Autonomy:**
	• "I have always enjoyed a lot of freedom in terms of how I put what I do in the classroom together."
	• "For the most part, I have enjoyed freedom in how I have been able to teach what I needed to teach without people telling me what I needed to teach or how I need to teach it."
	Competence:
	• "I know what works. I know what doesn't work. At least for me. In the classroom."
	• "I'm very confident in my skills and the level at which I engage."
	• "I'm very confident. I've been doing it a long time."
	Relatedness:
	• N/A

Dr. Statistics	**Autonomy:**
	• "I don't feel enough autonomy."
	• "I feel like I'm under a certain amount of pressure to cover certain topics."

Competence:
- "These people who've been through the College of Education, you know, they're better teachers."
- "I think I can teach it effectively."
- "So, so, I'm sort of in between. I'm sort of in between being really competent and, you know, and needing to improve."

Relatedness:
- "There's a wide variation in the amount of material covered by the different professors."

Note. N/A does not mean there was no indication of the behavioral needs theory component in the conversation, but that including the exemplifying quote/story may identify the interviewee and is being withheld.

Autonomy was essentially satisfied for all but the statistics professor. The statistics professor seemed to be under pressure from the administration to cover certain topics, go at a certain speed and meet certain benchmarks. The statistics professor was not shy about communicating the lack of autonomy afforded to them. Across disciplines, it is important to note that just because a professor felt autonomy to make their own decisions and teach their own way, this did not make them want to pursue a graduate certificate focusing on pedagogy. Autonomy was a necessary condition for interest in a graduate teaching certificate. However, autonomy alone was not sufficient in motivating faculty members to want to engage in a graduate certificate program. The math and engineering professors asserted that there was more autonomy as the difficulty of the courses increased. This theme could be more prevalent among other faculty members but was not explicitly expressed, with most professors indicating they had high levels of autonomy, regardless of the course level, graduate/undergraduate status, or difficulty, except for the statistics professor.

In terms of competence, most of the professors I interviewed stressed a high level of competence in terms of their content knowledge, even the aviation professor whose highest degree was their master's. Interestingly, it did not appear that the level of degree impacted the level of perceived competence (at least considering this limited data set). Additionally, Dr. Chemistry stressed that he had more competence in his content knowledge than his teaching ability but is continuously improving (without the need for courses in pedagogy). Finally, Dr. Statistics is again the outlier, as they were in the autonomy section. Dr. Statistics did not exude confidence in their ability to teach statistics, for reasons withheld due to the possibility of identifying the interviewee.

In terms of relatedness, most professors wanted to build relationships with their students, although success was variable among the professors. There was the notion that "a lot of people are probably really jaded by students" (Dr. Chemistry). So, while some professors want to relate with their students, others see relating to students as challenging. Moreover, relatedness with peers was problematic for some, and Dr. Math exemplifies this notion by indicating that "most of the math department is like in the ground already." As such, relatedness may be something that individuals were striving for, but it was not as easily accomplished in some fields as in others. For example, in medicine, the relatedness among the faculty was highly prevalent, with meals between staff members and book clubs, and in engineering, the two-day retreats, interested faculty went on to discuss pedagogical approaches.

The level of autonomy, competence, and relatedness varied by field and, more than likely, by individual. It would be inappropriate to stipulate whether the behavioral needs of the department are being met based on the behavioral needs of an individual, which is a limitation of this research and an opportunity for further study. However, what can be observed from the data

is that the behavioral needs of all faculty are not being met, and considerable improvements can be made.

Themes

The themes consistent across multiple interviews are presented in Table 5, along with supporting narratives.

Table 5

Themes & Supporting Narratives

Theme	Supporting Narrative
Every college has a different culture.	• "We meet weekly to share teaching moments and insights" (Dr. Engineering). The quote highlights the cooperative and supportive culture of the chemical engineering department. • "We've got a small helicopter program... We've got about 50 to 60 students... There's ten of us that are flight instructors, teaching within the department" (Professor Aviation). This quote illustrates the small culture of the department. • "Two other aviation professors, a guy from the med school, and [someone] from Tada," (Professor Aviation) read Spark of Learning in a book club. This speaks to the extraordinary cultures of the aviation department and the medical school as fostering relationships between colleges to further pedagogy. We also see this learning culture in the engineering department, where Dr. Engineering was involved in the book club. • "The math department is, like, virtually dead in so many ways" (Dr. Math).
Professors believed that teaching can be learned and improved upon. In other words, people are not born educators, but teaching may come more quickly to some.	• "I approach teaching the same way that the Army approaches leadership and leaders and educators are **built**. They're **not born**. Okay. So, you have to be coachable and open to feedback in order to actually get better as an instructor" (Professor Aviation). • "I definitely go with neutral, like, I mean, you know, some people **might be born,** but ultimately...there's a

lot that one can do to be a better or worse teacher" (Dr. Chemistry).

- "I think it's something that can be improved on. I think there have been some people that I've met, I think, who just walked into the classroom, and they were just a success immediately, you know, and then for me, you know, I, you know, it took a long time to get a little bit better. And I still have to work really hard at it. So, I mean, **in some sense, people are born for this**. I mean, some people just, well, maybe they're not born for it, but due to their background and their upbringing and what they've done before, they teach, I think some people, you know, **it just comes a lot more easily than it does for others**" (Dr. Statistics).

Professors would not be willing to enroll in the certificate program because their peers have to "pick up the slack."

- "We are **short people** in the aviation department, and it would be difficult" (Professor Aviation).
- "People would dislike it. Because it would mean that they are each more they have to **pick up the slack**" (Dr. Math).
- "So, we are a very small department. We have eight full-time equivalent faculty. All of us, pretty much all of us, have similar contracts, you know, 5050 teaching and research and with some service in it. So, it's always a question of … I think it would be difficult to make time for a separate workshop or a certificate in addition to what commitments we already have" (Dr. Engineering).

A lack of time was viewed as a barrier to pedagogical development.

- "Reduced my contract by one class per semester, that would afford me the time. But to counter that, we are short people in the aviation department, and it would be difficult to try to find the time" (Professor Aviation).
- "It's always a question of time" (Dr. Engineering).
- "So, what barriers? Well, the first word that comes to mind is time" (Dr. Statistics).

Professors learned about pedagogy on their own time.

- "We actually did a book club this year … it was about two other aviation professors, a guy from the med school, and a [person] from TADA … we read *Spark of Learning*" (Professor Aviation).
- "Book clubs that discuss how to improve our teaching methods" (Dr. Engineering).

- "We have a two-day retreat every year" (Dr. Engineering).

Note. This table was modeled after (Bayraktar, 2017, p. 9). The bold words indicate critical concepts/phrases used to answer the research questions

After a few interviews, it became apparent that every college had its own unique culture that influenced the value of furthering pedagogical training and development. While not all departments had pedagogically supportive cultures, there were several instances of teaching being valued in departments. Sometimes, pedagogical development was given the same importance as research, as Dr. Medicine indicated. Other times, pedagogical development was seen as something that was trivial. However, if there were complaints about professors from students, then the quality of teaching was seen as significant, as Dr. Math indicated. The differing cultures again meant saturation would not be achievable in this research, as every department's culture helped shape the interviewees' responses. In the future, research may be conducted in an individual department or across multiple departments and universities. However, these endeavors were not feasible for this DiP, given the often small sizes of the STEM departments, the typical response rates to interview requests, and the challenges associated with receiving institutional review board (IRB) approval from multiple institutions to conduct research.

Overall, most professors believed that educators were not born. Even the statistics professor clarified that while certain people are initially more gifted at teaching, teaching skills can be improved. It seemed that many professors were trying to improve their pedagogy by engaging with each other, participating in book clubs, working with members of pedagogical improvement university offices and programs by attending their workshops, and engaging in

pedagogical retreats. The belief that teaching can be improved upon was integral to Artifact III, as we propose a solution to the problem of practice, which, according to data analysis, does not lie in utilizing or encouraging enrollment in a college teaching certificate, but encouraging activities that promote autonomy, competence and relatedness more fully, such as promoting book clubs.

There was a noticeable contradiction in the sense that a lack of time was often cited as a barrier to pedagogical development, but many professors had the time to engage in book clubs, conversations of pedagogy, retreats, and other pedagogical activities. One possible explanation for this is that the pedagogical activities occurred on the professors' own time and did not have fixed "due dates" as a class in pedagogy would have.

Interestingly, money/cost was rarely cited as a barrier to enrolling in a graduate teaching certificate. However, it should be noted that in the state where this research was conducted, when faculty enroll in a college course as part of their tuition waiver, this is considered additional income for tax purposes (V. Clinton-Lisell, personal communication, July 22, 2024).

The above themes help us answer the research questions, as we explicitly do in the next section. It is important to note that Table 6 omits themes involving SDT and the basis of behavioral needs being satisfied or thwarted, as is considered in Table 5.

Answering the Research Questions

The following analysis answers the research questions. In table 6, we present the answer to the research questions in table form, stating the question, answer, and justification with direct quotes from the interviewees.

Table 6

Analysis & Justifications for the Answers to the Research Questions

Question	Answer	Justification (Exemplars in Bold)
What factors motivate STEM professors to enroll in a college teaching certificate? Are there any common professional reasons that help determine this choice?	Reaching saturation was not achieved because of the variability of varying departmental cultures, individual attitudes, and beliefs. In answering this research question, we see from the supporting justifications in the next column that most of the professors were not willing to enroll in a college teaching certificate (three out of six). Moreover, the statistics and chemistry professors would not consider enrolling in a college teaching certificate unless it was "strongly suggested" that they do so. Of the two remaining professors who seemed enthusiastic and motivated to enroll in a college teaching certificate, both seemed interested in enrolling in the certificate program because of self-growth opportunities. For example, taking every opportunity to develop their skills and because they enjoy teaching. It is important to note that because Dr. Medicine was near the end of their career, they would not consider enrolling in the certificate program. So, the circumstances would have to be favorable, which leads only the professor of aviation, willing, able, and motivated to enroll in the teaching certificate program. However, the aviation professor countered that they are "short	"I'd say probably… between military retirement and VA disability, **I could actually afford not to work**. It's the same reason I go out and fly as a flight instructor. **I do it because I enjoy it,** and I really enjoy being faculty here" (Professor Aviation) "**Initiative driven by the chair**… Sure. Why not? And **I get to put this on my CV**, if nothing else" (Dr. Chemistry). "I think it would have a significant impact. You know, if there were courses that **directly addressed some of the needs** that I identified for myself, where I want to go with my own teaching career. I would consider, or I certainly would consider, taking those kinds of opportunities to be able to **further develop my skills**" (Dr. Medicine). "I will always take those opportunities with an eye toward, definitely, putting myself in a position of **improving myself** and **improving student learning** through what I learned" (Dr. Medicine). "I might enroll in something like that if the department chair, you know, **strongly suggested** that, you know, I mean, if I were **under some pressure** to do that, I would. I might do that, but I probably would **not do it on my own**" (Dr. Statistics).

[on] people in the aviation department," so depending on coverage for other classes, the aviation professor would not be motivated to enroll in a teaching certificate, making the answer to this research question clear: Even though most of the professors' behavioral needs are sufficiently satisfied, overall, professors were not motivated to enroll in a college teaching certificate.

- Math: No quotes explaining the motivation to enroll in a teaching certificate.
- Chemistry: No quotes explaining the motivation to enroll in a teaching certificate.
- Engineering: No quotes explaining the motivation to enroll in a teaching certificate.

Do STEM professors have any concerns regarding the value of pedagogical training to promote college students' STEM advancement?

There were several noted concerns regarding the value of pedagogical training to promote college students' STEM advancement. For example, Professor Aviation mentioned that it would be "hard to find the time" to participate in a certificate program. Dr. Chemistry mentioned that the students were often the "limiting factor" and was skeptical of how pedagogical training would be able to positively impact students' learning, and Dr. Math was blunt, saying he couldn't see "a huge amount of benefit" from getting a teaching certificate. Conversely, Dr. Statistics indicated no significant concern regarding the value of studying pedagogy being used to promote student learning, but that they were afraid to try something new. Additionally, Dr. Medicine was highly supportive and encouraging of anyone enrolling in a pedagogy course (as many of his peers had). Dr.

- "Reduced my contract by one class per semester, that would afford me the time. But to counter that, we are short people in the aviation department, and it would be difficult to try to find the time" (Professor Aviation).
- "In research, the limiting factor is ourselves. But with teaching, the students are often the limiting factor" (Dr. Chemistry). Implying there is a limit to how much pedagogical training can impact the student.
- "College of Engineering teaching council summer **teaching development program**. So, where they discuss some best practices in online teaching" (Dr. Engineering): As Dr. Engineering is already enrolled in a pedagogy program. This implies, in addition to his other comments, that he has a few concerns regarding the value of pedagogy to promote students' STEM advancement.

97

Engineering was already in a pedagogy class (indicating minimal concerns).

As such, in answering this research question, we see that the answer is dependent on the culture of the department, the individual, and making generalizations challenging.

- "I think math is well suited for the classical, like the lecture format. So, I **didn't see like a huge amount of benefit**" (Dr. Math).
- Dr. Medicine did not express any concerns regarding the value of pedagogical training to promote college students' STEM advancement. In fact, Dr. Medicine was a staunch supporter of pedagogy, indicating "I really encourage our faculty members to take opportunities to make their teaching the basis of their scholarship" (Dr. Medicine).
- Dr. Statistics did not express any concern regarding the value of pedagogical training. However, he did indicate: "Maybe [I am] just unwilling to try new things, you know, afraid to try new things. And I guess, you know, that's a barrier, an unwillingness to take chances, you know, things like that" (Dr. Statistics).

Do STEM professors think studying pedagogy is a feasible and practical method to address a potential lack of pedagogical training opportunities? Why or why not?

A theme emerged in the data regarding a lack of time and resources, making studying pedagogy infeasible and impractical to address a lack of pedagogical training opportunities typically experienced by STEM faculties. There were a significant lack of resources and people to cover the classes professors would normally teach should they enroll in teaching courses. Specifically, Dr. Math, Dr. Chemistry, and Dr. Aviation

- "Reduced my contract by one class per semester, that would afford me the **time**. But to counter that, we are **short people** in the aviation department, and it would be **difficult to try to find the time**" (Dr. Aviation).
- "There's something to be said about the **division of labor** and specialization where the teachers really specialize in teaching" (Dr. Chemistry): Implying that the study of pedagogy would be more geared towards clinical

echoed this concern. As such, studying pedagogy in the form of a graduate teaching certificate is often viewed as impractical and not feasible because of the lack of resources. Additionally, there was a theme of being short on staff members to fill teaching loads that was predominantly echoed by Professor Aviation, and Dr. Math. This concern demonstrated connectedness (not wanting to hinder the bonds already formed by abandoning staff to take pedagogy classes) with other departmental members. A relatedness to other departmental members (knowing they themselves would not want to teach more classes, so their peers may not want that as well). Moreover, the concern of being short staffed also demonstrates relatedness in that professors are able to relate and anticipate what an increased teaching load would mean for their colleagues. Finally, there was an autonomy component; as to make the decision that because of the stress placed on the department, a college teaching certificate would not be worth pursuing if it caused undue hardship to others in the professor's department. In essence, the professors who were concerned about being short on people were being team players. For all of the above, a graduate certificate was deemed less than desirable as it did not

teaching faculty rather than research faculty.

- "Currently, no, because we are **eight full-time** equivalent faculty."
- "We haven't had **enough people** in the department to cover teaching load" (Dr. Math): Implying that studying pedagogy is not practical because the math department would not be able to cover the classes the professors enrolled in teaching courses were not teaching.
- "Yeah. You know, I'm pretty **late in my career** here, so, you know, the **circumstances would have to be right**. But, you know, if I were **early** on or, you know, I think even **mid-career**, I, I would say **yes**, definitely" (Dr. Medicine).
- "I mean, I think, I mean, **different people are different.** I mean, different people have time for things, you know, and there might be some really good researchers that are just so on top of the research and everything that they're doing that they would have **time**" (Dr. Statistics).

	sufficiently satisfy the behavioral needs of the professors and did not provide a feasible and practical way to fill the gap of a lack of pedagogical training.	
What may hinder STEM faculty from enrolling in pedagogy-related classes?	One of the main themes in the collected data was the time constraints that would prevent professors from enrolling in a teaching certificate program (see supporting justification in RQ III) above. In addition, there was often a lack of staff available to teach the classes that the professors who would be enrolled in the pedagogy class would not be teaching (see RQ III above). We also see that the personal characteristics of the professor (research vs teaching faculty) were a major motivating factor for participating in pedagogy courses.	"I would probably not do it because I already have attended workshops and training" (Dr. Chemistry) "At the moment, I would say no, because I have a **lot of research going on**" (Dr. Chemistry) "The benefit of a teaching certificate or teaching type offering as workshop is **not immediately obvious** to me" (Dr. Engineering). - Somebody who is an active researcher. You will never. I mean, your odds of them getting to enroll in the certificate is very [minimal]" (Dr. Engineering). "Yeah. You know, I'm pretty **late in my career** here, so, you know, the circumstances would have to be right" (Dr. Medicine).

