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Brain-Targeted Teaching As A Tool To Facilitate Implementing Mind Brain And Education Science Into Community College Pedagogy

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BRAIN-TARGETED TEACHING AS A TOOL TO FACILITATE IMPLEMENTING MIND

BRAIN AND EDUCATION SCIENCE INTO COMMUNITY COLLEGE PEDAGOGY

By

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BRAIN-TARGETED TEACHING AS A TOOL TO FACILITATE IMPLEMENTING MIND,

BRAIN, AND EDUCATION SCIENCE INTO COMMUNITY COLLEGE PEDAGOGY

Abstract

Applying findings from mind, brain, and education science (MBES) could improve teaching and learning yet, MBES is not consistently applied in higher education pedagogy. This qualitative study examined the perceptions of community college faculty of the Brain-Targeted Teaching (BTT) framework as a tool to facilitate implementing MBES into pedagogy. Two research questions guided the study: (1) How did community college faculty describe changes to their pedagogy after participating in professional development that presented and modeled the BTT framework? and (2) What was the perception of participants of the value of the BTT framework as a tool to facilitate implementing MBES into their pedagogy? Data collection methods included online surveys before, during, and after the professional development experience. This study yielded two key findings: 1) Participants perceived the BTT framework to be valuable to support implementation of MBES in pedagogy, and 2) Faculty made and planned changes as a result of a professional development experience with BTT. The study's findings indicated the need for further study of the impact of learning about BTT on pedagogy.

Keywords: Mind, brain, and education science, brain-targeted teaching, higher education pedagogy, community college, professional development

University of New England

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Community colleges play a crucial role in higher education by providing access to a large and diverse group of students (Boggs, 2011). Contemporary community college faculty and administrators face pressure to increase student success in courses, certificates, and degrees (Alexander, Karvonen, Ulrich, Davis & Wade, 2012; Apigo, 2015; Boggs, 2011). Increased demand for improving completion rates has generated initiatives to address student success and necessitated new approaches to teaching (Boggs, 2011). Community college faculty need both information and support to hone their pedagogy to best serve their students (Alexander et al., 2012).

Advances in technology in recent decades have led to an explosion of information in neuroscience and prompted new fields of study including mind, brain, and education science (MBES) (Tokuhama-Epinosa, 2014; Whitman & Kelleher, 2016). MBES seeks to facilitate implementing findings from the fields of neuroscience, cognitive neuroscience, social neuroscience, cognitive psychology, and educational neuroscience into improvements in teaching methods and educational systems (Fischer, 2009; Whitman & Kelleher, 2016). With a focus on how people learn rather than what they should learn, MBES is applicable to educating people of any age in any setting (Tokuhama-Epinosa, 2014).

The purpose of MBES is to understand how people learn best (Tokuhama-Espinosa, 2014; Whitman & Kelleher, 2016). The core understanding that guides MBES is that every student's brain is unique due to each individual's particular set of genes and experiences (Hardiman, 2012; Tokuhama-Espinosa, 2014; Whitman & Kelleher, 2016). MBES is potentially

a valuable resource for all teachers to refine their teaching approaches because it applies to all learners regardless of age or ability (Hardiman, 2012; Tokuhama-Espinosa, 2014; Whitman & Kelleher, 2016).

The Brain-Targeted Teaching (BTT) framework, developed by Hardiman (2012), provides a framework for teachers in any setting with a tool for understanding MBES and how to apply it to their pedagogy. In her book Hardiman (2012) included an overview of research about the brain as it relates to learning. She first deconstructed neuro-myths and then described six brain-targets that can be used to design learning experiences. The six brain-targets are: emotional climate, physical environment, big picture learning design, mastery of content, skills, and concepts, application of knowledge, and evaluation and assessment (Hardiman, 2012). Rather than prescribe specific strategies that all teachers should employ, Hardiman (2012) presented a lens for educators and educational leaders to use to evaluate the alignment between their existing teaching practices and research about the brain.

BTT is one of a small group of tools that have been developed to support teachers in bridging MBES and pedagogy (Whitman & Kelleher, 2016). BTT was selected for this study because of its strong foundation in research and the likelihood that the model could be applied to teaching adult students. BTT was the basis for a recent study of the value of the framework for K-12 teachers conducted by Parr (2016). This research seeks to build on Parr's (2016) inquiry by examining the value of BTT for community college faculty.

Understanding how the brain learns has the potential to enhance the effectiveness of teaching and therefore student success (Tokuhama-Epinosa, 2014; Wolfe, 2010), and yet, college faculty may not have knowledge of MBES or how it might inform pedagogy (Hardiman, 2012; Whitman & Kelleher, 2016). Faculty's widespread use of lecture as a common instructional

mode (Nilson, 2016; Slavich & Zimbardo, 2012; Smith & Valentine, 2012) is indicative of the limited connection between pedagogy in higher education and findings from educational research. Despite the fact that researchers stopped measuring the effectiveness of lecturing in the 1980s after determining it had minimal impact on students' learning (Nilson, 2016), lecture continues to be used as a common approach for teaching adults.

Straumanis (2012) identified three key factors that lead faculty to use lecture as a teaching strategy: 1) faculty teach the way they were taught; 2) those who choose to be professors are likely comfortable and skillful at learning in passive modes themselves; 3) many professors focus on covering content rather than student retention of the information presented. Chew et al. (2018) identified additional factors that hinder faculty in applying research about how people learn best to their pedagogy including simplistic ideas about how learning occurs, a lack of an articulate understanding of what high quality teaching is, and a lower value of teaching as compared to research. Additionally, faculty who want to utilize research from MBES in their pedagogy may struggle to identify reliable information. Neuromyths, or false beliefs about neuroscientific facts, such as the existence of learning styles persist in teacher education programs and educational product marketing (Hardiman, 2012; Tardif, Doudn & Meylan, 2015; Whitman & Kelleher, 2016).

Some authors (Alferink & Farmer-Dougan, 2010; Clement & Lovat, 2012; Howard-Jones, 2014) contest the appropriateness of incorporating findings from neuroscience and related fields into educational practices. Efforts to generalize findings from studies conducted in controlled laboratory settings to classrooms are of particular concern for this group. However, other researchers including Cozolino (2013), Hardiman (2012), Sousa (2010), Whitman and Kelleher (2016), Willis (2006, 2010), Wolfe (2010) and Zull (2006, 2010) have argued that the

time has come to utilize MBES to improve pedagogy. Tokuhama-Espinosa (2014) stated that teacher quality is the most important factor for impacting student learning. Although everything a teacher does may produce some learning for some students, MBES provides a body of evidence about how teaching could be optimized to improve outcomes for all students (Collins, 2016; Hardiman, 2012; Tokuhama-Espinosa, 2014; Whitman & Kelleher, 2016).

In the California Community College system, faculty are qualified for their jobs based on their content expertise, not their training in pedagogy (Apigo, 2015; Body, 2009). Higher education faculty may have limited or no formal education about teaching, therefore, they may only learn about emerging fields such as MBES during professional development after they are hired (Brancato, 2003). Faculty who may have had training in college pedagogy, but who have been teaching for more than a decade, are unlikely to be aware of MBES because it is still an emerging field. Although professional development is recognized as important to support faculty's development of pedagogy rooted in research (Brancato, 2003; Chew et al., 2018), the overall quality of professional development for faculty is uneven. Professional development commonly models outmoded techniques such as lecture, despite evidence that faculty benefit from experiencing other types of teaching and learning approaches that better support student success (Brancato, 2003; Bransford, 2000; Parr, 2016; Whitman & Kelleher 2016). Denckla stated in the preface to Hardiman's (2012) book that professional development programs have perpetuated neuro-myths or false beliefs about how the brain works. This assertion was supported by Tardif, Doudin, and Meylan (2015) in an article about neuromyths and their prevalence among teachers.

In the United States there is a lack of professional development for community college teachers focused on pedagogy (Alexander et al., 2012). In the California Community College

system, professional development is largely an unfunded mandate and there is minimal

infrastructure for strategic professional development (Burns, 2012; Davison & Immerblum,

2015). Professional development offerings from the California Community College

Chancellor's Office are typically organized around systemwide initiatives such as Distance

Education or Guided Pathways. However, some of the system's 115 campuses have been able to

develop and offer innovative professional development opportunities for their faculty (Davison

& Immerblum, 2015).

Statement of Problem

Community college faculty's pedagogy demonstrates limited integration of mind, brain,

and education science (MBES). MBES encompasses a body of research that has the potential to

equip community college faculty to deliver more effective pedagogy by informing them about

how the brain learns. Contemporary literature makes a compelling argument on the value of

bridging neuroscience and education (Clement & Lovat, 2012; Collins, 2016; Cozolino, 2013;

Darling-Hammond, Chung Wei, Andree, Richardson, & Orphanos, 2009; Hardiman, Rinne,

Gregory & Yarmolinskaya, 2012; Knowland & Thomas, 2014; Tommerdahl, 2010; Willis, 2010;

Whitman & Kelleher, 2016; Wolfe, 2010; Zull, 2010). However, there is limited application of

MBES in college pedagogy and a gap exists in the literature addressing how MBES should be

applied in higher education (Hagen & Park, 2016).

The California Community College system was founded in the early 1900s as a way to

give students in local communities, who were unable to attend a distant college, an opportunity

to continue their education, often in preparation for a specific vocation. Over the course of the

20th century, California's system became the largest in the country and now serves 2.1 million

students with a continued focus on access to low cost higher education (California Community

College Chancellor's Office, 2019a). The system serves a diverse student population in terms of age, race and ethnicity, and preparation for college coursework (The Campaign for College Opportunity, 2018). Access to education continues to be a priority for the community college system. According to the 2013 System Strategic Plan, the current systemwide vision is that "California's Community Colleges provide upward social and economic mobility through a commitment to open access and student success by delivering high quality, affordable and comprehensive higher education" (California Community College Chancellor's Office, 2013, p. 11).

Funding for the system is linked to the overall health of the California economy and can vacillate significantly from year to year. There is increased pressure from legislators for California community college students to earn degrees and certificates. In 2018, the funding formula for colleges was changed to monetize student completions rather than enrollment. As of the spring 2020 the new funding formula had not been fully implemented and changes were still being made to the formula, resulting in uncertainty about funding levels for colleges.

The California Community College system struggles in several areas including student completion and the number of students earning degrees and certificates (Moore & Shulock, 2010). Through a statewide implementation of Guided Pathways faculty are explicitly tasked with ensuring learning for students (California Community Colleges Chancellor's Office, 2020). However, Guided Pathways does not suggest methods for accomplishing this directive. Faculty need concrete tools to facilitate improvement in their teaching strategies. Hardiman's (2012) BTT is a possible tool for faculty to use to implement MBES in their pedagogy. This in turn could potentially yield increased student success and completion.

Although professional development is recognized as a key element of changing practice at community colleges, it is largely an unfunded mandate and there is limited systemwide infrastructure for strategic professional development (Apigo, 2015; Body, 2009). At Manzanita College (pseudonyms are being used for the college and college district to protect anonymity), professional development is directed by a faculty and staff driven initiative called Teaching, Learning, and Community (TLC). The initiative began in the fall of 2017 and has established a foundation for a sustained strategic professional development program. TLC is working toward shifting professional development from a haphazard, individually directed system where opportunities were not broadly disseminated and funding was only available to those who knew how to access it, to a strategic system that responds to campus and individual needs and provides access to funding and learning opportunities for all faculty and staff. TLC also models evidence-based teaching and learning strategies in the activities it offers to faculty and staff.

Research on the efficacy of professional development for college faculty shows that no one approach is universally effective (Avalos, 2011). However, there is evidence that participation in professional development does have a positive impact on faculty's learning and development. Detailed claims about how to achieve the best results from faculty professional development are not substantiated in the literature (Avalos, 2011). Similar to the complex task of educating contemporary students, offering meaningful professional development to college faculty demands thoughtful design based both on evidence about effective practices as well as the particular needs of faculty being served (Avalos, 2011; Brancato, 2003; Bransford, 2000).

Despite evidence in the literature suggesting the benefits of applying MBES to pedagogy, few college teachers have information about MBES and how to implement it (Bransford, 2000; Collins, 2016). Hardiman's (2012) BTT framework is a promising tool for supporting faculty in

aligning their pedagogy with findings from MBES (Parr, 2016; Whitman & Kelleher, 2016). This study was designed to provide a professional development experience to participants that models research about how people learn and the features of effective professional development. See Appendix G for the agendas for the professional development sessions.

Purpose of the Study

Recognizing that mind, brain, and education science (MBES) is underutilized in college faculty's pedagogy, the purpose of this qualitative study was to examine the perceptions of community college faculty of Brain-Targeted Teaching (BTT) as a tool to facilitate implementing findings from mind, brain, and education science (MBES) into their pedagogy. There is limited data available about the impact BTT has on teachers, and no data about the value of BTT for college faculty. Parr (2016) conducted BTT research with K-12 teachers in a public school system, but that study did not include college faculty.

The California Community College system is distinct from public K-12 with divergent resources, goals, and constraints. One key difference is the age of the students served. K-12 education generally serves students between the ages of 4 or 5, and eighteen. Community college serves older adults (42.3%) with significant populations of teens (26.8%) and young adults (30.9 %) (California Community College Chancellor's Office, 2019b). Another difference pertinent to this study is teacher preparation. K-12 teachers hold teaching credentials that are earned by completing a combination of subject matter and education courses. California community college faculty are qualified based on their subject matter expertise alone (California Community College Chancellor's Office, 2018), although colleges often seek faculty with some level of previous teaching experience. With the exception of online teaching, community colleges do not prescribe professional development relating to pedagogy for faculty. As a result,

some college faculty lack any training in pedagogy and many do not have information about new or emerging fields such as MBES.

Research Questions

The research questions this qualitative study sought to answer were:

1. How do a select sample of community college faculty describe the changes they plan to make in their pedagogy as a result of participating in professional development that presents and models the BTT framework (Hardiman, 2012)?

2. What is the perception of a select sample of community college faculty of the BTT framework (Hardiman, 2012) as a tool to facilitate the implementation of MBES into pedagogy in higher education?

Conceptual Framework

The conceptual framework for this study consisted of Hardiman's (2012) BTT model and Mezirow's (1991) theory of transformative learning. Hardiman's BTT model is a framework organized into six brain-targets that allows teachers to connect research in MBES to their pedagogy. The BTT framework was presented as the content of the professional development sessions offered during this study. The professional development facilitator (the researcher) modeled the brain-targets and utilized evidence based professional development strategies while presenting the BTT framework. Data was collected about participants' perceptions of BTT as a tool to facilitate implementation of findings from MBES into their pedagogy and analyzed using Mezirow's (1991) transformative learning theory.

Mezirow's (1991, 1997) transformative learning theory focuses on adult learning and emphasizes the importance of adults becoming autonomous and critical thinkers through engaging specific learning processes, particularly reflection. Mezirow (1991) positioned learning

for adults in the context of each person's accumulated experiences. He used the label frame of reference to describe the impact those accumulated experiences have on adult learners. According to Mezirow (1991) transformative learning is a process where adults move through phases of critical reflection to make sense or meaning of their experiences. First, the learner experiences a disorienting experience or dilemma that prompts examination of their faulty thinking or assumptions. This disorienting experience catalyzes a process of critical reflection about alternative perspectives or new ideas. Finally, the learner resolves the initial dilemma when their new thinking has been integrated into an updated frame of reference.

When college faculty engage in professional development their learning has two distinct dimensions. They are potentially learning information, skills, or strategies to apply to their pedagogy and they are also experiencing the role of an adult student. The process of moving between the roles of teacher and student resonates with Mezirow's (1991) transformative learning theory as individuals actively shift their perspective from teacher to learner and back again. Mezirow's theory provided a meaningful framework for understanding faculty's responses to a professional development experience as adult learners and the changes they made as a result of that experience.

Transformative learning theory primarily addresses the mind and education strands of MBES. During the time period that Mezirow developed his theory, the technology driven explosion in neuroscience research was taking place. Mezirow referred to early neuroscience studies but constructed the concepts of transformative learning from the work of philosophers, educational theorists, and his own experiences as a teacher and learner (Mezirow, 1991). Hardiman's (2012) BTT framework addresses the brain and education strands of mind, brain, and education science (MBES). By pairing Hardiman and Mezirow's ideas, the conceptual

framework for this study was sufficiently robust to address the research questions posed and engaged each element of MBES.

<div align="center">**Assumptions, Limitations, and Scope**</div>

During this study, the BTT framework developed by Hardiman (2012) was presented as a professional development experience to a cohort of full-time and part-time (adjunct) faculty at Manzanita College. The format was a face to face, six-session experience that both taught and modeled MBES concepts to participants. The researcher has considerable experience offering professional development workshops and teacher training courses at Manzanita College, in the community, and at conferences. Both the researcher's relationship with faculty at the College, and role as facilitator of the professional development experience, enhanced the possibility of bias in this study. Several actions were taken to address potential bias including, active awareness and reporting of bias, use of an online survey tool to allow for anonymous responses, and peer debriefing.

The researcher's experience working with children and families, in addition to teaching early childhood education to college students, is grounded in a constructivist approach to teaching and learning. Through working with young children, the researcher has developed a pedagogy that is founded on a belief that learners can be trusted to learn. Experience implementing findings from neuroscience and related fields in educational practice has led to an understanding that many of the strategies that work well with young children are applicable to teaching learners of all ages. For example, strategies such as trusting the learner's competence to learn and providing a supportive and positive emotional learning context, are likely to be effective with students of any age, including adults.

It was assumed that the faculty participating in the study responded both thoughtfully and truthfully to questions posed to them on online surveys. It was further assumed that participants had some interest in exploring MBES as indicated by their participation in an optional professional development experience. Participants were understood to have unique experiences as teachers and learners.

Limitations of the research design of this study include a reliance on college faculty's own descriptions of their perceptions and actions as a result of the professional development experience. It would be difficult to replicate this study because the professional development experience was designed by the researcher and informed by the specific needs of Manzanita College faculty (see Appendix G for the professional development session agendas). Data were collected from the participants themselves and were not validated through other observable, objective assessments. The methods used to collect the data focused on protecting participants' identity to mitigate potential bias. This meant that the data could not be linked to individuals therefore it was not possible to analyze it in the context of participant's individual demographic profiles. Data were only collected from a small sample of California community college faculty at a single campus. College faculty in different regions of the country, or those working in different types of institutions, may have divergent perspectives about their pedagogy or respond differently to a professional development experience about BTT than the participants in this study.

This study took place during the fall semester of 2019 with a small group of faculty that opted to participate. Participants included 9 full-time and 3 part-time (adjunct) community college faculty who taught in a variety of disciplines. All participants were employed by Manzanita College. The study design focused on faculty perceptions of Hardiman's BTT

framework as a tool to facilitate implementing findings from MBES into their pedagogy. The study documented the short-term changes faculty made or planned to make in their pedagogy as a result of their experience with BTT. Future research could explore the impact of similar professional development experiences with different groups of faculty, as well as potential long-term impacts of BTT on pedagogy including measuring changes in student success.

Significance

Although MBES fundamentally applies to learners of any age, in any setting, little research has been conducted on implementing MBES in higher education. This research took place seeking to fill this gap in the literature. Whitman and Kelleher (2016) called for research examining how different kinds of teacher professional development might lead to teachers' increased application of MBES research-informed strategies and ultimately increase student achievement. This study addressed the first element of the research called for by Whitman and Kelleher (2016). Building on Parr's (2016) investigation of the efficacy of Hardiman's (2012) BTT framework as a tool for K-12 teachers to implement MBES in their teaching, this inquiry documented a similar experience for community college faculty.

In California, one-quarter of the nation's community college students are taught by faculty who could hone their pedagogy to better support student success. College leaders are held accountable for increased student success as well as using taxpayer dollars judiciously (Bohn, Reyes & Johnson, 2013). The results of this study can inform policymakers and leaders in higher education looking for tools to help faculty implement MBES into their pedagogy in response to the current demands for increased student success.

The study's findings may have value to faculty who are seeking to refine their own pedagogy by engaging research from MBES, as well as people who coordinate and offer

professional development for college faculty. Formalizing this study as a research project makes the results available beyond the host campus and adds to a growing body of Scholarship of Teaching and Learning (SoTL) at California Community Colleges (Burns, 2012).

Definition of Terms

Brain-Targeted Teaching (BTT). A framework that allows teachers to "plan effective instruction informed by research from the neuro- and cognitive sciences and research-based effective instruction" (Hardiman, 2012, p. xiv). The BTT framework is one of a handful of tools that have been developed to help teachers implement mind, brain, and education science (Whitman & Kelleher, 2016).

California Community College System. "As the largest system of higher education in the nation, the California Community Colleges is uniquely positioned to help residents of all backgrounds improve their social and economic mobility and build a better future for themselves and their families. Our 115 colleges serve more than 2.1 million students annually and transfer nearly 80,000 each year to the University of California and California State University systems while providing hundreds of thousands more with a skills-based, career education needed to secure good-paying jobs" (California Community Colleges Chancellor's Office, 2019a, para. 1).

Community college student completion. Nodine, Venezia, and Bracco (2011) define student completion at a community college as "Earning a market-valued or academically credible postsecondary credential, which includes (1) occupational certification; (2) a state-board recognized certificate; (3) a two-year associate of science degree (A.S.) or associate of arts degree (A.A.); or (4) transfer, with a credential, to a bachelor's-degree-granting institution" (p. 31).

Guided Pathways. "The Guided Pathways framework creates a highly structured approach to student success that provides all students with a set of clear course-taking patterns to promote better enrollment decisions and prepare students for future success" (California Community Colleges Chancellor's Office 2020, para 1). The pillars of Guided Pathways are: 1) create clear curricular pathways to employment and further education, 2) help students choose and enter their pathway, 3) help students stay on their path, and 4) ensure that learning is happening with intentional outcomes (California Community Colleges Chancellor's Office 2020, para 3).

Master Plan for Higher Education. According to the California Legislative Analyst's Office (2010) the master plan consists of "the major higher education policy goals" (para. 11) for California's three-tiered model. The state's higher education model includes the Community College, California State University, and University of California systems.

Mind, Brain, and Education Science (MBES). An emerging multidisciplinary field of study often used interchangeably with educational neuroscience that focuses on how to bring findings from learning sciences into the classroom (Whitman & Kelleher, 2016).

Neuromyths. According to David Sousa (2010) neuromyths are "…attractive sounding beliefs about the brain that are largely false" (p. 262).

