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"Even if the research says it doesn't work, it works:" Teachers' epistemic beliefs and enactment

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“Even if the research says it doesn’t work, it works:” Teachers’ epistemic beliefs and enactment

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The purpose of this study was to examine teachers' availing and nonavailing epistemic beliefs about teaching and learning, with particular focus on beliefs about visual, auditory, and kinesthetic (VAK) learning styles; the study investigated VAK belief sources and justification, and the ways those beliefs were enacted in classroom practice. 660 teachers in Mississippi were surveyed, with the large majority (94.5%) reporting they believed that students' learning styles are important for learning. Most teachers had been introduced to the idea in teacher preparation coursework, and few had heard about information suggesting learning styles were not supported by research. Teachers reported that they considered learning styles to be useful for student grouping, assessments, and instructional delivery. Implications for bridging educational psychology research and teacher practices are discussed in light of findings.

DEDICATION

I dedicate this manuscript, and the effort it represents, to my family.

To my father, Benny Jeffcoat, who left school his Mississippi Delta elementary school in 5th grade to labor in the hot fields of the Mississippi Delta after his mother died. He modeled to me the value of work and humility. I wish he had lived long enough to see me get the education that wasn't available to him.

To my mother, Leona Spears Jeffcoat, who resolutely confronted a school system she didn't understand so that her daughter could get an appropriate education. You modeled to me the value of fighting for what's right, even when people signal that your voice doesn't matter.

To my children, Cameron, Mason, and Camille. I'm so proud of who each of you are. You've taught me so much about love and patience, and the value of humor in chaos. I finally did the thing—I hope I've modeled to you that it's never too late to forge a new path.

And to my husband, Michael. You've always inspired me, and I can't list all the things that you've modeled to me over the years about work, integrity, perseverance, humor, and love. I still hope to be like you when I grow up.

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CHAPTER I

INTRODUCTION

Over the past several decades, educational psychologists have greatly expanded the body of research related to epistemic cognition in both amount and scope. Understanding individuals' epistemic cognition, the cognitive processes by which people acquire, justify as true, and use knowledge, has rich traditions in classical and modern philosophy (Moser, 2002; Pollack & Cruz, 1999). Greek philosophers used the Greek word for knowledge, *episteme*, to describe the study of sorting "justified and true" knowing from mere beliefs; epistemology, then, refers literally to the theory of knowledge. Some philosophers, the Skeptics, debated whether anything at all can be known for certain, because it seems unlikely that any claim can be justified to the point of absolute certainty. Other epistemological stances debated whether evidence was most reliable if it came from direct sensory experience (Empiricism), intuited by individuals using innate knowledge (Rationalism), or whether knowledge is entirely constructed by individuals through experiences and can therefore change when new experiences contradict what was known (Constructivism).

Though the debates can seem esoteric, it's not difficult to see how the cognitions that individuals employ to sort "justified and true" knowledge from fiction has real-world impacts. We live in an age where information abounds but is consumed in ways that are highly individualistic; rather than changing what is known in response to compelling contradictory evidence, it's as easy to find information that supports the original belief. Rather than seeking

information, people often seek affirmation of what they believe to be true, leading to an epistemic landscape that includes public skepticism of "fake news," uncertainty about climate change, fear of medical immunizations, and self-professed "flat-earthers," despite factual or scientific evidence having converged upon a unified truth in each case. It's plausible that the Information Age has presented to us so *much* information—a good deal of it contradictory—that people have difficulty sorting the factual from sheer superstition; this is an epistemic cognition problem. In 1997, astronomer and philosopher Carl Sagan wrote:

> I have a foreboding of an America in my children's or grandchildren's time [when] … no one representing the public interest can even grasp the issues; when the people have lost the ability to set their own agendas or knowledgeably question those in authority; when, clutching our crystals and nervously consulting our horoscopes, our critical faculties in decline, unable to distinguish between what feels good and what's true, we slide, almost without noticing, back into superstition and darkness. (p. 28)

Epistemological issues have relevance to psychologists, who are less interested in philosophical discussions about whether or not anything can be known with certainty, and more focused on the ways that individuals gain knowledge, authenticate it, and integrate the information into "what is known." These cognitive processes are dynamic, as people usually develop more sophisticated methods over time (Baxter Magolda, 2004; Hofer & Pintrich, 1997; King & Kitchener, 2004; Perry, 1970; Rule & Bendixen, 2010), gradually forming epistemic belief systems.

The complex processes of discerning and justifying truths have far-reaching consequences; with effortful thinking being necessary for a viable, well-informed society, the task of imparting

the skills necessary to sort truth from fiction is considered central to formal education. As such, a good deal of scholarship has been devoted to epistemic cognition as it is situated in schools generally (Fives & Gill, 2015; Greene, Sandoval, & Bråten, 2016). How students and teachers think about best practice for discerning truth and what information is knowable impacts what and how students learn, and what and how teachers teach. For example, given the tentative nature of scientific discovery, a teacher's epistemic belief that only unchanging information can be considered "certain knowledge" would necessarily impact what content was taught, the methods used to deliver it, and students' views about the usefulness of studying it.

Epistemic Beliefs

If epistemic cognition is the process by which individuals attain knowledge and authenticate truth through attending, reasoning, and decision-making, *epistemic beliefs* are the key result of epistemic cognition (Sinatra, 2016). Epistemic beliefs are individuals' conceptions about how people know, what the effective strategies are for determining whether information is true or valid, and when the reliability of sources of information is such that existing beliefs should change (Bricker & Bell, 2016).