Note. The bold words indicate critical concepts/phrases used to answer the research questions.

Artifact II Concluding Thoughts and Interpretations

In general, enrolling in a graduate teaching certificate was not feasible, practical, or an idea many professors seemed enthusiastic about. The main concerns about the value of pedagogical training were related to the value of pedagogical training, the lack of resources, including resources and time that faculty would need to teach one less class in exchange for taking a class on pedagogy. What is clear to me after interviewing multiple STEM professors is

that pedagogical learning cannot be a class or a certificate; it must be a regular part of the culture that permeates the department and the college, for example, the book club and retreats that were mentioned. Professors must have the autonomy to further pedagogy in whatever form they take. Additionally, professors must always feel competent in improving their pedagogy through their chosen form of pedagogical improvement. Finally, professors must feel a relatedness component: their peers and chairs support their pedagogical advancement and development choices.

After conducting Artifact II, I felt confident that many professors were not motivated to enroll in a graduate teaching certificate to further advance their pedagogical knowledge and skills. The professors would instead prefer to learn in their own way (autonomy), the ways their peers are already learning, mainly book clubs (relatedness), and in a manner that the professors feel is effective and worth their time (contributes to their competence). So, the solution to the pedagogically under-trained professors is not graduate certificates.

Artifact III

The Final Product – The Implementation of a Solution to Pedagogically Under-Trained STEM Faculty

It became evident after interviewing several STEM faculty members, that to address the pedagogically under-trained professor issue, graduate certificates could be a feasible solution, but not for everyone. Consistent with existing research, e.g., (Brownell & Tanner, 2012), this DiP found that professors often lacked the time and resources necessary to commit themselves to such a learning expenditure. Moreover, the graduate certificate provided insufficient autonomy for the professors who enrolled in such a program, neglecting one of the basic psychological needs that Deci & Ryan ((1985)) assert is necessary to sustain motivation for an endeavor. Surprisingly, there was an overwhelming mention of "book club" in the interviews. Moreover,

book clubs are gaining popularity (Mowreader, 2025) and are great ways to satisfy a faculty member's need for autonomy, competence, and relatedness. As such, my solution to my problem of practice is to obtain funding for book clubs in universities by applying for a grant that will pay for the purchase of books that are not accessible for the faculty to read (for example not in libraries), to facilitate the dissemination of domain-specific pedagogical techniques for a professor's discipline.

Concerns or Issues with Book Clubs

From this study, and a review of SDT, I have been convinced that forcing a professor into pedagogical courses is not a viable solution to address a typical lack of pedagogical knowledge. Any method of force is sure to fail, as this not only hinders the autonomy of the professor to learn and develop pedagogy in their own way, and serves as a reason to seek employment in the private sector, where they will almost certainly be compensated for their talents more than in their university setting. Upon speaking with several employees in a university in the upper Midwest, I learned that there are offices in many universities that solely devote themselves to helping professors plan, develop, and teach their class. Anything relating to pedagogy, these offices will help with, but not everyone takes advantage of what these offices have to offer, believing that they can solve the pedagogical or technological problems they face without assistance. Admittedly, there are many STEM professors who teach effectively on their own, and they may be resistant to change (Dana et al., 2021) because they feel that they are teaching effectively. However, there are benefits to be had from learning new pedagogical techniques. Conversely, there are some professors who need pedagogical development, but do not seek help for a myriad of reasons, and hence would see no need for pedagogical development, including graduate certificates or book clubs.

How to Overcome Challenges

While a book club was something that several interviewees mentioned, there were some interviewees who were critical of the benefits of further pedagogical training. Overcoming the issue of getting more professors to engage with book club activities will almost certainly be a matter of departmental culture and individual preference. One thing is clear: mandating participation in a book club, offering a reward for participation, and bribing faculty for promotions is not the route to go as these options conflict with the basic tenets of behavioral needs theory. If such pedagogical advancement is to be made via book clubs, then participation in this activity needs to be a choice, consistent with the main tenants of SDT. That is to say, "to feel competent and autonomous in their attempts to live more sustainably, people need help, they need reasonable choices, and they need information that helps them learn and helps them choose" (Manning, 2009, p. 21). To that end, we must address the question of how the challenges of implementing book clubs for pedagogical advancement will be addressed.

For starters, to alleviate financial challenges, the final product of this DiP includes a draft of a grant proposal that interested parties may modify to help pay for books that faculty in disciplines choose, and think would be beneficial for their teaching. Moreover, to help alleviate time as a barrier, book club could be designated primarily as a summer activity, when the student enrollment is generally down compared to Fall and Spring Semesters.

Conclusion

Artifact I detailed a problem of practice: mainly that pedagogically under-trained professors were being asked to teach when they often had minimal teaching training or experience (Fertig, 2012). Throughout Artifact I, an argument was unveiled explaining two sides of the issue. One side claimed that professors need to learn how to teach. The other side is that

professors are already experts in their own discipline. To ask them to be masters of pedagogy goes too far and opens the professor to other demands, for example, to be counselors, advisors, etc.

A series of interviews were conducted in Artifact II to determine the pedagogical views of STEM faculty, and to determine if the faculty members at a large public research university in the upper Midwest would be willing to engage in a four-class college teaching and leadership graduate certificate program. Overwhelmingly, there was support for wanting to be better teachers, but not through a graduate certificate. Instead, professors wanted to learn their own way, consistent with behavioral needs theory. It seemed that the most popular idea was to engage in an informal book club, in which the department could benefit from choosing a book that professors thought had the potential to improve their teaching practices.

Artifact III was about implementing a solution to the problem of practice, specifically, book clubs. For starters, to alleviate the financial burden of books for several staff members, a grant proposal was provided in Artifact III that was designed to help interested departments seek funds for procuring books.

Implications of the Work Presented in the Artifacts

What became clear as a result of this research was that while many professors that I interviewed lacked a formal theory-based background in teaching, that did not deter these professors from wanting to master the teaching of their disciplines. Only one professor, the statistics professor, expressed any concern or doubt centered around their ability to teach, and this was partially due to the belief that those who studied pedagogy would be better teachers than they were.

Implications are broad for this research as the study was able to demonstrate that increased training is sometimes not necessary for pedagogical improvement. What was called for was listening to the concerns of professors and coming to the realization that many professors are under heavy time commitments and do not have the resources in their schedule to devote to an entire graduate certificate in collegiate education. However, it was interesting that professors preferred to be in book clubs with their peers, as there was minimal judgment for not spending this time on research-related endeavors. As such, one major implication of this research was that the professor needs to learn in an environment where they feel a connection with others (a major component of behavioral needs theory), and this was unlikely to happen in a college certificate program that had students from varying disciplines at all levels of their graduate careers. Simply put, departments looking to improve teaching quality should not expect professors to hold favorable views of graduate certificates, or courses focused on pedagogy. Rather, departments that are interested in improving the quality of teaching in their STEM departments need to ensure that professors have the time to improve their teaching and the resources to do so.

How this DiP Contributes to the Body of Research on the Problem of Practice

As of the writing of this paper, the research team is unaware of any peer-reviewed literature or dissertation research papers that attempted to understand STEM professors' motivation to engage in college teaching certificate programs, using self-determination theory as a theoretical framework. While most professors interviewed in this research indicated that they would probably not enroll in a college teaching certificate program, there were some who were intrigued by the idea, and even those who were enthusiastic about the idea. However, this DIP was limited to serving as a steppingstone to initiate a conversation about improving pedagogical practice and understanding for professors in various STEM and other disciplines.

Reflection on the Extent to which the Selected Research Approach Addressed the Problem of Practice

In this research, the research team interviewed several STEM faculty at a major research university in the upper Midwest. During the interviews, the research team was strongly convinced of the honesty of the participants when many of the faculty members indicated that they would not be willing to enroll in a certificate program. Many professors were passionately concerned about how enrolling in a graduate certificate would be a hindrance to their research and already demanding schedules. However, there were faculty who were enthusiastic and curious about enrolling in a teaching certificate. Still, one interesting thing resonated with the researchers: the surprising willingness to improve pedagogical practices by participating in book clubs that focused on STEM pedagogy.

The sample size was small for this study, but the research gathered rich results and opinions that related to STEM faculties' willingness to participate in graduate teaching certificate programs. The main disadvantage of this study was that the sample size was small, and opinion, and hence generalizability suffered. However, this study does provide a useful path for future researchers to engage in research that involves more participants. Since this research focused on interviewing STEM faculty, few participants could be obtained.

Suggestions for Future Lines of Inquiry and Research

Now that evidence exists of the extremely drastic opinions regarding faculty perceptions of enrolling in a graduate certificate, this suggests a need for future research to utilize a survey or some other quantifiable measure that can account for more STEM faculty than interviews. For future research, more than one doctoral research university should be examined, and an endeavor to include more academic disciplines should be considered. The authors recommend that future

approaches learn from the contributions of this research to inform future survey questions that would be able to determine the conditions required for faculty members to be most likely to be willing to participate in organized pedagogical advancement; for example, early in their careers or still in graduate school (if they plan on pursuing a university career).

Grant Proposal

The Myra Foundation was established in 1941 and was the first private charitable foundation of its kind in the State of North Dakota. This grant was chosen to provide funding for books pertaining to STEM pedagogy as the program awards money for "charitable, character building and educational purposes" ((Myra Foundation, 2024, para. 1). The research team examined the contents of the Myra Foundation's website and found the instructions for the grant application.

The grant focused on the goal of providing the residents, and those who come to North Dakota's largest university to teach, with the best STEM learning experience possible to ensure that faculty members have opportunities to improve their pedagogical practices by purchasing books that are deemed appropriate by the group of professors interested in participating in a book club focusing on STEM pedagogical techniques and practices. Below, the application is included as part of this DiP.

Note that the Myra Foundation requires applicants to complete an online form. The following questions were asked by the Myra foundation, as of October 19, 2024. The bold "input" text is what would go into the text box of the form on the Myra foundation's website.

2024 Myra Foundation Grant Application

Project Information

Project Name

The term "project name" can include a project, event, equipment, supplies, or other materials for your organization.

Character Limit: 100

Input: Pedagogical books and opportunities for STEM Faculty at the University of North Dakota

Applicant Amount Requested from the Myra Foundation

Character Limit: 20

Input: 1,000

Project Details and Outcomes/Impacts

Provide details and describe outcomes for your program/project. Remember to include the impact in Grand Forks County.

Character Limit: 7500

Input: In the United States, half of U.S. college students who enroll in STEM degree programs fail to graduate (Hamm et al., 2020). Moreover, most faculty obtain little to no formal guidance in teaching (Fertig, 2012), as reflected in student attrition and the 96 percent of students who exit a STEM major citing inadequate teaching as a motivating factor (Thiry et al., 2019).

Unfortunately, the question has often been asked if STEM professors earn their bachelors, masters, and Ph.D. in their content areas, when were they trained to teach their students. The purpose of this grant proposal is to address this issue in the Grand Forks County community by funding pedagogical advancement opportunities for STEM faculty at the University of North Dakota by purchasing STEM-pedagogy- related books that are not available for check out at the UND library, or Grand Forks public library. The motivation for the book purchasing is a result of a dissertation study conducted by the grant applicant, which indicates that STEM faculty are motivated to participate in book clubs surrounding effective research-based pedagogical practices to enhance the quality of education they can provide to students in the Grand Forks County community. If the grant is approved, the outcome of a better STEM education for those in the Grand Forks community is more likely and may bring other students to the Grand Forks County for education because of the innovative approaches found at UND, should this grant be approved.

The need for effective STEM education in Grand Forks County, and North Dakota, in general, is paramount for the defense, aviation, oil, and other industries relying on STEM graduates from the University of North Dakota. Unfortunately, many faculty in STEM were never trained as educators (Fertig, 2012), and there is a need to ensure that STEM professors can meet to advance their pedagogy, without being told they need to purchase the supplies for themselves; akin to making teachers buy the school supplies or construction workers concrete. As such, this is the purpose of the grant: to provide funding opportunities for professors who want to engage in book club with their peers to advance their pedagogical skills by learning from pedagogy-centered books.

The structure will be similar to the way an interlibrary loan works, but the STEM professors would get to keep the books for future reference. A website, pending university approval, will be set up where groups of STEM professors can request books that are not available in bulk in either the Grand Forks Public library, as part of the university library collection, or available online. When sufficient interest is shown in the book, Dr. Grace Keengwe will issue funds for the purchase of the books, keeping detailed records of purchases and other financials. The funds may also be used to purchase audiobooks, which some professors may find more appealing than print books.

Solving the issue of the pedagogically undertrained stem professor issue will take more than just ensuring that they have access to pedagogically orientated books and a meeting space, but this is a good start. With the autonomy to choose the books they read, the relatedness that professors have with others who face pedagogical challenges in their fields, and the increased competence that will come along with learning new teaching approaches in book clubs, as has been the case for teachers in the K-12 setting (White, 2016).

The outcome of this endeavor will be improved pedagogical experience for STEM faculty at the University of North Dakota, just like in other institutions that have invested in book clubs for faculty (Ney et al., 2023) and consequently, a better learning experience for students of the university in Grand Forks County, and beyond.

Community Partnerships

Include potential community partners if applicable.

Character Limit: 1000

Input: Potential community partners include the University of North Dakota. The Grand Forks Public Library may also be part of this endeavor, as the program gains popularity.

Event Details

Include dates and location of event if applicable.

Character Limit: 1000

Input: The book club meeting will be held at the University of North Dakota. No funding is anticipated for the use of the university spaces.

Project Focus

The Myra Foundation funds projects in Grand Forks County and prioritizes those projects focusing on charitable, character building, and educational purposes.

Check all that apply:

Choices:

Character Building ✅

Charitable ✅

Educational Purposes ✅

Project Budget

- Project budget should include expenses and revenue.

- Format can be submitted in .xls, .doc or .pdf.

- Designate any other organizations you have approached or intend to approach about investing in this project and any internal fundraising efforts conducted by the organization.

- If you prefer to submit your budget as text, please use the space below.

Character Limit: 1500 | File Size Limit: 5 MB

Input: I have not sought out any external funding sources, except for the Myra foundation. If the program is popular, I plan to ask a University of North Dakota representative if the university would like to become involved in this endeavor.

As there is no way to predict the books faculty members from varying disciplines will find helpful to their pedagogy, this project seeks a lump sum amount of $1,000.00 to be held by Dr. Grace Keengwe to distribute to STEM faculty members who are interested in purchasing STEM-pedagogy related books to support their teachings at the University of North Dakota. If, at the end of one year's time, the funds have not been used, or there are remaining funds, these monies will be promptly returned to the Myra Foundation. Note that there will be no expenses other than the books that are purchased, and no money will be made from this endeavor (revenue).

Other Financial Opportunities

- Describe how funds will assist with a matching grant opportunity, if applicable.

- Identify naming opportunities for the Myra Foundation, if applicable.

Character Limit: 1500

Input: The University of North Dakota may choose to initiate a grant match if the program is successful. There are also many naming opportunities to help spread the good name of the Myra institution including: placing the book club purchasing program on the UND website, publicizing the book club program and purchasing opportunities at faculty senate meetings, putting Myra foundation acknowledgment leaflets into the purchased books, and spreading the contributions of the Myra foundation by word of mouth.

Supporting Materials

Please upload documents or photos to support your request if applicable. If you have more than one document, please combine them into a single file before uploading them below. *Character Limit: 5000 | File Size Limit: 5 MB*

Input: N/A

As part of the online grant application system you are using, you may receive emails related to your request. These emails will be sent from the following address: MyraFoundationadministrator@grantinterface.com. To ensure you receive these emails, please add this address to your safe sender list. For instructions on adding an email address to the safe senders list, CLICK HERE.