Pedagogy. "The professional knowledge of the teacher, and the enacted practice of teaching, set within the context of theories of human development and learning, cultural reproduction and transformation, political and social progress, and intellectual engagement" (Anderson in Flynn, Mathien, Mitchell & Whalen, 2017, p. 72).

Transformative learning. "A constructivist learning theory of adult learning addressed to those involved in helping adults learn" (Mezirow, 1991, p. 33). "Transformative learning is

the process of effecting change in…the structures of assumptions through which we understand our experiences" (Mezirow, 1997, p. 5)**.**

Conclusion

In summary, the convergence of demand for increased community college student completions, the diverse characteristics of community college students, and findings from the field of MBES creates an opportunity for college faculty to better align what is known about the learning process and their pedagogical practices. Many community college faculty may not have implemented MBES into their pedagogy and professional development is the venue for faculty to explore MBES research and how to apply it to their pedagogy. This study was designed to explore the perceptions of community college faculty of BTT as a tool for implementing MBES in their teaching practices. The following literature review will further explore MBES as it applies to college pedagogy, the community college context, the elements of high-quality professional development, Hardiman's (2012) BTT framework, and Mezirow's (1991) transformative learning theory. Chapter 3 will describe the methods used and chapters 4 and 5 will present results and conclusions for this study.

CHAPTER 2

LITERATURE REVIEW

This chapter presents evidence in three areas to provide a foundation for this study of faculty perceptions of the value of BTT as a tool to facilitate implementation of MBES into their pedagogy. Research from MBES and an overview of the community college setting are described first. Next, the characteristics of effective professional development for faculty are explored. Finally, the conceptual framework consisting of Hardiman's (2012) BTT framework and Mezirow's (1991) transformative learning theory is presented. The literature referenced in this chapter was located through a thematic review using key word and database searches (Creswell, 2015). After the initial review, the collected literature was analyzed for themes and additional information was sought through snowballing, exploring subject specific journals, and seeking diverse types of sources.

Terms Used in This Study

Due to the proliferation of emerging and interdisciplinary fields related to using neuroscience in education (Tokuhama-Espinosa, 2014; Whitman & Kelleher, 2016), it is necessary to clarify the terms used in this study. Neuroscience focuses on understanding the structure or function of the brain and nervous system. Cognitive neuroscience addresses the biological processes that underlie cognition through interdisciplinary study of neuroscience, psychology, artificial intelligence, anthropology, philosophy, and linguistics (Gazzaniga, Ivry & Mangun, 2009). Cognitive psychology is a branch of psychology studying mental processes including perception, thinking, learning, and memory (Lary, 2011). Educational neuroscience attempts to bridge the gap between conscious minds and living brains (Campbell, 2011). Social

neuroscience is another interdisciplinary field dedicated to understanding how the brain mediates social processes and behavior (Cozolino, 2013). Mind, brain, and education science (MBES) is an interdisciplinary study of cognitive science, biology, and education (Battro, Fischer & Lena, 2008). Whitman and Kelleher (2016) utilized the term mind brain and education science (MBES) to emphasize a focus on classroom practices. With a similar objective, MBES is used in this study.

Mind, Brain, and Education Science and Pedagogy

Since Bruer (1997) described utilizing neuroscience findings in classroom practice as premature and inadvisable, his cautions have often been referenced in the literature. Bruer (1997) suggested that cognitive science (including cognitive psychology) was a better partner for education than neuroscience and warned against implementing practice based on neuroscience laboratory findings (almost always using animal subjects) in the classroom. In the subsequent 20 years interdisciplinary research groups have emerged to build the bridges that Bruer found lacking in 1997. Some examples include the Centre for Educational Neuroscience at University College London, the Society for Neuroscience, and the University of Washington I-Lab. However, critics found that research focused on the child or student and has not made a widespread foray into teacher education, professional development, or parent education (Twardosz, 2012). In response to these concerns, Tommerdahl (2010) proposed a model for moving information from neuroscience all the way to classroom practice. With a similar goal of connecting research and practice, several models have been developed to support teachers in implementing evidence about how students' brains function including Hardiman's (2012) BTT framework (Whitman & Kelleher, 2016).

Researchers, scientists, and educators have connected findings from neuroscience and related fields to education (Brown, Roediger & McDaniel, 2014; Caine, Caine, McClintic & Klimek, 2009; Cozolino, 2013; Jensen, 2008; Lang, 2016; Taylor & Marienau, 2016; Whitman & Kelleher, 2016; Willis, 2006; Wilson, 2006; Wolfe, 2010; Zull, 2010). Key themes emerged from the many recommendations researchers have made about how MBES can inform pedagogy. The four presented here were selected because of their relevance to college faculty.

Emotion and Relationships in Adult Learning.

Emotion and relationships are the driver of both learning and memory for people of all ages (Caine & Caine, 2006; Caine et al., 2009; Cozolino, 2013; Hardiman, 2012; Immordino-Yang & Faeth, 2010; Taylor, 2006; Taylor & Marienau, 2016; Zull, 2006). "Emotion is probably the most important factor for learning" (Zull, 2010, p. 77). Emotional climate is the first brain target in the Brain-Targeted Teaching (BTT) framework (Hardiman, 2012). Hardiman (2012) recommended using emotional connection to make learning more meaningful as well as to use positive emotion to boost learning outcomes. Collins (2016) wrote that if people who train or educate adults did just one thing differently after reading her book, she hoped it would be to include emotions in their trainings, even if the topic is technical in nature.

Emotion is particularly connected to both storing and retrieving memories. As Brown, Roediger, and McDaniel (2014) explained, narratives play an essential role in our understanding of ourselves and our lives and "we gravitate to the narratives that best explain our emotions. In this way, narrative and memory become one" (p. 110). Collins (2016) stated that emotional information is more easily remembered. Information that has meaning to the learner or an emotional hook is much more likely to be retained so adult educators are urged to help students engage with the emotional content of the topic being presented (Caine & Caine, 2006; Wolfe,

2010). Emotion can also impede learning. There is evidence that stress has negative effects on both short and long-term memory (McGuire, 2015).

Nearly one-third of adult students have been impacted by trauma (Perry, 2006). Even students who haven't experienced trauma but have negative emotional memories of school may be immobilized in a classroom. According to Dr. Perry (2006), people become unable to learn if they are anxious, uncomfortable, or fearful. Students need to feel safe in order to be effective learners (Cozolino, 2013; Johnson, 2006). Predictability, a sense of safety, and appropriate structure can help traumatized or stressed students open up to learning (Perry, 2006; Willis, 2006; Wolfe, 2010). Traumatic experiences can have lasting impacts on the brain, but cognitive neuroscience has provided evidence that education can help adults repair and replace damaged neurons. By learning to reflect and gain insight into their own experience, adults can rewrite their learned narratives and change their beliefs and actions (Caine & Caine, 2006; Cozolino & Spokay, 2006; McGuire, 2015; Ross, 2006; Zull, 2010.

Cozolino and Spokay (2006) described the brain as a social organ that by nature seeks shared experience in order to learn. Therefore, relationship building should not be seen as a by-product of teaching, rather as the primary function of educators. To maximize students' potential to learn, faculty should help students build positive, safe relationships with their peers. A focus on relationships can be used as a filter to assess how effective teaching strategies will be with relationship-based strategies being the most effective and activities that take place outside of relationships as the least effective. For example, Whitman and Kelleher (2016) identified homework as a less effective learning activity because it takes place outside of the context of students' relationships with the teacher or peers.

Hardiman (2012) summarized the research on the importance of relationships on learning for students of all ages in her first brain-target, establishing the emotional climate for learning. Feeling connected with a caring adult had a positive impact on school completion, attendance, academic performance, students' perception of school, and academic and social outcomes (Hardiman, 2012). Positive relationships with adults were also found to be protective against risky adolescent behaviors and suicide (Hardiman, 2012). McGuire (2015) identified the relationship with the faculty member as the source of about a third of college students' motivation. Connecting with fellow students as a member of the group also supports students' motivation and success by providing a sense of belonging (McGuire, 2015).

Prior Experience in Adult Learning

Building on what students already know and are interested in and helping make new connections between old and new information, is a powerful approach that not only acknowledges the competence and life experience of adult learners, but also utilizes areas of the brain that remain plastic throughout the aging process (Caine & Caine, 2006; Centre for Educational Research and Innovation, 2007; Cozolino & Spokay, 2006; Sheckley & Bell, 2006; Taylor & Marienau, 2016; Wolfe, 2010). Taylor and Marienau (2016) described the way the brain takes in new information or experiences as a process of comparing the new with the known. They further explained that the brain is designed to detect patterns and that learning is the process of creating and expanding on existing neural networks. Information that has meaning to the learner or an emotional hook is much more likely to be retained (Caine & Caine, 2006; Wolfe, 2010). When faculty use students' interests to guide the experiences they offer in the classroom research has demonstrated that the material being taught will be more likely to

connect with students on an emotional level and therefore be more easily remembered (Immordino-Yang & Faeth, 2010; McGuire, 2015).

Hardiman (2012) encouraged teachers to access students' prior knowledge and help them add new information to that foundation by explicitly teaching global concepts. Hardiman (2012) described global concepts as the overarching ideas being taught. Brain-target 3 explored the use of concept maps or graphic organizers to present global concepts. Once the main ideas of a particular course or study are made clear, students are better able to connect both prior knowledge and new information to them (Collins, 2016; Hardiman, 2012).

Active Learning for Adults

Prince (2004) defined active learning as "any instructional method that engages students in the learning process" (p. 1). Active learning in all its forms is typically contrasted with traditional lecture-based instruction where the student is expected to passively receive information while sitting and listening. In an analysis of the available literature on active learning including collaborative, cooperative, and problem-based learning Prince (2004) concluded that there is evidence that supports active learning as an effective strategy for adult learners. Research in MBES provides insight into why this may be the case beginning with biology. Taylor and Marienau (2016) identified multiple benefits of including physical movement in educational experiences for adults. On a basic level, moving the body stimulates an increase in blood flow that results in increased oxygen being delivered to the brain. This allows a student who is moving to be more alert than one who is sitting. Changing a student's location in the learning space can trigger mild increases in neurochemicals that also lead to enhanced alertness and learning (Taylor & Marienau, 2016).

Engaging students in active learning through teaching peers, problem-based learning, case studies, and experiential learning builds on prior knowledge. This serves to build more durable neural networks and a higher likelihood of the information being retained (Caine et al., 2009; Hardiman, 2012; Sheckley & Bell, 2006; Straumanis, 2012). These approaches build the back cortex where reflection takes place rather than the front cortex that is better suited to getting the "right answer" (Taylor, 2006). For many college students knowing the "right" answer is only a small part of the skill set needed as they move into the workplace or transition between careers or colleges. The ability to reflect and examine a problem from various perspectives will be a more portable and ultimately valuable skill.

In the BTT framework Hardiman (2012) used the label *enactment* to describe the ways that students might physically act out information or ideas. She cited evidence showing that enactment enhances retention of information. In the same brain-target Hardiman described the value of generation, or having students construct the content of the learning experience themselves. She suggested faculty consider arts integration for ideas about how to prompt students to generate information such as drawing or otherwise visually representing the material being covered.

Research Supported Study Habits

When a person learns something his or her brain is changed in an observable physical way that can be seen with imaging technology (Hardiman, 2012; McGuire, 2015; Whitman & Kelleher, 2016; Willis, 2006; Zull, 2006). Research has revealed that the term *hardwired* that is sometimes used to describe the process of brain development is in fact a misnomer that belies the brain's continued plasticity throughout adulthood. In fact, the brain is capable of change throughout the human lifespan (Brown, et al., 2014; Centre for Educational Research and

Innovation, 2007; Zull, 2006). The most powerful and long-lasting learning engages and ultimately changes many areas of the brain (Zull, 2006). This information can be applied in the classroom by building a variety of experiences into pedagogy and encouraging students to use research-informed study techniques.

Research has shown that empowering students with information about how the brain works increases not only their efficacy as learners but their motivation to study as well (Brown, et al., 2014; Collins, 2016; McGuire, 2015; Whitman & Kelleher, 2016; Willis, 2010; Zull, 2010). McGuire (2015) stated that student learning, rather than how faculty teach, should be the priority for college educators. McGuire (2015) asserted that students won't learn, even from the best teachers, if they don't know how to learn. Whereas, students who know how to learn will be able to learn from teachers of any skill level. Convincing students that they have control over their brains and their learning, or helping them develop metacognition (thinking about their thinking), may be enough to increase success (Agarwal & Bain, 2019; Brown, et al., 2014; Cozolino, 2013; Dweck, 2006; McGuire, 2015).

Hardiman's (2012) brain-target 4, teaching for mastery, described evidence about the power of particular study habits to increase retention of information and overall performance for students. In brain-target 4 Hardiman (2012) reported evidence that supports the use of arts integration to enhance memory. Asking students to repeatedly rehearse information and elaborate on the concepts presented by drawing or creating skits, dances, or other physical enactments results in more engagement and better retention of the material presented (Hardiman, 2012).

Brown et al. (2014) presented study techniques rooted in MBES research. The research they described demonstrated that to learn and retain information people must retrieve

information and that effortful retrieval is the most effective way to build lasting memories. Brown et al. (2014) stated the value of spaced practice and interleaved practice. Spaced practice is supported by findings in MBES that indicate that to create durable memories the brain requires time and sleep to consolidate short-term memory into long-term memory. Brown et al. (2014) presented interleaving and varied practice as effective study strategies. Interleaving is studying at least two different topics at the same time and varied practice is practicing the same skill in different ways. McGuire (2015) included related strategies in her book but directed them to college faculty and the ways they can help students use evidence-based strategies to enhance their success.

The Community College Model

Public junior colleges were established in the United States in the early 1900s in part to respond to educational reformers who called for a reorganized system of higher education (Beach, 2011). Junior colleges also met the country's need to train workers for increasing industrial development (Cohen, Brawer & Kisker, 2013). During the same period, vocational education was flourishing and over the course of the 20th century would become an essential part of junior colleges (O'Banion, 2019). At the time, junior colleges were an outgrowth of normal schools or teacher preparation colleges. An increase in both normal school students and high school graduates seeking higher education prompted rapid growth in the number of students attending newly established junior colleges between the late 1910s and 1930 (Beach, 2011).

During this early period of growth there was variation in the location, structure, and curriculum offered at junior colleges. Although early junior colleges were founded in part on the democratic ideal of a better educated citizenry and access for all, they also created vocational programs considered appropriate for middle class students. The process of directing some

students to vocational programs and others to continued higher education has been labeled sorting, cooling-out, or diversion, and has been criticized over time. The tension between the democratic and capitalist goals embedded in the broad mission of the junior college continues to draw criticism and debate (Beach, 2011).

The Truman Commission's 1947 report titled, *Higher Education for American Democracy,* marked the beginning of widespread public community colleges (Beach, 2011). The report identified a comprehensive mission for community colleges that included providing academically oriented general education, vocational education, adult education, and programs that respond to the particular needs of the local community. The name junior college began to shift to community college during this time period. In the 1950s and 60s more community colleges were established and more students served (Beach, 2011). Although every state had established publicly funded community college systems by the 1960s a wide variety of locations and approaches persisted as did the debate about the role of the community college (Cohen, et al., 2013).

During the Civil Rights movement community colleges were alternately praised and criticized. The system's founding principle of open access aligned with the goals of desegregation. However, community colleges served few minority students and those who did enroll had low rates of success. In the 1970s community colleges experienced the first downturn in overall enrollment. During the 1970s and 1980s community colleges continued to struggle with the demands of preparing all students, including those designated educationally underserved or underprepared for either a vocation or transfer to a four-year university. Compounding this challenge, community colleges were still expected to respond to specific community needs and to do so with limited budgets (Beach, 2011). In the early 1980s, concern about the United States'

inability to be competitive in the global economy prompted new initiatives and funding sources for vocational education. In the mid 1980s, just over half of all associates degrees awarded by community colleges were awarded to students in vocational curricula (O'Banion, 2019).

In the 1990s community college pedagogy and organizational efficiency drew criticism. Policy makers called for economic development and institutional accountability, while budgets for community college stagnated or were cut. Globalization of the country's economy, the emergence of critical pedagogy, and the possibility of community colleges awarding bachelor's degrees all impacted the community college system. At the beginning of the 21st century writers and researchers increasingly described the structural and functional challenges of carrying out the broad and often contradictory roles assigned to community colleges. Researchers also began analyzing data about the value of sub-baccalaureate education on students' future earnings and concluded that a community college education had little or no impact on students' earning potential (Beach, 2011). Increasingly, legislators became interested in seeing how students progressed through education from preschool to college. This resulted in a need for community colleges to coordinate their efforts with both high schools as well as four-year colleges and universities (Cohen et al., 2013).

In 2009, President Obama set a goal for the United States to increase the percentage of college graduates to be competitive with other developed nations worldwide by 2020 (Alexander et al., 2012; Flynn et al., 2017). Obama's American Graduation Initiative paired with the recession of 2009 served to increase enrollment at and scrutiny of community colleges across the country (Boggs, 2011). California plays a unique role in realizing the nationwide campaign for graduates because close to a quarter of the nation's community college students are enrolled in its community college system (Moore & Shulock, 2010).

Along with Florida, California has been a leader in community college education (Beach, 2011). California was among the first states to establish community colleges in the early 1900s. California's current community college system serves 2.1 million students at 115 campuses. Since its inception, one of the hallmarks of California's Community College system has been access. This priority was further cemented by the 1960 California Master Plan for Higher Education (Boland, Gasman, Nguyen & Samoyoa, 2018). California's higher education system is comprised of three tiers, community colleges, state universities, and universities. Community colleges serve a variety of roles in the state's higher education system, including supporting students transferring into the state university or university systems (Boland et al., 2018). However, the following statement from the California Community College Chancellor's Office underscores the continued focus on access, describing that "California's Community Colleges provide upward social and economic mobility through a commitment to open access and student success by delivering high quality, affordable, and comprehensive higher education" (California Community College Chancellor's Office, 2013, p. 11).

To address the demand from the legislature for increased completions, in 2016 California joined a group of other states in implementing Guided Pathways (GP). In the California Community College system, the GP framework is designed to address multiple issues impacting students' completion of college degrees and certificates by creating clear pathways, and helping students choose and stay on a path by integrating student services and supports in new ways. One of the core elements of GP is ensuring learning (California Community College Chancellor's Office, 2020). Responsibility for implementing this aspect of GP lies primarily with faculty. As with any significant change to existing systems, implementing GP poses unique challenges to each college. In recognition of these challenges, professional development is

identified as one of the key institutional capacities for implementing GP and as a result, GP implementation brings a needed influx of funding for professional development to the California Community College system (California Community College Chancellor's Office, 2019c).

California Community College Students and Faculty

In California, as in the nation, more college students are enrolled at community colleges than other higher education systems and more of those students are low income and students of color (Boland, et al., 2018; Flynn, et al., 2017). The student population at California Community Colleges is diverse in terms of age, race, and preparation for college coursework (California Chancellor's Office, 2019b). The largest group of students in the system are ages 20 to 24 (30.9%) with nearly equal groups of students younger than 20 (26.8%) and 25 to 39 (26.9%). Students aged 40 and over comprise the smallest group at 15.4%. Hispanic students make up 43.6% of the total student population, 26.4% of students are white, 11.5% Asian, and smaller groups identify as African-American, multi-ethnicity, and Filipino. Less than 1% of students are Pacific Islander or Native American (California Chancellor's Office, 2019b). It is notable that most students of color and low-income students enrolled in all postsecondary education in California begin their postsecondary education in the community college system (Boland, et al., 2018). Student preparation for college coursework also has an impact at community colleges. The Public Policy Institute of California reported that 80% of all California community college students enrolled in at least one developmental (below college level) course (Mejia, Rodriguez & Johnson, 2016).

As of the fall of 2018 the California Community College system employed 19,162 tenured or tenure track (full-time) faculty and 42,159 temporary (part-time or adjunct) faculty (California Community Colleges Chancellor's Office Management Information Systems Data

Mart, 2019). The demographics of faculty teaching at community colleges across California does not reflect the diversity of the student body. While Hispanic students are the largest group of students, only 15% of faculty are Hispanic. The majority of faculty (61%) are white (The Campaign for College Opportunity, 2018). There is a call for higher education across the country and in California in particular to continue to work to address the disparity in racial diversity between students and faculty (Gordon, 2018). It is important to note that California is a large and diverse state and regional demographics vary significantly (Boland, et al., 2018).

Pedagogy at Community Colleges

Pedagogy is defined by different authors in different ways. The following definition fits well with the community college context, stating that pedagogy is "…the professional knowledge of the teacher, and the enacted practice of teaching, set within the context of theories of human development and learning, cultural reproduction and transformation, political and social progress, and intellectual engagement" (Anderson in Flynn, et al., 2017, p. 72). Beyond a general understanding of pedagogy, there are countless specific pedagogies that college faculty might employ including, critical, feminist, and culturally relevant pedagogies. Critical pedagogy places learning in the context of the relationship between teacher and student with a humanist belief in the value and worth of humans (Cowden & Singh, 2013). In critical pedagogy knowing is understood to be a result of the interaction between people, not an interaction with an institution (Cowden & Singh, 2013). Feminist pedagogy centers on teaching and learning that acknowledges social inequality and difference, teaches students to construct knowledge based on their lived experiences, and often critiques traditional knowledge and ways of knowing (Light, 2015). Culturally responsive pedagogy shares some of the same values as critical and feminist

pedagogy, including supporting students in developing critical perspectives, but positions

cultural competence at the forefront of the educator's goals for students (Heringer, 2018).

Researchers have argued that critical and culturally responsive pedagogy are particularly

appropriate in the community college setting because of the diversity of learners (Flynn, et al.,

2017). There is evidence that critical and culturally responsive pedagogy best supports low

income first generation college attendees, and those less likely to complete a degree or certificate

based on their race or ethnicity (Flynn, et al., 2017). However, which pedagogy to employ is a

decision left to individual faculty members, often with little formal information or support.

As described previously, community college faculty often lack formal pre-service

training in pedagogy (Body, 2009; Flynn, et al., 2017). Flynn et al. (2017) suggested that

pedagogy is generally overlooked at community colleges as administrators respond to the latest

initiatives. This means that despite the impact of classroom experiences on student success, most

faculty are left to develop and evaluate pedagogy on their own, frequently using trial and error to

build their repertoire (Flynn, et al., 2017).