Beliefs about knowledge and knowing are a challenge to study, as they can be held consciously or unconsciously (Chinn, Buckland, & Samarapungavan, 2011; Murphy & Alexander, 2013), and function both domain-generally and domain-specifically (Buehl & Alexander, 2001; Muis, Bendixen, & Haerle, 2006). In spite of lingering questions about the boundaries of the construct (Hofer & Pintrich, 1997; Sinatra, 2016), what individuals believe about their own ability to identify, learn, and use knowledge has far-reaching impacts. After conducting a meta-analysis of epistemic beliefs, Muis (2004) proposed that individuals' beliefs about learning and knowing could be classified into two dimensions: "availing" beliefs that

promote knowledge acquisition and "nonavailing" beliefs that have no or negative effects on learning.

For example, Kloosterman and Cougan (1994) found that elementary mathematics students often believed that they were incapable of learning math—and that the inability was fixed and unchanging despite practice. This clearly nonavailing belief impacted student self-efficacy and outcomes. In the longitudinal study, however, the nonavailing belief shifted over time, and by the time the students were in sixth grade, they held the availing belief that anyone can learn math with sufficient effort and practice. Although researchers have dedicated a good deal of study to determine environmental sources of students' availing and nonavailing beliefs (Muis, 2004; Schommer, 1990), Doyle (1988) has found that teachers' classroom practices (influenced by their own beliefs about student learning) also influenced students' availing and nonavailing belief formation, underscoring the critical importance of what teachers believe about learning.

Teachers' Epistemic Beliefs

In 1979, Fenstermacher forecasted that studies about beliefs would become a cornerstone of pedagogical research. That prediction was on target; especially over the past two decades there has been burgeoning interest in the epistemic beliefs held by teachers, and the ways those held beliefs impact classroom climate (Duffy, Muis, Foy, Trevors & Ranellucci, 2016; Muis & Duffy, 2013), teachers' enacted practice (Lunn, Walker, & Mascadri, 2015), and student learning (Hennessey, Murphy, & Kulikowich, 2013). Pajares (1992) argued that the epistemic beliefs of teachers have greater impact on student achievement than content knowledge or pedagogical training. This is important in a practical sense, since the epistemic beliefs students hold influence their motivation (Buehl & Alexander, 2005), their ability to employ effective cognitive strategies (Alexander, Murphy, Guan, & Murphy, 1998; Feucht, 2010; Muis & Duffy, 2013), the goals

students set for themselves (DeBacker & Crowson, 2006) and are predictors of positive learning outcomes (Bråten, Britt, Strømsø, & Rouet, 2011) and greater educational achievement (Rodriguez & Cano, 2006).

Not surprisingly, then, researchers have studied the impacts of teachers' nonavailing epistemic beliefs on their practice and student learning (Buehl & Beck, 2015; Lunn et al., 2015). Slavin (2008) has argued that the epistemic beliefs of teachers (and school administrators), and not research or evidence, is the driving force behind selection of textbooks, interventions, school policies, and classroom practice. This idea is important, because when teachers are found to hold nonavailing epistemic beliefs, the most common remedy has been for additional training so that teachers will simply change their beliefs. Skott (2015) suggested that this solution is naive, considering the growing body of research that suggests that teachers' epistemic beliefs have proven resistant to revision. Of particular importance, he cited Spillane, Reiser, and Reimer (2002) that even when teachers' epistemic beliefs do change, classroom practices may not, making a study of the connection between beliefs and practice vital to understanding teacher development.

Problem Statement

In spite of the promising lines of inquiry affirming the importance of teachers' epistemic beliefs, Greene (2016) wrote that fundamental aspects of the research have been overlooked. In particular, he urged researchers to investigate the ways teachers form and update epistemic beliefs: what information sources most impact teachers' beliefs? How do teachers evaluate information sources? In light of new or competing information, do teachers update their beliefs? If so, which sources for new information are most compelling to teachers? What factors influence whether or not teachers enact their beliefs in classrooms?

Extending this area of study is important because there has been conflicting evidence about the ways and the extent to which teacher beliefs influence practice (Elby, Macrander, & Hammer, 2016; Gill & Fives, 2015; Hofer, 2010; Kang, 2008; Lunn et al., 2015). Additionally, a broader understanding of the teachers' epistemic cognition will lend insight into questions that remain around teachers' source justification, the ways teachers evaluate new information, the extent to which epistemic beliefs change in light of conflicting evidence, and how those beliefs are manifested in classrooms. The nature of epistemic belief change has implications for preservice teacher education and in-service professional development, since past methods for changing nonavailing epistemic beliefs—those that do not advance or may even impede student learning—have met with limited success.

One common nonavailing teacher belief that has been difficult to dispel is that of visual, auditory, and kinesthetic (VAK) learning styles. Past researchers have found that, in spite of a great deal of study that does not support the usefulness of VAK, a majority of teachers cling to the belief that students are predisposed to learn best through specific sensory modality (Alekno, 2012; Dekker et al., 2012; Lethaby & Harries, 2016; Tardif, Doudin, & Meylan, 2015). Because the belief is so prevalent among teachers, and because it has proven extremely resistant to change (Bailey, Madigan, Cope, & Nicholls, 2018; Lethaby & Harries, 2016; Macdonald, Germine, Anderson, Christodoulou, & McGrath, 2017), it is a good lens for examining why teachers believe what they do (in spite of countering evidence) and how those beliefs are formed.