Applicant Organization Information

Applicant Organization Mission/Purpose

Character Limit: 1500

The grant aims to fund opportunities for STEM faculty at the University of North Dakota to meet to discuss their thoughts, opinions, and ideas for improving their teaching sparked by reading pedagogy-related books. The mission is to enhance the teaching practices of STEM faculty members at the University of North Dakota and consequently provide better learning opportunities in varying STEM disciplines at the university.

Additional Space for Purpose of Organization

Character Limit: 6000

The purpose/mission of the University of North Dakota is "To provide exceptional educational experiences that enrich the lives of North Dakotans and the global community through excellence in teaching, innovative research, and meaningful engagement" (University of North Dakota [UND], 2024, Mission section). Moreover, the mission of this Dissertation in Practice, is to understand faculty motivation for teaching, and to improve STEM teaching education for faculty and students at the University of North Dakota, consistent with the Myra Foundation's goals of providing funding for "charitable, character building and educational purposes" (Myra Foundation, 2024, para. 1).

Grand Forks County

Does this project serve the residents of Grand Forks County?

Choices:

Yes ✅

No

Current Board of Directors

Please include a board roster, including board members' contact information and professional affiliation. You can upload this information or type in your board roster.

Character Limit: 10000 | File Size Limit: 5 MB

Input: Dr. Grace Keengwe will be responsible for holding funds, should they be approved.

Additional Information Agreement

If requested, do you agree to provide the Myra Foundation Board of Directors with the following? Please check all three to confirm your agreement. The Myra Foundation funds organizations with non-profit status within Grand Forks County. If the organization is not either a 501C3 school or government entity, the applicant shall provide evidence that the organization meets the qualifications as a recipient of grant funds from a private charitable foundation. If you need to prove your tax-exempt status, the IRS can supply a "government information letter" free of charge by calling 1-877-829-5500.

Choices

501C3 certificate or proof of tax-exempt status ✅

Annual budget for your organization ✅

Most recent audited (or unaudited) financial statement ✅

Next Steps

Next steps may include an expansion of the efforts found in this DiP to include a study seeking to understand what steps university administrators can take to better prepare future professors for their teaching roles, initiatives to make pedagogical books and materials more accessible to professors, and catalyzing changes in doctoral research universities to place more value and emphasis on teaching quality.

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References

Appendix A

Interview Questions

I.   What are your percentages for teaching, research, service (and any others)?

II.   Tell me about teaching your discipline.

    (a) What field are you in?

    (b) Which classes do you currently teach?

    (c) What is the most challenging thing about teaching in your discipline? Why is this so challenging?

    (d) What pedagogical training were you provided, or have you had?

III.   What pedagogical training have you had in the past?

    (a) To what extent did you feel this training was effective?

    (b) Tell me about what has helped (or hindered) your teaching skills.

    (c) Tell me more about how competent you feel in your pedagogical skills.

    (d) Do you feel you have sufficient opportunities to teach in your own way?

    (e) Have you taken courses in pedagogy before? Why or why not?

    (f) What do you think the purpose of collegiate pedagogy courses is?

    (g) How do you feel that taking courses in pedagogy would impact teaching your STEM courses?

    (h) What do you think about STEM faculty, such as yourself, taking pedagogy classes?

What are your thoughts on this, and do you think these pedagogy classes would improve your teaching skills? Why or why not?

IV. If you could change one aspect of how you were prepared to teach your discipline, what would you change and why?

V. What are some ways you could suggest that STEM professors could use or do to improve their teaching?

(a) Do you feel that teaching well can be learned, or is it something you are born able to do? In other words, is teaching good a skill that can be developed or a trait, like red hair?

(b) Do you, or others you know, have a natural ability for teaching?

(c) How often do you execute a lesson perfectly as planned?

(d) What do you do when a student makes a mistake or has trouble?

(e) How do you feel when a student has trouble learning something? In other words, is this a teaching or learning issue?

(f) What is one change you made recently to become a better teacher? How did you decide to make this change? In other words, did you get advice from another educator, read about the idea, etc.?

(g) How much progress do you think you have made in your teaching ability since you first started teaching?

VI. Have your peers engaged in professional development, focusing on pedagogy?

(a) How do you think your peers would respond to your taking courses in pedagogy?

(b) Have any of your peers taken courses in pedagogy?

VII.   What impact do you think taking courses in pedagogy would have on your students?

(a) How do you think STEM professors can best help students learn?

(b) In your department, how do you feel the quality of teaching contributes to promotion, tenure, and retention?

VIII.   A graduate certificate in college teaching is designed to assist prospective and current college and university faculty to acquire and further develop skills and knowledge essential for effective teaching in higher education. Graduate certificates in college teaching normally consist of four classes (12 credits). If you taught one less class, with no change in pay, would you be willing and able to enroll in a college teaching graduate certificate and take one class at a time until certificate completion?

(a) Why or why not? Is this feasible and practical for your unique circumstances?

(b) What barriers do you see to enrolling in a college teaching certificate?

(c) What benefits do you see from engaging in a college teaching certificate?

IX.   Is there anything else you could share with me today regarding your work and teachings in STEM, elements related to pedagogy?

Appendix B

Attitude Codes

Files\\Aviation_Transcript - § 20 references coded [2.28% Coverage]

Reference 1–0.04% Coverage

It's going to sound odd, but teaching is not hard.

Reference 2–0.06% Coverage

The students who come here who care are the easiest ones to teach.

Reference 3–0.04% Coverage

OSHA is not required. It's a voluntary program.

Reference 4–0.02% Coverage

Fairly confident

Reference 5–0.10% Coverage

We were having pedagogical discussions about how to teach. And the question they asked. I was terrified.

Reference 6–0.15% Coverage

If you have someone who is teaching at the college level who doesn't seem like they know how to teach, give them a little bit of leeway, as they may not have been hired to teach.

Reference 7–0.06% Coverage

I enjoy the student interaction because I can clear up any areas.

Reference 8–0.34% Coverage

That's the thing that I liked about the Army instructor courses that we did was we not only learned, hey, here's how you're supposed to teach this stuff, but now get up and put that in practice and get feedback from your peers and senior instructors. If you understand how to ask a

question and then let five seconds go by without answering your own question or answering by asking another question.

Reference 9–0.20% Coverage

Yes. Teaching courses I think are a positive impact, and they should help enhance some of these delivery techniques, because I can be a technical expert, like an engineer. But that doesn't mean that I can explain to my wife how that thing works.

Reference 10–0.09% Coverage

I enjoy the pedagogical aspect of teaching. If I was to do a doctorate, it would be educational leadership.

Reference 11–0.20% Coverage

I'm doing that course. It's not required for my job. It'll get me another dollar an hour as a flight instructor, which right now I get $20 an hour as a flight instructor, and I simply fly because I enjoy it, not because it's a financial reason.

Reference 12–0.18% Coverage

I'm not out there flying for the money. I'm flying out there because I've got a different background as an aviator, and I can put things in terms that students will hopefully understand from a career aspect.

Reference 13–0.11% Coverage

I approach teaching the same way that the Army approaches leadership and leaders and educators are built. They're not born.

Reference 14–0.15% Coverage

I have 20 years of experience in the aviation field. You guys have like six months to a year. Give it time. If you care enough, you will acquire the knowledge and experience.

Reference 15–0.12% Coverage

I have fun with that one because, in a class of 36, there are students that if I ask them a question, they are not going to give me an answer.

Reference 16–0.09% Coverage

You can either tell me you don't understand it now, or you can demonstrate you don't understand it on the exam.

Reference 17–0.14% Coverage

I could actually afford not to work. It's the same reason I go out and fly as a flight instructor. I do it because I enjoy it and I really enjoy being faculty here.

Reference 18–0.12% Coverage

Look, there is no financial benefit or reason that I'm out here flying. I'm like, I'm out here flying because I like to fly, and I like to teach.

Reference 19–0.05% Coverage

If you don't let me at least meet me halfway. I don't care.

Reference 20–0.03% Coverage

Learn something new every day.

Files\\Chemistry_Transcript - § 3 references coded [0.12% Coverage]

Reference 1–0.06% Coverage

I find that at some point we just have to take what we get.

Reference 2–0.03% Coverage

I do my best with all that.

Reference 3–0.04% Coverage

I learned the names of all my students.

Files\\Math_Transcript - § 16 references coded [1.97% Coverage]

Reference 1–0.11% Coverage

You don't get like any more credit for teaching the class better than worse.

Reference 2–0.28% Coverage

If you're like, oh, I would have gotten it. But I refuse to because there are too many other people learning right now. Like, that's weird. That's not our problem. That's your problem was my stance.

Reference 3–0.09% Coverage

So, you're learning a thing. Just go learn it. It's up to you.

Reference 4–0.03% Coverage

Silly and cowardly

Reference 5–0.22% Coverage

If you care so little that you'll like to fail if there aren't the right number of people in the room, then like, why are we bending over backwards to help you?

Reference 6–0.04% Coverage

I think you can learn to do it.

Reference 7–0.16% Coverage

I think you also have some level of natural ability, probably like every other, pretty much everything else.

Reference 8–0.07% Coverage

Most things can be improved upon to some extent.

Reference 9–0.03% Coverage

Like your discipline

Reference 10–0.02% Coverage

enthusiasm

Reference 11–0.06% Coverage

Give people a sense that they, too, can belong.

Reference 12–0.04% Coverage

I'd say 90% of them can't do it.

Reference 13–0.14% Coverage

But there's probably no box in that survey that said, like, I'm not really smart enough to do it.

Reference 14–0.52% Coverage

Like, which sounds really mean. No one wants to say that anyone's not smart, but like, some people aren't that smart, man. It's like a thing, like it's real. There are people who are very smart. There are people who, like, really struggle to get stuff, you know, and like, if you want to, like, there are people who are really good at picking up heavyweights.

Reference 15–0.05% Coverage

You can improve; anyone can improve.

Reference 16–0.12% Coverage

I want to believe everyone can do it, but I don't think everyone can do everything.

Files\\Medicine_Transcript - § 2 references coded [0.23% Coverage]

Reference 1–0.08% Coverage

There's always lots more to learn, right?

Reference 2–0.16% Coverage

The goal would be to improve student learning. Certainly, that would be my goal.

Files\\Statistics_Transcript - § 3 references coded [0.18% Coverage]

Reference 1–0.07% Coverage

Maybe I'm just unwilling to try new things.

Reference 2–0.04% Coverage

Afraid to try new things.

Reference 3–0.06% Coverage

An unwillingness to take chances.

Appendix C

Autonomy Codes

Files\\Aviation_Transcript - § 6 references coded [0.38% Coverage]

Reference 1–0.04% Coverage

We could teach our course. However, we saw fit.

Reference 2–0.03% Coverage

I can pretty much cover what I want.

Reference 3–0.09% Coverage

We have complete academic freedom of what we assign, how we grade, and basically, the content of the course.

Reference 4–0.12% Coverage

I have the same freedom in all four levels except for the OSHA classes that I'll teach, because those are some very specified requirements.

Reference 5–0.06% Coverage

As far as delivery technique in the aviation department, it is 100% my techniques.

Reference 6–0.04% Coverage

I get complete academic freedom in my classes.

Files\\Chemistry_Transcript - § 5 references coded [0.46% Coverage]

Reference 1–0.11% Coverage

You're always going to have to deal with the administration. So, all of that can detract from teaching.

Reference 2–0.03% Coverage

A lot of academic freedom

Reference 3–0.06% Coverage

Even our colleagues don't really bug us that much about

Reference 4–0.15% Coverage

We have almost full control over the course, the syllabus and all that. And, actually, under this current administration, it is really pretty good.

Reference 5–0.11% Coverage

We have a president right now who's humble and listens to people. That's pretty unusual. I think.

Files\\Engineering_Transcript - § 3 references coded [0.23% Coverage]

Reference 1–0.07% Coverage

We have a very cooperative department.

Reference 2–0.06% Coverage

I've been given complete liberty.

Reference 3–0.09% Coverage

In graduate course, I have a lot more flexibility.

Files\\Math_Transcript - § 6 references coded [1.88% Coverage]

Reference 1–0.05% Coverage

Generally, I don't feel constrained.

Reference 2–0.28% Coverage

Math has become like math in college courses and has become far less rigorous than it once was because they would fail. Too many students and the administrators won't like that and won't let them.

Reference 3–0.51% Coverage

What we used to be taught and feel like they can't do anymore. And so, they have to teach these kinds of watered-down versions. So, I think that's happened all across most math. Most of the time I feel like I'm just like, all right, whatever. If you want to replace this course with, like, a lower-level version of it, like I can, I can teach a lower-level version.

Reference 4–0.50% Coverage

So, there have been substantial drifts and, like a lot of classes, have gotten way easier, way less rigorous, and maybe to the detriment of the field. And, you know, I do feel like, yeah, no, I'm definitely not allowed to, like, really push against that because I would probably fail 90% of the class at minimum, like almost certainly maybe even 100%.

Reference 5–0.35% Coverage

I don't feel like I can do that though I might want to, but mostly I just don't really care that much. Like, I don't know whatever class you want to teach that class, okay. I don't care what you call it. It's my feeling towards the administration.

Reference 6–0.18% Coverage

Your freedom definitely increases with difficulty, and also, like, you know, increases, like as the enrollment decreases,

Files\\Medicine_Transcript - § 2 references coded [0.50% Coverage]

Reference 1–0.18% Coverage

I have always enjoyed a lot of freedom in terms of how I put in, what I do in the classroom together.

Reference 2–0.32% Coverage

For the most part, I have enjoyed freedom in how I have been able to teach what I needed to teach without people telling me what I needed to teach or how I need to teach it.

143

Files\\Statistics_Transcript - § 2 references coded [0.19% Coverage]

Reference 1–0.06% Coverage

I don't feel enough autonomy.

Reference 2–0.14% Coverage

I feel like I'm under a certain amount of pressure to cover certain topics.

Appendix D

Balance Codes

Files\\Chemistry_Transcript - § 1 reference coded [0.07% Coverage]

Reference 1–0.07% Coverage

It's more about struggling and trying to find the best balance.

Files\\Engineering_Transcript - § 2 references coded [0.82% Coverage]

Reference 1–0.58% Coverage

Each teaching quality is important. It is absolutely important. And in fact, when we bring in faculty, it is written when we interview the faculty to bring them on board. It is that we make sure that we don't care if you are a high-fly researcher who hates teaching, right? You need to be able to balance both.

Reference 2–0.24% Coverage

You have to keep incentivizing, but, yes, it's nice to bring in a million dollars and money, but you have to be a good teacher, too.

Files\\Medicine_Transcript - § 5 references coded [2.58% Coverage]

Reference 1–0.56% Coverage

Take opportunities to make their teaching the basis of their scholarship. You know, and so when we talk about the scholarship of teaching and learning, you know what questions you are asking yourself that you want answers to that other educators would be interested in hearing about?

Reference 2–0.76% Coverage

You take a scholarly approach to your teaching and your teaching turns to scholarships. In your published articles on approaches you have taken in the classroom or approaches you

have taken with assessments that have assessments demonstrate a clear impact on student learning. And, having that kind of orientation to your work as an educator, I think adds another dimension to your expertise.

Reference 3–0.43% Coverage

Not only are you really effective in what you do in the classroom, but now you are contributing to literature and to a body of knowledge that is in a position to help others who are developing those kinds of skills as well.

Reference 4–0.52% Coverage

Finding a way to establish yourself, as, as a, as a scholar, in the area in which you spend a lot of time as an educator making your teaching the basis of your scholarship is a great way, is a great way to do that. and so that's why I tie those things very closely together.

Reference 5–0.31% Coverage

We value teaching very highly. We value scholarships very highly. How can we marry those things in a way that makes a faculty member as productive as they can be?

Appendix E

Born vs. Learned Codes

Files\\Aviation_Transcript - § 1 reference coded [0.04% Coverage]

Reference 1–0.04% Coverage

Leaders and educators are built. They're not born.

Files\\Chemistry_Transcript - § 1 reference coded [0.26% Coverage]

Reference 1–0.26% Coverage

I definitely go with neutral, like, I mean, you know, some people might be born, but ultimately. 00:41:50:24–00:41:52:17 Justin Alexander It's. 00:41:52:19–00:41:57:08 Dr. Chemistry There's a lot that one can do to be a better or worse teacher.

Files\\Engineering_Transcript - § 1 reference coded [0.05% Coverage]

Reference 1–0.05% Coverage

No, I can't think of anybody.

Files\\Math_Transcript - § 1 reference coded [0.20% Coverage]

Reference 1–0.20% Coverage

I think you can learn to do it. And I think you also have some level of natural ability, probably like every other, pretty much everything else.