Like K-12 education, community college pedagogy experiences shifts in popular ideas

about the best approaches to teaching and learning (Kim, 2004). In the last decade, community

colleges have focused on doing more with less and meeting ambitious completion goals

(Swanger, 2016). In 2018, the editors of the *Journal on Excellence in College Teaching*

identified understanding how students learn as the current hot topic in faculty development

(Richlin, Wentzell & Cox). The editor of the journal *New Directions for Community Colleges*

introduced the September 2016 issue of the journal by acknowledging that despite colleges' need

to increase completions and implement high impact practices, there simply is not one approach

that will meet individual campus's needs (Crisp, 2016). Crisp (2016) stated that there remains a

need for evaluating the impact of promising programs. Despite an increase in the study of teaching and learning (SoTL), for the last two decades the topic of effective teaching at community colleges is noticeably absent from the publications of the Community College Research Center (Community College Research Center, 2019). While the literature indicates there is a need for research about effective pedagogy at community colleges, to date that research is not widely available.

Evidence from MBES offers research-informed strategies for faculty and administrators seeking to improve teaching and learning. Proponents of MBES argue that it addresses diverse learners in any educational setting (Hardiman, 2012; Tokuhama-Espinosa, 2014; Whitman & Kelleher, 2016). Whitman and Kelleher (2016) asserted that MBES benefits all students from the struggling student to the most successful student including people with learning disabilities. MBES is also applicable to teachers across disciplines because it focuses on how students learn rather than on what they learn (Hardiman, 2012). Essentially, the principles of MBES recognize the diversity of individual brains due to the unique nature of each learner's history and therefore support educational approaches particularly well suited for diverse student groups such as those found at community colleges.

Characteristics of Effective Professional Development

Professional development plays an essential role in higher education, to support faculty learning about and applying new information about teaching and learning (Flynn, et al., 2017). Despite the fact that over the last ten years a body of research has explored what makes professional development in education successful or effective, Whitman and Kelleher (2016) identified a lack of high-quality professional development in the teaching profession. To demonstrate this point Whitman and Kelleher (2016) contrasted the thousand hours students

spend learning a year with the thirty hours (or less) a teacher typically spends in professional development. Whitman and Kelleher (2016) went on to describe teachers as practitioner researchers. They called for time for teachers to engage in research with a focus on sharing findings in deep ways. Findings might include why a strategy, program, or approach may be working as well as the qualitative or quantitative data that demonstrate how it is working.

Writing about effective practices for teaching adults Pratt (2002) offered a cautionary note about endorsing a single approach to teaching. Like Hardiman (2012), Pratt (2002) placed the priority for professional development on supporting teachers in uncovering and critiquing the assumptions that underlie their teaching methods rather than mastering technique. This type of approach is well suited for the community college setting because it is applicable to faculty teaching diverse disciplines to diverse student groups. An underlying premise of MBES is that educators need information and experience about how the brain works to evaluate and potentially change their teaching (Hardiman, 2012; Whitman & Kelleher, 2016). Because few college faculty receive pre-service education about pedagogy (Burns, 2012; Flynn et al., 2017) professional development is the primary venue for providing ongoing learning for educators and therefore has an essential role in bringing new information including MBES to higher education faculty.

Sun, Penuel, Frank, Gallagher, and Youngs (2013) identified three basic elements of successful professional development and these themes reoccur in the work of other researchers. First, sustained effort is valuable. No defined number of hours has been set, but well-established professional development programs use 25 to 30 hours over the course of the school year. Duration has been identified as a key component of effective professional development (Darling-Hammond, et al., 2009; Pop, Dixon & Grove, 2010). Second, professional development should

be anchored in the teacher's practice or content area. Connection to practice or content area and a strong fit between the professional development offered and the goals and standards of the school have been found to be important elements of effective professional development (Pallof & Pratt, 2011; Penuel, Fishman, Yamaguchi & Gallagher, 2007). Third, the professional development program requires active engagement of participants (Darling-Hammond et al., 2009; Penuel et al., 2007; Pop et al., 2010).

Although professional development is widely understood to be an essential aspect of a higher education institution (Lavis, Williams, Fallin, Barnes, Fishback & Thien, 2016) there remain gaps and contradictions in the literature about the impact of professional development for higher education faculty. In addition to the three characteristics of professional development described in the previous paragraph, researchers have reported uneven results from various types of professional development. For example, Harmon (2017) found that a two-day, one-time, professional development experience about active learning for community college science faculty had mixed results in terms of student success as measured by students' test scores. Test scores in sections taught by some of the faculty who received professional development improved but in others they got worse. In contrast, Lavis et al. (2016) asserted that professional development could have wide reaching impacts including increased student satisfaction and retention. Postareff, Lindblom-Ylänne, and Nevgi (2007) reported evidence that professional development did result in changes to faculty pedagogy including a shift to more student-centered pedagogy. The discrepancies reported in the literature may be explained by the different assessments used to evaluate impacts, as well as variations in the professional development experience provided to faculty such as duration and methods of instruction. Additionally, the

characteristics of the group of faculty being studied such as motivation, previous experience, and personal identity likely impact outcomes.

If a faculty member is to implement changes in pedagogy they must change their behavior (Penuel et al., 2007). Researchers have attempted to identify the variables that lead to change, as well as the barriers that prevent change, in teacher behavior. In their study of science faculty Brownell and Tanner (2012) identified lack of time, training, and incentives as the most cited barriers to pedagogical change for higher education faculty. They found a dissonance between faculty's professional identities as scientists and teachers. This dual role identity was reported to be a barrier to pedagogical change. In a study of psychology professors, Chew et al. (2018) examined the possible explanations behind why psychology professors do not implement findings from their own field in their teaching. The researchers identified eight barriers that might hinder application of psychology concepts (Chew, et al., 2018). Notably, their list does not include the three factors identified by Brownell and Tanner (2012). In a study of professional development for adjunct faculty at a community college, Borque (2016) found that after receiving professional development faculty made only small changes in their teaching, if any. The varied findings about what makes effective professional development underscore the complexity of the variables present during any teaching and learning interaction.

Professional Development at Community Colleges

There is growing recognition that if colleges are to improve outcomes for students, professional development for faculty will be necessary (Mundy, Kupczynski, Ellis & Salgado, 2012). Writing in *Community College Week*, Padron (2016) called for college administrators to invest in professional development and declared that faculty professional development will yield the highest return on investment. However, in order to deliver the desired results of improved

teaching and in turn enhanced student success, professional development must be grounded in research and meet the specific needs of the faculty (Wallin & Smith, 2005).

Professional development programs often fail to meet this benchmark. For example, under the auspices of the National Research Center for Career and Technical Education, Sanford and McCaslin (2004) studied instructional needs and delivery modes of professional development for part-time (adjunct) faculty. They found that the content, delivery modes, and times and locations of professional development could all be more responsive to the needs of part-time faculty (Sanford & McCaslin, 2004). For example, the most frequently offered professional development options were focused on orientations and introductions which, although valuable, did not meet the needs of part-time faculty to learn about pedagogy. Fink (2013) criticized the lack of assessment of professional development activities and suggested approaches to collect outcomes data.

Although some four-year colleges and universities have been able to create formal centers for teaching and learning for faculty, this is not the case for most community colleges. In California's community colleges, funding, staffing, and format for professional development varies widely from campus to campus. Although there is an Educational Programs and Professional Development Unit at the California Community College Chancellor's Office (CCCCO), the Dean of this area oversees twenty-three distinct systemwide programs and there is no information on how this unit supports professional development on the CCCCO website. The most visible systemwide professional development efforts are taking place through the California Virtual Campus – Online Education Initiative. Notably, Cerritos College and Mt. San Antonio College have both developed robust professional development programs, but there is no evidence that the CCCCO has attempted to scale these successes system-wide.

Conceptual Framework

This study used Hardiman's (2012) Brain-Targeted Teaching (BTT) model and Mezirow's (1991) transformative learning theory as the platform for exploring the perceptions of community college faculty of BTT as a tool to facilitate implementation of MBES into their pedagogy. Applying both Hardiman's and Mezirow's ideas provided a sufficiently complex framework for describing college faculty's experience as they learn about teaching. Together, Hardiman and Mezirow's work encompasses the three distinctive strands of mind, brain, and education that comprise MBES.

Brain-Targeted Teaching

There are many professional development programs and educational products that claim to offer brain-based strategies or solutions to teachers (Hardiman, 2012; Whitman & Kelleher, 2016). Some of them are not actually backed by empirical evidence, and frequently they neither engage the research about effective professional development nor reflect what is known about the brain and learning (Whitman & Kelleher, 2016). Hardiman (2012) developed the BTT framework to respond to educators' desire to know more about the brain and to furnish teachers with enough information to be able to assess the value of programs and products that claim to be based on research in neuroscience. Hardiman (2012) explained that she arrived at the name for her framework because, although all learning could reasonably be described as brain-based, all teaching could not because not all teaching results in learning.

Hardiman's (2012) BTT framework is an approach to designing, implementing, and evaluating teaching that invites educators to deepen their understanding of the brain and its functions and implement MBES research into their teaching. It is one of the few models that have been developed to support teachers in using research-based information about the brain in

their pedagogy (Whitman & Kelleher, 2016). Hardiman's (2012) framework also meets the

criteria for a successful translational framework to bridge science and education called for by

Stafford-Brizard, Cantor, and Rose (2017). BTT is interdisciplinary and independent, reflects

principles of human development, and allows teachers to apply it to their particular teaching

context.

The BTT consists of a framework of six evidence-based brain targets (Hardiman, 2012).

Each target references applicable MBES research about learning and suggests possible

instructional practices. The BTT model is not a curriculum but rather a framework for teachers to

use to connect their pedagogy to findings from learning science effectively bridging the gap

between research and sound educational practice. Hardiman (2012) asserted that using the BTT

model will lead to student outcomes including increased motivation, improved understanding of

the skills and concepts being taught, and heightened engagement.

The first brain-target, emotional climate, encompasses the detrimental effect of stress on

learning, the beneficial impact of positive emotion, and the value of emotional connection in

making learning relevant for students. Brain-target two, physical environment, addresses how

elements of the physical environment can impact attention and engagement, particularly, the use

of movement, order, and beauty. Brain-target three, designing the learning experience, presents

information about how learners make meaning through global understanding. Brain-target four,

teaching for mastery of content, skills, and concepts, consists of how memory systems work and

the benefits of integrating the arts to support the retention of knowledge. Brain-target five,

teaching for application, focuses on learners' ability to apply knowledge through problem

solving and real tasks. This target includes information about how teachers can leverage

creativity to promote innovative or divergent thinking. Brain-target six, evaluating learning,

explores the intersection between assessing what students know and cultivating learning and memory (Hardiman, 2012).

Although not specifically designed for educating adults, the BTT framework could easily be applied to teaching in higher education. Thus far, there is a lack of literature about the results of implementing BTT. However, a recent dissertation by Parr (2016) that studied the impact of delivering BTT content to K-12 teachers in the form of a professional development experience that modeled and taught BTT provided a starting point for this study.

In 2019, Hardiman, JohnBull, Carran, and Shelton published an article about the long-term impacts on memory when elementary science teachers integrated art into their pedagogy. The study used a randomized control trial method and yielded results that demonstrated that arts integration did not prompt either better or worse retention of the science content taught to students except for students with low reading skills. For this group arts integration did increase the retention of science concepts. In their conclusion the authors offered encouragement to teachers about employing arts integration despite their finding that it did not increase retention of science concepts for all students. They also suggested further research about the use of arts integration for students at lower reading levels and that other studies employ a randomized control trial approach for investigating pedagogical interventions.

Transformative Learning

In the preface of his book, *Transformative Dimensions of Adult Learning*, Mezirow (1991) shared the experiences that prompted him to develop his theory of transformative learning. Both he and his wife personally experienced transformations. Mezirow's transformation was prompted by encountering the work of Paulo Freire and Ivan Illich, and his wife's by returning to college. Along with the opportunity to collaborate with psychiatrist Roger

Gould on bridging psychotherapy and education, these personal transformations fueled a shift in the way Mezirow made sense of his role as an adult educator (through critical reflection and ultimately change in his frame of reference) and prompted him to develop his theory of transformative learning.

Mezirow (1991) described transformative learning as a change in an adult's frame of reference. He defined frames of references as the collective experience and set of assumptions that guide adults' thoughts and actions. According to Mezirow (1997), frames of reference have multiple dimensions and are made up of habits of mind and points of view. Mezirow (1997) described habits of mind as the deeply entrenched beliefs that we adopt through socialization influences during our development. By contrast, points of view are more easily recognized and more easily influenced by inputs from others including adult educators. Mezirow identified transformation as occurring when adults use critical reflection to examine their assumptions, habits of mind, and point of view. Mezirow named four processes of learning: elaborating on an existing point of view, establishing new points of view, transforming our own point of view, and developing awareness of and critically reflecting about our assumptions (Mezirow, 1997). With the goal of furthering emancipatory teaching and learning, and to satisfy the demands of contemporary work, Mezirow emphasized the importance of adults becoming independent, self-aware thinkers (Mezirow, 1991, 1997).

Mezirow (1991) provided specific direction to adult educators seeking to catalyze transformative learning in their students. His approach called for teachers to assist students with developing the ability to examine their own frames of reference, using imagination to reframe problems, and to be effective participants in discourse (Mezirow, 1997). Mezirow suggested that adult education build on the "real life experiences" of adult learners, be participatory and

interactive, and use metaphors as a tool for problem solving. He also directed adult educators to use assessments other than quizzes and tests to better document transformation in students' thinking.

Conclusion

This literature review presented information about MBES, pedagogy, community colleges, and characteristics of effective professional development. The conceptual framework consisting of Brain-Targeted Teaching and transformative learning was described. Drawing on the themes in the literature review, this study was designed to offer an experience for college faculty about BTT that embodied the research-based elements of effective professional development and modeled the pedagogical practices presented in Hardiman's framework. Chapter 3 will describe the research methodology and methods for this study in depth.

CHAPTER 3

METHODOLOGY

This chapter consists of an overview and explanation of the qualitative research

methodology used in this study including the relationship between the methodology and the

conceptual framework for the study. The setting and characteristics of the sample are described.

Data collection and analysis methods are presented. The process for protecting participants'

rights is described and the limitations of the study are identified.

This research built on a dissertation written by Parr (2016) about how public K-12

teachers responded to a professional development experience that modeled and presented BTT.

This study differs in that it took place at a small California community college and utilized a

qualitative approach rather than the mixed methods design Parr employed. A qualitative

approach was selected as the best fit for the researcher's epistemology as well as the perceptual

focus of the inquiry.

Teaching is both an art and a science (Whitman & Kelleher, 2016). Many great educators

intuitively use research-based strategies that benefit their students without being able to describe

the science behind why those strategies work (Tokuhama-Espinosa, 2014). Conversely, the

science of teaching and learning can provide important data that may inspire educators to

transform their practice and ultimately yield better outcomes for their students (Hardiman, 2012;

Whitman & Kelleher, 2016). Educators and educational systems are faced daily with the

challenge of fostering learning for a given group of students. Teaching is made up of countless

interactions with students both planned and improvised in a constantly changing context of

relationships between teacher and students. Ultimately, educational research must address the multi-dimensional, hands-on nature of teaching and learning.

Qualitative inquiry, although not the only appropriate approach to educational research, is described by Merriam and Tisdell (2015) as having the greatest potential for making a difference in people's lived experiences. According to Merriam (2009), qualitative researchers seek to understand people's interpretations of their experiences and the meaning they assign to those experiences. The qualitative research process starts with assumptions and theoretical frameworks to craft studies that investigate the experience of individuals or groups with a social or human problem (Creswell & Poth, 2018). Next, the researcher engages an emerging qualitative approach to creating research questions, uses the subjects' own environments as the context for the study, and both inductive and deductive analysis of the resulting data to identify themes (Creswell & Poth, 2018). Qualitative researchers include the voices of participants, statements about the researcher's reflexivity, and rich descriptions and interpretations of the problem in their written work. The approaches and outcomes described by Creswell and Poth (2018) have served as a roadmap for this research and guided a rigorous qualitative inquiry process in this study.

In his text on conducting education research, Creswell (2015) advised researchers to consider whether a study should be and can be done. To address the practical issue of feasibility Creswell (2015) identified, this study was limited to faculty at a single college in the California community college system. The researcher's understanding of the problem was significantly informed and influenced by employment at the college where this study took place. The researcher's role with the campus she studied enhanced her ability to describe the context, access the population, and utilize existing relationships to engage participants. However, existing

relationships also introduced the potential for bias on the part of both the researcher and the participants.

As stated in Merriam and Tisdell (2015) the merits and drawbacks of observation and participation in research have been debated in the literature. This researcher's beliefs align with a feminist and critical stance that assumes that every researcher has an impact on the subjects studied (Merriam & Tisdell, 2015). Further, all qualitative researchers bring subjectivity to their interpretations of the data collected because they serve as the primary conduit for that data (Merriam & Tisdell, 2015). Rather than deny her influence on the study and its participants, the researcher sought to actively address her potential bias through ongoing reflection and peer debriefing. Statements about her reflexivity have been included in the study's findings. Anonymous online surveys were chosen for data collection for their potential to minimize biased responses from participants (Whitley & Kite, 2012).

Methodology and the Conceptual Framework

The conceptual framework for this study consists of Mezirow's (1991) transformative learning theory and Hardiman's (2012) BTT framework. Both transformative learning and BTT resonate with the principles of qualitative investigation. Layering qualitative inquiry with this conceptual framework created a rich context for uncovering participants' perceptions of BTT as a tool for implementing MBES in their pedagogy.

Mezirow's (1991) transformative learning theory exemplifies the socially constructed knowing that qualitative researchers seek. Both Mezirow's transformative learning theory (1991) and qualitative inquiry are based in an interpretive or constructivist epistemology (Creswell, 2015; Merriam & Tisdell, 2015; Mezirow, 1991). Mezirow's (1991) theory is grounded in the belief that adult learners construct knowledge based on their experiences and

interpretations of those experiences. Transformative learning as described by Mezirow (1991) requires adults to examine and potentially deconstruct their beliefs in order to truly learn. Merriam and Tisdell (2015) wrote that interpretive research is founded in the belief that there is no one reality, rather, reality is constructed of the various interpretations of individuals or groups. Therefore, "researchers do not 'find' knowledge: they construct it" (Merriam & Tisdell, 2015, p. 9). In effect, conducting qualitative research can be seen as transformative learning.

By developing a framework Hardiman (2012) invited educators to examine their pedagogy from a new perspective that is grounded solidly in research in MBES. Rather than declare which teaching practices should be avoided and which should be adopted, Hardiman trusted the teacher to construct his/her own meaning about brain-targeted teaching, and develop strategies that fit both with research findings about how the brain works, as well as the teacher's unique subject, context, and students.

The methodology in this study collected and analyzed data about college faculty's process of learning about and perhaps applying the concept of brain-targeted teaching to their pedagogy. As described by Merriam & Tisdell (2015) qualitative research results are "richly descriptive" (p. 17). The value of dense data about teachers' experience is affirmed by both Hardiman's (2012) BTT framework as well as Mezirow's (1991) transformative learning theory because both Hardiman and Mezirow's ideas hinge on the real experiences of teachers.

Overview of the Study

The problem that provided the context of this study was the limited implementation of MBES in higher education pedagogy. The purpose of the study was to examine the perceptions of community college faculty of BTT as a tool to facilitate implementing findings from MBES into their pedagogy. This study was designed to answer two research questions:

1. How do a select sample of community college faculty describe the changes they plan to make in their pedagogy as a result of participating in professional development that presents and models the BTT framework (Hardiman, 2012)?

2. What is the perception of a select sample of community college faculty of the BTT framework (Hardiman, 2012) as a tool to facilitate implementing MBES into pedagogy in higher education?

The study design was inspired by Parr's (2016) research on K-12 teachers' application of BTT after a one-day professional development session. For this study the researcher created a six-session professional development experience that presented and modeled BTT. Data collection methods were designed to uncover participants' perception of the BTT framework as a tool to facilitate implementing MBES in their pedagogy. The study's methodology is presented in detail in the remainder of this chapter.

Setting

This study took place at a California community college, Manzanita College (pseudonyms are being used for the colleges and college district). Manzanita College is the smaller of two colleges in the Valley Community College District (VCCD). The college is located in a rural setting, near the largest town in a rural county of approximately 50,000 residents. Manzanita College serves the county where it is located and parts of three neighboring counties. It is located about 60 miles away from its much larger sister campus, Central College. As of fall 2019, Manzanita College employed 54 full-time faculty and 69 adjunct or part-time faculty. The campus served 4,764 unduplicated students in the 2018-2019 school year. The college is known for its small school feel and reputation for hands-on, personalized education and service.

Professional development at Manzanita College falls under the auspices of an initiative created by faculty in the 2017-2018 school year called Teaching, Learning, and Community (TLC). The mission of the TLC initiative is to promote excellence in teaching and learning across the entire college community, including students, staff, faculty, and administration, in an ongoing climate of growth and improvement. Through TLC, faculty have engaged in a variety of professional development opportunities and reported that they are utilizing what they have learned in their teaching and work with students outside of the classroom. One of the professional development activities offered to faculty through TLC is participation in Teaching Labs (TLs) (pseudonym is being used for this activity).

TLs consist of small groups of faculty, including a faculty lab leader, who have identified a need or issue in the classroom. TLs can be made up of faculty from a single department or of faculty across disciplines. Based on the identified issue the TL creates an action plan to explore and improve teaching and/or student success. All participants receive a stipend for their involvement in TLs, with the lab leader's stipend being larger than the participants' stipends to acknowledge the additional time spent on organizing the group and presenting results to the campus. Stipends are awarded by the Vice President of Instruction. The TL format was utilized as the vehicle for this study, with the researcher holding a dual role of lab leader and participant observer (Creswell, 2015). The researcher declined a stipend due to her concurrent role as researcher and was not involved in the granting of stipends for the TL participants.

As a longtime employee of Manzanita College, in a variety of roles, the researcher had ready access to the faculty at Manzanita College. The researcher built rapport and strong professional relationships with staff, faculty, and administrators through holding a variety of leadership positions on campus over time. The researcher has a reputation for offering engaging

and worthwhile professional development experiences during her current assignment as co-facilitator of Manzanita College's TLC Initiative and past administrative roles. As previously described, the researcher was aware of the potential for bias that was raised by doing research at her place of employment, and engaged several strategies to identify, mitigate, and report bias.