Purpose of Research

This study investigates the prevalence of a nonavailing teacher belief, specifically VAK learning styles, sources of that belief, ways that teachers justify their epistemic beliefs in light of new evidence, and the extent to which teachers enact VAK in practice. Using regression

techniques, the study examines the traits of teachers most likely to espouse VAK belief. Insight into the link between teachers' epistemic beliefs and pedagogy is useful not only because learning style theory has been empirically shown to be a nonavailing epistemic belief, but because a deeper understanding of what teachers believe, where those beliefs originate, how context influences beliefs, and the extent to which the belief is stable can inform future directions in fostering teachers' belief change (in this case, replacing a nonavailing belief with an availing one; Fives & Buehl, 2012; Greene, 2016, Woolfolk Hoy, Davis, & Pape, 2006).

There are several reasons that learning styles was chosen as the neuromyth of interest for this study. First, the idea is content- and subject-neutral, meaning that teachers across disciplines will have heard of the idea and considered ways to use it in practice. Additionally, learning styles are discipline specific, part of educator expertise, and of high interest for teachers. Finally, as pointed out by Murtaugh (2016), the concept of learning styles is easily operationalized into practice.

The research questions that guided this investigation were: what sources do teachers use when adopting pedagogical beliefs, how are those beliefs evaluated, and how do they influence practice? Two general areas of sub-questions helped to organize and design the investigation:

A. Descriptive information about teachers' views of nonavailing beliefs using VAK as case
    - To what extent do teachers believe in learning styles?
    - To what extent do teachers use VAK ideas in instruction?
    - Is endorsement of VAK associated with endorsement of other nonavailing beliefs?
    - Have teachers heard conflicting accounts of learning styles but still endorse? Why?
B. Sources of belief in and factors associated with teachers' use of VAK in classroom

- Which original information source(s) influence teachers' present-day learning style beliefs (i.e., preservice training, continuing development, peer or administrator influence, classroom experiences)?
- How do teachers who believe in VAK justify that belief?
- What factors influence teacher use of VAK in practice (i.e., external influences, information source)?
- What school- and teacher-level traits are most associated with learning style belief and pedagogical application (i.e., experience, licensure route, grade level taught, school rating)?

Significance of Research

The significance of research on teachers' nonavailing learning style beliefs and their influence on enacted practice has significance on micro- and macro-levels. First, insight into the extent to which teachers endorse VAK is useful, even if simply to examine for longitudinal attitude change as compared to earlier teacher surveys on the topic (Kirschner & van Merriënboer, 2013; Sharp, Bowker, & Byrne, 2008). Second, there is consensus (Dekker, Lee, Howard-Jones, & Jolles, 2012: Pashler, McDaniel, Rohrer, & Bjork, 2008) among neuropsychologists and educational psychologists that learning styles instruction is not useful for student learning; knowing more about how VAK is enacted in classroom instruction would give educational psychologists and teacher education researchers a frame for changing those enacted beliefs through professional development or pre-service training. Third, while there is some information about the sources of VAK belief, there is only anecdotal evidence about how teachers justify the belief in the face of contradicting research; knowing more about the cognitions related to sustained VAK endorsement would also lend insight into possibilities for

promoting belief change. Third, there has been research into the prevalence of VAK belief by teachers, but no apparent inquiry into the strength of that belief or its stability.

And finally, there are implications for the teaching profession, since Zembylas & Chubbuck (2015) noted that teachers' beliefs contribute to their professional identity. This identity, the authors argued, impacts public perceptions of schooling. In recent years, Zembylas and Chubbuck pointed out, there has been a trend of "media-driven depictions of members of [the teaching] profession as lazy, lacking in accountability and deserving of punishment" (p. 186). Such a narrative results in teachers who leave the profession in frustration, or are "omitted from the discussion" around educational reform and policy (p. 186), leading Zembylas and Chubbuck to urge a redoubling of efforts to understanding how teachers derive their beliefs, how they justify them, and the ways those beliefs influence practice.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this study is to investigate the nature of teachers' beliefs, the sources of those beliefs, how those beliefs are justified, and whether conflicting evidence has been considered. To do so, it is necessary to provide a description of the literature about epistemic cognition and epistemic beliefs and more specifically about teacher beliefs about how people learn and the nature of classroom instruction. Before a historical overview of important epistemic cognition models and frameworks, however, it is necessary to acknowledge the limitations and uncertainties that surround the field of epistemic cognition study.

Challenges of Epistemological Research: Terminology, Theory, and Measurement

Over the past 40 years, lines of research around epistemic cognition have increased exponentially, and contemporary study is characterized by an ever-broadening scope that places less emphasis on development, and greater foci on individuals' beliefs about knowing and knowledge. The burgeoning of research, however, has called attention to four critical shortcomings in epistemic cognition research: the inability of educational psychologists to settle on common terminology (Greene, Sandoval, & Bråten, 2016; Hofer, 2010); a lack of conceptual agreement about the nature of the epistemic cognition construct (Hofer and Pintrich, 1997; Pajares, 1992) and its theoretical boundaries (Hofer, 2016; Sinatra, 2016); and psychometric inadequacy (Chinn et al., 2011). The inability to settle on common language and conceptual

definition is especially ironic, considering the field's epistemological philosophy roots and the meticulous care for language and meaning that characterizes philosophical discourse.

Issues of Terminology

Greene and his colleagues (2016) observed that language around epistemic cognition is bound to be an imprecise idea, subject to differences in interpretation, since philosophers and researchers are still parsing epistemic versus epistemological versus ontological, the distinction between cognition and belief, and the precise definition of knowledge and what it means to know. Consequently, research terminology has been characterized by a variety of related, but not well-agreed upon, labels to refer to individuals' cognitions around knowledge and knowing, typically with some variant of the word epistemology: "epistemological reflection" by Baxter Magolda (1992); "personal epistemology" (Hofer & Pintrich, 2002); "epistemological beliefs" (Schommer-Aikins & Hutter, 2002); "epistemological resources" (Hammer & Elby, 2002) and "epistemic cognition" (Kitchener, 1983). The disunity among researchers around nomenclature has made the psychological study of knowledge and knowing a challenge, leading Tafreshi and Racine (2015) to suggest that differences in theoretical concepts cannot be resolved before psychologists establish clarity about fundamental labels.