Files\\Medicine_Transcript - § 5 references coded [0.26% Coverage]

Reference 1–0.05% Coverage

Those skills can be learned.

Reference 2–0.05% Coverage

They can be well-developed.

Reference 3–0.07% Coverage

I think it can certainly be learned.

Reference 4–0.04% Coverage

I've gotten better.

Reference 5–0.05% Coverage

I won a Golden Apple Award

Files\\Statistics_Transcript - § 10 references coded [1.74% Coverage]

Reference 1–0.10% Coverage

I think I'm a much better teacher now than I was earlier on.

Reference 2–0.08% Coverage

I think it's something that can be improved on.

Reference 3–0.26% Coverage

I think there have been some people that I've met, I think, who just walked into the classroom, and they were just a success immediately,

Reference 4–0.21% Coverage

For me, you know, I, you know, it took a long time to get a little bit better. And I still have to work really hard at it.

Reference 5–0.07% Coverage

In some sense, people are born for this.

Reference 6–0.26% Coverage

Some people do just well. Maybe they're not born for it, but due to their background and their upbringing and what they've done before, they teach.

Reference 7–0.15% Coverage

I think for some people, you know, it just comes a lot more easily than it does for others.

Reference 8–0.25% Coverage

She was an outstanding teacher, I think. And so, I mean, she was suggesting that she had to learn how to teach. She wasn't just born for it.

Reference 9–0.21% Coverage

I don't think anybody's really born to be a good teacher, but I think it comes more easily for some people than others.

Reference 10–0.13% Coverage

A lot of progress? I mean, certainly in the long term, I think I've made.

Appendix F

Changes Codes

Files\\Chemistry_Transcript - § 4 references coded [0.34% Coverage]

Reference 1–0.19% Coverage

They were going to tech.com and get the answers from there. So, they learned nothing from the homework. And that was the last time I ever asked homework questions from the textbook.

Reference 2–0.10% Coverage

I took that to heart, and I'm just pretty careful in how I interact with students and try and be.

Reference 3–0.03% Coverage

Encouraging as possible

Reference 4–0.03% Coverage

Being willing to adjust

Files\\Engineering_Transcript - § 3 references coded [0.45% Coverage]

Reference 1–0.08% Coverage

Over the years, I've, I've adapted my own.

Reference 2–0.21% Coverage

Online proctoring was previously possible through a library or a community college. Then they changed things.

Reference 3–0.17% Coverage

I don't think there's anything that would greatly alter the way in which I work right now.

Files\\Math_Transcript - § 13 references coded [0.54% Coverage]

Reference 1–0.03% Coverage

Increase in lecture sizes.

Reference 2–0.03% Coverage

Condense lectures.

Reference 3–0.04% Coverage

Reduce overall teaching load.

Reference 4–0.03% Coverage

Organization staff

Reference 5–0.02% Coverage

Materials

Reference 6–0.03% Coverage

Provide lecture notes.

Reference 7–0.05% Coverage

Orderly way with lots of feedback

Reference 8–0.02% Coverage

Writing, really

Reference 9–0.05% Coverage

Trying to figure out how to make videos

Reference 10–0.07% Coverage

Is it more engaging if they can see people talking?

Reference 11–0.07% Coverage

Getting a sense of how people think about things.

Reference 12–0.05% Coverage

When the right is the right pacing

Reference 13–0.03% Coverage

How to do good board work

Files\\Statistics_Transcript - § 3 references coded [0.80% Coverage]

Reference 1–0.32% Coverage

I look at my old solution case for my old homework problems, and then I can see a better way of dealing with the problem. And sometimes I do it in a better way and I improve my answer keys.

Reference 2–0.40% Coverage

A lot of times I can see better ways of explaining things or, you know, I see that I did a bad job before. A lot of times I just delete things that I covered before, and I just thought I never should have covered those things.

Reference 3–0.08% Coverage

So, have I done anything differently? Not a lot

Appendix G

Competence Codes

Files\\Aviation_Transcript - § 11 references coded [1.18% Coverage]

Reference 1–0.09% Coverage

So, the aviation department. We're an anomaly. We hire instructor-level positions with a bachelor's degree.

Reference 2–0.07% Coverage

I'm an assistant professor. Yes, but I do not have a PhD. Nor does anyone here.

Reference 3–0.07% Coverage

There is no requirement for me to do any career progression that requires a doctorate.

Reference 4–0.37% Coverage

A doctorate means that that person has written and defended a dissertation, and they did research on something that does not mean that they either like or are capable of teaching an undergrad course, because I've had people who had engineering doctorates who were really smart, but could not explain that concept to somebody else. In a manner in which they understood because they didn't understand the fundamentals of instruction.

Reference 5–0.07% Coverage

They had a tendency to read the slides and basically like it was a transfer of material.

Reference 6–0.02% Coverage

The slides to the students.

Reference 7–0.02% Coverage

Fairly confident

Reference 8–0.09% Coverage

One of the beautiful things about the instructor certificate is that we talk about how to teach adult learners.

Reference 9–0.16% Coverage

We have about 200 flight instructors who don't even have a bachelor's degree, but they have an FAA instructor certificate. They're teaching people how to fly airplanes out of the airport.

Reference 10–0.12% Coverage

I am using these exams to verify one that you have learned the material, and two that I have taught it effectively enough for you to understand.

Reference 11–0.08% Coverage

The group discussions about aviation safety. I get significant positive feedback from that.

Files\\Chemistry_Transcript - § 2 references coded [0.11% Coverage]

Reference 1–0.04% Coverage

I certainly know the material very well.

Reference 2–0.07% Coverage

I am certainly getting better and better at explaining things.

Files\\Engineering_Transcript - § 1 reference coded [0.04% Coverage]

Reference 1–0.04% Coverage

Nothing challenging.

Files\\Math_Transcript - § 1 reference coded [0.11% Coverage]

Reference 1–0.11% Coverage

You don't get like any more credit for teaching the class better than worse.

Files\\Medicine_Transcript - § 10 references coded [1.48% Coverage]

Reference 1–0.10% Coverage

I have been a faculty member here at UMD for 33 years.

Reference 2–0.10% Coverage

I'm very confident. I've been doing it a long time.

Reference 3–0.15% Coverage

I know what works. I know what doesn't work. At least for me in the classroom.

Reference 4–0.13% Coverage

I'm very confident in my skills and the level at which I engage.

Reference 5–0.08% Coverage

I have never taught a truly online course.

Reference 6–0.24% Coverage

I would have to learn tons about how to develop materials, recordings, other materials that I would if I were teaching online.

Reference 7–0.23% Coverage

I'd have a ton to learn about how to do that and how to do that effectively. I am most effective in person in the classroom.

Reference 8–0.03% Coverage

I'm ready for that.

Reference 9–0.09% Coverage

I was the one that got that golden Apple Award.

Reference 10–0.33% Coverage

I knew I didn't know everything, but I was comfortable walking into those learning environments and comfortable that I could be effective in those learning environments.

Files\\Statistics_Transcript - § 5 references coded [0.84% Coverage]

Reference 1–0.28% Coverage

I've only taken one statistics course in my entire life. You know, that was a beginning undergraduate statistics course, and it was on the quarter system.

Reference 2 - 0.10% Coverage

I actually had my own clown funeral for part of the time.

Reference 3 - 0.06% Coverage

I think I can teach it effectively.

Reference 4 - 0.21% Coverage

So, I'm sort of in between. I'm sort of in between being really competent and, you know, needing to improve.

Reference 5 - 0.18% Coverage

These people who've been through the College of Education, you know, they're better teachers.

Appendix H

Existing Pedagogical Training or Knowledge Codes

Files\\Aviation_Transcript - § 21 references coded [1.50% Coverage]

Reference 1–0.11% Coverage

I was like, I got to figure out how to get better at this because I struggled at the time. So did that course at Fort Leavenworth.

Reference 2–0.04% Coverage

Fort Knox and did a two-week Army instructor course.

Reference 3–0.03% Coverage

Ground instructor certificate.

Reference 4–0.03% Coverage

Flight instructor certificate

Reference 5–0.06% Coverage

I had to demonstrate that I could teach flight maneuvers in the aircraft.

Reference 6–0.03% Coverage

OSHA trainer course last week

Reference 7–0.04% Coverage

OSHA is not required. It's a voluntary program.

Reference 8–0.17% Coverage

I felt pretty fortunate that I understood the exponential learning model, because we used to use that where, hey, you have a concrete experience, you allow your students to publish and process.

Reference 9–0.08% Coverage

The two-week Army instructor course that I did was required by U.S. Army's cadet command.

Reference 10–0.05% Coverage

It was far more beneficial to get trained as a facilitator.

Reference 11–0.09% Coverage

One of the beautiful things about the instructor certificate is that we talk about how to teach adult learners.

Reference 12–0.02% Coverage

So, we talked about Blooms taxonomy.

Reference 13–0.03% Coverage

We talked about defense mechanisms.

Reference 14–0.03% Coverage

We talked about computer-based training.

Reference 15–0.04% Coverage

We talked about how to teach flight maneuvers.

Reference 16–0.10% Coverage

I've been flying for 20 years. In order to be a flight instructor on the helicopter side, you have to have 200 hours.

Reference 17–0.01% Coverage

Ta da!

Reference 18–0.08% Coverage

We cover that in the training that multiple choice and true false are the worst exams possible

Reference 19–0.07% Coverage

That's the most effective way to learn something is to actually write it out.

Reference 20–0.05% Coverage

We learned emergency procedures and limitations for aircraft.

Reference 21–0.34% Coverage

That's the thing that I liked about the Army instructor courses that we did was we not only learned, hey, here's how you're supposed to teach this stuff, but now get up and put that in practice and get feedback from your peers and senior instructors. Oh, hey. If you understand how to ask a question and then let five seconds go by without answering your own question or answering by asking another question.

Files\\Chemistry_Transcript - § 17 references coded [0.98% Coverage]

Reference 1–0.04% Coverage

Very little, very little formal things

Reference 2–0.03% Coverage

Some mentoring programs

Reference 3–0.01% Coverage

workshops

Reference 4–0.01% Coverage

talks

Reference 5–0.02% Coverage

Teacher training

Reference 6–0.06% Coverage

I have attended quite a few of those workshops in the past.

Reference 7–0.04% Coverage

There was one, which was a whole five days.

Reference 8–0.04% Coverage

It was a little bit. The biology center

Reference 9–0.05% Coverage

I have attended other sorts of workshops before.

Reference 10–0.02% Coverage

Sometimes a half day.

Reference 11–0.02% Coverage

Sometimes 1 or 2 days

Reference 12–0.06% Coverage

There was a physics teacher education coalition conference.

Reference 13–0.20% Coverage

Supervisions, but that those are really one on 1 or 1 on three sessions, where students get

to meet with somebody, with some instructor to go through the homework and things like that.

Reference 14–0.01% Coverage

tutor

Reference 15–0.09% Coverage

They give us these viewpoints and perspectives when applying things in practice.

Reference 16–0.06% Coverage

I haven't taken courses from the education department.

Reference 17–0.22% Coverage

I have reading comprehension exercises that I'll read this passage and look up the stuff that you don't know. And you need to answer these questions, but, so it's guided exploration, and I think that's valuable.

Files\\Engineering_Transcript - § 15 references coded [2.27% Coverage]

Reference 1–0.18% Coverage

Most of the new faculty in our department are encouraged to go to our teaching workshop.

Reference 2–0.15% Coverage

I went to a workshop which was offered at State University of New York, Buffalo.

Reference 3–0.23% Coverage

They taught us how to do a case, case study-based teaching methodology or, you know, storytelling and those kinds of things.

Reference 4–0.24% Coverage

I am enrolled in a summer session for this summer. Offered through, it's called, I forget what it's called. It's online teaching.

Reference 5–0.15% Coverage

College of Engineering teaching council summer teaching development program

Reference 6–0.10% Coverage

They discuss some best practices in online teaching.

Reference 7–0.35% Coverage

Not too much of a commitment. It's about a couple of hours, I think. All hours or 24 hours, you know, so I'm just doing it to, you know, keep things fresh, making sure that I'm not losing any skills.

Reference 8–0.08% Coverage

Create, you know, student learning outcomes.

Reference 9–0.14% Coverage

Make sure that students of that are aware of what their learning outcomes

Reference 10–0.10% Coverage

How the content relates to those learning outcomes

Reference 11–0.09% Coverage

Creating a course map and things of that nature

Reference 12–0.12% Coverage

I think 3 or 4 faculty in total on this course right now.

Reference 13–0.09% Coverage

I was a bit surprised myself, but I'm the only.

Reference 14–0.21% Coverage

The other three are fairly new lecturers. So, I think they were curious to know how to improve online teaching.

Reference 15–0.06% Coverage

I'm the only person from my department.

Files\\Math_Transcript - § 3 references coded [0.36% Coverage]

Reference 1–0.22% Coverage

Some sort of course in graduate school that was like, you know, like an introduction to, you know, teaching for graduate teaching assistant kind of thing.

Reference 2–0.11% Coverage

A good grad student class, like, you know, just like one credit or something,

162

Reference 3–0.02% Coverage

It was required.

Files\\Medicine_Transcript - § 15 references coded [2.17% Coverage]

Reference 1–0.14% Coverage

As a graduate student, I did research and trained for a career in research.

Reference 2–0.16% Coverage

Also, I did a lot of teaching as a graduate student. I taught mainly medical students.

Reference 3–0.18% Coverage

I was teaching medical students as well as graduate students who were behind me in the program.

Reference 4–0.19% Coverage

I have been a small group facilitator for medical students who are learning and learning medicine.

Reference 5–0.03% Coverage

Active learning

Reference 6–0.20% Coverage

I watched my professors, who were the most effective at what they did and actually going back to college.

Reference 7–0.17% Coverage

You know, there were mentors of mine who, you know, I really hold up as models.

Reference 8–0.15% Coverage

I didn't have any formal training through college or graduate school.

Reference 9–0.10% Coverage

I took some education courses when I was in college.

Reference 10–0.09% Coverage

I took an adult learning theory course.

Reference 11–0.19% Coverage

I loved it. I loved those courses. But, you know, I really haven't had any formal training otherwise.

Reference 12–0.06% Coverage

I go to meetings and conferences.

Reference 13–0.09% Coverage

I really didn't have any kind of preparation.

Reference 14–0.29% Coverage

The education courses I did take I took in college, and it was just a couple of courses that really just kind of turned me on to wanting to be an educator.

Reference 15–0.13% Coverage

Making a lot of mistakes, as well, and learning from those mistakes.

Files\\Statistics_Transcript - § 11 references coded [2.36% Coverage]

Reference 1–0.26% Coverage

In a, in a sort of informal sense, I've been taught how to teach. I think, you know, the most extensive training I've had was when I was a PhD student.

Reference 2–0.10% Coverage

We'd have weekly meetings with the teaching supervisor.

Reference 3–0.32% Coverage

There was the director of this tutorial lab, and then, you know, we would just talk about teaching a little bit there, you know, but I don't have any degree in teaching.

Reference 4–0.08% Coverage

I've never taken any courses in teaching.

Reference 5–0.26% Coverage

There was a seminar in undergraduate mathematics education, and that was something that you could sign up for and get on your transcript.

Reference 6–0.18% Coverage

Every week, you know, we would meet every week, and somebody would give some kind of talk about teaching.

Reference 7–0.10% Coverage

I wouldn't say I really had any teacher training at all.

Reference 8–0.10% Coverage

There was very little training, you know, for teaching.

Reference 9–0.16% Coverage

The most extensive training I've had is that, when I said that I was a graduate student.

Reference 10–0.60% Coverage

We have some meeting or the supervisor will look at a draft of our exams and, and just look for points to criticize, you know, and I think maybe that exercise will just kind of, you know, maybe be a little more careful, maybe, you know, these exams more seriously, maybe do everything more seriously, you know, more carefully,

Reference 11–0.21% Coverage

I did attend that seminar in undergraduate mathematics, just because I thought that would help me get a job.

Appendix I

Feelings Regarding Pedagogy Codes

The following data represents NVivo data output. In the text after "Files" the interested reader can see from which interviewee the code was obtained from. For example, "Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the following data was obtained from the Aviation professor's interview transcript, there were 14 codes (instances that fit the code's description), and that these codes represented a total of 1.85% of the aviation professor's interview. The references are numbered. For example, "Reference 1–0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the interview (whatever is mentioned after "Files").

Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]

Reference 1–0.17% Coverage

I felt pretty fortunate that I understood the exponential learning model, because we used to use that where, hey, you have a concrete experience, you allow your students to publish and process.

Reference 2–0.05% Coverage

It was far more beneficial to get trained as a facilitator.

Reference 3–0.09% Coverage

One of the beautiful things about the instructor certificate is that we talk about how to teach adult learners.

Reference 4–0.15% Coverage

If you have someone who is teaching at the college level who doesn't seem like they know how to teach, give them a little bit of leeway, as they may not have been hired to teach.

Reference 5–0.34% Coverage

That's the thing that I liked about the Army instructor courses that we did was we not only learned, hey, here's how you're supposed to teach this stuff, but now get up and put that in practice and get feedback from your peers and senior instructors. Oh hey, you understand how to ask a question and then let five seconds go by without answering your own question or answering by asking another question.

Reference 6–0.20% Coverage

Yes. Teaching courses I think are a positive impact, and they should help enhance some of these delivery techniques, because I can be a technical expert, like an engineer. But that doesn't mean that I can explain to my wife how that thing works.

Reference 7–0.09% Coverage

I enjoy the pedagogical aspect of teaching. If I was to do a doctorate, it would be educational leadership.

Reference 8–0.10% Coverage

Things that we teach in aviation is basically continuing to professionally develop yourself as an instructor.

Reference 9–0.14% Coverage

So, the educational leadership and doctorate kind of fascinates me because, again, it's an opportunity to adjust delivery and get better as an instructor.

Reference 10–0.17% Coverage

I found I was grading them exam by exam, and it started to piss me off because I would go back and make changes to other ones, and I was like, right, this is I am not being impartial or objective here.

Reference 11–0.02% Coverage

I find it fascinating.

Reference 12–0.05% Coverage

I teach here in the aviation department because I like to teach.

Reference 13–0.05% Coverage

It was fascinating because we approach stuff the same way.

Reference 14–0.23% Coverage

It's a demonstration of continuing to professionally develop one's craft, which I can explain to students. To be like, hey, I went and did the double II course, not because I needed to, but because I enjoy teaching, and it gives me the ability to teach other courses.

Files\\Chemistry_Transcript - § 17 references coded [1.76% Coverage]

Reference 1–0.03% Coverage

They were very interesting.

Reference 2–0.13% Coverage

They made me understand the principles, like, you can't teach one thing and expect the students to be able to do something else.

Reference 3–0.06% Coverage

Hey, they really drilled it into us at these workshops.

Reference 4–0.02% Coverage

Not always so easy

Reference 5–0.03% Coverage

I do my best with all that.

Reference 6–0.33% Coverage

I would actually almost prefer to be in a 100% teaching position, in which case I would be investing a foot, not only in pedagogy for the students' benefit, but also, for our own sanity, just like learning management systems. And, you know, dealing with huge amounts of stuff can be a chore and grading can be a chore.

Reference 7–0.08% Coverage

There's a huge amount of thinking going on in education, and I value that.

Reference 8–0.10% Coverage

I would strongly recommend, to people like that, that, you know, training would be really useful.

Reference 9–0.14% Coverage

. Even if it's ongoing training, you know, maybe there's something new that's available; new AI tools, new learning management systems.

Reference 10–0.06% Coverage

There's a lot that one can do to be a better or worse teacher.

Reference 11–0.11% Coverage

I was kind of shocked. I was like, this is just a short amount of time spent between 00:45:31:24 - 00:45:33:00

Reference 12 - 0.03% Coverage

Dr. Chemistry Student.

Reference 13 - 0.05% Coverage

They teach, you learn, and you do an exam, and you pass.

Reference 14 - 0.17% Coverage

If you want to make an impact, there's something to be said about the division of labor and specialization where the teachers really specialize in teaching.

Reference 15 - 0.02% Coverage

There's cool stuff.

Reference 16 - 0.18% Coverage

Maxwell's equations may have been around for 150 years, but I think how we teach them and how we build these invisible frameworks, your student minds are still evolving.

Reference 17 - 0.22% Coverage

I have reading comprehension exercises that I'll read this passage and look up the stuff that you don't know. And you need to answer these questions, but, so it's guided exploration, and I think that's valuable.

Files\\Engineering_Transcript - § 27 references coded [4.87% Coverage]

Reference 1 - 0.06% Coverage

We ask them to do it themselves.

Reference 2 - 0.52% Coverage

I think that workshop was catered more towards subjects which are very theory-heavy, you know, biology of history and things of that nature. On how to make things interesting, how to make the content interesting by telling stories or, you know, rather than mundane lecturing and so on.

Reference 3 - 0.04% Coverage

I offer to take home exams.

Reference 4 - 0.07% Coverage

Cheating is not very widely prevalent.

Reference 5 - 0.16% Coverage

At the end of the day, it looks like everybody's learning what they're supposed to learn.

Reference 6 - 0.19% Coverage

I don't see why I don't think there was one particular tip or trick that profoundly altered the way I teach.

Reference 7 - 0.15% Coverage

We are not a training college for industry. That's always in the back of my mind.

Reference 8 - 0.08% Coverage

My goal is to make the students marketable.

Reference 9 - 0.27% Coverage

I am making use of the best possible use of technologies and tools available to help the students understand the content. So that's my primary goal.

Reference 10 - 0.35% Coverage

Not too much of a commitment. It's about a couple of hours, I think. All hours or 24 hours, you know, so I'm just doing it to, you know, keep things fresh, making sure that I'm not losing any skills.

Reference 11 - 0.31% Coverage

Once you've been here a long time, you kind of get into a kind of rut in the way of thinking, of thinking about things. So, I just wanted to make sure I was keeping things fresh.

Reference 12 - 0.26% Coverage

I don't think it'll alter the way in which I deliver the content, but it might help, or it might help reinforce some of the things in the classroom.

Reference 13 - 0.18% Coverage

I constantly check in with myself on my strengths and weaknesses, so. And then do tweaks as needed.

Reference 14 - 0.09% Coverage

If it's very helpful, I would share it with them.

Reference 15 - 0.08% Coverage

The culture has to permeate into the college.

Reference 16 - 0.26% Coverage

Even the most senior of our faculty members say that, hey, I tried this thing this year. It failed. Next year I'm going to try something different.

Reference 17 - 0.22% Coverage

It takes a lot of courage and, you know, having 20 years of experience to come and say, I tried something I failed.

Reference 18 - 0.05% Coverage

You all have to work as a team.

Reference 19 - 0.33% Coverage

You know, it's not about delivering content. It's providing them with enough knowledge. So that they remember something from it. You know, that's the goal of a course.

Reference 20 - 0.10% Coverage

We never dissuade each other from doing these things.

Reference 21 - 0.46% Coverage

Put student learning as your priority. So, otherwise, it completely affects the dynamics of our department as well. So, we want to see if somebody is not interested in teaching or if teaching is just an afterthought to them. Don't even bring them on board.

Reference 22 - 0.15% Coverage

The culture has to first permeate through the department and then to the college.

Reference 23 - 0.08% Coverage

I think the entire nation needs a mind shift.

Reference 24 - 0.13% Coverage

There's this ice hockey culture, right? 00:59:48:18 - 00:59:49:13

Reference 25 - 0.11% Coverage

Dr. Engineering It's that kind of thing that has to permeate STEM.

Reference 26 - 0.08% Coverage

Education has to permeate into each house.

Reference 27 - 0.09% Coverage

Pursuing excellence has to be there everywhere.

Files\\Math_Transcript - § 30 references coded [4.16% Coverage]

Reference 1 - 0.41% Coverage

I had to take some sort of course in graduate school that was like, you know, like an introduction to, you know, teaching for graduate teaching assistant kind of thing. 00:11:25:23 - 00:11:27:03 Dr. Math 00:11:27:05 - 00:11:46:11 Dr. Math And it was fine. It was kind of a joke.

Reference 2 - 0.14% Coverage

I think it was like, nice to think about some of those things and have discussions with people.

Reference 3 - 0.08% Coverage

Overall, I didn't really like taking too much away from it.

Reference 4 - 0.03% Coverage

Some of it was good.

Reference 5 - 0.14% Coverage

Some of it was nice. Like, you know, writing like, like, statements of, like, teaching philosophy.

Reference 6 - 0.09% Coverage

Boils down to as people go, like I looked at it and I didn't get it.

Reference 7 - 0.04% Coverage

I don't think it's as useful.

Reference 8 - 0.09% Coverage

I think math is well suited for the classical, like lecture format.

Reference 9 - 0.09% Coverage

I didn't see like a huge amount of benefit in some of that stuff.

Reference 10 - 0.08% Coverage

Word. 00:14:59:06 - 00:15:02:05 Dr. Math Salad, sort of.

Reference 11 - 0.22% Coverage

You have, like, all these nice, like, taxonomies or like, you know, hierarchies of blah, blah, blah, and student motivation, and it's like, I guess maybe.

Reference 12 - 0.22% Coverage

We're just doing like a lot of, like armchair psychoanalysis of our students, getting off of essentially zero information. And it seems silly to me.

Reference 13 - 0.46% Coverage

Even if it, like, fully convinced me that I should do something different, like, there is essentially no reason for me to like if that required taking, like, a large amount of time. There's essentially, like, no reason for me to engage in it, right? It would just be mostly to my detriment to spend a ton of time redoing any.

Reference 14 - 0.04% Coverage

There are other things to do.

Reference 15 - 0.11% Coverage

You don't get like any more credit for teaching the class better than worse.

Reference 16 - 0.15% Coverage

I can't foresee any particularly great non-monetary version of way to incentivize course redesign.

Reference 17 - 0.10% Coverage

I don't have any strong feelings about if they should or shouldn't.

Reference 18 - 0.21% Coverage

If you're going to fail because you're in like a room with lots of people versus not a lot of people, like, I don't know, that's not really my problem.

Reference 19 - 0.09% Coverage

I kind of want you to learn like I do. Like I care that people learn

Reference 20 - 0.06% Coverage

Paint the walls the right color for you

Reference 21 - 0.04% Coverage

Part my hair a different way

Reference 22 - 0.20% Coverage

I can present the material in the same way to an audience of virtually any size, you know, like if you're going to get it, you're going to get it.

Reference 23 - 0.03% Coverage

That's not our problem.

Reference 24 - 0.14% Coverage

I don't think there's any time for that. You barely cover enough material as it is.

Reference 25 - 0.07% Coverage

I don't see why that would be particularly helpful.

Reference 26 - 0.09% Coverage

So you're learning a thing. Just go learn it. It's up to you.

Reference 27 - 0.03% Coverage

Like your discipline

Reference 28 - 0.06% Coverage

Give people a sense that they, too, can belong.

Reference 29 - 0.14% Coverage

But there's probably no box in that survey that said, like, I'm not really smart enough to do it.

Reference 30 - 0.52% Coverage

Like, which sounds really mean. No one wants to say that anyone's not smart, but like, some people aren't that smart, man. It's like a thing, like it's real. There are people who are very smart. There are people who, like, really struggle to get stuff, you know, and like, if you want to, like, there are people who are really good at picking up heavyweights.

Files\\Medicine_Transcript - § 17 references coded [3.38% Coverage]

Reference 1 - 0.13% Coverage

When I was in college, what I discovered, I really enjoyed teaching.

Reference 2 - 0.19% Coverage

I'm interested in research, and I'm interested in teaching. And so that's the path that I pursued.

Reference 3 - 0.11% Coverage

What I want to try and overcome is that it is that resistance.

Reference 4 - 0.47% Coverage

I create an environment where my goal with students is always to have students kind of listen to me, and, and watch me and form an opinion of me that says, you know what? 00:15:41:16 - 00:16:28:09 Dr. In medicine, I can learn something from this guy.

Reference 5 - 0.27% Coverage

When I feel like I've got a kind of better rapport with students, then I feel like we're on a good trajectory, and we can be successful together.

Reference 6 - 0.23% Coverage

I'd have a ton to learn about how to do that and how to do that effectively. I am most effective in person, in the classroom.

Reference 7 - 0.21% Coverage

As a graduate student, I would have benefited from opportunities to take some teaching and learning courses.

Reference 8 - 0.29% Coverage

The education courses I did take I took in college, and it was just a couple of courses that really just kind of turned me on to wanting to be an educator.

Reference 9 - 0.29% Coverage

I think I could have really benefited from, from some teaching and learning courses, understanding what my trajectory was for the career that I wanted.

Reference 10 - 0.07% Coverage

I am always looking for ways to improve.

Reference 11 - 0.04% Coverage

You need to be patient.

Reference 12 - 0.10% Coverage

You need to try and understand where the student is.

Reference 13 - 0.04% Coverage

Maintain patience.

Reference 14 - 0.38% Coverage

I still get surprised by some of the responses to questions that I ask, you know, the responses that I get or just the fact that it demonstrates to me that, like, wow, you really didn't get that.

Reference 15 - 0.24% Coverage

I expect students to read. I don't feel like I need to just deliver content to students that they can read somewhere.

Reference 16 - 0.15% Coverage

If you are professional with the students, they will be professional with you.

Reference 17 - 0.17% Coverage

Lot of interest among faculty here at the medical school in professional development

Files\\Statistics_Transcript - § 11 references coded [2.15% Coverage]

Reference 1 - 0.04% Coverage

I think it was effective.

Reference 2 - 0.19% Coverage

Was the training effective? I think it helped, but there's been a lot to my learning besides the training.

Reference 3 - 0.53% Coverage

You have to interact with the classroom. You can't just make sure you have to ask the class questions and get them to interact. But I've learned that, you know, you've got to be very careful when you do that. 00;09;33;16 - 00;09;49;00 Dr. Statistics And you can't ask the class dumb questions

Reference 4 - 0.10% Coverage

Having a course in teaching would have been a luxury.

Reference 5 - 0.14% Coverage

Don't take any of those educational courses. He said it didn't help.

Reference 6 - 0.18% Coverage

These people who've been through the College of Education, you know, they're better teachers.

Reference 7 - 0.33% Coverage

I think teaching skills are probably less important for college, you know, students in college classes because, at that level, by that time, the students are a little better.

Reference 8 - 0.16% Coverage

If they have a teacher who isn't so good, you know, then they can just make do, if you know.

Reference 9 - 0.17% Coverage

I very seldom talk to students and say, you know, you really ought to talk to me about this.

Reference 10 - 0.05% Coverage

I want to be a good teacher.

Reference 11 - 0.27% Coverage

I don't hold the office hours any way. You know, I'll be in my office but, but you, I mean I'll go for long periods of time. Nobody comes to the office.

Appendix J

Importance of Teaching Quality Codes

The following data represents NVivo data output. In the text after "Files" the interested reader can see from which interviewee the code was obtained from. For example, "Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the following data was obtained from the Aviation professor's interview transcript, there were 14 codes (instances that fit the code's description), and that these codes represented a total of 1.85% of the aviation professor's interview. The references are numbered. For example, "Reference 1– 0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the interview (whatever is mentioned after "Files").

Files\\Aviation_Transcript - § 3 references coded [0.22% Coverage]

Reference 1 - 0.09% Coverage

Oh. So, the aviation department. We're an anomaly. We hire instructor-level positions with a bachelor's degree.

Reference 2 - 0.05% Coverage

It was far more beneficial to get trained as a facilitator.

Reference 3 - 0.08% Coverage

We cover that in the training that multiple choice and true false are the worst exams possible

Files\\Chemistry_Transcript - § 6 references coded [0.67% Coverage]

Reference 1 - 0.08% Coverage

I certainly always look for creative ways to present it and explain it.

Reference 2 - 0.14% Coverage

You can teach the same course year after year in a similar way and survive like that. But you can't do the same research year after year.

Reference 3 - 0.06% Coverage

We should always update our materials and courses, and I do.

Reference 4 - 0.19% Coverage

We have had people before that were so bad that they could not. They got let go before they even got tenure because, well, they insulted students in front of the classroom observers.

Reference 5 - 0.14% Coverage

I spent an hour with these three students. And then, from that point onwards, the student that had been getting these was getting A's.

Reference 6 - 0.06% Coverage

More valuable than telling them to memorize this and that.

Files\\Engineering_Transcript - § 4 references coded [1.80% Coverage]

Reference 1 - 0.58% Coverage

Each teaching quality is important. It is absolutely important. And in fact, when we bring in faculty, it is written when we interview the faculty to bring them on board. It is that we make sure that we don't care if you are a high-fly researcher who hates teaching, right? You need to be able to balance both.