<div align="center">**Participants/Sample**</div>

The sampling methodology used for this study was non-probabalistic using a convenience sampling approach based on the researcher's access to the population (Creswell, 2015). The sample also possessed some traits of purposeful sampling because it consisted of participants in a professional development experience provided during the study, in other words, "participants who have experienced…the key concept being explored" (Creswell & Plano Clark, 2018, p. 176). This researcher's perspective as a member of the group being studied allowed for a deep understanding of the organization's context including history, culture, and priorities in keeping with qualitative research approaches described by Merriam and Tisdell (2015).

In accordance with the inclusive vision of the TLC Initiative and to generate a large enough sample, all Manzanita College faculty (54 full-time faculty and 69 part-time faculty) were invited to participate in a Brain-Targeted Teaching TL through an email sent using campus email (see Appendix A). Participation in the study was not a requirement of participation in the TL, although all TL participants opted to participate in the study. Full-time and part-time (adjunct) faculty have inherently different roles at the college and both groups offer valid and valuable perspectives about the potential of using BTT as a tool to facilitate implementing MBES in their pedagogy. At Manzanita College, adjunct faculty play a particularly integral role in pedagogy because many disciplines have only a single full-time faculty member teaching in

them and in some cases, there are no full-time faculty. The result is that courses in some disciplines are only taught by adjunct faculty.

Participation in the study was not screened by the researcher. Spaces in the TL and the study were filled on a first come, first served basis. The sample encompassed both full and part-time (adjunct) faculty who taught in diverse disciplines and settings with a variety of teaching experience and formal education about pedagogy. This diversity of roles and experiences made this sample typical as described by Merriam and Tisdell (2015). The diversity of perspectives of participants yielded varied and valuable perceptual data.

Sample Size

The literature does not present clear guidelines of appropriate sample sizes in qualitative inquiries. Blaikie (2018) acknowledged the discrepancy in guidelines for sample sizes and suggested that the appropriate sample size for a study cannot be determined before the researcher is collecting data due to the nature of the iterative and emergent character of qualitative research. Rather, he proposed that researchers identify a range for sample size that may be sufficient for a particular study based on relevant literature.

Related research conducted by Parr (2016) included a sample size of 46 or just over 9% of the total population of the educational staff at the district where the study took place. In Parr's study, the professional development experience took place on a single day and data was analyzed using a combination of quantitative and qualitative methods. Other related studies used larger sample sizes than this study but were conducted by a team of researchers or were funded studies (Lavis et al., 2016; Penuel et al., 2007).

In this study, qualitative data were collected using seven online surveys about participants' perceptions. The sample included 12 participants. Twelve participants represented

10% of the total campus faculty. This study's sample size proved to be large enough to yield sufficient data for meaningful qualitative analysis, while still being small enough to allow the whole group to find times to meet.

Data

Related studies about the impact of professional development on pedagogy (Body, 2009; Lavis et al., 2016; Parr, 2016; Penuel et al., 2007) utilized data collection methods that included online surveys. To address the research questions for this study, qualitative data were collected through a series of seven online surveys (see appendices C, D, and E) and researcher observation during the six TL sessions (see Appendix F). Research memos were also used to identify bias during the analysis process. Creswell (2015) cautioned that surveys or questionnaires may provide data that is detached from participants' context. However, in this research design the researcher was able to leverage well-developed insider information about the college as a whole, and additional data about the specific context for the professional development experience were collected using an observation protocol for the TL meetings (see Appendix F).

Anonymous online surveys were selected as the tool to collect data for the convenience of the participants and ready access to participants' responses by the researcher (Evans & Mathur, 2005; Wright, 2005). Additionally, there is evidence in the literature that online surveys may elicit less biased responses from participants (Whitley & Kite, 2012). In this way, the data collection method helped to address the potential bias created by the existing relationships between the researcher and study participants. The series of online surveys also allowed the researcher to capture data over time, specifically before, during, and after the BTT professional development experience. This approach was selected in response to the study's research

questions that focused on exploring possible short-term change in faculty's pedagogy and their

perception of the BTT framework as a result of participation in the BTT TL.

The surveys were developed by analyzing the type of information needed to answer the

research questions. Bloomberg and Volpe (2016) identified four types of information typically

collected in qualitative research: contextual, demographic, perceptual, and theoretical. To collect

data that aligned with the research questions for this study, demographic and perceptual data

were needed. Once the surveys had been drafted, they were field tested with two faculty

members using the suggestions provided by Whitley and Kite (2012) on survey research.

Whitley and Kite (2012) proposed devising questions during the field test that draw out the

process a respondent uses as they respond to each question. For example, "Directly ask

respondents what the question meant to them" (Whitley & Kite, 2012, p. 440). In this study, the

researcher asked each of the field testers to think out loud while completing each of the three

types of surveys (pre, post-session, and post-teaching lab). The field-testers' questions and

comments prompted minor changes in the surveys, primarily to improve clarity.

Creswell (2015) described the participant observer role as "an observational role adopted

by researchers when they take part in activities in the setting they observe" (p. 213). Creswell

(2015) identified the challenge of documenting observations while simultaneously fulfilling the

participant observer role. To address this challenge, a protocol was developed for collecting data

for each of the TL meetings (see Appendix F). Merriam and Tisdell (2015) stated that

observations or field notes in qualitative research should be both descriptive and reflective. In

this study researcher observations supplement the data collected through the online surveys; the

focus of the observation protocol was primarily on capturing reflective information. Merriam and

Tisdell (2015) emphasized the importance of timely documentation of observations. In this study

some observations were captured during the TL meetings and more in-depth notes were recorded on the observation protocol after each session ended.

Surveys were administered to participants using REDCap (Research Electronic Data Capture). REDCap is a secure web-based application that offers data collection tools including easy to design and deploy online surveys. REDCap was created by a consortium at Vanderbilt University in 2004 and has since been utilized by researchers around the world. The University of New England is a REDCap partner allowing access to the application.

Each of the seven surveys were delivered to study participants via campus email. The pre-survey (see Appendix C) was sent to all study participants one week prior to the first BTT TL, with the request that participants complete it before the first meeting. Questions on the pre-survey included demographics as well as questions to establish participants' existing awareness and utilization of MBES and BTT strategies. The post-session surveys (see Appendix D) were delivered within six hours of the completion of the first through fifth TL sessions to only those participants who attended each session. The end of session surveys requested information about the participants' experience in each TL session and asked participants to report any changes they may have immediately implemented in their pedagogy as a result of the BTT TL (see Appendix D). The pre-survey and post-session surveys were closed when the first and subsequent BTT TL sessions began. The post-lab survey (see Appendix E) was delivered within six hours of the completion of the final TL. The post-lab survey included demographic questions and questions to determine what short-term changes participants made or planned to make in their pedagogy as a result of the experience, as well as which aspects of BTT inspired them to consider changing their frame of reference (see Appendix E). The post-lab survey was closed seven days after the

conclusion of the final BTT TL. Reminders to complete each survey were sent via email to participants who had not yet responded, one day before the closing time for each survey.

Triangulation between survey responses, and researcher observations made during the TL sessions, were employed to ensure credibility of the interpretations presented (Bloomberg & Volpe, 2016). The researcher engaged a colleague to provide peer debriefing. As presented by Bloomberg and Volpe (2016), peer debriefing is a process where the researcher engages with a colleague who reads field notes and poses questions that help the researcher explore assumptions and/or alternative perspectives about the data. A fellow Manzanita College faculty member and current graduate student who was not a study participant offered feedback on the draft findings. The process resulted in more clearly articulated findings.

Analysis

One distinctive quality of qualitative research is the reflexive and iterative nature of the analysis process (Creswell, 2015; Merriam & Tisdell, 2015). Although there are identifiable stages in a process of analysis, each stage may be revisited multiple times. Creswell (2015) listed six steps in the process of analyzing and interpreting qualitive data: preparation and organization, initial exploration and coding, developing descriptions and themes from codes, creating narratives and visuals to present themes, interpreting results in light of personal experience as well as literature, and finally, validating findings. Merriam and Tisdell (2015) described data analysis as "the process of making sense out of the data" (p. 202). They stated that data analysis is the process of answering the study's research questions.

As recommended by Merriam and Tisdell (2015), analysis of data in this study began as soon as results of the first survey were available and continued throughout the data collection period. The process began with reading the data provided on the pre-lab survey and the early

post-session surveys. At this stage research memos were used to make notes about the comments from participants and document observations about reactions and bias. Formal analysis of the data was undertaken once data collection ended. The first step was to assess the data and determine that there were sufficient data to address the research questions. Next, the data were organized by exporting the results from each survey from REDCap as excel files and then collating the qualitative responses into a word document. In the word document the data were grouped into responses to each qualitative question, on each survey, in chronological order. Data that were collected in response to demographic and pedagogical questions were examined in REDCap, which includes tools that represent participant responses graphically and numerically.

Coding was the process used for data analysis. Elliott (2018) described coding as a decision-making process and recommended that the coding process be individualized for each study to align with the methodology used. Coding strategies as described by both Creswell (2015) and Merriam and Tisdell (2015) were applied to the data. First the data were read but no notes or analyses were made. Next the data were revisited with the goal of identifying themes. The themes were then developed into a list of codes. Concepts from Hardiman's (2012) BTT framework and Mezirow's (1991, 1997) transformative learning theory were used as initial codes. The data were reviewed again using this list of codes. As a result of this iterative analysis process some of the codes evolved. Finally, data were grouped sequentially by TL session and then organized into findings and supporting sub-findings. Where applicable the numbers of participants who didn't respond to a survey question were reported as part of the data (Whitley & Kite, 2012).

Merriam and Tisdell's (2015) detailed guidance about the complex process of data analysis was followed. As recommended, the researcher actively moved between the big picture,

and the details of the data, and built regular bias checks into the analysis process. Both the literature identified in the literature review and personal reflections were utilized to analyze the data and formulate interpretations. As the foundation for the conceptual framework for the study, Mezirow's (1991) transformative learning theory and Hardiman's (2012) BTT framework were used as a primary lens to interpret the data collected. Recognizing the value of an iterative approach, the data were revisited often to examine and reexamine assumptions and analysis. Research memos were used to document the data analysis process (Merriam & Tisdell, 2015).

Participant Rights

In accordance with federal law, Institutional Review Board (IRB) approval was obtained from the University of New England and Manzanita College before recruiting participants to this study. The risk to participants in this study was deemed to be minimal due to the nature of the data being collected and the protections put in place. Questions posed in the study related to participants' professional roles and did not touch on sensitive or controversial topics. The sample was made up of well-educated, professional adults, and did not include protected populations. Participation in this study was voluntary and contingent upon full consent from each participant. The consent form can be found in Appendix B. Participants were informed of the purpose and components of the study during the consent process and throughout the study. Any participant had the ability to drop out of the study at any time, but no participants chose to do so.

Participants' names were not collected to protect participant privacy and the confidentiality of the information they shared. Pseudonyms were used for the college and college district to further protect participant anonymity. Each of the surveys administered asked whether or not participants granted permission to share direct quotes from the responses provided. If permission was granted, no identifying information was included with the direct quotes in data

reporting. At the completion of the study participants were provided with an executive summary and access to the full study.

Limitations

While access and trust were more readily available because the study took place at the researcher's work place, the potential for bias both on the part of the researcher and participants might have been enhanced due to existing relationships. However, emic or insider's perspective is a valued stance in qualitative research (Merriam & Tisdell, 2015). Dwyer and Buckle (2009) shared a thoughtful analysis of the literature and their own research experiences with the tension created by conducting research or taking an outsider stance in a group that you are member of. Ultimately, they encouraged researchers to find ways to creatively embrace the inherent tension between insider and outsider status. In this study the possible tension between on campus roles and relationships and research goals was actively acknowledged. Research memos were used to document bias and bias was reported in the findings section of this paper.

Anonymous online surveys were selected as the data collection method in part based on evidence that this method may yield less biased responses from participants than other data collection strategies (Whitley & Kite, 2012). The researcher was the presenter for the professional development experience, and in this way, a full participant as described by Creswell (2015) and Merriam and Tisdell (2015). In the tradition of qualitative research in general and feminist, postmodern, and critical research in particular (Merriam & Tisdell, 2015), the researcher acknowledged that she had an impact on the participants and situation studied. Rather than try to ignore this dynamic, the researcher was instead aware of it and endeavored to document and represent it in her reporting of the study's findings.

Through decades of work both as a college faculty member and an early childhood educator, the researcher has extensive experience both as a skilled observer as well as receiving feedback about her instruction from students, peers, and administrators. The researcher maintains an open and welcoming approach to all feedback and has implemented several strategies to verify data and interpretations as previously described. Identifying and reflecting on her own bias and supporting students to do the same are an important part of her work as community college faculty. Additionally, as a professor of Child Development the researcher practices and teaches reflection as a key activity of teaching. This well-developed skill set of observation skills, cultivated awareness of bias, and reflective practice supported the researcher in conducting a qualitative study in her own workplace.

As previously stated, educational research is challenging because of the myriad of variables in even a single interaction between a student and a teacher. This qualitative study documented and described the experience of a small group of community college faculty in a particular context. The nature of the small sample size, in a convenience sample, means that the results of this study are not broadly generalizable to other settings. The unique character of the BTT TL also creates a challenge for replicating the study. Faculty working in other regions, systems, or contexts may have divergent experiences from those described by the participants in this study.

Conclusion

This qualitative study examined the perceptions of community college faculty of BTT as a tool to facilitate implementing MBES into their pedagogy. In this chapter the methodology and methods selected have been justified as appropriate to answer the research questions. The benefits and liabilities of conducting the study at the researcher's place of work have been

described. The following chapters include the data collected, data analysis, and the conclusions the data supported.

CHAPTER 4

RESULTS

This chapter presents the results of this qualitative study. The study was designed to examine the perceptions of community college faculty of Brain-Targeted Teaching (BTT) as a tool to facilitate implementing findings from Mind, Brain, and Education Science (MBES) into their pedagogy. This study sought to answer two research questions:

1. How do a select sample of community college faculty describe the changes they plan to make in their pedagogy as a result of participating in professional development that presents and models the BTT framework (Hardiman, 2012)?

2. What is the perception of a select sample of community college faculty of the BTT framework (Hardiman, 2012) as a tool to facilitate implementing MBES into pedagogy in higher education?

The data collection process is reviewed, the demographics of the participants are presented, and then the findings of the study are shared.

Data Collection

Participants in this study were community college faculty who opted to take part in a six-session professional development activity called a Teaching Lab (TL) (see Appendix G for the Teaching Lab agendas). The researcher facilitated the one-hour TL sessions and modeled teaching strategies related to the concepts the group was exploring in each session. Between TL sessions participants read assigned sections of Hardiman's (2012) text about BTT.

Data in this qualitative study were collected through a series of seven anonymous online surveys (see Appendices C-E). The surveys were created using a secure online platform called

Research Education Data Capture (REDCap) and delivered to participants via campus email. Participants were asked whether or not they granted permission for the researcher to use direct quotes from their responses on each survey. Participants granted permission on all surveys except for two participants on the fifth post-session survey, therefore direct quotes from those two participants for that survey are not included in this study.

Participants completed a pre-lab survey that asked for demographic information as well as initial levels of knowledge about BTT and MBES in the week before the first TL session (see Appendix C). Post-session surveys were deployed within six hours after the first through fifth TL sessions. On the first post-session survey, faculty were asked if they planned to implement any changes in their pedagogy based on what they learned during the first TL session. Beginning with the second post-session survey, participants were asked what changes, if any, they had implemented in their teaching/pedagogy since the last session (see Appendix D). Plans for change and strategies faculty had already implemented in their pedagogy were discussed during the face to face TL sessions. Observations about each session were documented using the TL observation protocol (see Appendix F). The post-lab survey was administered within six hours after the final TL meeting and included demographic information and questions about how participants had changed their pedagogy after participation in the TL (see Appendix E).

All twelve of the participants who began the study completed the study. The pre and post-lab surveys were distributed to all twelve participants in the sample, while the post-session surveys were distributed only to the participants who attended each session. The number of attendees for each session is included in Table 1 below. As described in Table 1, five of the seven surveys were completed by 100% of the participants they were administered to. One participant who attended TL session three did not complete the post-session survey and one

participant did not complete the post-lab survey. There were no data available about why these

participants did not complete these surveys and because of the survey design that protected

faculty identities, the researcher cannot isolate which faculty did not respond on these two

surveys.

Table 1

Data Collection Timeline and Survey Participation Levels

Name of survey	Timeline	Participation
Pre-lab survey	Survey opened September 20, 2019 & closed September 27, 2019	12 of 12 participants 100%
Post-session survey 1	Survey opened September 27, 2019 & closed October 4, 2019	8 of 8 participants 100%
Post-session survey 2	Survey opened October 4, 2019 & closed October 11, 2019	12 of 12 participants 100%
Post-session survey 3	Survey opened October 18, 2019 & closed October 25, 2019	9 of 10 participants 90%
Post-session survey 4	Survey opened October 25, 2019 & closed November 1, 2019	10 of 10 participants 100%
Post-session survey 5	Survey opened November 1, 2019 & closed November 8, 2019	10 of 10 participants 100%
Post-lab survey	Survey opened November 8, 2019 & closed November 15, 2019	11 of 12 participants 92%

Demographics

The twelve participants in the study reflected diversity in gender, age, faculty roles, years

of teaching experience, and levels of formal education. Gender was captured with an open-ended

question and ten of the 12 participants in the sample listed their gender identity as female, two

identified as male. The age of participants ranged from 20 to 70 years old. Participants ages 51-

60 made up the largest group with four participants (33%). No one in the study was over 70

years old. The age distribution of participants is represented in Figure 1 below.
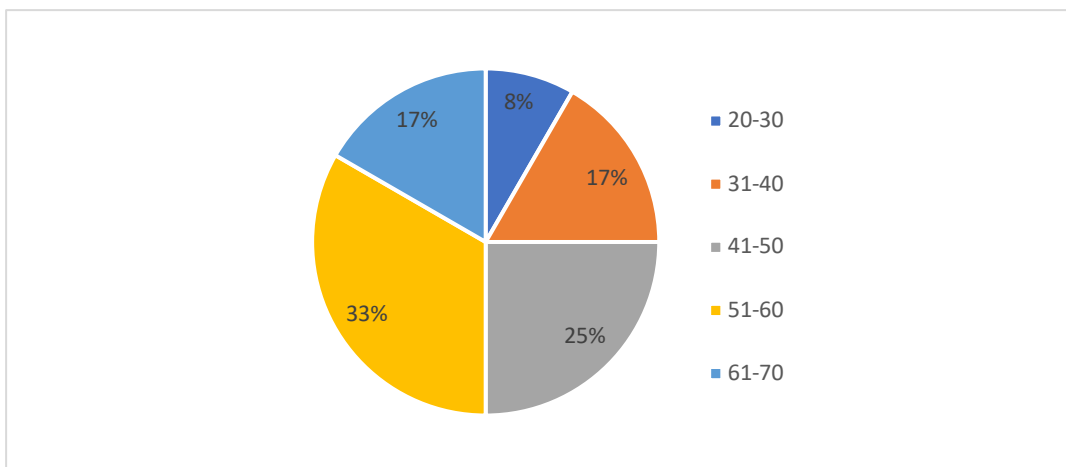
Figure 1 Age of Participants

Of the twelve participants, eight (67%) were full-time faculty, while four (33%) participants were part-time (adjunct) faculty. Only two participants had experience teaching at other colleges. However, all but one participant had taught in other settings besides community college. Those settings included: public and private elementary school, junior high, high school, environmental or outdoor education, Elder Hostel (now called Road Scholars), the California State Prison System, job training program, and behavior intervention in home, school, and group home settings.

Data about the participants' years of teaching are detailed in Table 2 below. None of the participants were beginning teachers, but four (33%) were new to teaching at the college level. Ten of 12 participants (83%) indicated they had formal training to teach community college students, while two participants (17%) indicated that they did not. When asked to list formal training (courses, degrees, and certificates) respondents included:

- California State Fire Marshall, National Fire Academy, and CALFire Academy

- Course in Theories and Strategies for Teaching Writing

- Doctorate of Arts in Biology (focus on pedagogy in undergraduate education)

- Doctorate in Educational Leadership

- MA in Counselor Education

- MA in English

- MS in Psychology with emphasis on Behavior Analysis

- Registered Associate Marriage and Family Therapist

- Requirements toward Certification as Board Certified Behavior Analyst

- Training for Teachers Workshops.

Table 2

Years of Teaching Experience

Pre-Survey Respondent	Total Years Teaching	Total Years Teaching College	Years Taught at This College
1	11-15	6-10	1-5
2	16-20	11-15	1-5
3	26+	21-25	21- 25
4	11-15	1-5	1-5
5	26+	26+	26+
6	6-10	6-10	6-10
7	11-15	6-10	6-10
8	21-25	16-20	16-20
9	6-10	1-5	1-5
10	11-15	1-5	1-5
11	6-10	1-5	1-5
12	11-15	11-15	11-15

Only six of the 10 respondents (60%), who indicated formal training to teach college, responded

to the prompt to list that training. It's unclear to what extent participants experienced training

about pedagogy during the masters and doctoral level work they listed, except where the name of

the degree included an emphasis in education.

The participants in the study taught in a variety of disciplines and many of them taught in

multiple disciplines. The list of disciplines taught by study participants is as follows:

- Accounting

- Biology

- Computer Information Systems

- Counseling

- Customer Service

- English

- Entrepreneurship

- Guidance

- Health and Human Performance

- Health/Wellness

- Human Relations

- Management

- Marketing

- Online Course Design

- Philosophy

- Productivity Software Applications

- Science Teacher Preparation

- Spanish for the Spanish Speaker

- Spanish for Transfer

- Speech Communication

- Website Design and Development.

Faculty in the study taught in a variety of contexts including face to face, online, and at a

nearby prison. Some of the full-time faculty in the cohort had roles other than teaching, including

academic counseling and coordination of a program. Faculty in these roles typically taught a single class per semester.

Findings

This section begins with a report of the bias identified on research memos during the analysis process, followed by a description of the six TL sessions and participants' responses to each session from the post-session and post-lab surveys. The arc of the participants' experiences in the TL over time are reported. The study's findings and sub-findings follow the description of the data captured from each of the TL sessions.