It is unlikely that most individuals have a "personal epistemology," or explicit theory around how knowledge is attained, authenticated as truth, and justified (Alexander, 2016; Greene et al., 2016; Muis & Franco, 2009), leading R. F. Kitchener (2002) to question the use of the word "epistemology" to describe the psychological context of individuals' cognitions related to knowledge. Greene and colleagues (2016) proposed the phrase *epistemic cognition*, first used by K. S. Kitchener in 1983, to refer to the field of study that is concerned with "how people acquire, understand, justify, change, and use knowledge in formal and informal contexts" (p. 1). Barbara

Hofer (2016) has expressed optimism that the use of *epistemic cognition* might unify researchers in a wide range of disciplines who seek greater understanding about how individuals develop and use knowledge.

Although the term "epistemic cognition" still requires further clarity and specificity (Sinatra, 2016), Greene, Azevedo, and Torney-Purta (2008) argued that it (unlike previous assigned labels) "emphasizes knowledge and the processes involved" in acquiring and using knowledge (p. 143). In an essay investigating epistemic cognition for the information age, Strømsø and Kammerer (2016) simplified the definition of "epistemic cognition" to mean "cognitions related to knowledge and processes of knowing" (p. 231). That definition is especially appropriate for and will be used in this study, as it is focused on the cognitive processes underlying knowledge and acquisition of knowledge, but flexibly allows for the inclusion other possible facets of epistemic cognition, especially *epistemic beliefs* about the ways knowledge is transmitted, assumptions about whether that knowledge is simple or complex, and assumptions about the reliability of information sources such that existing beliefs could change (Bricker & Bell, 2016).

Conceptual and Theoretical Imprecision

Besides the difficulties settling on a common terminology, Hofer and Pintrich (1997) noted that the construct of epistemic cognition had significant conceptual challenges. Examining two decades of previous models and research methodology, the authors explicated major threats to the quality of epistemological knowledge including a lack of clarity about the concept. In 2007, Greene pointed out that ten years after Hofer's and Pintrich's writing, the field seemed no closer to settling on definitional clarity. And now more than ten years after Greene's 2007 observation, there are still significant discrepancies between epistemological models; a lack of

consensus about whether epistemological issues are domain-specific or –general; and questions about the boundaries of an epistemic cognition theoretical framework, vis a vis constructs like motivation and metacognition (Sinatra, 2016).

Sinatra (2016), expressed concern that the study of epistemic cognition had gone too far afield and that there was a need for "putting 'cognition' back in epistemic cognition" (p. 480). She noted investigations by herself and her colleagues examining epistemic motivations (Sinatra, Kardash, Taasoobshirazi, & Lombardi, 2012) epistemic emotions (Muis et al., 2015), epistemic virtues (Chinn et al., 2011), and epistemic beliefs. She urged researchers to carefully consider the boundaries of what should be considered epistemic *cognition* and what may be related but separate concepts. In particular, Sinatra criticized her peers for conflating epistemic beliefs and epistemic cognition, which she considered not at all the same idea.

This paper investigates teachers' beliefs about what is true for teaching and learning as a matter of epistemic cognition, on the basis of argument put forth by Hofer and Pintrich (1997). The authors, attempting to refine the operational definition of *epistemic cognition*, questioned whether beliefs about learning and teaching could be correctly considered part of the domain. The authors acknowledged that for conceptual clarity, it was reasonable to assume that only individuals' ideas about knowledge, reasoning, and justification should be considered to be epistemic cognition. "On the other hand," they wrote, "beliefs about learning and teaching are related to how knowledge is acquired, and in terms of the psychological reality of the network of individuals' beliefs, beliefs about learning, teaching, and knowledge are probably intertwined" (p. 116).

Psychometric Issues

Finally, across four decades of epistemic cognition literature, the subtheme of measurement challenges is apparent. Because reliable measurement of any construct is tightly aligned to theoretical clarity, it follows that there is a lack of consensus around both *what* should be measured and *how* to measure the construct (Chinn et al., 2011; DeBacker, Crowson, Beesley, Thoma, & Hestevold, 2008; Mason, 2016). Classic approaches that have gauged cognitive reflection (Baxter Magolda, 1992), thinking skills (King & Kitchener, 1994), developmental indicators (Belenky, Clinchy, Goldberger, & Tarule, 1986; Perry, 1970), and beliefs about the nature of learning (Schommer, 1990) have met with limited success (Mason, 2016). Chinn and colleagues (2011) suggested that the psychometric inadequacies of current measures of epistemic cognition demonstrate the shortcomings of current theoretical models and encouraged psychologists to continue to develop a cohesive framework. The inability of current instruments to meet psychometric criteria for reliability and validity influenced the methodology of this study, in that it directed the survey design away from measuring participants' epistemic development stage or position, and instead asked respondents about specific epistemic beliefs.

Review of Epistemic Cognition Research

In light of terminology challenges discussed above, a survey of research was conducted using several search key phrases: *epistemic cognition*, *personal epistemology*, *epistemological beliefs*, and *epistemic beliefs.* Generally, the resulting literature was organized around three major lines of study: unidimensional models centered on developmental changes in individuals' epistemic cognition, multidimensional models to clarify and refine the earlier developmental models; and exploration of constructs and contexts that have a theoretical relationship to epistemic cognition. Although an exhaustive review of all epistemic cognition models, model

clarifications, and model expansions is beyond the scope of this literature review, what follows is a review of frequently cited models that center the process of source justification by adults (the cognition and population of interest in this research).