Reference 2 - 0.46% Coverage

Put student learning as your priority. So, otherwise, it completely affects the dynamics of our department as well. So, we want to see if somebody is not interested in teaching or teaching. It is just an afterthought to them. Don't even bring them on board.

Reference 3 - 0.64% Coverage

There are other departments where teaching is not as much of a priority. Right. We hope that, you know, others can learn from us. In fact, you know, our department has one; university-wide awards for both teaching. 00:39:52:24 - 00:40:20:21 Dr. Engineering And we are one of the few departments that has won awards both in teaching and research.

Reference 4 - 0.12% Coverage

You better have teachers that know how to teach the stuff.

Files\\Math_Transcript - § 4 references coded [0.55% Coverage]

Reference 1 - 0.16% Coverage

People think you're a great teacher. You're good. Like, they like they probably make some want you to stay around.

Reference 2 - 0.15% Coverage

If you're, like, extremely terrible, I imagine that might cause some questions about a tenure decision.

Reference 3 - 0.15% Coverage

Unless it's exceptionally strong in either direction, I don't expect it to be terrifically important.

Reference 4 - 0.09% Coverage

If you're just a solid, regular teacher, like, that's fine

Files\\Medicine_Transcript - § 3 references coded [0.67% Coverage]

Reference 1 - 0.31% Coverage

Most of the anatomy teaching gets done in a cadaver laboratory, and so we have dead bodies that we usually, to teach medical students, the anatomy of the human body.

Reference 2 - 0.31% Coverage

You absolutely get credit for being an effective educator as a part of your role as a faculty member here. That is our culture here at the medical school.

Reference 3 - 0.06% Coverage

We value teaching very highly.

Files\\Statistics_Transcript - § 1 reference coded [0.16% Coverage]

Reference 1 - 0.16% Coverage

If they have a teacher who isn't so good, you know, then they can just make do, if you know.

Appendix K

Lack of Resources Codes

The following data represents NVivo data output. In the text after "Files" the interested reader can see from which interviewee the code was obtained from. For example, "Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the following data was obtained from the Aviation professor's interview transcript, there were 14 codes (instances that fit the code's description), and that these codes represented a total of 1.85% of the aviation professor's interview. The references are numbered. For example, "Reference 1– 0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the interview (whatever is mentioned after "Files").

Files\\Aviation_Transcript - § 1 reference coded [0.09% Coverage]

Reference 1 - 0.09% Coverage

So, the aviation department. We're an anomaly. We hire instructor-level positions with a bachelor's degree.

Files\\Chemistry_Transcript - § 1 reference coded [0.19% Coverage]

Reference 1 - 0.19% Coverage

What we would like to do is to devote 100% of our effort to research and 100% of teaching and a hundred surveys. Right. We can't do that. And that's why we have to sacrifice something.

Files\\Math_Transcript - § 5 references coded [0.52% Coverage]

Reference 1 - 0.27% Coverage

We haven't had enough. 00:02:51:21 - 00:02:53:01 Dr. Math: People in the department from 00:02:53:01 - 00:02:58:00 Dr. Math covers the teaching load, which is frustrating, but that is what it is.

Reference 2 - 0.03% Coverage

Four hires this year

Reference 3 - 0.06% Coverage

If you're at like 30%, you just get zero.

Reference 4 - 0.10% Coverage

Teaching assistants. But as far. Yeah, I think that's pretty uncommon.

Reference 5 - 0.06% Coverage

Trying to juggle all those different things

Appendix L

New Learning Opportunities Codes

The following data represents NVivo data output. In the text after "Files" the interested reader can see from which interviewee the code was obtained from. For example, "Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the following data was obtained from the Aviation professor's interview transcript, there were 14 codes (instances that fit the code's description), and that these codes represented a total of 1.85% of the aviation professor's interview. The references are numbered. For example, "Reference 1– 0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the interview (whatever is mentioned after "Files").

Files\\Aviation_Transcript - § 16 references coded [1.95% Coverage]

Reference 1 - 0.10% Coverage

We were having pedagogical discussions about how to teach. And the question they asked. I was terrified.

Reference 2 - 0.09% Coverage

I bribe my students to do selfie surveys. So, we have the student feedback forms that they fill out.

Reference 3 - 0.20% Coverage

Yes. Teaching courses I think have a positive impact, and they should help enhance some of these delivery techniques, because I can be a technical expert, like an engineer. But that doesn't mean that I can explain to my wife how that thing works.

Reference 4 - 0.09% Coverage

I enjoy the pedagogical aspect of teaching. If I was to do a doctorate, it would be educational leadership.

Reference 5 - 0.10% Coverage

Things that we teach in aviation is basically continuing to professionally develop ourselves as an instructor.

Reference 6 - 0.13% Coverage

The educational leadership and doctorate kind of fascinates me because, again, it's an opportunity to adjust delivery and get better as an instructor.

Reference 7 - 0.04% Coverage

If I don't know the answer, I will go find out.

Reference 8 - 0.04% Coverage

As a flight instructor, I still learn stuff.

Reference 9 - 0.26% Coverage

I learn stuff from students, and I tell them upfront, hey, I don't have all the answers. That's why I teach college. I'm like, there's 36 of y'all and one of me. The collective brainpower in this class at the undergrad level far exceeds what I have. I'm like, the only difference between you and me is experience.

Reference 10 - 0.13% Coverage

When we do group discussions, there are people who bring stuff up that I feel like I have not seen that before, but I did not consider it from that perspective.

Reference 11 - 0.16% Coverage

I reduced my contract by one class per semester, which would afford me the time. But to counter that, we are short people in the aviation department, and it would be difficult to try to find the time.

Reference 12 - 0.02% Coverage

Book club this year,

Reference 13 - 0.16% Coverage

Interesting there because we talked about, like, the person who wrote the book brought up a bunch of different ways to enhance learning in the classroom and facilitate that.

Reference 14 - 0.17% Coverage

I did book club this year because it was another opportunity to interact with other people differently on campus because, on the west side of 42nd, we are viewed radically differently from the rest of campus.

Reference 15 - 0.03% Coverage

Independent study graduate class

Reference 16 - 0.23% Coverage

It's a demonstration of continuing to professionally develop one's craft, where I can explain to students like, hey, I went and did the double II course, not because I needed to, but because I enjoy teaching, and it gives me the ability to teach other courses.

Files\\Engineering_Transcript - § 2 references coded [0.49% Coverage]

Reference 1 - 0.15% Coverage

I just had some free time in the summer, so I thought, okay, let me try something new.

Reference 2 - 0.34% Coverage

Leadership, whether it be department relationships or college leadership, starts incentivizing research more than teaching, then teaching is going to fall through the cracks.

Files\\Math_Transcript - § 11 references coded [1.21% Coverage]

Reference 1 - 0.04% Coverage

I doubt I'd be able to do that.

Reference 2 - 0.14% Coverage

People would dislike it. Because it would mean that they are each more they have to pick up the slack.

Reference 3 - 0.09% Coverage

If you're not teaching that class, someone else has to teach it.

Reference 4 - 0.10% Coverage

There's like a fixed amount of teaching and it must be distributed.

Reference 5 - 0.03% Coverage

No, I don't think so.

Reference 6 - 0.13% Coverage

Yeah, it seems cool and interesting, but, you know, teaching classes is valuable.

Reference 7 - 0.21% Coverage

I would be, you know, I would lose. 00:42:53:22 - 00:42:55:03 Dr. Math Chances to recruit good. 00:42:55:03 - 00:42:56:20 Dr. Math Students.

Reference 8 - 0.15% Coverage

They or would they just make everyone teach more. They probably would do that. Most departments would.

Reference 9 - 0.13% Coverage

You're looking at like a huge amount of time commitment just to hiring someone to be there.

Reference 10 - 0.06% Coverage

No one's going to apply for a short-term gig.

Reference 11 - 0.14% Coverage

But there's probably no box in that survey that said, like, I'm not really smart enough to do it.

Files\\Medicine_Transcript - § 7 references coded [2.71% Coverage]

Reference 1 - 0.51% Coverage

I will go to education-based sessions where people will talk about approaches they take in the classroom or the teaching laboratory, and, you know, and so, from that kind of professional development standpoint, I am very interested in doing those kinds of things.

Reference 2 - 0.67% Coverage

I think it would have a significant impact. You know, if there were courses that directly addressed some of the needs that I identified for myself, where I wanted to go with my own teaching career. I would consider, or I certainly would consider, taking those kinds of opportunities to be able to further develop my skills.

Reference 3 - 0.18% Coverage

I've got many faculty members who try and take full advantage of everything that they can.

Reference 4 - 0.45% Coverage

We've got a faculty development office here at the medical school as well. I can reliably tell you who's going to show up for those noon faculty development sessions because those are the people that show up all the time.

Reference 5 - 0.17% Coverage

Lot of interest among faculty here at the medical school in professional development

Reference 6 - 0.56% Coverage

Take opportunities to make their teaching the basis of their scholarship. You know, and so when we talk about the scholarship of teaching and learning, you know what questions you are asking yourself that you want answers to that other educators would be interested in hearing about?

Reference 7 - 0.17% Coverage

I'm looking for the advantages. These are not necessarily the disadvantages. You know.

Files\\Statistics_Transcript - § 2 references coded [0.70% Coverage]

Reference 1 - 0.35% Coverage

Would my teaching improve? C it might not, because I might not want to do the things they teach me to do in these classes, you know, so, so, but it's just hard to say my teaching would improve.

Reference 2 - 0.35% Coverage

Active learning Lab. Yeah. If you've heard of that, yeah. I think it's just part of their standard pedagogy that they have some of these in-class activities, you know, in, in those things.

Appendix M

Profanity Codes

The following data represents NVivo data output. In the text after "Files" the interested reader can see from which interviewee the code was obtained from. For example, "Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the following data was obtained from the Aviation professor's interview transcript, there were 14 codes (instances that fit the code's description), and that these codes represented a total of 1.85% of the aviation professor's interview. The references are numbered. For example, "Reference 1– 0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the interview (whatever is mentioned after "Files").

Files\\Aviation_Transcript - § 2 references coded [0.12% Coverage]

Reference 1 - 0.08% Coverage

They bitch about how much they hate the short answer exams because they can't just guess.

Reference 2 - 0.04% Coverage

There are people who just write down some bullshit.

Appendix N

Promotion Codes

The following data represents NVivo data output. In the text after "Files" the interested reader can see from which interviewee the code was obtained from. For example, "Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the following data was obtained from the Aviation professor's interview transcript, there were 14 codes (instances that fit the code's description), and that these codes represented a total of 1.85% of the aviation professor's interview. The references are numbered. For example, "Reference 1– 0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the interview (whatever is mentioned after "Files").

Files\\Aviation_Transcript - § 2 references coded [0.19% Coverage]

Reference 1 - 0.05% Coverage

I'm not eligible for promotion until four years from now.

Reference 2 - 0.14% Coverage

As far as promotion and tenure, there's a reason a handful of my colleagues years ago went and got doctorates because they thought they needed it to be a full professor.

Files\\Chemistry_Transcript - § 4 references coded [0.42% Coverage]

Reference 1 - 0.08% Coverage

The tenure criteria are more about research success than about teaching.

Reference 2 - 0.12% Coverage

It's certainly something I never wanted to be involved in. If I could, I would hate to be a chair or a dean or something like that.

Reference 3 - 0.13% Coverage

If you do it really, really badly, and if you insult students by deploying new grievances, then you won't get tenure.

Reference 4 - 0.10% Coverage

If you do a reasonable job, then really, the tenure decision hinges on research productivity.

Files\\Math_Transcript - § 2 references coded [0.58% Coverage]

Reference 1 - 0.49% Coverage

People think you're a great teacher. You're good. Like, they like they probably make some want you to stay around. But like, if you're, like, extremely terrible, I imagine that might cause some questions about a tenure decision. But, unless it's exceptionally strong in either direction, I don't expect it to be terrifically important.

Reference 2 - 0.09% Coverage

If you're just a solid, regular teacher, like. that's fine.

Files\\Medicine_Transcript - § 1 reference coded [0.75% Coverage]

Reference 1 - 0.75% Coverage

It's huge. And that's what is the culture here at the School of Medicine. I'm not sure what it's like in other colleges, but, you know, the school's guidelines on evaluation, promotion and tenure, departmental guidelines on evaluation, promotion and tenure all emphasize the fact that effectiveness as an educator is a key critical component for promotion and or the award of tenure.

Files\\Statistics_Transcript - § 5 references coded [1.22% Coverage]

Reference 1 - 0.14% Coverage

You know, getting tenure. I think that the research is probably the big thing.

Reference 2 - 0.08% Coverage

Teaching would have an effect on promotion.

Reference 3 - 0.42% Coverage

I kind of think that the research is a kind of research and, you know, service on committees outside the department. 00;25;57;25 - 00;26;01;11 Dr. Statistics. I think those are two of the biggest things for getting promotions.

Reference 4 - 0.28% Coverage

When somebody is up for a promotion and tenure, we have to have external reviewers from outside the university, you know, review this person's portfolio.

Reference 5 - 0.29% Coverage

There is a lot of pressure to do research. And I kind of think that being a good researcher, at least getting a few publications, is probably more important.

Appendix O

Relatedness Codes

The following data represents NVivo data output. In the text after "Files" the interested reader can see from which interviewee the code was obtained from. For example, "Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the following data was obtained from the Aviation professor's interview transcript, there were 14 codes (instances that fit the code's description), and that these codes represented a total of 1.85% of the aviation professor's interview. The references are numbered. For example, "Reference 1–0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the interview (whatever is mentioned after "Files").

Files\\Aviation_Transcript - § 2 references coded [0.25% Coverage]

Reference 1 - 0.10% Coverage

I prefer an interactive guided discussion classroom versus standing up in front and lecturing and imparting my knowledge.

Reference 2 - 0.15% Coverage

Jimmy was making a performance. He was up on a stage, and he was doing a performance. He couldn't really respond very well to student questions that came from out of nowhere.

Files\\Chemistry_Transcript - § 3 references coded [0.23% Coverage]

Reference 1 - 0.05% Coverage

I didn't really interact much with students.

Reference 2 - 0.11% Coverage

If the students have a good relationship with you, which they do with me, I think that's generally a good sign.

Reference 3 - 0.06% Coverage

I'm sure a lot of people are probably really jaded by students.

Files\\Math_Transcript - § 6 references coded [1.24% Coverage]

Reference 1 - 0.28% Coverage

Math has become like math in college courses and has become far less rigorous than it once was because they would fail. Too many students and the administrators won't like that and won't let them.

Reference 2 - 0.35% Coverage

I don't feel like I can do that though I might want to, but mostly I just don't really care that much. Like, I don't know whatever class you want to teach that class, okay. I don't care what you call it. It's my feeling towards the administration.

Reference 3 - 0.38% Coverage

Go, oh, you have to take. 00:22:52:12 - 00:23:07:01 Dr. Math Calculus from this professor because that one won't teach you the stuff that you need for this class. And then everyone will be lined up for that. The professor and the other professor's class will be empty,

Reference 4 - 0.05% Coverage

I feel like they do whatever they want.

Reference 5 - 0.11% Coverage

If you can't make yourself work unless you feel connected to your teacher.

Reference 6 - 0.08% Coverage

Most of the math department is like in the ground already.

Files\\Statistics_Transcript - § 1 reference coded [0.16% Coverage]

Reference 1 - 0.16% Coverage

There's a wide variation in the amount of material covered by the different professors.

Appendix P

Responsibility Codes

The following data represents NVivo data output. In the text after "Files" the interested reader can see from which interviewee the code was obtained from. For example, "Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the following data was obtained from the Aviation professor's interview transcript, there were 14 codes (instances that fit the code's description), and that these codes represented a total of 1.85% of the aviation professor's interview. The references are numbered. For example, "Reference 1– 0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the interview (whatever is mentioned after "Files").

Files\\Chemistry_Transcript - § 6 references coded [1.05% Coverage]

Reference 1 - 0.28% Coverage

Well, I mean, obviously, as an educator, I'm supposed to try and create the best learning experience, which means adapting to the students and figuring out what they're lacking and giving them that. So, I mean, if I don't do that, well, then of course it is also my fault.

Reference 2 - 0.05% Coverage

It is my responsibility to try and do as much as I can.

Reference 3 - 0.19% Coverage

I mean, you know, sometimes if you have students that are not motivated, and then you can't help it, but, apart from that, if I have students that are motivated, then, I have to try.

Reference 4 - 0.21% Coverage

If the students are self-aware enough to know what they're lacking and to come to me, great. If they are not, then I have to design exercises and quizzes to try and figure out what it is they are lacking.