Research memos were used to record the analysis process and to identify feelings or bias that arose in response to the data. Documenting feelings and bias on research memos allowed the researcher to return to an analytical stance. During the early reading of the first surveys, a desire to explain the plan for the TL sessions when participants expressed some uncertainty about the material covered was noted. While reading and analyzing participants' responses feelings of admiration for colleagues were documented repeatedly. This was typically prompted by participants' descriptions of the changes they made or planned to make in their teaching, and their overall engagement and enthusiasm for the topics covered in the TL. The researcher also described a sense of pride at being part of the faculty at Manzanita College. In the tradition of qualitative research, this positive bias was considered in light of how it might influence interpretations of the data throughout the analysis process.

The study's design was created in part to address the potential bias created by the researcher's dual role of facilitator and researcher in her place of work. Anonymous surveys were used and only the pre-survey and post-lab surveys collected demographic information. As a

result of this choice in research design, percentages of participants who responded in a certain way can be reported, but it is not possible to link those groups to demographic traits.

Teaching labs (TLs)

Each of the six TL sessions were designed to model BTT strategies, findings from MBES, and evidence about effective professional development. It was assumed that each participant had read the assigned material in Hardiman's (2012) book and the time in the TL sessions was used to lead the group through a series of experiences designed to facilitate active engagement with the topics presented. The strategies shared in Hardiman's (2012) text were modeled, rather than lecturing on the material participants had read in the text (See Appendix G for the TL agendas). Not all of the TL participants had previously worked directly together. However, from the beginning of the TL sessions an engaged, relaxed, and playful group dynamic was noted on the observation protocol (see Appendix F). Laughter and teasing between the participants and alert attention to the speaker as participants shared ideas during the TL sessions were recorded.

Session 1: Introduction to brain-targeted teaching. The first TL session was designed to allow the group to get to know each other and to introduce BTT. Of the six TL sessions, attendance was the lowest (eight participants) for this session due to a variety of scheduling conflicts. The decision to begin the TL's work on this date rather than waiting for a date everyone could attend was made in order to avoid ending the TL too far into the semester. During this session participants were asked to share a doodle or informal sketch about what they already knew about the brain and how they applied it in their pedagogy. This prompt led to a discussion about the amygdala. One participant shared that they taught students to identify when their emotions have taken control of their thinking using the metaphor of a flipped lid. This

participant shared the strategy of using a closed and opened fist to visually represent the processes taking place in the brain when the brain's emotional center takes over.

Participants were asked to complete the first post-session survey during the week between the first and second TL meetings. Four (50%) participants reported that they were still working on developing a definition or understanding of BTT. One of these four faculty described their experience of developing their understanding of BTT this way,

> Still not sure what BT is, though I do understand it is based on what we know of how the brain works. I am looking forward to reading and digging into this a bit more. I need more things to chew on to know what I don't understand.

A different group of four (50%) faculty indicated they planned to make immediate change in their pedagogy based on the information they learned in the first TL session. One faculty member described their plans as follows,

> … I think I will explore language related to assessment. I have worked for years on reframing what a quiz is for my students and wonder if I could rebrand it as I have homework (which I call Preparation, Practice, and Review...) A check in?

Another faculty reported, "I added a guest speaker who talked about the differences between studying and learning with my class. The guest speaker has already delivered the information and it was well received by the class participants." The guest speaker referred to in this quote was a colleague in the TL and the plan for visiting a colleague's class was made during the first TL session.

When asked if there was anything they wanted to add about the first TL session on the first post-session survey all eight faculty completed this field and reported positive feelings about the session itself or a sense of looking forward to future sessions and learning more. All of the

comments included at least one of the following elements: enjoyment of connecting with each other, looking forward to reading Hardiman's (2012) book, and anticipating learning more about BTT and how they might apply it to their pedagogy.

Session 2: Neuro-myths & Overview of brain-targeted teaching. Before this session participants read the first three chapters in Hardiman's (2012) book that presented basic information from neuroscience, named and debunked neuromyths, and then introduced the BTT framework. During the second TL session faculty were asked to create before and after skits about neuromyths and to choose a synonym for the title of one of the brain-targets. Finally, participants were asked to doodle or map the relationship of the target they chose to the BTT framework. Post-session survey two was delivered to participants within six hours of the conclusion of the first session and participants were asked to complete it in the week before the next TL session.

The second TL session was emotional for some participants. Participants expressed a variety of emotions including intense or negative emotions during this session and on the post-session survey. This stands in contrast to the almost exclusively positive emotions shared by faculty in the rest of the study. Some participants shared during the session that they felt panic, were overwhelmed, and felt incompetent or inadequate while reading the information about neuromyths. It was noted on the observation protocol that two participants who shared their emotional response to neuromyths cried while sharing those feelings with the group.

One participant included this comment on the post-session survey about the experience of hearing emotions shared by their peers during the second TL session, "… It was a surprise when several colleagues expressed feelings of vulnerability uncertainty in their teaching efficacy." In response to the same experience another participant reported, "I learned/confirmed that my

colleagues are passionate, caring teachers." A third participant commented, "I learned that neuromyths, and in fact, other types of teaching myths, are hard for both the teacher and the student to let go of, even in the face of new evidence."

Learning styles were labeled as a neuromyth and debunked by Hardiman (2012). Of the list of neuromyths Hardiman (2012) identified, participants reported responding to this neuromyth in particular. On the second post-session survey, a faculty member wrote about considering a change in their approach to teaching about learning styles based on the new information that learning styles don't in fact exist.

> …I am a bit lost in how that research translates to individual students. And how do I talk with students in a supportive way. I don't want to dismiss their self-identified effective ways of learning. Yet I do want to help them expand their tool set, and recognize when they are using different modes of learning. It is an interesting puzzle to ponder.

On the same survey, four of 12 (33%) participants reported that they planned to make immediate changes to their pedagogy in response to the information that individual learning styles are a myth.

As participants in the TL faculty had the opportunity to connect with the content of the BTT framework both as students and as educators. The dual roles of adult learner and college faculty seemed to prompt reflection about the relationships between personal and professional experiences. This participant wrote about how learning about BTT influenced their personal choices and how that in turn impacted their approach to teaching.

> … conversations and experiences in the [TL] are helping me to truly reflect on putting into practice both in the classroom and my life how to better learn. I too need to pay

attention to my emotional climate and physical environment to learn how to lead a class
better.

Another faculty member wrote about a new insight into students' experience, "…I am beginning to enjoy the dynamics of the group. I felt overwhelmed and out of place in the first meeting-perhaps like my students feel at the beginning of the semester!..." A third participant commented,

A skit can be a creative way to synthesize information. I read through the chapters and basically understood them. When we did the skits, I realized I had to look at the book to remember what the misconceptions were. It reminded me of the discussions I so frequently have with students, reading and understanding does not mean you are retaining the information and can recall it. That takes externalization of your thinking. Using a means that physically asks students to demonstrate what they know is a powerful way to learn.

On the second post-session survey all but one participant (92%) reported that they already used the concepts presented in this TL in their pedagogy. On the third post-session survey seven of nine (77%) participants reported that they had made changes since the second TL session. When asked to describe the changes they made those seven reported adding more movement, more creative activities, attending to students' emotional state more directly, and changing the order of activities during class periods.

One participant shared an in-depth example of how they transformed a lesson after the second TL session.

… I started with giving them a choice between activities - this was new. Giving them the opportunity to choose how they wanted to explore the topic. This got them engaged, intellectually and emotionally. This laid the foundation for getting to a bit of the nuts and

bolts of climate change. I then divided the group into three groups, and each group was

assigned an Act. The play was climate change. They applied what they had learned in

clever and humorous ways. I finished the class with Act 4, a challenge to all of us to

reduce our carbon footprint, something we could do this semester.

This description of changes to a lesson demonstrated the interconnectedness of the faculty

member's experience in the TL where the group was asked to create skits to embody their

thinking about implementing brain-targets in their pedagogy. This participant continued by

writing,

…I feel exuberant, not something I ever thought would happen with a climate change

lesson. But we did it. We learned about the concepts in a meaningful way that engaged

our emotions and got us to move! And the best part? The transition wasn't monstrously

hard. It just took a moment to breath, ask what were the primary learning objectives, and

what was a pathway that engaged the emotional and physical brain-targets to get to those

learning objectives...

Session 3: Brain-targets 1 & 2. The third TL session consisted of discussion about and

active engagement in a variety of activities related to Brain-Target 1: Emotional Climate, and

Brain-Target 2: Physical Environment. Participants read about these two brain-targets to prepare

for this session. During the TL meeting participants shared their thoughts and feelings about the

content of two chapters of Hardiman's (2012) text, drew a map of the emotions that typically

occur for their students in their classes, and shared the impact of stress on their own learning.

All nine of the participants who completed the third post-session survey indicated that

they had implemented some of the topics covered during this TL session in their teaching in the

week between the TL sessions. Eight of nine (88%) participants also reported that they planned

to make changes to their pedagogy based on something they learned in the third teaching lab session. Participants reported building on information and ideas they already employed.

In response to Brain-Target 1: Emotional Climate participants shared the following:

- "Keeping an open heart and open mind to the emotional innerscapes of our students is paramount in being an effective educator."

- "I also want to start taking a quick survey of emotions at the beginning of every class … to get aggregate data, but also individual patterns (and perhaps refer to mental health)."

- "I am encouraged to 'humanize' my courses even more by sharing more images and personal anecdotes."

For this TL session the tables and chairs in the meeting room were rearranged and the facilitator placed gourds and fall leaves on the tables to model Brain-Target 2: Physical Environment. During this TL session several participants expressed that they might not have much control over the physical spaces they teach in, however, their responses on the post-session survey suggested that despite potential challenges, faculty did experiment with the physical spaces they taught in after exploring this brain-target.

One participant reported a change that had been implemented immediately following this session,

After reading the chapter about Creating a Physical Learning Environment, I moved one of my class activities outside. Students immediately responded positively. They were engaged with the material and it brought a positive energy to the classroom. One student commented about how much she enjoyed class that day.

Other faculty described the changes they were planning, or had already implemented, relating to the physical environment as follows.

- *"I have been working on ways to change the classroom environment. I'm aware of the dryness of the power point presentation and working on group activities."

- *"More movement in group activities- having them get up and physically move to different spaces in the classroom."

- "I have re-evaluated the space I set up for learning in my class."

This faculty member reflected on how to reach online students with Brain-Targets 1 and 2.

> I'll also simply address the issues of physical and emotional environments and their effect on our learning so my students can consider their own spaces where they work and perhaps share their thoughts with each other on how to manage/improve for their own learning, particularly in the online courses.

In response to the changes in the room where the TL sessions were held one participant commented, "Like our students, we are often initially uncomfortable with physical changes in our learning environment." A second participant wrote,

> Change is interesting, even when small, like leaves on the table or moving tables. But not always inviting, walking in I felt like I needed to 'choose a group'. For me it felt less cohesive, which I missed. On the flip side, I did have deeper one-on-one conversations. As a teacher, this informs me to know my intention when changing the physical environment of the room.

One faculty member engaged the brain-targets personally. This allowed this participant to create more effective learning experiences for students.

> The past few weeks I have learned that when I step outside my office and take a 10 minute walk and think about what the big picture is, my mind is able to process the ideas

better. I also generate ideas of how to approach the topic that incorporates a Brain Target

or two.

For some faculty the applicability of the brain-targets went beyond teaching strategies, inspiring

them to actively engage brain-targets in order to facilitate their process of designing BTT

inspired learning experiences for their students. The faculty member quoted above paired a

change in physical environment (Brain-Target 2) with a focus on connecting the content to

global concepts (Brain-Target 3).

The responses from faculty on post-session survey three reflect a sense that they saw the

BTT framework as a tool to hone their teaching, and felt energized to consider making changes.

One participant who reported they had immediately applied BTT concepts from session three to

their teaching wrote,

In this session the concepts really started to come together and I am actually enjoying

applying them with my students. I applied an art activity and turned a very dry Fire 1

class into a fun and different activity for my students. I had the power to let the students

enjoy themselves and learn something at the same time!

Another participant expressed, "I'm excited to change the way I teach!"

Session 4: Brain-targets 3 & 4. The focus of session four was Brain-Target 3: Designing

the Learning Environment, and Brain-Target 4: Teaching for Mastery. During this TL session

faculty worked in small groups to discuss how they already used visual representations of

concepts with students and how they could improve their use of this strategy. The small groups

reviewed the types of memory that were presented in Hardiman's (2012) text then they created a

short skit about how they might encourage students to utilize the type of memory that they were

least familiar with.

Participants reported that the third and fourth brain-targets were not as accessible as the first two. The fourth post-session survey was the only instance that seven of the ten (70%) faculty responded with a list of concepts they were still grappling with. One participant wrote,

I would likely benefit from having this either be a longer session or twice in order to better see how it is all connected and to learn how to incorporate the ideas in my classroom. It is not something that necessarily comes naturally or is not something I am currently doing, so more practice may be needed.

Despite reporting challenges with the content of the session, faculty still wrote about immediate changes they planned to make in their pedagogy based on these brain targets. The following are some of the planned changes described by participants.

- "As I am designing my new course for next semester, I plan on incorporating a graphic organizer or flow chart of some sort of convey the big picture to students."

- "I plan on creating a concept map for the end of my course to students can see how everything is connected. I will also have the students create their own concept map."

- "More and different concept maps I'd like to incorporate some artistic thinking and habits of working."

On post-session survey four participants talked about changes they planned to make in the future, rather than changes they thought they could make immediately. On the post-lab survey, four out of 11 (36%) participants selected Brain-Target 4 as the target that prompted them to make change. None of the other targets were selected by more than two (18%) of the participants.

Although they indicated plans for future change, rather than immediate change on post-session four, on the following survey faculty reported that they had made changes to their

teaching in the week between the two sessions. The following comments from participants described the changes participants reported as a result of exploring Brain-Targets 3 and 4.

- "I added in an extra credit assignment where students can create an image to reflect their essay."

- "Proving more frequent and timely feedback. The group teach project is an example. I met with the groups after to discuss what they did well and how I graded each area on the rubric."

- "Tried to improve learning environment (not easy in prison) and be aware of the class room setting and trying some creative teaching for extra credit (not forcing them to do something uncomfortable)."

Another faculty wrote about their effort to incorporate more visuals by using funny gifs delivered in text messages along with supportive emails to reach out to students who had stopped attending class.

Participants continued to report a sense of engagement and inspiration even as they expressed uncertainty about how to implement Brain-Targets 3 and 4. A faculty member wrote "I learned quite a bit. It is overwhelming but I love all the ideas and it has made me excited about teaching and how to keep my students engaged." Another participant shared "…all the teaching labs are influencing my teaching."

Session 5: Brain-target 5 & brain-target 6. Session five of the TL covered Brain-Target 5: Teaching for the Extension and Application of Knowledge, and Brain-Target 6: Evaluating Learning. It was noted that participants reported feeling tired and fatigued on the observation protocol for this session. Wildfires in other areas of the state impacted the families of some participants and became a topic of conversation as participants gathered for the session.

Despite reporting that they felt tired, once the session began the group appeared to be positive and engaged with the content. During this session faculty shared ideas with the whole group, and in small groups, including questions and ideas about how they might apply these two brain-targets.

When asked on the post-session survey what they learned in this session several participants wrote that the lab built on knowledge they held previous to the TL. One participant shared,

> These two chapters/session was a review of ideas I have been previously exposed to. It was valuable to be reintroduced to them and think about how what I am doing fits (or doesn't fit) with application of knowledge and assessment. I had not considered differences in the effectiveness of performing some tasks as a group and others as an individual.

As with the previous two brain-targets, participants expressed that they needed time to effectively digest and apply the content of Brain-Targets 5 and 6. Seven out of 10 (70%) of participants in this session reported that they already implemented some of the concepts covered in the TL session in their teaching. When asked to identify the changes they planned to make immediately, most participants wrote about future plans or new thinking that would prompt future change. Faculty wrote the following comments about implementing the brain-targets covered in this session.

- "…I can see me reevaluating my assessment measures during the intersession between semesters."

- "I want try to incorporate lessons that generate multiple solutions instead of one right answer."

- "This last session really made me realize how using class time wisely is more important than content dumping."

The timing of the last three TL sessions coincided with the mid-term period of the semester. One faculty member wrote,

> I think in the longer term, the ideas in this session will have a larger impact. At the moment, it is week 11 of the semester. My personal life has been busy and interrupted by usual work flow, and I have had less energy to dedicate to teaching. I am tired, and implementing new things just doesn't happen when I am tired and stretched.

Two other participants expressed a similar lack of energy and sense of fatigue that limited their ability to engage with these two brain-targets. Despite reports of waning energy, faculty continued to report planning changes to their pedagogy in response to Brain-Targets 5 and 6.

Session 6: Implementing brain-targeted teaching. The final TL session provided an opportunity for faculty to discuss and interact with the last chapter of Hardiman's (2012) book. This chapter covered implementing the BTT framework in courses and schools, and the group was also encouraged to read the appendices, including an implementation checklist. During this session, participants worked in groups and reflected on the changes they had made or planned to make in their pedagogy as a result of their work in the TL. Participants who had implemented change during the course of the study reported that changes seemed to be having a positive impact on students. One participant shared that she felt nervous before making change in her classes based on what she learned about BTT. Although she expressed concern that the changes might not work, she reported that they were well received by students.

The group discussed next steps for continuing the TL's work with BTT. Ideas included bringing BTT to other groups on campus, continuing to meet to discuss changes and offer

support to each other, creating tools for using BTT with college students, and integrating BTT into campus-wide initiatives such as Guided Pathways and Equity. The group said that workshops on neuroscience and how to continue to implement the arts to support learning would be valuable. One participant wondered about using BTT as a self-evaluation tool for faculty. The group identified additional time, money, workgroups, change in campus climate, and feedback from students and colleagues as supports that would help them continue to implement BTT.

The final TL session prompted discussion about BTT on a global level. The tone of the conversation was somewhat different from previous sessions, given the shift in content in Hardiman's text from individual brain-targets to a holistic approach for implementing BTT. During this final gathering of the group participants expressed looking forward to the end of the commitment to the TL along with a desire to continue the work and the connections with each other. After this session, the more in-depth post-lab survey was administered.

Teaching lab conclusion. The content and tone of each TL session was unique. The facilitator modeled a variety of BTT strategies in each of the TL meetings. Participants' responses to each session and the brain-targets presented varied, with some brain-targets prompting immediate changes in pedagogy and other brain-targets inspiring plans for future change. The percentages of participants that reported planning to make immediate change in response to each TL session is represented in Table 3 below.

Table 3

Planned Change by Teaching Lab Session

	Introduction	Brain-targets 1 & 2	Brain-targets 3 & 4	Brain-targets 5 & 6	Implementation
Number of participants that planned to apply concepts immediately	4 of 8 50%	10 of 12 83%	8 of 9 88%	7 of 10 70%	6 of 10 60%

The second through fifth post-session surveys asked participants to report changes they had

implemented since the last TL session. Table 4 represents that data.

Table 4

Changes Implemented in Pedagogy After Teaching Lab Sessions

	Brain-targets 1 & 2	Brain-targets 3 & 4	Brain-targets 5 & 6	Implementation
Number of participants that reported implementing change since last session	5 of 12 42%	7 of 9 77%	5 of 10 50%	4 of 10 40%

The study's findings and sub-findings follow. The findings are first represented graphically in

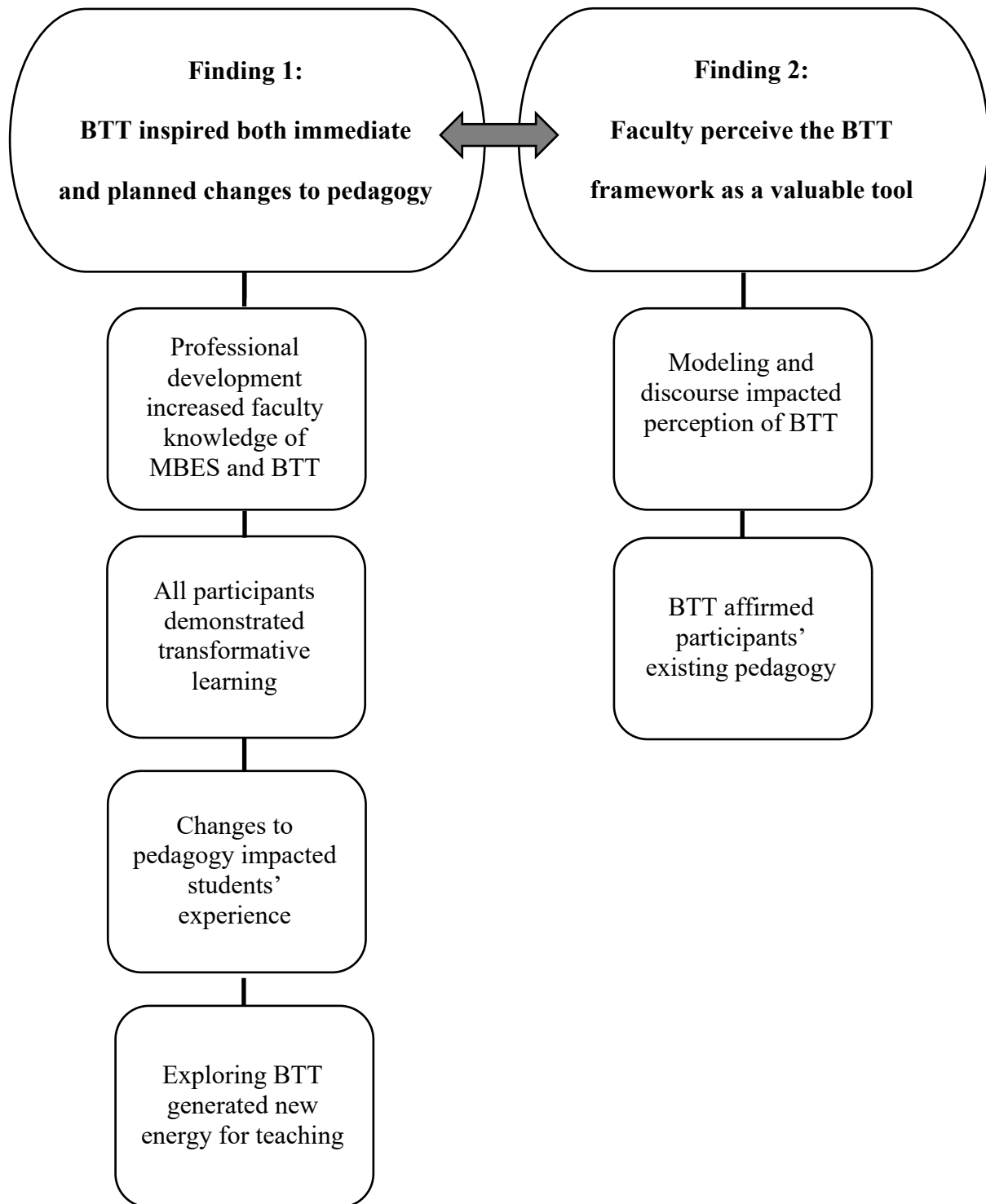Figure 2 and then detailed in the text in the remainder of this chapter.