Unidimensional Developmental Frameworks of Epistemic Cognition

Educational philosopher Noddings (2012) examined the role of educational philosophers in developing the contemporary understanding of epistemology as a matter of educational psychology. Educator and philosopher John Dewey, she noted, shifted the discourse such that "the line between epistemology and psychology becomes blurred, and we can no longer study knowledge without studying the knower" (p. 117). Dewey was most interested in how an individual's cognitions related to knowledge and knowing might impact learning across the lifespan, a stance Noddings called *nonfoundational* because it placed less importance on the absolute certainty of truth, and more on individual outcomes.

Piaget, the Swiss psychologist who pioneered the study of cognitive and epistemological development, also placed greater emphasis on traits of the knower than the justifiability of truths; Hofer (1997) positioned that work as a rebuke of behaviorism, which had essentially denied the importance of individual trait differences in the learning processes. Piaget considered his work not psychology, but genetic epistemology (Niaz, 1992) because it centered around the ways people develop knowledge according to a set of universal and predictable stages. Piaget's framework, which emphasized the development of epistemological sophistication, inspired later researchers to describe the ways individuals weigh and define knowledge throughout the lifespan. This influence is especially evident in the work of William Perry, who laid the foundation for a body of research on the developmental nature of epistemic cognition.

William Perry's Scheme of Intellectual Development. The developmental aspect of epistemology set forth by Piaget has continued importance to psychologists' understanding of epistemology. When William Perry began studying Harvard University students in 1950 to investigate how they interpreted the college experience, he noticed differences in how the young men understood what constituted truth, or "real" knowledge. Over many longitudinal interviews, Perry determined that the ways students evaluated sources of information and thought about knowledge began to develop in late adolescence and continued into adulthood (1970), making Perry the first to describe epistemic stages and development in adults. Because the focus of Perry's work centered around understanding the knowledge of students, and their strategies for distinguishing between truth and beliefs, Perry quite naturally referred to the phenomenon as epistemological development, which he conceptualized as a hierarchical stagelike process, in which cognitive disequilibrium acted as a catalyst for change from one stage or "position" to another. He pointed out that advancing from one position to the next (more complex) way of knowing seemed to correspond to shifts in learning strategies and source evaluation methods (1981).

Perry explicated nine positions in his scheme of epistemological development, which since have been clustered into four broader categories by contemporary researchers (Hofer, 1997; Moore, 1994): *dualism*, *multiplicity*, *relativism*, and *commitment within relativism*. Dualist epistemology, the least sophisticated position, was rarely found by Perry in his research subjects. Dualism is associated with belief in absolute and knowable truths that are derived from authority, and unchanging. Students categorized as dualists trusted that all problems had correct and incorrect solutions, and that "knowing" meant learning the correct answer from an authoritative source. Multiplist viewpoints acknowledge that experts may have divergent opinions about a

subject, but that those opinions are equally valuable; while multiplist students acknowledged that some problems do not have solutions, they inferred the ambiguity to mean that all opinions about solving them were valid, regardless of expertise.

Perry considered the relativistic epistemological position a turning point, in that once thinkers could be categorized as relativists, they would remain so throughout the lifespan. Relativist students saw knowledge and truth as contextual and pointed out that there may be different methods of finding truth, depending on the subject area. Unlike simpler thinking characterized by multiplism, relativistic epistemology acknowledges that some solutions are better than others, and it is the learner's task to evaluate the quality of those, in the context of the problem. The final position, commitment within relativism, was very rarely observed in Perry's research subjects (Hofer, 1997), but he conceptualized an epistemological stage in which learners were fully committed to relativistic reasoning strategies as the dominant way of thinking, including continuous evaluation of sources and the examination of new information against what is known. Students in this position took responsibility for examining current beliefs against updated knowledge as a lifelong process.

Perry's research was the catalyst for a flurry of epistemic cognition theories that were developmental in nature, and his Scheme for Intellectual Development is considered the basis of the epistemic cognition field (Hofer & Pintrich, 1997). Although nearly all of the ensuing epistemic cognition models were clearly derived from Perry's foundational work (Hofer & Pintrich, 1997), they generally sought to investigate epistemic development in more diverse populations, to examine the ways culture and context influence that development, to refine methods for measuring those stages, and to describe in finer detail the sequences and processes that are involved as individuals develop the capacity for more sophisticated epistemic cognition.

Although most of the extending studies of Perry's framework found relatively minor reorganizations or points of departure, the study of women's epistemological development, in particular, indicated significant differences in how women come to know and justify what they know.

Women's Ways of Knowing. Perry's developmental scheme, justifiably criticized for its sole basis in interviews with Ivy League college-aged men, was expanded to investigate the individual differences in epistemological development in women (Baxter Magolda, 1992; Belenky et al.,1986). For their book *Women's Ways of Knowing*, Belenky and her colleagues interviewed 135 women from a variety of backgrounds and found that women's epistemological "perspectives" (a word they preferred to "stages") did not exactly match the scheme Perry proposed for men. First, the authors wrote, although the women they interviewed did experience change in their perspectives, they could not be certain that these changes progressed developmentally. And second, women's ways of knowing were profoundly impacted by cultural values and standards, and a society that associated intellectual work with maleness.