Reference 5 - 0.12% Coverage

It's certainly something I never wanted to be involved in. If I could, I would hate to be a chair or. Dean or something like that.

Reference 6 - 0.20% Coverage

I do need to invest energy in the research and into training the grad students who work with me on research, because there's definitely a benefit there. And I need to do that to keep my job.

Files\\Medicine_Transcript - § 3 references coded [0.89% Coverage]

Reference 1 - 0.48% Coverage

It's my job as a small group faculty facilitator in that environment to help students work their way through a case and to ask questions and to kind of facilitate the groups and movement through that case. In helping them identify their own learning needs.

Reference 2 - 0.31% Coverage

A student's got to demonstrate interest in it to be able to be open, to learn. and so, it's my job, I think, to create an environment where students are fully engaged.

Reference 3 - 0.09% Coverage

I should be constantly self-assessing that way.

Appendix Q

Self-Blame or Regret Codes

The following data represents NVivo data output. In the text after "Files" the interested reader can see from which interviewee the code was obtained from. For example, "Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the following data was obtained from the Aviation professor's interview transcript, there were 14 codes (instances that fit the code's description), and that these codes represented a total of 1.85% of the aviation professor's interview. The references are numbered. For example, "Reference 1– 0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the interview (whatever is mentioned after "Files").

Files\\Chemistry_Transcript - § 3 references coded [0.48% Coverage]

Reference 1 - 0.08% Coverage

Discipline can be a problem in terms of the discipline and written work.

Reference 2 - 0.28% Coverage

Well, I mean, obviously, as an educator, I'm supposed to try and create the best learning experience, which means adapting to the students and figuring out what they're lacking and giving them that. So, I mean, if I don't do that, well, then of course it is also my fault.

Reference 3 - 0.12% Coverage

I tend to be very critical of myself. I'm always asking what I could do better. And, in hindsight, there's always 20, 20.

Files\\Medicine_Transcript - § 2 references coded [0.39% Coverage]

Reference 1 - 0.25% Coverage

It doesn't benefit anybody to get frustrated with students who are having difficulty. I have done that, and I have regretted it.

Reference 2 - 0.14% Coverage

I have had to apologize to students for, you know, losing my patience.

Appendix R

Teaching Certificate Feelings Codes

The following data represents NVivo data output. In the text after "Files" the interested reader can see from which interviewee the code was obtained from. For example, "Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the following data was obtained from the Aviation professor's interview transcript, there were 14 codes (instances that fit the code's description), and that these codes represented a total of 1.85% of the aviation professor's interview. The references are numbered. For example, "Reference 1– 0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the interview (whatever is mentioned after "Files").

Files\\Chemistry_Transcript - § 7 references coded [0.94% Coverage]

Reference 1 - 0.09% Coverage

I would probably not do it because I have already attended workshops and training.

Reference 2 - 0.10% Coverage

The limiting factor is ourselves. But with teaching, the students are often the limiting factor.

Reference 3 - 0.30% Coverage

It's usually an initiative driven by the chair. So, we have had two chairs since I've been here. And sometimes they see these opportunities, and they say, hey, I'll give you an incentive to go do this. If you go for this, the department will pay for your lodging and travel and what not.

Reference 4 - 0.06% Coverage

Sure. Why not? And I get to put this on my CV, if nothing else.

Reference 5 - 0.07% Coverage

At the moment, I would say no, because I have a lot of research on.

Reference 6 - 0.15% Coverage

I would recommend that if you put this into practice, advertise it widely, especially because we have people whose sole focus is teaching.

Reference 7 - 0.17% Coverage

If you want to make an impact, there's something to be said about the division of labor and specialization where the teachers really specialize in teaching.

Files\\Engineering_Transcript - § 6 references coded [1.08% Coverage]

Reference 1 - 0.20% Coverage

The benefit of a teaching certificate or teaching type offered as a workshop is not immediately obvious to me.

Reference 2 - 0.08% Coverage

I think it's just barely gotten off the ground.

Reference 3 - 0.26% Coverage

I don't think it would be difficult to make time for a separate workshop or a certificate. In addition to what commitments we already have.

Reference 4 - 0.03% Coverage

Currently, no

Reference 5 - 0.18% Coverage

You would have better luck with departments like electrical engineering or computer science.

Reference 6 - 0.33% Coverage

Somebody who is a research active faculty. 00:50:10:11 - 00:50:16:09 Dr. Engineering you will never do. I mean, your odds of them getting to enroll in the certificate are small.

Files\\Medicine_Transcript - § 6 references coded [4.48% Coverage]

Reference 1 - 0.67% Coverage

I think it would have a significant impact. You know, if there were courses that directly addressed some of the needs that I identified for myself, where I wanted to go with my own teaching career. I would consider, or I certainly would consider, taking those kinds of opportunities to be able to further develop my skills.

Reference 2 - 0.85% Coverage

Well, I would always take those. I always take those opportunities with an eye toward, definitely, putting myself in a position of improving myself and improving student learning through, through what I learned. At any opportunity, I took it like that. So, yes, I, you know, again, if we went back to teaching an online course, if I took courses that were designed to help me be a better instructor in an online environment, I would say yes.

Reference 3 - 0.25% Coverage

I don't know of anyone right now enrolled in a degree granting program or a certificate program. Specifically along those lines.

Reference 4 - 0.60% Coverage

The College of Education and Human Development, either in the educational foundation of research or in teaching and learning, have really been the kind of area where our faculty members have enrolled in degree-granting programs to help prepare them better as educators. I've seen that multiple times.

Reference 5 - 1.06% Coverage

Yeah. You know, I'm pretty late in my career here, so, you know, the circumstances would have to be right. But, you know, if I were early on or, you know, I think even mid-career, I, I, would say yes, definitely. If I, if I saw, if I saw an opportunity there to, to take four courses and to construct, you know, a program of study for a certificate, that was directly in line with what my goals for the rest of my career would be, especially if maybe I were thinking about, making a particular emphasis or even making a change in what my career trajectory was.

Reference 6 - 1.05% Coverage

I would have no problem talking with my department chair about what my goals are and trying to figure out a way of negotiating how to arrange my allocations of effort in ways that allow me to take that professional development opportunity. So, I would say yes, if it aligned with my goals. And I could get my department chair to agree with that in a way that, if I were, if I got a break from teaching, a course or a couple of courses over a couple of semesters, to be able to take this professional development opportunity, I certainly would explore that.

Files\\Statistics_Transcript - § 7 references coded [2.13% Coverage]

Reference 1 - 0.07% Coverage

I've not heard of anybody doing that.

Reference 2 - 0.22% Coverage

I've not heard of any mathematics people taking any of those statistics or certificate courses or anything like that.

Reference 3 - 0.18% Coverage

I might enroll in something like that if the department chair, you know, strongly suggested that.

Reference 4 - 0.18% Coverage

If I were under some pressure to do that, I would. I might do that, but I probably would not do it on my own.

Reference 5 - 0.56% Coverage

If I had a three-credit reduction in my normal load, as we see now, that would be a three-credit reduction in my teaching load in exchange for taking this class. Okay. So, what barriers? Well, the first word that comes to mind is time. But like you said, you're kind of removing that argument, but just initially.

Reference 6 - 0.57% Coverage

And I kind of think that being a good researcher, at least getting a few publications, is probably more important. 00;31;14;01 - 00;31;26;05 Dr. Statistics have been teaching so that that's a strong, at least for non-tenured people. I think that's a strong incentive not to enroll in the certificate program.

Reference 7 - 0.35% Coverage

There might be some really good researchers that are just so on top of the research and everything that they're doing that they would have time to, you know, enroll in this certificate thing.

Appendix S

Teaching Challenges Codes

The following data represents NVivo data output. In the text after "Files" the interested

reader can see from which interviewee the code was obtained from. For example,

"Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the

following data was obtained from the Aviation professor's interview transcript, there were 14

codes (instances that fit the code's description), and that these codes represented a total of 1.85%

of the aviation professor's interview. The references are numbered. For example, "Reference 1–

0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the

interview (whatever is mentioned after "Files").

Files\\Aviation_Transcript - § 17 references coded [1.88% Coverage]

Reference 1 - 0.04% Coverage

It's going to sound odd, but teaching is not hard.

Reference 2 - 0.09% Coverage

The people who want to be there. It's the people who are like, I don't know why I'm

taking this thing.

Reference 3 - 0.10% Coverage

I struggle with that because I don't like online teaching, because you lose that interaction

with the student.

Reference 4 - 0.37% Coverage

A doctorate means that that person has written and defended a dissertation, and they did

research on something that does not mean that they either like or are capable of teaching an

undergrad course, because I've had people who had engineering doctorates who were really smart, but could not explain that concept to somebody else. In a manner in which they understood because they didn't understand the fundamentals of instruction.

Reference 5 - 0.15% Coverage

If you have someone who is teaching at the college level who doesn't seem like they know how to teach, give them a little bit of leeway, as they may not have been hired to teach.

Reference 6 - 0.13% Coverage

Aviation department, but there was 120. I was enrolled in that course, and it was straight lecture the entire time, and I was bored out of my frickin mind.

Reference 7 - 0.18% Coverage

They don't give you any feedback as an instructor and true false questions. It's a 50-50. It all comes down to whether or not I want to be a dick. When I write that question, do I make it the sort of word that trips you up?

Reference 8 - 0.09% Coverage

I bribe my students to do selfie surveys. So, we have the student feedback forms that they fill out.

Reference 9 - 0.07% Coverage

I've made more money as a youth hockey official than I did as a flight instructor.

Reference 10 - 0.02% Coverage

The problem is time.

Reference 11 - 0.05% Coverage

It took some time for me to get command of the material.

Reference 12 - 0.17% Coverage

That I think is probably the biggest fault that I've seen in some higher education is the expectation that the instructor has to be the technical expert and know everything about everything.

Reference 13 - 0.06% Coverage

All of my exams are short answers. It is an absolute slog to grade them.

Reference 14 - 0.17% Coverage

I found I was grading them exam by exam, and it started to piss me off because I would go back and make changes to other ones, and I was like, right, this is I am not being impartial or objective here.

Reference 15 - 0.06% Coverage

It took me eight hours to grade the first exam, and I'm not doing that again.

Reference 16 - 0.08% Coverage

The threshold of embarrassment is so high they don't want to answer in front of the entire class.

Reference 17 - 0.06% Coverage

I hated it because 50 minutes wasn't enough time to cover the topic.

Files\\Chemistry_Transcript - § 35 references coded [3.05% Coverage]

Reference 1 - 0.03% Coverage

There are many challenges.

Reference 2 - 0.06% Coverage

It's difficult to identify the most challenging thing.

Reference 3 - 0.24% Coverage

Our graduate students are often international, and so they usually have a fairly good math background, but sometimes they can behave as if they have no common sense, or they don't understand the meaning of what they're doing.

Reference 4 - 0.05% Coverage

To train them, to communicate is training.

Reference 5 - 0.11% Coverage

Undergraduates, especially the local ones, there's generally no difficulty with communication.

Reference 6 - 0.03% Coverage

Math skills can be a problem.

Reference 7 - 0.08% Coverage

Discipline can be a problem in terms of the [academic] discipline and written work.

Reference 8 - 0.19% Coverage

I mean, you know, sometimes if you have students that are not motivated, and then you can't help it, but, apart from that, if I have students that are motivated, then, I have to try.

Reference 9 - 0.05% Coverage

I didn't really interact much with students.

Reference 10 - 0.06% Coverage

They didn't actually teach us anything about tutoring.

Reference 11 - 0.15% Coverage

If you focus a lot on assessment, there's a danger that you are going to assess them. You know, it's very difficult to eliminate bias in that,

Reference 12 - 0.07% Coverage

If you were to get any statistics, it might not be that meaningful.

Reference 13 - 0.05% Coverage

And we have huge fluctuations from cohort to cohort.

Reference 14 - 0.04% Coverage

The Covid era really screwed things up.

Reference 15 - 0.07% Coverage

It turns out that all the answers to textbook questions are on it.

Reference 16 - 0.04% Coverage

They learned nothing from the homework.

Reference 17 - 0.11% Coverage

You're always going to have to deal with the administration. So, all of that can detract from teaching.

Reference 18 - 0.22% Coverage

If the students have a good relationship with you, which they do with me, I think that's generally a good sign. 00:17:24:22 - 00:17:30:21 Dr. Chemistry. But it doesn't necessarily mean that they learn anything.

Reference 19 - 0.12% Coverage

Ultimately, you know, if you could implant a chip in their brain to make them know stuff, that would be great.

Reference 20 - 0.20% Coverage

What we have to do is use very indirect means to create structures in their minds, to create connections between their neurons. That's what teaching is, right? That's right. It's tricky.

Reference 21 - 0.09% Coverage

If we cover this material better or some other thing, get sacrificed in the process.

Reference 22 - 0.09% Coverage

You can't change how other people behave, but you can change how you yourself behave.

Reference 23 - 0.07% Coverage

It's more about struggling and trying to find the best balance.

Reference 24 - 0.06% Coverage

I've tried to reorganize the material in the form of mind maps.

Reference 25 - 0.06% Coverage

Trying to give them exercises in critical thinking.

Reference 26 - 0.08% Coverage

It's like parenting basically. And it's sad that I had to talk about this.

Reference 27 - 0.10% Coverage

Okay. You use the potty. No. Go wipe your butt. But that's what I have to do with some students.

Reference 28 - 0.04% Coverage

We have problems, we have problems.

Reference 29 - 0.16% Coverage

I wouldn't be surprised if we didn't have students. We have students that don't understand that A implies B doesn't necessarily mean that B implies A.

Reference 30 - 0.04% Coverage

Don't even get the concept of equality.

Reference 31 - 0.05% Coverage

Sometimes, students are really limited.

Reference 32 - 0.06% Coverage

We are not only teaching, we create learning experiences.

Reference 33 - 0.04% Coverage

It's not about us. It's about them.

Reference 34 - 0.13% Coverage

It's not about how well I presented my lecture. It's about how much they retain and how much they can do. At the end of the day,

Reference 35 - 0.04% Coverage

I've had to face many, many problems.

Files\\Engineering_Transcript - § 11 references coded [2.25% Coverage]

Reference 1 - 0.04% Coverage

I see no challenges,

Reference 2 - 0.09% Coverage

I wish I could interact with the students a lot more.

Reference 3 - 0.21% Coverage

Coming up with a robust teaching course is always challenging because of the wide disparity in our disciplines.

Reference 4 - 0.31% Coverage

It's often very hard for faculty to do a good job at both, you know, because, if you invest too much time in teaching, then you can't get research done, and vice versa.

Reference 5 - 0.06% Coverage

Each of our courses is unique.

Reference 6 - 0.31% Coverage

The student cohort is also very different, because for some years, our on-campus student cohort was very strong. The online cohort is weak. Some years it's the reverse.

Reference 7 - 0.13% Coverage

How do you make somebody from Texas connect with somebody in New York?

Reference 8 - 0.65% Coverage

So, sometimes you have a very strong cohort and everything that is outlined in the syllabus I'm able to cover and more, and sometimes I have a big cohort. They haven't gotten all the foundational, most of the foundational knowledge, or they were introduced to it differently in their undergrad. Then I have to kind of tone it down and then slow down the pace.

Reference 9 - 0.09% Coverage

Sometimes I can cover only 90% of what I intend to

Reference 10 - 0.16% Coverage

If a student is just blowing it off, that means they haven't even bothered to do anything.

Reference 11 - 0.21% Coverage

I think, you know, it's a much deeper problem. You know, I think, the salary has to. The teacher's salary has to be better.

Files\\Math_Transcript - § 20 references coded [2.10% Coverage]

Reference 1 - 0.06% Coverage

Students will ask for a lot of your time,

Reference 2 - 0.03% Coverage

Prepare lectures.

Reference 3 - 0.02% Coverage

Give lectures.

Reference 4 - 0.02% Coverage

Grade stuff.

Reference 5 - 0.03% Coverage

Provide feedback.

Reference 6 - 0.04% Coverage

Super detailed feedback.

Reference 7 - 0.03% Coverage

Lots of office hours.

Reference 8 - 0.06% Coverage

Answer all students' questions and emails.

Reference 9 - 0.03% Coverage

Writing lecture notes.

Reference 10 - 0.06% Coverage

Trying to juggle all those different things.

Reference 11 - 0.16% Coverage

Trying to get people to be clear about what they don't understand, that is easily the

hardest part of it.