Figure 2 Study Findings and Sub-Findings

Finding 1: BTT inspired both immediate and planned changes to pedagogy

The first research question in this study asked how a select sample of community college faculty describe the changes they plan to make in their pedagogy as a result of participating in professional development that presents and models the BTT framework (Hardiman, 2012). Beginning with the first post-session survey, participants reported that they made immediate change in their pedagogy. Faculty found ways to implement BTT strategies into their pedagogy during the course of the study, and on the post-lab survey all participants reported that they planned to make changes to their pedagogy in response to the BTT framework in the future.

Many of the changes participants made to their pedagogy have been shared in the previous sections of this chapter. Changes included small adjustments to individual lessons such as modifying the order of the activities during a class meeting, using more student and faculty generated graphics, using learner-directed approaches, and implementing skits and other active learning strategies. Faculty also reported broad changes to their beliefs about teaching, learning, and their pedagogy. One faculty member reported on the post-lab survey, "My whole mindset about delivery of information changed…". Another faculty member shared on the same survey, "…I now view myself on a journey of learning with my students, rather than showing them how to get on the 'train' of learning…" This same faculty member continued, "…It has been transformative to think about each target as I work on teaching, especially bringing in art to help students gain a deeper understanding…"

The post-lab survey was designed to capture the changes that faculty had made or planned to make in their pedagogy as a result of their overall experience exploring BTT. All but one of the twelve TL participants completed the post-lab survey. Eight (73%) of 11 faculty who completed the survey reported that they had already made changes to their pedagogy as a result

of their participation in the BTT TL. Two (18%) faculty indicated that they had not made

changes to their pedagogy after participation in the BTT TL. One participant (9%) didn't answer

this question. Ten (91%) of the 11 respondents on the post-lab survey responded that they

planned to make changes to their pedagogy in the future as a result of the BTT TL. One

participant (9%) didn't answer this question.

Figure 3 graphically presents the levels of change made by participants after the

conclusion of the BTT TL.
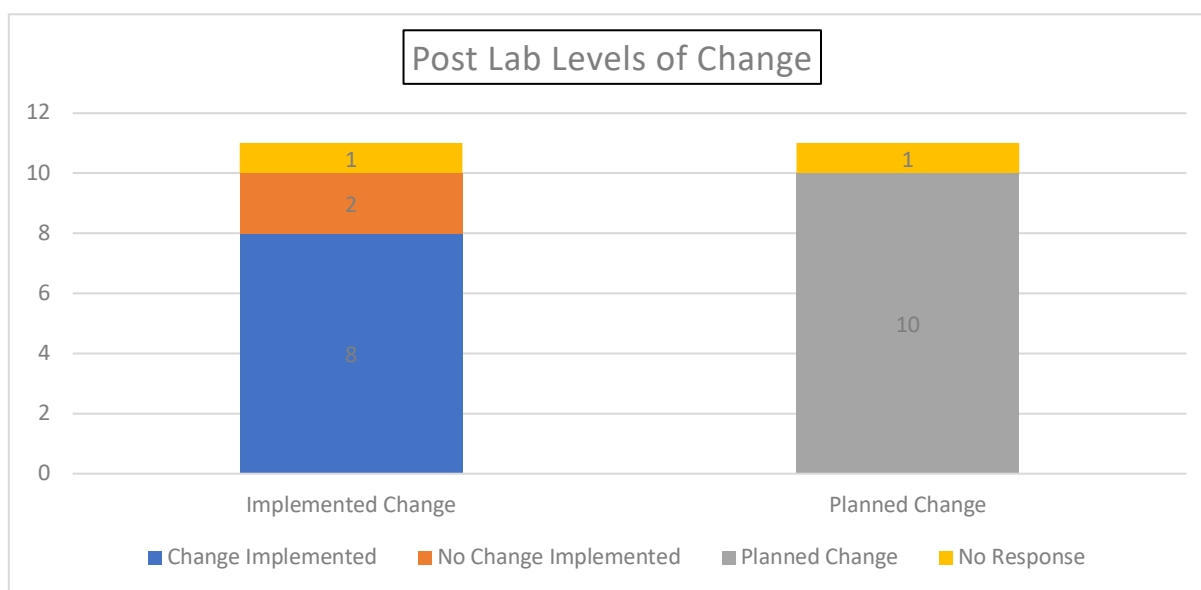
Figure 3 Post Lab Levels of Change

The two (18%) faculty who indicated that they did not make any changes to their

pedagogy after participation in the BTT TL on the post-lab survey were asked to explain why

not. One of these two wrote, "I am mid-stream! I don't change horses in the middle of a race.

Next semester I will revisit some of the ideas." The other reported, "Limited time and extensive

disruptions during the semester prevented implementation." The majority of the participants

(73%) reported that they made changes in their pedagogy during the course of the study. All

participants indicated that they planned to make changes in their pedagogy in the future as a result of participation in the BTT TL.

        Sub-finding 1: Professional development increased faculty knowledge of MBES and BTT. Participants' baseline understanding of MBES and the BTT framework was established on the pre-survey. On the pre-survey eight (66.7%) participants indicated that they did not know what MBES was while four participants (33.3%) indicated that they did know what MBES was. Nine faculty (75%) indicated that they did not utilize MBES in their pedagogy and three faculty members (25%) indicated that they did use MBES in their pedagogy. Nine faculty (75%) responded that they did not know what BTT was and three faculty (25%) responded that they did know what BTT was. Ten faculty reported that previous to the TL they already implemented one or more of the six brain-targets. Two participants reported that they had not implemented any of the six brain-targets in their teaching. This data is presented graphically in Figure 4 below.
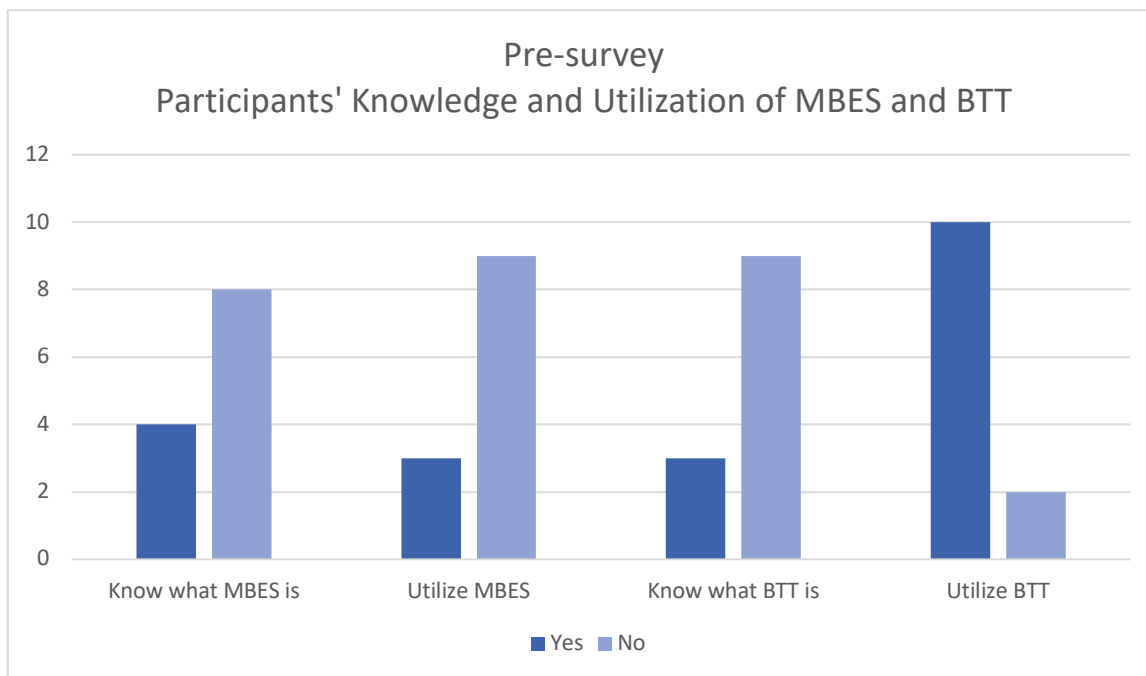
Figure 4 Pre-survey Knowledge and Utilization of BTT and MBES

The relationship between participants' level of knowledge about and implementation of MBES can be explained by the fact that the majority of participants didn't know what MBES was, and therefore they were not implementing it in their pedagogy. The pre-survey included follow up questions to the yes or no responses about knowledge and implementation of MBES. Participants who indicated they utilized MBES were asked to share an example and those who indicated they did not utilize MBES were asked why not. The examples provided by those who indicated that they did utilize MBES did not make direct connections between their pedagogy and MBES. One participant shared, "the five E's in biology education follows some of the same principles as MBES (5-E's- Engage, explore, Explain, elaborate, and Evaluate)." When asked why they didn't utilize MBES five or 41% of participants used the words uncertain, unsure, unfamiliar, and unintentional. One participant wrote,

> I think I may be using MBES but unintentionally because it may have overlapped other previous training I have had. I currently do not know enough information about MBES at the moment to identify that I am utilizing it (and utilizing it correctly) in class.

The discrepancy between participants' limited knowledge of BTT and their widespread implementation of brain-targets on the pre-survey is notable. Faculty made more direct connections between the strategies they already employ in their pedagogy and the brain-targets than with MBES. For example, one participant connected an example of a teaching strategy they already used to Brain-Target Four: Teaching for Mastery.

> …Over the course of several weeks, we start with parts of speech, then move to subject and predicate, and then clauses, and finally sentence types. When we get to sentence types, we do several examples all together as a class. Next, they work on their own completing a worksheet. If they get any questions wrong, I tutor them briefly, and then

send them back to try again. Finally, the create their own sentences. This is teaching for

mastery of concepts.

Even one of the faculty members who indicated they didn't currently utilize BTT in their

pedagogy seemed to have chosen to answer no because of their lack of understanding of BTT but

went on to describe examples of how they may already be applying BTT in their pedagogy as

described in this statement,

> First and foremost, I am not familiar enough with the specific BTT strategies to confirm
>
> that I use them in my teaching. However, from reading through brief descriptions, I can
>
> see that portions of the strategies do show up in my teaching…

This participant went on to offer examples that related to Brain-Targets 3, 4, 5 and 6. Overall,

faculty expressed a lack of confidence applying MBES and BTT in their pedagogy before the TL

began.

Ten out of 11 (91%) of the faculty who completed the post-lab survey indicated that their

understanding of MBES and BTT had changed as a result of participation in the BTT TL. When

asked if their understanding of MBES had changed as a result of the TL experience, one faculty

member did not answer the question. A different faculty member did not answer the question

asking if their understanding of BTT had changed as a result of the TL experience. When asked

to describe the changes in their understanding of MBES after the BTT TL participants shared

that they learned more about neuromyths, developed a better understanding of learning and the

brain, and made connections between MBES and their pedagogy.

When asked to describe the changes in their understanding of BTT after participation in

the TL one faculty member wrote,

I know what the six targets are (which I didn't before), and have ideas of how they integrate as a scaffold for teaching and learning. I also know that I already do many things in my teaching that hit the targets. Now I understand why those targets are important and how to expand on them.

Even for a participant who had some information about learning and the brain before the TL, exploring BTT brought about significant changes in understanding. One participant wrote,

Before this lab, I knew quite a bit about how the brain learns, but all of the information was disjointed and not cohesive. I applied it in the classroom, but only sporadically. This method has shown me how to incorporate brain science into every lesson so that it is more cohesive and effective.

At the conclusion of the BTT TL participants reported increased understanding of MBES and BTT.

Sub-finding 2: All participants demonstrated transformative learning. Over the course of the study all faculty demonstrated transformative learning as they interacted with the BTT framework. Mezirow (1997) identified critical reflection as an essential process for adults to transform their existing frames of reference. Critical reflection was frequently used by faculty in the study as they identified their existing thinking about teaching and learning (frames of reference). Faculty consistently reported that they had extended their existing frames of reference by formulating plans to interact with their students in new ways. One participant commented on the post-lab survey,

This was a great experience- we often do not have the opportunity to expand upon our own ideas of teaching ideas and this offered a new organized lens of how to accomplish the goals of what we are trying to teach in our classrooms.

Through both reflection and discourse with their peers in the TL they made meaning with the new information provided by Hardiman's (2012) BTT framework. One faculty shared on the post-lab survey "I love being part of collective growth and exploration. The material covered was also consciousness raising." Ultimately, faculty reported that they had transformed their pedagogy as a result of their experience in the BTT TL.

Sub-finding 3: Changes to pedagogy impacted students' experience. This study was not designed to explore how implementing BTT in pedagogy impacted students. However, participants shared that the changes they implemented in their teaching made a difference in students' experience in their classes. All of the comments faculty shared about student reactions to the changes they made were positive. This doesn't mean that all students responded positively to the changes faculty made only that the positive student responses were the ones reported by faculty on the surveys.

The changes in student experience faculty reported varied. This faculty member appeared to be talking with students about the changes they were implementing, but didn't indicate what the changes were in what they wrote. "I am enjoying this so much and my students when I tell them they are my Guinea Pigs the responses have been very positive. They say that it is working and that the content is easier for them to understand." Some of the changes participants implemented were simple shifts in how information was presented. For example, one faculty shared, "Instead of having students just review scenarios, I have asked students to role-play instead. They seem to have a lot more fun with the activity versus just discussing the scenarios." Another participant wrote, "I gave the students a folder to write and keep track of their assignments... a portfolio of sorts and they really liked it!!"

One participant took an interesting approach to implementing change by creating a test situation that allowed them to compare the difference between their existing pedagogy and a BTT informed class period.

> For our most recent vocabulary/theory lesson I created a practice lab for myself: 8am class was subjected to (!) a blah blah yaddah yaddah lecture. White board, take notes, show examples. 9:40 class were divided into 4 groups. Each group was a collaborative effort to discuss the same vocabulary and theories presented in 8 am class. My findings were that the student run discussions were more vibrant and interactive.

Another faculty member wrote about a similar change to the order of activities during a class period. After experimenting with beginning the class period with an activity followed by the lecture, rather than lecturing first, the faculty reported that despite being initially apprehensive, students appeared to be more actively learning the concepts and held more lively discussions about the content.

A third participant reported that changing the physical environment and introducing more doodling in their lessons resulted in students being "energized and ready to participate." Another faculty member wrote about fine tuning their approach to assessing student work and how it appeared to be influencing students. This faculty member had developed a process of grading student essays in person with the student sitting next to them. After participating in the BTT TL this participant asked the student to begin the session by describing what they did well and what they struggled with. This created a more interactive experience with assessment and helped the faculty member more accurately assess the students' strengths and needs.

Faculty were not asked to identify the impact of the changes they made on students as part of this study. However, multiple faculty reported promising and positive outcomes for students' experience in their courses as result of implementing BTT in their pedagogy.

Sub-finding 4: Exploring BTT generated renewed energy for teaching. The impact of a professional development experience on faculty's enthusiasm for teaching was not a focus of this study. However, beginning with the pre-survey, faculty reported a sense of excitement and energy about exploring BTT and this emerged as a theme in participants' responses. This quote represents the early enthusiasm documented by study participants, "Knowing other people are engaged and growing in their teaching is inspiring to me. That is part of why I am so excited about this upcoming experience. It is a challenge to make time for those conversations." On the first post-session survey, three faculty wrote about "looking forward to" reading the book and continuing to discuss the content with their peers. Two others commented that they enjoyed hearing others talk about their pedagogy.

Over the course of the TL one participant reported that the experience had "…definitely changed my teaching style and my enthusiasm for teaching!" Another participant wrote, "It is overwhelming but I love all the ideas and it has made me excited about teaching and how to keep my students engaged." One faculty member reported a transformation in their teaching as a result of participating in the TL, and the way it impacted their energy for teaching with the following comment.

> …It has been transformative to think about each target as I work on teaching, especially bringing in art to help students gain a deeper understanding. We do skits, make more sketches, I draw more on the board. Students draw more. It has helped to renew my

teaching and get out of the rut of just getting through the day. I look forward to going to

class more.

Documenting participants' emotional reactions to BTT was not a goal of this study, but positive

feelings, and renewed enthusiasm was a theme in faculty's responses to TL participation on

surveys and in the TL sessions.

Finding 2: Faculty perceive the BTT framework as a valuable tool

Research question two in this study asked: What is the perception of a select sample of

community college faculty of the BTT framework (Hardiman, 2012) as a tool to facilitate the

implementation of MBES into pedagogy in higher education? The overall perception of

participants in this study is that BTT is an effective tool for translating MBES into their

pedagogy.

Participants were asked to rate the perceived value of BTT on the post-lab survey.

Options for ratings were *very valuable, somewhat valuable*, *minimally valuable,* and *not*

valuable. Of the 11 participants who completed the post-lab survey six (54.5%) selected *very*

valuable and five (45.5%) selected *valuable*. Participants were then asked to describe why they

selected the value they chose. Participants who selected *very valuable* wrote about the ways the

framework provided a practical, cohesive, and evidence-based tool to help them refine their

teaching.

The following comments speak to participants' perception that BTT is a valuable tool for

implementing MBES into their pedagogy. One faculty member commented,

> I am amazed at how much I think about BTT. I find myself looking at my course content
>
> for the daily lesson and asking myself if the approach I am taking is really effective. Then
>
> I make small changes on the fly.

Another wrote,

> It has shifted my paradigm of what I am doing in the classroom. It has given a scaffold to the phrase 'student centered teaching.' I have more depth and understanding to what it means to be student centered. To be student centered is to be brain centered. Understanding how the brain works is a guiding principle for planning and teaching. I have had pieces of this in the past, but seeing all of these together gives me a more cohesive picture of what type of learning journey I am on with my students.

There appeared to be a correlation between the perceived value of the framework and the immediate application of the BTT concepts. In other words, those faculty who rated the BTT framework as *very valuable* reported having already implemented BTT strategies. The following quote is one example of this observation.

> As the faculty coordinator of the tutoring center, I have the opportunity to directly teach my tutors how to learn and what factors they need to take into consideration when working with students. The tutors can implement all of the principles in the Brain-Targeted Teaching framework.

The BTT framework was also reported to be *very valuable* by those who had less formal training about teaching. One participant wrote, "I hadn't thought of teaching in any other way than what I learned in grad school in terms of facilitating groups. I've had no formal teacher training so this was exceptionally useful."

The five (45.5%) participants who selected *somewhat valuable* revealed in response to a follow up question that they believed the BTT framework itself was very valuable, but were unsure of their ability to successfully implement it. One participant commented,

I selected 'somewhat' instead of 'very' valuable and to clarify, that is in no way reflective

of how I rate the value of the labs, book, and the information, it was all VERY

VALUABLE. How much of me will stand in the way of translating my findings into my

teaching is the question.

Another faculty member wrote,

Although the framework gave me ideas, it is yet to be determined if I can follow through

with them. Often I hear about best practices that are impractical in the actual classroom.

I'm not sure if my planned changes will be fruitful or not in the long run.

Two of the five faculty comments, about why they rated the framework as *somewhat valuable*,

referenced a need for a deeper understanding of the science to allow them to fully utilize the

BTT framework. Comments from the group that rated the framework as *somewhat valuable*

suggested a need for continued professional development to support implementation of BTT,

particularly for those participants who did not implement brain-targeted strategies during the

course of the study.

A theme that emerged from the data was facultys' reported difficulty in making change.

On the pre-survey a faculty member shared that, "Having to invent and produce the 'cool' new

things has been my biggest limiter." One participant wrote, "I can never decide what to remove

to add something new. Not sure where to go--need more of a push to substitute something out for

something new.*"* Another participant pointed out the challenge of putting ideas into practice.

They shared that a lab session was a "fun overview of things to do--need to figure out the next

step- as they say talk is cheap, but walking the talk is harder." Faculty reported that they had

identified areas that they would like to change in their teaching but were, "nervous and unsure

about how to do it," or were uncertain about what the outcome would be.

The design of the TL sessions presented two of Hardiman's (2012) brain-targets at a time. Each pair of brain-targets prompted varied responses from participants. On the fourth post-session survey seven of 10 (70%) faculty who completed the survey wrote about challenges they experienced digesting the material Hardiman (2012) presented about Brain-Target 3: Learning Design and Brain-Target 4: Teaching for Mastery. Two faculty indicated that they were not satisfied with the way Brain-Target 5: Evaluating Learning, was covered in Hardiman's (2012) text. One participant wrote on the fifth post-session survey "A lot of this chapter was not well explained." Another participant wrote:

> The chapter on Target 5 was difficult to follow. So many research papers were referred to and summarized cryptically in one sentence. I struggled to understand several of the research findings she was integrating to support/explain the ideas in target 5. I wish there was less jargon and more explanation.

Although faculty in this study found the BTT framework to be valuable overall, questions about the framework arose both during the lab meetings and on the post-session surveys. The cultural relevance of the BTT framework was questioned by one participant on post-session survey three.

> I mentioned this during our session, but would like to see how brain science interfaces with culture, especially in multicultural classrooms. While I can appreciate the generalizability that a brain-based program could offer, I would wonder that even if the underlying brain structures and processes are the same, that cultural instantiation might not be.

One participant wondered at the mid-point of the teaching lab "how much do you need to incorporate to have meaningful learning?" Faculty also raised questions about the recency and

relevance of the science presented in Hardiman's (2012) text during the lab meetings. Participants reported a perception that some targets had more research behind them while other areas were less supported by evidence.

To summarize, the small sample of community college faculty in this study found the BTT framework to be a valuable tool for implementing MBES in their pedagogy. Participants found it easier to understand and implement some brain-targets than others. Faculty raised important questions about the cultural relevance of the framework and the level of implementation that is likely to result in change for students.