Belenky and her co-authors posited five epistemic cognition perspectives observed in the women they studied: *silence* (in which women perceive themselves as voiceless and compelled to silence by dominant authority), *received knowledge* (a position in which women feel that they are capable of receiving knowledge from authority, but not of creating or evaluating it reliably), *subjective knowledge* (a position in which truth is perceived as personally intuited and often privately derived and justified), *procedural knowledge* (in which women assume that they are capable of learning how to obtain and communicate knowledge for themselves), and *constructed knowledge* (a perspective characterized by sophisticated ideas about the complexity and knowledge and ways of justifying truth). Because teaching is often characterized as a majority

female profession, it's possible that these stages have additional relevance to studying teachers' beliefs overall.

But theorists have generally cautioned against a gender-focused approach: although *Women's Ways of Knowing* had been written to represent women's epistemic development, some have criticized the work for excluding men and therefore ignoring questions about whether and how epistemic development differed between genders. Ensuing models have largely abandoned gender-specific development, and focused on how adults, generally, come to know and justify what they know, a process King and Kitchener called "reflective judgment".

King and Kitchener's Reflective Judgment Model. Working with Karen Kitchener (1994), Patricia King interviewed more than 1,700 people (of both genders and multiple ethnicities) to investigate the relationship between epistemological development and critical thinking. Kitchener (1983) had already endorsed a developmental epistemological framework, that the ability to solve ill-structured problems—those without a single or clear solution—developed from childhood. With some changes in terminology, King and Kitchener (1994, 2004) generally accepted Perry's scheme, but disagreed with him that the final stage of "commitment in relativism" represented epistemic development. Instead, King and Kitchener's Reflective Judgment Model described the development of more sophisticated cognitions around the processes of monitoring "knowledge about the limits of knowing (e.g., some things can be known, and others cannot), the certainty of knowing," and ways of justifying that knowledge (p. 225).

Studying adolescents and young adults, the researchers observed how participants approached ill structured problems. The least sophisticated level, *prereflective thinking*, was characterized by a view that truth is absolutely certain, and that answers are knowable and

derived from authority. To solve ill-structured problems or controversy, prereflective thinkers posited, one must simply find the expert who knows the answer. Second level thinkers, called *quasiflective* by King and Kitchener, acknowledged that some truth is unknowable and that not all ill-structured problems have definite answers; therefore, they believed, any opinion is as valid as another. Quasireflective thinkers could not successfully weigh competing knowledge claims and evidence, and viewed differing points-of-view as subjective truth—the views are true for the holder, so truth could be considered context-dependent. Finally, *reflective thinking* was categorized by strategies for weighing competing evidence, for acknowledging that some problems do not have certain solutions, but that good judgements could be made using reflection. Reflective thinkers acknowledged that some truths change, in light of new and better evidence; although there are still questions around the catalysts for reconsideration of beliefs, the importance of critical and reflective thinking is of special relevance to the kind of belief change examined in this study.

Although King and Kitchener's model is developmental in nature and clearly based on Perry's scheme, the authors found that individuals' thinking did not develop in a linear fashion. Individuals could exhibit more than one stage of thinking at a time, and that transitions between stages were gradual and not step-like. King and Kitchener (2004) observed that while high school students were consistently prereflective, the college years were marked by a gradual shift toward more sophisticated thinking; true reflective thinking, however, was only used with consistency by advanced doctoral students, leading some to wonder whether stagelike models should be replaced by frameworks that recognized the dynamic and individual nature of epistemic cognition development.

Clarifying Developmental Models: Multidimensional Epistemological Framework

Though a good deal of epistemic cognition research is grounded in stage-organized developmental schemes, more recent models have suggested that individuals' ways of knowing and justifying truth develops in ways that are more fluid, individualistic, and recursive. One such framework that has gained increasing favor is the Multidimensional Epistemological Framework developed by Hofer and Pintrich (1997). Although, as with previous frameworks by Perry and others, Hofer and Pintrich placed individuals along a continuum of epistemic thinking that develops from less to more sophisticated, the authors stressed that knowledge acquisition and knowledge justification are multidimensional processes that can be influenced by affect, domain, and context and can develop asynchronously (Feucht & Bendixen, 2010).

Hofer's and Pintrich's framework has been important to epistemic cognition researchers since its introduction (Bråten et al., 2011; Chinn et al., 2011; Strømsø & Kammerer, 2016). While some theorists have challenged its completeness (Chinn et al., 2011; Hammer & Elby, 2002; Muis et al., 2006) and aspects of its scope (Greene et al., 2008; Strømsø & Kammerer, 2016), for the past two decades, there has been widespread acknowledgement in the field of the usefulness and adaptability of its general structure (Chinn et al., 2011; Greene et al., 2008; Strømsø & Kammerer, 2016).

Hofer and Pintrich (1997) began their study by conducting an exhaustive review of current understandings of epistemic cognition and its development. They found two general areas that had organized previous models, and that were of use for framing future conceptions of epistemic cognition: the *nature of knowledge* itself, and the *nature of knowing*. In turn, each of those broad areas was comprised of two dimensions, yielding four dimensions to frame epistemic

cognition theories, all constituted by continua of simpler to more sophisticated cognitions (Fig.1).

Dimensions that made up *nature of knowledge* were *certainty of knowledge* (the degree to which knowledge is absolute or tentative) and *simplicity of knowledge (*whether it is represented by a collection of discrete facts or contextual and interrelated). For discussion about the second general area (the *nature of knowing*), Hofer and Pintrich posited that differences could also be found along two dimensions: *source of knowledge* (external authority or self-constructed) and *justification for knowing* (reliance on authority or sophisticated methods for evaluating claims). The *justification for knowing* dimension has been criticized for its lack of specificity and development (Greene, 2007). Hofer and Pintrich describe it in two sentences, one of which is mostly a definition of source justification: "This dimension includes how individuals evaluate knowledge claims, including the use of evidence, the use they make of authority and expertise, and their evaluation of experts" (p. 120).