Reference 12 - 0.13% Coverage

Pretty dense information that I have to convey to you and help you, you know, make

sense of

Reference 13 - 0.09% Coverage

Boils down to as people go, like I looked at it and I didn't get it.

Reference 14 - 0.54% Coverage

If you got more credit for teaching classes better, then we would be making sure that the worst teachers taught the most classes. And the alternative would be to try to, you know, if you're trying to say like, well, it's like taking the highest ranked teachers and making them teach the worst, then making it really incentivizes people to perform poorly. Then they would have less to do

Reference 15 - 0.04% Coverage

People should be organized.

Reference 16 - 0.04% Coverage

I'd say 90% of them can't do it.

Reference 17 - 0.52% Coverage

Like, which sounds really mean. No one wants to say that anyone's not smart, but like, some people aren't that smart, man. It's like a thing, like it's real. There are people who are very smart. There are people who, like, really struggle to get stuff, you know, and like, if you want to, like, there are people who are really good at picking up heavyweights.

Reference 18 - 0.06% Coverage

There are people who are not that good at it.

Reference 19 - 0.12% Coverage

I want to believe everyone can do it, but I don't think everyone can do everything.

Reference 20 - 0.04% Coverage

People don't want to be online.

Files\\Medicine_Transcript - § 13 references coded [2.34% Coverage]

Reference 1 - 0.13% Coverage

The most challenging thing I have found is, is keeping students engaged.

Reference 2 - 0.18% Coverage

Convincing students about the approach that they need to take in the work that they are doing.

Reference 3 - 0.03% Coverage

Staying curious

Reference 4 - 0.63% Coverage

If I've got students who aren't curious and are just going through the motions, that becomes the most challenging opportunity for an instructor to try and make inroads there with, with students who otherwise maybe don't even want to be there or don't want to engage at the level at which they need to engage to be able to learn

Reference 5 - 0.20% Coverage

As they transition to medical school. It may not be the things that make them successful as medical students.

Reference 6 - 0.03% Coverage

Study habits

Reference 7 - 0.05% Coverage

Approaches to your work

Reference 8 - 0.03% Coverage

Time management

Reference 9 - 0.19% Coverage

There are students who are really kind of the most interested in taking the easiest route they can take.

Reference 10 - 0.07% Coverage

Just wanting to know what's on the test.

Reference 11 - 0.17% Coverage

When you're asking them to really kind of to engage at a deeper level, there's resistance.

Reference 12 - 0.24% Coverage

They're bringing with them are habits that may not make them fully successful, as they were in undergrad, in medical school.

Reference 13 - 0.39% Coverage

I would have to take a lot of professional development, opportunities to be able to, I think, get up to speed in terms of what I needed to do there to be most effective in that kind of learning environment.

Files\\Statistics_Transcript - § 5 references coded [1.08% Coverage]

Reference 1 - 0.09% Coverage

There's something called hypothesis testing.

Reference 2 - 0.36% Coverage

It's not just, you know, solving, you know, computing answers that you kind of think about. So yeah, I'd say that's probably the hardest thing for my students, the hardest thing for me to teach.

Reference 3 - 0.41% Coverage

They talk about things like cookbook problems, and I can sort of say, here's the problem and here's how you solve it. You do this and this and this and this. And yet for that hypothesis testing, you have to think about what the goal is.

Reference 4 - 0.13% Coverage

Students get awfully boring sometimes if it's not going fast enough.

Reference 5 - 0.10% Coverage

Just trying to streamline it, be more, you know, concise.

Appendix T

Teaching Feedback Codes

The following data represents NVivo data output. In the text after "Files" the interested reader can see from which interviewee the code was obtained from. For example, "Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the following data was obtained from the Aviation professor's interview transcript, there were 14 codes (instances that fit the code's description), and that these codes represented a total of 1.85% of the aviation professor's interview. The references are numbered. For example, "Reference 1– 0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the interview (whatever is mentioned after "Files").

Files\\Chemistry_Transcript - § 2 references coded [0.53% Coverage]

Reference 1 - 0.34% Coverage

Times when we have classroom observations of a year when a colleague watches our class and gets feedback, and so, on one of those occasions, my colleague gently told me that, you know, you need to be really careful not to spook these students or say things that might sound degrading, because they're already struggling

Reference 2 - 0.19% Coverage

What is your name? Try to associate with them. 00:44:37:03 - 00:44:55:05 Dr. Chemistry And, eventually, I do get it. And some of them do appreciate that and write about it in feedback.

Files\\Medicine_Transcript - § 5 references coded [2.02% Coverage]

Reference 1 - 0.29% Coverage

You know, when I finished teaching the semester of undergraduate anatomy, I got really constructive feedback using the UMD selfie instrument.

Reference 2 - 0.18% Coverage

Students have been very honest, and I have found students very constructive there.

Reference 3 - 0.38% Coverage

And that's what I have seen with the student evaluations that I have received that help me be a better teacher, because students have given me feedback like, look, yeah, you were very receptive to me.

Reference 4 - 0.32% Coverage

Based on feedback, to incorporate more opportunities for students to self-assess what they know or how to use, what they know to be able to solve problems.

Reference 5 - 0.85% Coverage

We'd like more opportunities to get points. The way I took that feedback was, look, I can improve my course by giving students more opportunities to and better opportunities to self-assess so that their confidence is increased when it comes time for an exam or a final, and, they walk into those, those assessment environments confident in, in what they know and confident in, the fact that they can answer virtually any question that I ask them.

Files\\Statistics_Transcript - § 1 reference coded [0.26% Coverage]

Reference 1 - 0.26% Coverage

We have these teacher evaluations here from the students and, you know, I mean, that was just brutal the first time I got those evaluations.

Appendix U

Timing Codes

The following data represents NVivo data output. In the text after "Files" the interested reader can see from which interviewee the code was obtained from. For example, "Files\\Aviation_Transcript - § 14 references coded [1.85% Coverage]" means that the following data was obtained from the Aviation professor's interview transcript, there were 14 codes (instances that fit the code's description), and that these codes represented a total of 1.85% of the aviation professor's interview. The references are numbered. For example, "Reference 1– 0.17% Coverage" means that this is the first reference to the code and represents 0.17% of the interview (whatever is mentioned after "Files").

Files\\Aviation_Transcript - § 9 references coded [0.68% Coverage]

Reference 1 - 0.02% Coverage

80% teaching. 20% service

Reference 2 - 0.03% Coverage

I teach 9 to 12 credits per semester.

Reference 3 - 0.13% Coverage

So, my contract is 12 in the fall, 12 in the spring. So, this fall, I'll teach 15 in the fall and nine in the spring in order to meet my contract requirement.

Reference 4 - 0.02% Coverage

The problem is time.

Reference 5 - 0.05% Coverage

It took some time for me to get command of the equipment.

Reference 6 - 0.15% Coverage

I have 20 years of experience in the aviation field. You guys have like six months to a year. Give it time. If you care enough, you will acquire the knowledge and experience.

Reference 7 - 0.06% Coverage

It took me eight hours to grade the first exam, and I'm not doing that again.

Reference 8 - 0.06% Coverage

I hated it because 50 minutes wasn't enough time to cover the topic.

Reference 9 - 0.17% Coverage

Reduced my contract by one class per semester. That would afford me the time. But to counter that, we are short people in the aviation department, and it would be difficult to try to find the time like

Files\\Chemistry_Transcript - § 8 references coded [0.65% Coverage]

Reference 1 - 0.16% Coverage

4540 ten. It doesn't quite add up, does it? You know, it's an odd number, but it's something like a 47.5 and. No, no, no, no. 00:01:59:23 - 00:02:02:08

Reference 2 - 0.08% Coverage

Dr. Chemistry Well, it's 42 plus 42 plus 16 kinds of adds up. It's mostly that.

Reference 3 - 0.05% Coverage

And we have huge fluctuations from cohort to cohort.

Reference 4 - 0.05% Coverage

These are constraints. 00:18:08:23 - 00:18:11:09

Reference 5 - 0.06% Coverage

Dr. Chemistry Time is basically my time and the student's time.

Reference 6 - 0.11% Coverage

I don't always have time to prepare everything to be as perfect as I'd like it. Or systematic as I like it.

Reference 7 - 0.04% Coverage

Students don't always have time.

Reference 8 - 0.09% Coverage

If the student doesn't have time to do homework, and if you don't submit it, then, yeah.

Files\\Engineering_Transcript - § 4 references coded [0.43% Coverage]

Reference 1 - 0.08% Coverage

45% teaching, 45% research, 10% service.

Reference 2 - 0.22% Coverage

You know, given that, you know, we have a huge teaching and research commitment. You know, we have to balance them both.

Reference 3 - 0.06% Coverage

Time management prioritizing

Reference 4 - 0.08% Coverage

It's always a question of time, right?

Files\\Math_Transcript - § 14 references coded [1.40% Coverage]

Reference 1 - 0.02% Coverage

30, 60 and ten

Reference 2 - 0.07% Coverage

They don't correspond to actual time commitments.

Reference 3 - 0.06% Coverage

Research, I might get like a few hours a week.

Reference 4 - 0.11% Coverage

If I'm lucky, like a good week and I get, like, eight hours to work on research.

Reference 5 - 0.06% Coverage

Students will ask for a lot of your time,

Reference 6 - 0.04% Coverage

Like super detailed feedback

Reference 7 - 0.03% Coverage

Lots of office hours

Reference 8 - 0.06% Coverage

Answer all students' questions and emails.

Reference 9 - 0.03% Coverage

Writing lecture notes

Reference 10 - 0.06% Coverage

Trying to juggle all those different things

Reference 11 - 0.46% Coverage

Even if it, like, fully convinced me that I should do something different, like, there is essentially no reason for me to like if that required taking, like, a large amount of time. There's essentially, like, no reason for me to engage in it, right? It would just be mostly to my detriment to spend a ton of time redoing any.

Reference 12 - 0.14% Coverage

Know exactly what you're going to teach that semester and everything that you teach every day.

Reference 13 - 0.16% Coverage

Have all your assignments prepared, or at least the first few, you know, probably have all your exams written?

Reference 14 - 0.10% Coverage

There's like a fixed amount of teaching and it must be distributed.

Files\\Medicine_Transcript - § 3 references coded [0.59% Coverage]

Reference 1 - 0.21% Coverage

Administrative position is listed as 85% of my effort. And so, I've got 5% teaching, 5% research, 5% service.

Reference 2 - 0.34% Coverage

When I was strictly a faculty member and didn't have an administrative component to my work, I usually typically ran about 50% teaching, and 40% research and 10% service.

Reference 3 - 0.03% Coverage

Time management

Files\\Statistics_Transcript - § 6 references coded [0.92% Coverage]

Reference 1 - 0.20% Coverage

5% service, and I think it's about 30% research. So, whenever there is 55%, teaching something like that.

Reference 2 - 0.14% Coverage

The reason why I didn't take courses in teaching was I just didn't have the time.

Reference 3 - 0.12% Coverage

There wasn't a lot of time even in the master's program for that.

Reference 4 - 0.08% Coverage

I spend an awful lot of time grading homework.

Reference 5 - 0.10% Coverage

Teaching takes so long that I'm pressed for time.

Reference 6 - 0.27% Coverage

It's just that I'm consumed by the teaching, you know, and all the grading and preparing the lectures and all that. It just takes a long time.

Appendix V

IRB Approval

Figure 16

THE UNIVERSITY OF NORTH DAKOTA
CONSENT TO PARTICIPATE IN RESEARCH

Project Title:	**STEM Professors' Motivation to Engage in a College Teaching Certificate**
Principal Investigator:	**Justin Alexander**
Phone/Email Address:	justin.alexander@UND.edu
Department:	**CEHD**
Research Advisor:	Dr. *Grace Keengwe*
Research Advisor Phone/Email Address:	grace.keengwe@UND.edu

What should I know about this research?
- Someone will explain this research to you.
- Taking part in this research is voluntary. Whether you take part is up to you.
- If you don't take part, it won't be held against you.
- You can take part now and later drop out, and it won't be held against you.
- If you don't understand, ask questions.
- Ask all the questions you want before you decide.

How long will I be in this research?
We expect that your taking part in this research will last 1 hour, but I may contact you after your interview with any follow-up questions.

Why is this research being done?
The purpose of this study is to explore whether STEM faculty at a mid-western research university (University of North Dakota) are interested in enrolling in a college teaching graduate certificate such as (https://und.edu/programs/college-teaching-certificate/index.html). This qualitative study will recruit STEM professors from varying academic disciplines to participate in Zoom interview sessions to share their experiences with pedagogy and whether they are interested in enrolling in a college teaching certificate.

What happens to me if I agree to take part in this research?
This research will involve your participation in an interview where I will inquire about your past pedagogical experiences and your interest in enrolling in a college teaching certificate program. The interview will be recorded via Zoom solely for research purposes, but all of your

Approval Date: __3/15/2024__

Expiration Date: __3/14/2025__

University of North Dakota IRB

Date: _____
Subject Initials: _____

231

Figure 17

contributions will be de-identified prior to publication or the sharing of the research results. These recordings, and any other information that may connect you to the study, will be kept in a locked, secure location and in online password-protected servers.

Could being in this research hurt me?
The primary risk is a loss of confidentiality of your interview data. To minimize this risk, recordings of interviews will be destroyed once transcripts are completed and verified. You will be given a pseudonym in the transcripts to further protect your identity.

Will being in this research benefit me?
There will be no direct benefit to you, but your participation may help others in the future.

How many people will participate in this research?
Six (6) people will take part in this study at the University of North Dakota.

What other choices do I have besides taking part in this research?
Instead of being in this research, your choices may include not participating.

Will it cost me money to take part in this research?
You will not have any costs for being in this research study.

Will I be paid for taking part in this research?
You will not be paid for being in this research study.

Who is funding this research?
The University of North Dakota and the research team are receiving no payments from other agencies, organizations, or companies to conduct this research study.

What happens to information collected for this research?
Your private information may be shared with individuals and organizations that conduct or watch over this research, including:
- The Institutional Review Board (IRB) that reviewed this research
- Dissertation advisor

We may publish the results of this research. However, we will keep your name and other identifying information confidential. We protect your information from disclosure to others to the extent required by law. We cannot promise complete secrecy.

The interview will be recorded and then transcribed for analysis. You have the right to review and edit the transcripts to ensure accuracy. Once transcripts are created and verified, the recordings will be destroyed.

Data or specimens collected in this research will not be used or distributed for future research studies, even if identifiers are removed.

Approval Date: ___3/15/2024_____

Expiration Date: _3/14/2025_____

University of North Dakota IRB

Date: _____
Subject Initials: _____

232

Figure 18

What if I agree to be in the research and then change my mind?
If you decide to leave the study early, we ask that you contact Justin Alexander at justin.alexander@und.edu.

Who can answer my questions about this research?
If you have questions, concerns, or complaints, or think this research has hurt you or made you sick, talk to the research team at the phone number listed above on the first page.

This research is being overseen by an Institutional Review Board ("IRB"). An IRB is a group of people who perform independent review of research studies. You may talk to them at 701.777.4279 or UND.irb@UND.edu if:

- You have questions, concerns, or complaints that are not being answered by the research team.
- You are not getting answers from the research team.
- You cannot reach the research team.
- You want to talk to someone else about the research.
- You have questions about your rights as a research subject.
- You may also visit the UND IRB website for more information about being a research subject: http://und.edu/research/resources/human-subjects/research-participants.html

Your signature documents your consent to take part in this study. You will receive a copy of this form.

Subject's Name: _____

_____   _____
Signature of Subject   Date

I have discussed the above points with the subject or, where appropriate, with the subject's legally authorized representative.

_____   _____
Signature of Person Who Obtained Consent   Date

Approval Date: __3/15/2024_____
Expiration Date: _3/14/2025_____
University of North Dakota IRB

Date: _____
Subject Initials: _____

233

Appendix W

Recruitment Email

Dear Professor,

I hope this email finds you well.

I am writing to you because I am conducting a research study on pedagogy and teaching certificates. My study aims to determine your beliefs and attitudes about pedagogy and explore whether you would be interested in enrolling in a college teaching certificate. If you agree to participate in this study, I will conduct and record a Zoom interview that should take approximately one hour.

Participation in this study will be voluntary, and your anonymity will be strictly maintained. You may choose to withdraw your participation at any time without any consequences.

If you are interested in participating in this study, please reply to this email. I will follow up with you to schedule the interview at your earliest convenience.

Thank you for taking the time to consider this invitation. Your contribution to this study is greatly appreciated.

Best regards,

Justin Alexander