Sub-finding 1: Modeling and discourse impacted perception of BTT. Faculty identified perceptions of the BTT framework as a tool to facilitate implementing MBES into their pedagogy throughout the TL experience, both during lab meetings as well as on the surveys. Participants' indicated that their perception of the BTT framework was influenced not only by Hardiman's (2012) text but also by the interactions with colleagues and the modeling of BTT that occurred during the teaching lab session. One participant explained the discrete roles the text and the TL sessions had on their pedagogy as follows.

> Reading the book inspired me to make changes in the future but experiencing strategies inspired me to make changes to my teaching now. I directly implemented many of the modeled strategies. I enjoyed the discussion with my colleagues because I was able to hear about what people are already doing in their teaching and that inspired me to make changes as well.

The value of experiencing the BTT strategies during the TL sessions, and discussing applications of BTT with colleagues who teach in a variety of disciplines, was identified by multiple participants throughout the study.

Sub-finding 2: BTT affirmed participants' existing pedagogy. Faculty reported that the BTT framework affirmed many of their current pedagogical practices. On the pre-survey participants were asked to identify which of the brain-targets they already used in their pedagogy. Their responses are detailed in Table 5 below. On each post-session survey, faculty were asked which of the topics covered in the lab they already used in their teaching. Levels of pre-existing implementation of brain-targets ranged from 70% on the fourth and fifth post-session surveys to 100% on the third post-session survey. The ideas presented in the BTT framework resonated with changes some faculty had already planned as shared by one participant, "It reinforced my idea to move my daily grammar (a ritual) from an individual activity to a collaborative activity." For others, the BTT framework affirmed their pedagogy overall, "Many of my practices were also validated through the experience, so I grew more confident as an educator." Another faculty member shared on the post-lab survey "…I discovered that I have cognitive strategies that work, intuitive strategies that were validated by my readings…"

Table 5

Pre-Teaching Lab Levels of BTT Implementation

	Brain-target 1: Emotional climate	Brain-target 2: Physical environment	Brain-target 3: Design for learning	Brain-target 4: Teaching for mastery	Brain-Target 5: Teaching for application	Brain-Target 6: Evaluating learning
Implementation of brain-targets reported on pre-survey	8 of 12 66.7%	7 of 12 58.3%	5 of 12 41.7%	7 of 12 58.3%	9 of 12 75%	7 of 12 58.3%

Conclusion

This qualitative study collected data from a select sample of community college faculty using seven anonymous online surveys, and an observation protocol for TL sessions. Coding, research memos, and peer debriefing were employed during data analysis. After an iterative analysis process, two major findings emerged from the data: BTT inspired both immediate and planned changes to pedagogy, and faculty perceive the BTT framework as a valuable tool. Each finding is supported by sub-findings.

First, after a six-session TL that presented and modeled BTT, participants described both immediate and planned changes to their pedagogy. The TL experience resulted in an increased understanding of both BTT and MBES. Participants reported changes in individual lessons, as well as their approach to whole courses or their overall views on students, teaching, and learning. All participants demonstrated transformative learning, particularly critical reflection. As a result of implementing BTT strategies in their pedagogy, faculty reported positive impacts on their students as well as a renewed energy for teaching.

Second, the perception of this select sample of community college faculty is that the BTT framework is a valuable tool to facilitate implementing findings from MBES into their pedagogy. The TL format influenced how faculty perceived BTT. Discourse with peers and experiencing BTT strategies modeled in the TL supported faculty's implementation of BTT. Chapter five presents conclusions, implications, and recommendations as a result of the findings reported in this chapter.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This chapter presents conclusions and implications of the study's findings organized around the study's two research questions. The implications are positioned in relationship to the conceptual framework and literature review. This chapter concludes with recommendations for practice and further research.

Overview of the Study

Community colleges are being called upon to increase student success and completion for the large and diverse group of students they serve (Apigo, 2015; Boggs, 2011). Research in neuroscience and related fields continues to yield evidence that might be used to hone pedagogy in higher education (Hardiman, 2012; Tokuhama-Espinosa, 2014; Whitman & Kelleher, 2016). College faculty are experts in their discipline but may not have been educated about how to teach adults effectively, including how they might apply Mind, Brain, and Education Science (MBES) to their pedagogy (Hardiman, 2012; Whitman & Kelleher, 2016). MBES is applied in college pedagogy on a limited basis (Nilson, 2010; Straumanis, 2012). Hardiman's (2012) Brain-Targeted Teaching (BTT) framework is a promising tool that might assist community college faculty in implementing findings from MBES into their pedagogy (Parr, 2016; Whitman & Kelleher, 2016).

Framed by this context, this study offered a professional development opportunity that allowed community college faculty to learn about the BTT framework and experience BTT strategies. The purpose of the study was to examine the perceptions of a select sample of community college faculty of the BTT framework as a tool to facilitate implementing MBES into

their pedagogy. Using a qualitative approach, this study was guided by the following research

questions:

1. How do a select sample of community college faculty describe the changes they plan to

    make in their pedagogy as a result of participating in professional development that

    presents and models the BTT framework (Hardiman, 2012)?

2. What is the perception of a select sample of community college faculty of the BTT

    framework (Hardiman, 2012) as a tool to facilitate implementing MBES into pedagogy in

    higher education?

All faculty at a small California community college were invited to participate in the

study and twelve faculty elected to participate. Participants were full-time and part-time faculty

in a variety of disciplines, who held diverse roles at the college. Qualitative data were collected

with seven anonymous online surveys, an observation protocol used during the professional

development sessions, and research memos that documented the researcher's analysis and

reflections.

Through an iterative analysis process using coding of participants' responses and the

conceptual framework for the study, two major findings emerged from the data. First, a

professional development experience that presented and modeled BTT inspired faculty to make

immediate and planned changes to pedagogy. Second, faculty perceived the BTT framework to

be a valuable tool. Both findings are supported by sub-findings. These findings affirm that the

BTT framework has value as a tool to support community college faculty in implementing

MBES into their pedagogy.

Conclusions and Implications

Research Question 1

The first research question asked how a select sample of community college faculty described the changes they planned to make in their pedagogy as a result of participating in professional development that presented and modeled the BTT framework (Hardiman, 2012). The data collected in response to this question indicate that faculty were inspired to make both immediate and planned changes to their pedagogy as a result of their participation in the BTT TL. This study found that a professional development experience that modeled BTT increased faculty's knowledge of MBES and BTT, even for participants who had pre-existing knowledge about neuroscience and the science of learning. After developing an understanding of the BTT framework, faculty reported using it as a tool to refine individual lessons and described plans to use it to guide their planning of future lessons and courses. Some participants expressed that the framework helped them to better understand and use the knowledge they already had about neuroscience and learning.

This study was not designed to document student outcomes as a result of faculty implementing BTT in their pedagogy. However, faculty reported that the changes they made in their teaching prompted positive feedback from students. After utilizing BTT informed strategies in their pedagogy, faculty reported increased student engagement and improvements in students' understanding of content. Although faculty shared that students were initially uncertain about some of the BTT techniques introduced, they ultimately enjoyed them and interacted more with the information being taught because of them.

This study found that exploring the BTT framework generated new energy for teaching for participants. Participants expressed that the time and space to connect with colleagues was an

important part of their exploration of BTT, particularly as they thought about how they might incorporate the framework into their teaching. The structure of the TL allowed faculty to prioritize taking time to learn new techniques with a group of engaged peers. Faculty reported that they were more excited to go to class and experienced a renewed energy about teaching overall, after learning about and beginning to implement BTT strategies. This finding is consistent with Whitman and Kelleher's (2016) experience that teachers and school leaders who add knowledge about the science of the brain to their pedagogy, "develop an enhanced belief in or efficacy of themselves as professionals" (p. 7). This finding aligns with Sabagh, Hall, and Saroyan's (2018) finding that professional development is one factor that can mitigate burnout for faculty and the accompanying negative effects on faculty performance.

It was anticipated that study participants would make changes to their pedagogy as a result of the professional development experience, but not as readily as the faculty in this group actually implemented change. Participants began making changes from the very beginning of the TL before they interacted with Hardiman's (2012) text. The changes they made were surprising in their depth and scope, given the relatively short duration of the study.

Research Question 2

Research question two assessed the perception of a select sample of community college faculty of the BTT framework (Hardiman, 2012) as a tool to facilitate implementing MBES into pedagogy in higher education. Participants were asked directly about their perception of BTT on the post-lab survey. All the participants in this study reported that they found the BTT framework to be a valuable tool. The most prevalent question from participants about the value of BTT related to their own ability to implement the information rather than the framework itself. A generally positive response to the BTT framework was expected, but it was not anticipated

that all participants would find the tool to be valuable. More criticism of the framework was forecast, because it was created for a wide audience of educators and focused more on K-12 settings than higher education. However, this critique was not raised by study participants.

Throughout the study, participants reported that they found the framework to be a helpful tool for evaluating and honing their pedagogy in light of MBES findings. The format of the TL, particularly the opportunity to experience the brain targets being modeled, influenced facultys' perception of the BTT framework. Faculty related their experiences as learners in the TL to their students' experiences and this deeper understanding of what students might be experiencing in their college courses seemed to inspire pedagogical change. When the brain-targets were modeled in the TL session, participants were able to consider what students would experience when brain-targets are applied to teaching approaches. Sometimes modeling BTT strategies prompted change and at other times it led to critical reflection about when to use a particular strategy and why.

Participants reported that discourse or discussion with faculty teaching in diverse disciplines inspired new ways to implement BTT strategies. An informal and family-like atmosphere is typical at Manzanita College and the researcher had positive relationships with all of the participants. Both of these factors may have contributed to the positive and playful group dynamic observed during TL sessions. Participants were willing to share difficult emotions during the TL sessions, indicating that they felt a sense of emotional safety. A positive and supportive group dynamic likely played a role in the group's perception of the tool and willingness to fully engage in discourse or discussion with colleagues. Without the opportunity to engage in discourse with each other participants' perception of the framework may have been different.

Participants reported that the BTT framework affirmed some of their existing pedagogy. Early in the TL there was an emotional discussion prompted by reading about neuromyths. Realizing that they may have perpetuated neuromyths raised questions for some faculty about their efficacy as teachers. As the TL progressed, participants identified ways that they were already implementing BTT. Some participants reported increased confidence as a result. The understanding that their pedagogy aligned with BTT in many places seemed to provide a counterweight to the uncertainty experienced by some participants at the beginning of the TL.

The six brain-targets were presented to the TL participants in pairs. Participants in this study made more immediate changes in response to the first two brain-targets (emotional climate, and physical environment) than the last four (learning design, mastery of content, concepts and skills, application of knowledge, and evaluation and assessment). This might be explained by two factors. First, the content of the first two brain-targets was perceived as more accessible by participants. Brain-targets three through six contain more dense information that might have been less familiar to participants. In retrospect, the last four brain-targets might have been better received if they were presented one at a time. Second, the timing of studying the last four brain-targets coincided with wildfires around the state and planned power outages to minimize the risk of wildfires locally. As the semester progressed past mid-term participants reported less energy to study and apply new ideas. The content might be perceived differently if presented at a different pace and during different times of the academic year.

Findings in response to the two research questions in the study indicated that the BTT framework was an effective tool for the small sample of college faculty. Learning about and experiencing BTT strategies prompted faculty to make immediate changes in their pedagogy, and inspired them to plan changes to future courses. Based on the perceptions of the participants

in this study, the BTT framework has value as a tool to support higher education faculty to implement MBES in their pedagogy.

Theoretical Implications

Mezirow's transformative learning theory (1991, 1997) and Hardiman's (2012) BTT framework made up the conceptual framework for this study. Transformative learning (Mezirow, 1991, 1997) was used as a tool to understand the participants' experience as adult learners in this study. There are significant intersections between Mezirow's (1991, 1997) and Hardiman's (2012) work. The goal of both Mezirow's transformative learning theory (1991, 1997) and Hardiman's BTT framework (2012) is to support educators in providing their students with optimal conditions and experiences for learning. In this study faculty were interacting with the BTT framework as students, while making and planning to make change to their pedagogy in their role as faculty.

Faculty demonstrated elements of transformative learning throughout the study as they described critical reflection about and changes to their pedagogy. As previously described the ability to discuss or discourse with peers in different disciplines was identified by participants as a valuable experience for refining points of view. Study participants reported that participation in the TL allowed them to transform their frames of reference and implement new information about pedagogy. Based on their responses to survey questions some faculty appeared to reach the level of transformation that could be described as "significant personal transformation" (Mezirow, 1997, p. 10) as a result of their experience in the BTT TL.

Mezirow (1991) found that transformation for adult learners took place through critical reflection in response to disorienting dilemmas. It appeared that reading about and discussing neuromyths may have served as a disorienting dilemma for some participants. Mezirow (1991)

found that recognizing that the process of transformation is shared, and that others have had similar experiences, can be a phase of change. This was evident in study participants' survey responses after hearing about other participants' emotional struggles during the second TL session.

From a theoretical perspective, the findings in this small-scale study supported both Mezirow's (1991) transformative learning theory and Hardiman's (2012) BTT framework. Both Mezirow (1991) and Hardiman (2012) recognized the benefit of actively engaging students in the content being presented, accessing prior knowledge, and creating a positive emotional environment where students can engage in discourse. These strategies were applied in planning the professional development experience. Transformative learning (Mezirow, 1991) and the BTT framework (Hardiman, 2012) provided a rich conceptual framework for designing the professional development experience for this study, as well as for analyzing the outcomes of the participants.

Implications and Literature Review

The implications presented in this chapter affirm and refute the literature reviewed in this study. This study's findings reinforced Parr's (2016) conclusions in a related study. Using a mixed methods approach, Parr (2016) found that K-12 teachers who participated in a one-day professional development session that presented and modeled BTT had an increased awareness and knowledge of brain-based learning and BTT concepts. Parr (2016) concluded that the experience participants had as learners influenced their pedagogy. Finally, Parr (2016) identified that after the professional development experience educators considered BTT when designing pedagogy. The Manzanita College study found that after a six-session professional development experience, that presented and modeled BTT, participants reported increased knowledge of

MBES and BTT and implemented immediate and planned changes in their pedagogy based on the BTT framework.

The professional development experience in this study was designed to embody the MBES concepts presented in the literature review. As explained in Hardiman's (2012) Brain-Target 1: Emotional Climate, emotions are a driver of learning and can either facilitate or impede learning. Emotional connection to content leads to better retention (Collins, 2016; Cozolino, 2013; Zull, 2006). The emotions participants reported feeling in response to reading about neuromyths, and their emotional connections to each other when those feelings were revealed in the second TL session, gave meaning to the group's exploration of BTT.

This study affirmed Parr's (2016) assertion that modeling MBES and BTT strategies in the presentation of the BTT framework impacts educators' application of BTT in their pedagogy. Based on evidence about the importance of accessing prior experience for adult learners (Taylor & Marienau, 2016), TL participants were asked to make connections between what they already knew and the material presented during each session. Each session employed active learning strategies derived from MBES findings and BTT strategies (Caine et al., 2009; Hardiman, 2012; Sheckley & Bell, 2006; Straumanis, 2012).

Flynn et al. (2017) stated that community college faculty often lack formal pre-service training in pedagogy. This was true for only two (16%) participants in this study. Notably, all participants in this study indicated that they perceived the BTT framework to be a valuable tool regardless of their level of previous education or experience. None of the participants were familiar with BTT before the study began. This study's findings aligned with the results of Postareff, Lindblom-Ylänne, and Nevgi's 2007 study that demonstrated that professional development did result in changes to pedagogy for higher education faculty, particularly a shift

to more student-centered strategies. Faculty in this study all reported that they made changes or planned to make changes to their pedagogy as a result of their experience in the BTT TL.

Further, this study affirmed the findings of Lavis et al. (2016) who found that professional development about brain-based learning resulted in increased student satisfaction. Participants in this study were not asked to comment directly about student satisfaction. However, they reported increased student engagement and livelier discussions after implementing BTT strategies in their courses.

The findings of this study provide information that addresses Whitman and Kelleher's (2016) call for research about the types of professional development that lead to application of MBES. This study indicated that professional development that models MBES strategies, including opportunity for discussion with peers, leads to application of MBES in pedagogy for community college faculty. This study's findings suggest that using the tenets of transformative learning along with the BTT framework to design a professional development experience can result in an experience that will prompt changes to pedagogy. This study resonated with Kelleher and Whitman's (2018) successful integration of Mind, Brain, and Education Science particularly the experience participants had when the encountered information about neuro-myths and what they meant for their teaching.

This study demonstrated that in the context of a six-session professional development experience faculty are willing to make changes to their pedagogy. This finding is contrary to research that has identified faculty as reluctant or unwilling to change (Borque, 2016; Chew et al, 2018). This may be because the professional development experience offered in this study provided the time, training, and incentives that Brownell and Tanner (2012) named as barriers for faculty. It is important to remember that the faculty in this study opted in to the experience.

Providing the same experience as mandatory for all faculty would likely have yielded more mixed results in terms of faculty's willingness to make change in their pedagogy. Further study will be needed to document the long-term impact of the BTT TL, including whether or not the changes made during the study are sustained by participants, and whether or not the changes planned during the course of the study are executed.

Recommendations

The literature reviewed, findings, and implications of this study provide a foundation for recommendations for practice and future research at Manzanita College and for community colleges in general. This study found that the BTT framework was a valuable tool for a small group of community college faculty to implement MBES into their pedagogy. The BTT framework was perceived as useful by faculty teaching in a broad range of disciplines and settings who had a variety of education and experience. This study found that exploring the BTT framework affirmed participants' existing pedagogy and generated new energy for teaching. Although it was not the purpose of this study, participants reported that changes they made to their pedagogy as a result of the BTT framework had positive outcomes for students. Participants reported that the shifts they made in their teaching as a result of applying brain targets to their pedagogy were simple to execute.

Recommendations for Practice

Based on the study's findings, BTT has value for faculty who are interested in honing their pedagogy and increasing student engagement. At the conclusion of the BTT TL, participants created a list of supports including additional time and resources that they would need to continue to implement BTT in their pedagogy. It is recommended that Manzanita College make a commitment to offer those supports to TL participants and explore ways to allow

additional faculty to engage with BTT. When asked to rate the value of the framework on the post-lab survey, participants rated the value of the framework as very high but expressed uncertainty about their own ability to implement the tool. This suggests that faculty would benefit from continued support in their exploration of implementing BTT in their pedagogy.

In this study participants linked the opportunity to experience the techniques modeled by the facilitator to their inspiration to implement changes in their own pedagogy. When employed together, Mezirow's (1991, 1997) transformative learning theory and Hardiman's (2012) BTT framework provided a sturdy foundation for designing a professional development experience for college faculty. The findings of this study aligned with Mezirow's (1991, 1997) assertion that the opportunity for discourse or discussion is important for facilitating adult learning. As a result, this researcher recommends that professional development for faculty at Manzanita College and other higher education settings be designed to model the ideas being presented and provide frequent opportunities for discussion with peers.

Recommendations for Further Research

Based on the findings of this research, the work of Parr (2016), and recommendations from Whitman and Kelleher (2016), it is recommended that faculty at the study site continue their exploration and application of BTT. Future research at Manzanita College could explore long term impacts of participation in the BTT TL on pedagogy and the impact of utilizing BTT strategies on student outcomes.

This study was limited in purpose and scope. In this study, there was a concern about potential bias because the study was conducted at the researcher's place of work. In response to this concern the methodology for this study was designed to allow participants to provide anonymous feedback. However, this limited the ability to analyze the impact of demographic

information on the study's findings. Future researchers conducting related studies could use methods that allow for demographic data to be included and analyzed in a more in-depth manner.

Further study is needed to establish BTT as an effective tool for implementing change in higher education pedagogy. Given the demand for increasing student success and completion, and the expectation that faculty ensure learning as part of Guided Pathways, a larger study about the utility of BTT in the California Community College system is suggested. Larger research projects are needed to document the value of BTT for broad use in higher education pedagogy. The data collection in both this study and Parr's (2016) were limited in duration. Studies that measure the long-term impact of learning about BTT are needed. The findings of this study indicated positive changes in students' experience when faculty used BTT to hone their teaching strategies. Research on student outcomes in courses where BTT has been implemented is necessary to demonstrate BTT's impact on students. Studies about student outcomes could also be designed to address the questions participants in this study raised about the cultural relevance of the BTT framework.

Conclusion

This qualitative study examined the perceptions of a small group of community college faculty of the BTT framework as a tool to implement MBES into their pedagogy. Based on the study's findings the BTT framework has value as a tool to support higher education faculty in honing their pedagogy by implementing evidence from MBES. This study affirms the utility of Mezirow's (1991, 1997) transformative learning theory and Hardiman's (2012) BTT framework as a foundation for planning appropriate professional development experiences for faculty. Recommendations include continued exploration, application, and research about BTT at the college where the study took place and in the California Community College system. This study

adds to the growing body of evidence that implementing MBES in pedagogy allows educators to

provide optimal learning experiences for all students, including adults.

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Appendix A

Letter of Invitation to Participate

Dear Colleagues,

As many of you know, I am pursuing a Doctorate in Educational Leadership at the University of New England. To meet the requirement for the dissertation I have designed a qualitative study to examine faculty perceptions of Brain-Targeted Teaching (BTT) as a tool to facilitate implementing Mind, Brain, and Education Science into their pedagogy. Here is some additional information about BTT: http://www.braintargetedteaching.org/.

I am writing to invite you to participate in a Teaching Lab (TL) as well as the study. **All faculty** (full-time and part-time/adjunct) are welcome. The TL will meet at least six times to explore BTT. I have designed the experience to both present and model BTT strategies as well as to be flexible enough to respond to the needs and interests of the TL group.

Please note that participation in the study is voluntary and may be ended at any time. You do not need to participate in the study to be a part of the TL. Participants will be asked to complete seven anonymous online surveys (before the TL begins, after each TL meeting, and after the TL concludes). Your name will be not be collected as part of the data and a pseudonym will be used for the College and College District in the reporting of the study findings to further ensure anonymity. Please respond to this email if you are interested and specify if you would like to participate in the TL only or both the TL and the study. Spaces will be filled on a first come, first served basis.

Sincerely,

Adrienne

Appendix B

Consent Form for Study Participants

UNIVERSITY OF NEW ENGLAND
CONSENT FOR PARTICIPATION IN RESEARCH

Project Title: Brain-Targeted Teaching as a Tool for Facilitating the Implementation of Mind, Brain, and Education Science into Community College Pedagogy

Principal Investigator: Adrienne Seegers

<u>**Introduction:**</u>
- Please read this form. You may also request that the form is read to you. The purpose of this form is to give you information about this research study, and if you choose to participate, document that choice.