What is the nature of knowledge?	What is the nature of knowing?
Certainty of knowledge: Is knowledge absolute or tentative?	*Source of knowledge:* Do authorities have the answers or can knowledge be created by me?
Simplicity of knowledge: Is knowledge a simple collection of facts or a complex structure of interrelated ideas?	*Justification for knowing:* How can I be sure that I know something and that my sources were reliable?

Figure 1. Hofer and Pintrich's Multidimensional Epistemological Framework.

Hofer (2004) argued that the dimensions represented in the multidimensional framework function more as a set of interconnected personal theories for knowledge and knowing than

separate beliefs, and have strong effects on the metacognitive strategies individuals use. For example, low levels of sophistication on the *source of knowledge* dimension may cause a student to reach a conclusion about a topic after reading a single newspaper article. A teacher who believes that authorities have the answers might discourage students from inquiry-based learning in favor of reading from the textbook.

Hofer and Pintrich's model is important for this study in several ways. First, it represents a distillation of many previous models that found generally that a person's ideas about "true beliefs" and how they are verified drive conceptions of epistemic cognition. Second, in contrast to the tightly stage-organized theories set forth by Perry (1970), King and Kitchener (1994, 2002), and others (Baxter Magolda, 1992; Kuhn, Cheney, & Weinstock, 2000; Schommer, 1990), the multidimensional framework allows for a more fluid and recursive developmental process for personal epistemology; although individual change along the dimensions occurs in predictable ways, the process is dynamic. In particular, the framework accommodates insights from the literature on conceptual change, including the roles of belief strength and context (Feucht & Bendixen, 2010), and individuals' epistemic beliefs about the best ways to evaluate competing claims (Briell, Elen, Verschaffel, & Clareabout, 2011; Hennessey et al., 2013; Lunn et al., 2015). The Hofer and Pintrich model, because it separates epistemic beliefs about the nature of knowing into two dimensions: source of knowledge and justification for knowing, is of particular use for this study about teachers' pedagogical beliefs, and for investigating how teachers have been exposed to VAK ideas and how they have justified those claims.

Epistemic Beliefs

Some researchers have not recognized a distinction between epistemic cognition and epistemic beliefs (Bråten, Ferguson, Strømsø, & Anmarkrud, 2013; Chen & Barger, 2016;

Schommer-Aikins, 2004), using the terms interchangeably in ways that suggest that the phrase "truth is knowable," for example, is both epistemic cognition *and* epistemic belief. But a few have found this thinking problematic in that it confounds epistemological claims and ontological ones (Alexander, 2006; Greene, 2007; Greene et al., 2008). Ontological discussions are those about individuals' conceptions of reality (e.g., truth is simple/complex, and knowledge is certain/changing). Greene (2007) contended that these questions are not epistemological at all, but that they are questions surrounding fundamental aspects of knowing. Perceptions about *what knowledge is* are ontological questions, and the beliefs that people hold around the characteristics of knowing and truth are ontological ones (Alexander, 2006). The distinction has led Greene (2007) to suggest that a great deal of research conducted under the heading of *epistemic cognition* research is really *ontologic cognition* in nature and should be reclassified.

In light of that distinction, and to support conceptual clarity, for the purposes of this discussion, the term *epistemic beliefs* refers to the closely held and often implicit understandings that people have *about methods for acquiring and justifying knowledge*. Those beliefs are individuals' conceptions about the ways people learn, which strategies are most effective for determining whether information is true or valid, and the threshold for deciding that the reliability of a new source of information is good enough that existing beliefs should be updated (Bricker & Bell, 2016). Most succinctly, if epistemic cognition is thinking about knowledge, epistemic beliefs are the beliefs people have about what the most reliable ways are for gaining and validating that knowledge. To further distinguish the two, Sinatra (2016) has suggested that epistemic cognition is a dynamic process—individuals are constantly making and remaking the structures that comprise knowing, while epistemic beliefs (the ways individuals espouse for doing that remodeling) are more stable over time.

Beliefs about acquiring and justifying knowledge are a challenge to study, as they can be held consciously or unconsciously (Chinn et al., 2011; Clement, 2016; Murphy & Alexander, 2013), and have proven difficult to measure (Barzilai & Zohar, 2016; Greene et al., 2008). Clement (2016) points out that they have a strong metacognitive component, and that people generally have a poor idea about why they've decided something as truth. But Mason (2016) wondered whether the distinction between ontological beliefs and epistemic beliefs matters for measurement methods. Although it may be difficult for individuals to explicate what they think about the nature of truth, she points to study by Greene and colleagues to suggest that self-report Likert and questionnaire data can be used to establish what people believe about specific learning methods, the strength of that belief, and how they justify knowing. Schraw and Olafson (2015) endorsed this methodology and argued that for purposes of measuring one or more specific epistemic beliefs for statistical analysis, questionnaires are of particular utility.

In spite of the measurement and theoretical issues that seem to characterize nearly every part of the epistemic cognition field, epistemic beliefs are of a great deal of importance to researchers because they have been shown to have significant impacts on learning and student achievement. Beliefs about knowing and acquiring knowledge have been found to influence nearly every stage of the learning process. Sandoval (2005) found that students' ideas about source and certainty of knowledge impacted their ideas about whether inquiry was preferable to textbooks for learning science. Kardash and Howell (2000) reported that undergraduate students who believed that knowledge was derived from authority and certain were much less likely to reread text for understanding, paraphrase, or use context clues to determine meaning than students with more sophisticated epistemic stances. Similarly, when Mason and Boscolo (2004) asked 10th and 11th graders to read texts with competing claims about genetically modified food,

the students who believed that knowledge was certain (versus contextual) and fixed (versus changing) were much less likely to successfully evaluate the text's claims and draw reasonable conclusions.