- You are encouraged to ask any questions that you may have about this study, now, during or after the project is complete. You can take as much time as you need to decide whether or not you want to participate. Your participation is voluntary.

<u>**Why is this research study being done?**</u>
The purpose of this qualitative study is to examine the perceptions of community college faculty of Brain Targeted Teaching (BTT) as a tool to facilitate implementing MBES into their pedagogy.

<u>**Who will be in this study?**</u>
All College faculty (full-time and part-time) will be invited to participate in a Brain-Targeted Teaching, Teaching Test Kitchen Lab (TL). The goal is to recruit 10 participants to the study. TL participants may opt not to participate in the study. Study participants may drop out at any time.

<u>**What will I be asked to do?**</u>
In addition to participation in the Teaching Lab (minimum of six, one-hour meetings and some outside reading and writing), participants in the study will be asked to complete seven anonymous online surveys (before the TL begins, after the first five TL meetings, and at the completion of the final TL meeting).

<u>**What are the possible risks of taking part in this study?**</u>
There is a risk of a loss of privacy, however, no names will be collected in the surveys and no identifying information will appear in any published reports of the research. A pseudonym will

be used for the College to further protect anonymity. The research material will be kept in a secure location, and only the researcher will have access to the data.

What are the possible benefits of taking part in this study?
Participation in the study will have no direct benefits outside of the professional development experience in the TL.

What will it cost me?
There is no cost to you for participation.

How will my privacy be protected?
Participation in the TL is open to all faculty regardless of participation in this study. The researcher will not share the names of study participants on campus or in other venues. The surveys administered as part of the study will be anonymous. A pseudonym will be used for the College. Direct quotes will only be included in the write up of the study if permission has been explicitly granted by the participant. If direct quotes are used with permission they will not be accompanied by any identifying information.

How will my data be kept confidential?
Only the researcher, Adrienne Seegers, will have access to survey data and will keep that data confidential.

What are my rights as a research participant?
- Your participation is voluntary. Your decision to participate will have no impact on your current or future relations with the University.
- Your decision to participate will not affect your relationship with Adrienne Seegers.
- You may skip or refuse to answer any question posed on a survey for any reason.
- If you choose not to participate there is no penalty to you and you will not lose any benefits that you are otherwise entitled to receive.
- You are free to withdraw from this research study at any time, for any reason.
  - If you choose to withdraw from the research there will be no penalty to you and you will not lose any benefits that you are otherwise entitled to receive.
- You will be informed of any significant findings developed during the course of the research that may affect your willingness to participate in the research.
- If you sustain an injury while participating in this study, your participation may be ended.

What other options do I have?
- You may choose not to participate.

Whom may I contact with questions?
- The researcher conducting this study is Adrienne Seegers

- o For more information regarding this study, please contact Adrienne Seegers at adrienne.seegers@gmail.com or (209) 768-2307

- If you choose to participate in this research study and believe you may have suffered a research related injury, please contact Adrienne Seegers at adrienne.seegers@gmail.com or (209) 768-2307

- If you have any questions or concerns about your rights as a research subject, you may call Mary Bachman DeSilva, Sc.D., Chair of the UNE Institutional Review Board at (207) 221-4567 or irb@une.edu.

Will I receive a copy of this consent form?
- You will be given a copy of this consent form.

_____

Participant's Statement
I understand the above description of this research and the risks and benefits associated with

my participation as a research subject. I agree to take part in the research and do so

voluntarily.

_____   _____

Participant's signature or   Date

Legally authorized representative

_____

Printed name

The participant named above had sufficient time to consider the information, had an

opportunity to ask questions, and voluntarily agreed to be in this study.

_____   _____

Researcher's signature   Date

Adrienne Seegers
_____

Printed name

Appendix C

Pre-Survey

Thank you for your participation in this study. This study is being conducted by Adrienne Seegers, graduate student in the University of New England's Ed.D Educational Leadership program. The purpose of this study is to examine the perceptions of community college faculty of Brain-Targeted Teaching (BTT) (Hardiman, 2012) as a tool to facilitate implementing findings from mind, brain, and education science into their pedagogy.

Please keep in mind that your participation is voluntary. You may drop out at any time. You are under no obligation to answer any of the questions posed on this survey, please skip questions if desired.

The information collected will be solely used for the purposes of this study. No personal information will be collected. The data collected from the responses will be anonymous, confidential, and only accessible to by the researcher, Adrienne Seegers. This survey does not collect any identifying information, only your responses to the questions. The first question on the following survey will ask if you grant Adrienne Seegers permission to use direct quotes from your responses in her writing. If you grant permission, no identifying information will accompany the quote.

Please complete this survey prior to the first Brain-Targeted Teaching Teaching Lab meeting. Thank you!

Hardiman, M. (2012). *The brain-targeted teaching model for 21st century schools.* Thousand Oaks, CA: SAGE.

Demographics

Do you grant permission for the potential use of direct quotes from open-ended response for reporting, professional presentations, and/or publications? Note: If you grant permission, no self-identifying information will be included with the quotations.
- o Yes
- o No

Position- choose the answer that best applies
- o Full-time (tenured, tenure track or interim full-time) faculty
- o Adjunct or part-time faculty
- o Other

If you selected other, please name your role here:

Total years of teaching experience with any age in any setting
- o 1-5 years

- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- 26+ years

Of your years of teaching experience how many are at the community college level?
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- 26+ years

How many years have you taught at this college?
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- 26+ years

What is your age?
- 20-30
- 31-40
- 41-50
- 51-60
- 61-70
- 71 or older

What is your gender identity?

Which disciplines or subjects have you taught at community college? Please list all.

Have you taught in other settings besides community college?
- Yes
- No

If you have taught in other settings besides community college please list them here:

Have you had formal training (courses, certificates, or degrees) to teach at community college?
- Yes
- No

If you have had formal training (courses, certificates, or degrees) to teach any group other than community college students please list them here:

Pedagogy/Teaching Practice

Do you know what mind brain and education science (MBES) is?
- o Yes
- o No

Do you currently utilize mind brain and education science (MBES) in your teaching/pedagogy?
- o Yes
- o No

If you indicated that you currently utilize mind brain and education science (MBES) in your teaching/pedagogy please share an example here:

If you indicated that you currently do not utilize mind brain and education science (MBES) in your teaching/pedagogy please explain why not. (For example, not enough information about MBES, lack of time to implement changes, etc.)

Do you know what brain-targeted teaching is?
- o Yes
- o No

Do you currently implement any of the following brain-targeted teaching strategies in your teaching/pedagogy?
- o Creating an emotional climate conducive for learning
- o Creating a physical environment conducive to learning
- o Designing learning experiences in a way that builds on cognitive processes of information processing
- o Teaching for mastery of content, skills, and concepts
- o Teaching for the extension and application of knowledge beyond the classroom
- o Utilizing evaluation of learning to support learning and memory
- o I do not implement any of the brain-targeted teaching strategies listed above in my teaching/pedagogy

If you indicated that you currently implement any of the brain-targeted teaching strategies listed above in your teaching/pedagogy please provide an example here:

If you indicated that you currently do not implement any of the brain-targeted teaching strategies in your teaching/pedagogy please describe why not here:

Please list the kinds of tools, strategies, or experiences that support you in making changes to your teaching/pedagogy.

Appendix D

Post-session Survey

This survey was administered after the first through the fifth Teaching Lab sessions. The

question marked with an asterisk (*) below was not asked on the first post-session survey.

Thank you for your participation in this study. This study is being conducted by Adrienne Seegers, graduate student in the University of New England's Ed.D Educational Leadership program. The purpose of this study is to examine the perceptions of community college faculty of Brain-Targeted Teaching (BTT) (Hardiman, 2012) as a tool to facilitate implementing findings from mind brain and education science into their pedagogy.

Please keep in mind that your participation is voluntary. You may drop out at any time. You are under no obligation to answer any of the questions posed on this survey, please skip questions if desired.

The information collected will be solely used for the purposes of this study. No personal information will be collected. The data collected from the responses will be anonymous, confidential, and only accessible to by the researcher, Adrienne Seegers. This survey does not collect any identifying information, only your responses to the questions. The first question on the following survey will ask if you grant Adrienne Seegers permission to use direct quotes from your responses in her writing. If you grant permission, no identifying information will accompany the quote.

Please complete this survey prior to the next Brain-Targeted Teaching Teaching Lab meeting. Thank you!

Hardiman, M. (2012). *The brain-targeted teaching model for 21st century schools.* Thousand Oaks, CA: SAGE.

Do you grant permission for the potential use of direct quotes from open-ended response for reporting, professional presentations, and/or publications? Note: If you grant permission, no self-identifying information will be included with the quotations.
- o   Yes
- o   No

What did you learn from the most recent Teaching Lab session?

Is there anything that you didn't understand about the topics covered in the most recent Teaching Lab session?

Of the topics covered in the most recent Teaching Lab session, do you already use any of them in your teaching/pedagogy?
- o Yes
- o No

Please list the topics covered in the most recent Teaching Lab session that you already use in your teaching/pedagogy.
Is there anything you learned in the most recent Teaching Lab session that you plan to apply immediately in your teaching/pedagogy?

*Have you made any changes in your teaching since the last Teaching Lab session?
- o Yes
- o No

If you have made changes in your teaching/pedagogy since the last Teaching Lab please list them here:

Please rate the significance of the most recent Teaching Lab session on your teaching/pedagogy:
- o Significant
- o Somewhat significant
- o Minimal
- o None

Is there anything else you'd like to add about the most recent Teaching Lab session?

Appendix E

Post-teaching Lab Survey

Thank you for your participation in this study. This study is being conducted by Adrienne Seegers, graduate student in the University of New England's Ed.D Educational Leadership program. The purpose of this study is to examine the perceptions of community college faculty of Brain-Targeted Teaching (BTT) (Hardiman, 2012) as a tool to facilitate implementing findings from mind brain and education science into their pedagogy.

Please keep in mind that your participation is voluntary. You may drop out at any time. You are under no obligation to answer any of the questions posed on this survey, please skip questions if desired.

The information collected will be solely used for the purposes of this study. No personal information will be collected. The data collected from the responses will be anonymous, confidential, and only accessible to by the researcher, Adrienne Seegers. This survey does not collect any identifying information, only your responses to the questions. The first question on the following survey will ask if you grant Adrienne Seegers permission to use direct quotes from your responses in her writing. If you grant permission, no identifying information will accompany the quote.

Please complete this survey prior to the next Brain-Targeted Teaching Teaching Lab meeting. Thank you!

Hardiman, M. (2012). *The brain-targeted teaching model for 21st century schools.* Thousand Oaks, CA: SAGE.

Do you grant permission for the potential use of direct quotes from open-ended response for reporting, professional presentations, and/or publications? Note: If you grant permission, no self-identifying information will be included with the quotations.
- o Yes
- o No

Demographics

Do you grant permission for the potential use of direct quotes from open-ended response for reporting, professional presentations, and/or publications? Note: If you grant permission, no self-identifying information will be included with the quotations.
- o Yes
- o No

Position- choose the answer that best applies
- o Full-time (tenured, tenure track or interim full-time) faculty
- o Adjunct or part-time faculty

    o   Other

If you selected other, please name your role here:

Total years of teaching experience with any age in any setting
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- 26+ years

Of your years of teaching experience how many are at the community college level?
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- 26+ years

How many years have you taught at this college?
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- 26+ years

What is your age?
- 20-30
- 31-40
- 41-50
- 51-60
- 61-70
- 71 or older

What is your gender identity?

Which disciplines or subjects have you taught at community college? Please list all.

Have you taught in other settings besides community college?
- Yes
- No

If you have taught in other settings besides community college please list them here:

Have you had formal training (courses, certificates, or degrees) to teach at community college?
- o Yes
- o No

If you have had formal training (courses, certificates, or degrees) to teach any group other than community college students please list them here:

Pedagogy

How many sessions of the Brain-Targeted Teaching Lab did you attend?
- o All six
- o Missed one
- o Missed two
- o Missed three

Has your understanding of mind brain and education science (MBES) changed after participating in the Brain-Targeted Teaching Teaching Lab?
- o Yes
- o No

If your understanding of mind brain and education science (MBES) has changed after participating in the Teaching Lab please describe what has changed here:

If your understanding of mind brain and education science (MBES) has not changed after participating in the Teaching Lab please describe why not here:

Has your understanding of Brain-Targeted Teaching changed after participation in the Brain-Targeted Teaching Lab?
- o Yes
- o No

If your understanding of Brain-Targeted Teaching has changed after participation in the Brain-Targeted Teaching Lab please describe the change here:

If your understanding of Brain-Targeted Teaching has not changed after participation in the Brain-Targeted Teaching Lab please describe why not here:

Have you implemented any changes in your teaching/pedagogy as a result of participating in the Brain-Targeted Teaching Lab?
- o Yes
- o No

If you have implemented any changes in your teaching/pedagogy as a result of participating in the Brain-Targeted Teaching Lab please describe the change/s here:

If you have not implemented any changes in your teaching/pedagogy as a result of participating in the Brain-Targeted Teaching Lab please describe why not here:
Do you plan to make any changes to your teaching/pedagogy in the future as a result of participating in the Brain-Targeted Teaching Lab?

Please describe the changes you plan to make in your teaching/pedagogy in the future as a result of participating in the Brain-Targeted Teaching Lab here:

Please describe why you do not plan to make changes to your teaching/pedagogy as a result of participating in the Brain-Targeted Teaching Lab here:

If you have made or plan to make changes to your teaching/pedagogy, please indicate which brain target, if any, prompted you to make changes. (Can only select one.)
- o   Brain-target 1: Emotional climate
- o   Brain-target 2: Physical environment
- o   Brain-target 3: Learning design
- o   Brain-target 4: Teaching for mastery
- o   Brain-target 5: Teaching for application
- o   Brain-target 6: Evaluating learning

Did any particular aspects of your experience exploring Brain-Targeted Teaching during the Teaching Lab inspire you to make changes or plan to make changes to your teaching/pedagogy? (For example: reading the book, experiencing strategies that were modeled, discussion with colleagues, etc.)
- o   Yes
- o   No

Please describe which aspects of your experience exploring Brain-Targeted Teaching during the Teaching Lab inspired you to make changes or plan to make changes to your teaching/pedagogy here:

If no aspects of your experience exploring Brain-Targeted Teaching during the Teaching Lab inspired you to make changes or plan to make changes please describe why not here:

To what degree has your experience in the Brain-Targeted Teaching Lab impacted your teaching pedagogy?
- o   Significantly
- o   Somewhat
- o   Minimally
- o   Not at all

How valuable is the Brain-Targeted Teaching framework as a tool for translating findings from mind brain and education science (MBES) into your pedagogy?
- o   Very valuable
- o   Somewhat valuable
- o   Minimally valuable

      o   Not valuable

Please describe why you selected the value you did in the previous question here. (Options were very valuable, somewhat valuable, minimally valuable, not valuable.)

Please share any additional thoughts about your experience participating in the Brain-Targeted Teaching Lab here:

Appendix F

Observation Protocol for Brain-Targeted Teaching Teaching Lab Sessions

Date:
Time:
Location:
Members present:
Members absent:

Draw a diagram of the participants in the room on the back of this page

Describe mood of the group. List 3 cues about mood that lead to this interpretation:

Tone of chit chat before work begins is:

Note change in group dynamic/energy/mood that occur during the meeting including time change was observed:

These questions were posed during the group meeting:

These indications of Mezirow's stages of transformative learning (disorienting experience, critical reflection, integration of new perspective) were evident during the meeting:

These changes in teaching/pedagogy were reported to the group:

These impressions of the BTT framework were reported to the group:

These indications of bias or underlying assumptions by researcher or participants were discovered:

Appendix G

Agendas for Brain-Targeted Teaching Teaching Lab Sessions

Brain-Targeted Teaching Session 1:
Introduction to the Brain-Targeted Teaching Teaching Lab
9/27/19
8:00-9:00 am

"…all teaching does not result in learning…" (Hardiman, 2012, p. xxi)

I.   Welcome & Introductions

II.   What do you want to learn in this Teaching Lab?

III.   Overview of Brain-Targeted Teaching

   A. Hardiman's bio

   B. Inspiration for the framework

   C. What do you already know about the brain?

      a. Doodle what you already know about the brain including an example of how

         you apply it in your pedagogy

      b. Pair & share

      c. Debrief

IV.   Nuts & Bolts of Teaching Lab & Adrienne's research

Before next meeting 10/4 8:00-9:00 am: Complete post session survey (a link will be sent to your

email within 24 hours of this session) and read Chapters 1-3 of Hardiman's book

Definitions

Brain Targeted Teaching (BTT): A framework that allows teachers to "plan effective instruction

informed by research from the neuro- and cognitive sciences and research-based effective

instruction" (Hardiman, 2012, p. xiv.). The BTT framework is one of a handful of tools that have

been developed to help teachers implement mind brain and education science (Whitman &

Kelleher, 2016).

Brain-Targeted Teaching Session 2:
Neuro-myths & Overview of Brain-Targeted Teaching
10/4/19
8:00-9:00 am

 "…it is unwise to base instruction on…unscientific pop culture notion[s]" (Hardiman, 2012, p. 24)

I.   Welcome & Check In: What are you thinking/how are you feeling about Chapters 1-3?

II.   Neuro-myths: What do they mean to you? Before and after skits.

III.   Overview of Brain-Targeted Teaching (jigsaw, pairs give a brief overview of each target)

IV.   Dyads choose a target, choose a synonym for the title of the target and doodle or map its relationship to the BTT framework

Before next session 10/18 8:00-9:00 am: Complete the post session survey (a link will be sent to

your email within 24 hours of this session) and read Chapters 4 & 5 of Hardiman's book.

References

Hardiman, M. (2012). *The brain-targeted teaching model for 21st century schools.*

Thousand Oaks, CA: SAGE.

Hardiman, M., Delgado, S., O'Malley Grizzard, C., Novak, S., Stella, J. & Gentry, K. (n.d.) *The*

brain-targeted teaching model for 21st century schools reading companion and study

guide. Retrieved from:

http://www.braintargetedteaching.org/Media/Reading%20Companion%20and%20Study

%20Guide%20BTT%20for%2021st%20C%20Schools%208.1.13%20word%20doc.pdf

Brain-Targeted Teaching Session 3
Brain-Target 1: Emotional Climate & Brain-Target 2: Physical Environment
10/18/19
8:00-9:00 am

"If you do nothing else after reading this book but include emotions in your training, even for technical topics, you'll already have gone a long way to help your learners" (Collins, 2013, p. 56).

I.   Welcome & Check In: what are you thinking/how are you feeling about Brain Targets 1 & 2? Share with a partner

II.   Emotion & Learning: draw a map of the emotions that typically occur for your students during your class. With a partner discuss how emotion impacts your students' learning.

III.   Impact of Stress on Learning: whip around, one example of how stress impacted your learning.

IV.   Physical Environment: what did you notice about the changes to the physical environment I made today? How did they impact your learning?

V.   Reflection: What do you do already in your teaching? Anything you want to do more of in your teaching?

Before next session 10/25 8:00-9:00 am: Complete the post session survey (a link will be sent to your email within 24 hours of this session) and read Chapters 6 & 7 of Hardiman's book.

References

Collins, C. (2016). *Neuroscience for learning and development: How to apply neuroscience and psychology for improved learning and training.* London: Kogan Page.

Brain-Targeted Teaching Session 4:
Brain-Target 3: Designing the Learning Experience & Brain-Target 4: Teaching for Mastery of Content, Skills, and Concepts
10/25/19

"If teaching were the same as telling, we'd all be so smart we could hardly stand it." -Mark Twain

I.   Welcome & Check In: What are these two targets about?

II.   Planning Learning Experiences: Small groups discuss how you use visual representations of concepts with students and what you'd like to do better.

III. Memory: Pick the type of memory that you encourage your students to use the least. Create a short skit about how you could encourage that type of memory more.

IV.   Arts Integration for Mastery of Content: What is your outlet or inspiration for creativity? How could you integrate that into your pedagogy?

Before next meeting on 11/1 8:00-9:00 am: Complete the post session survey (a link will be sent to your email within 24 hours of this session) and read chapters 8 & 9 of Hardiman's book.

References

Agarwal, P. K., & Bain, P. M. (2019). *Powerful teaching.* San Francisco: Jossey-Bass.

Brown, P.C., Roediger, H. L., & McDaniel, M.A. (2014). *Make it stick: The science of successful learning.* Cambridge, MA: Belknap.

Tokuhama-Espinosa, T. (2011). *Mind, brain, and education science: a comprehensive guide to the new brain-based teaching.* New York: W.W. Norton.

Brain-Targeted Teaching Session 5:

Brain-Target 5: Teaching for the Extension and Application of Knowledge & Brain-Target 6: Evaluating Learning
11/1/19

Quote: "Creativity and intelligence are separate entities. Creativity is not essentially innate. It can and should be taught in our schools" (Hardiman, 2012, p. 130).

Welcome & Check In: what are you thinking/how are you feeling about Brain Target 5 & 6?

I.   Whip around: What strategies do you already use that engage creative or divergent thinking in your students?

II.   With one or two others draw a concept map of Brain Target 5

III.   List your current assessment techniques. Find one that aligns with the recommendations in Brain Target 6 and one that doesn't. Share what you found with someone else.

Before 11/8: Complete the post-session survey that will be sent to you later today. Read Chapters 10 & Appendices of Hardiman's book

<div align="center">References</div>

Hardiman, M. (2012). *The brain-targeted teaching model for 21st century schools.*

      Thousand Oaks, CA: SAGE.

<div align="center">

Brain-Targeted Teaching Teaching Lab Session 6:
What? Now what? So what?
11/8/19

</div>

Quote: "I have learned the power that teachers gain when they understand the ways in which research from the neuro- and cognitive sciences can guide effective instruction." (Hardiman, 2012, p. 170).

I.   Welcome & Check In

II.   Discuss Chapter 10 & Appendices: What did you find that you can use in your teaching practice?

III.   Reflections:
      a. Changes you've made
      b. Changes you plan to make
      c. Supports needed to sustain change

IV.   Other Teaching Lab activities? Remaining questions?

V.   Letter to yourself

VI.   Stipend info from the VP's office

Reminder: Complete the Post Lab Survey no later than 11/14

<div align="center">References</div>

Hardiman, M. (2012). *The brain-targeted teaching model for 21st century schools.*

      Thousand Oaks, CA: SAGE.