But beliefs around what can be known and how knowledge is acquired impact more than learning skill or strategies; epistemic beliefs also impinge on learner traits. Paulsen and Feldman (2005) discovered a significant negative correlation (r^2 = -.39) between university students' belief that knowledge was simple and levels of intrinsic goal motivation and self-efficacy (r^2 = -.30). Although psychology researchers are in agreement about their importance, there has been some uncertainty around whether these effects function generally, or work in ways that are specific to academic domain or discipline.

It seems clear that epistemic beliefs function both domain-generally and domain-specifically (Buehl & Alexander, 2001; Hofer, 2000; Muis et al., 2006). "One might expect that when epistemic beliefs about physics … are compared to epistemic beliefs about psychology …, they may vary along some dimensions but are comparable on others" (Muis et al., 2006, p. 13). In spite of that general assumption, research foci around domain-related epistemic belief investigations have largely shifted to discovering *how* epistemic beliefs might differ across academic domains, and whether expertise in a specific domain impacts an individual's beliefs about learning the discipline.

Domain-specific, Domain-general

Discussions of epistemic beliefs in academic disciplines generally distinguish between technical fields (those that are well-structured like engineering, physics, and sometimes mathematics), and more ill-structured disciplines (e.g., history, psychology, and humanities) to investigate whether and how epistemic beliefs differ by domain (Buehl & Alexander, 2006;

Buehl & Alexander, 2004; Estes, Chandler, Horvath, & Backus, 2003; Hofer, 2000; Jehng, Johnson, & Anderson, 1993; Schommer-Aikins, Duell, & Barker, 2003). As might be expected, differences in epistemic beliefs between exact and social sciences were usually those related to whether or not the truth was knowable with certainty and finality; epistemic beliefs around the reliability of sources and methods for justifying sources, however, were often similar across disciplines (Muis et al., 2006; Sandoval, 2016).

The distinction between well-structured and ill-structured sciences is important, as beliefs that are domain-specific can contradict longstanding developmental models in important ways. Recall from the discussion of epistemic cognition models that a hallmark trait among them is the progression from simpler to more complex cognitions about the nature of truth and ways to justify knowing. In particular, "naive" epistemic cognition is categorized by the belief that knowledge is fixed, certain, and transmitted from authority, while more "sophisticated" thinkers view knowledge as tentative, changing, and self-constructed (Schommer, 1994). Schommer-Aikins (2002) wrote that sophisticated epistemic beliefs are those that support effective strategies for comprehending, studying and problem-solving. However Elby, Macrander, and Hammer (2016) pointed out there are problems given those theoretical assumptions in the exact sciences; the acceptance of Newton's law of motion (F = ma) as certain and correct is the more sophisticated stance for understanding physics, while a view of the law as tentative and apt to change would be unproductive.

The failure of common models to reconcile domain-specific assumptions in epistemic cognition development also makes obvious a problem with language; labeling beliefs naive and sophisticated has caused consternation in the field, with even Schommer-Aikins (2002) admitting that the terms seem more value-laden than she had intended. Muis (2004), searching for

nomenclature that reflected both domain-specific differences between belief utility, and neutral language, suggested *availing* and *nonavailing*. She defined availing beliefs as those "associated with better learning outcomes," while "nonavailing beliefs have no influence on learning outcomes or negatively influence learning outcomes" (p. 323). Muis has agreed that beliefs that may be availing in one area (e.g., that knowledge is derived from authority, on the topic of evolution) can be nonavailing in other domains (e.g., that knowledge is derived from authority, in the creative arts).

The Role of Expertise

Given those circumstances, it seems intuitive that expertise in a domain can influence epistemic beliefs, typically in more availing directions. Decades of cognitive and educational psychology studies affirm that experts in an area differ from novices in several ways: more sophisticated methods for claim evaluation, increased attenuation to relevant evidence, greater ability to solve ambiguous problems, and more facile access to helpful prior knowledge (Chi, Feltovich, & Glaser, 1981; Forbus, Gentner, & Law, 1994; Gick, 1986; Gick & Holyoak, 1983). The impact of expertise for heightening claim and source justification beliefs is not always predictive, however. Kuhn (1992), presented a group of 160 research participants of diverse age and backgrounds to evaluate competing claims to answer the ill-structured question, "What causes children to fail in school?" She found that the teachers in the participant pool were no better at evaluating claims or rating evidence quality than non-experts.

Kuhn's findings may be explained by research by Klaczynski and Lavallee (2005), who found that vocational identity was a significant predictor of reasoning biases. They presented high school and undergraduate students with a series of instruments to determine their commitment to their chosen occupations, the extent to which they identified with others in that

chosen profession, epistemic development, and intellectual ability. Next, they asked participants to read a series of nine hypothetical arguments, each of which involved personal observations or decisions that were based on small samples. For example, one argument explained that a woman named Sara knew six architects, all of whom abused their children; therefore, Sara had decided that architects were child abusers. Of the nine arguments that each participant read, six of those arguments were tailored specifically to the participants' chosen occupation—three casting the profession in a positive light, and three in a negative way. The other three of the nine arguments were neutral.

The authors found that more than age, intellect, or metacognitive abilities, the closely-held identities that individuals built around the occupations they held were the most influential factor causing individuals to reject solid evidence that was not in line with their professional identities, and to easily accept superficial evidence that confirmed to professional identity, possibly as a form of stereotype maintenance. Specifically, the authors found that the more strongly students identified with their future professions, the more robust the effect: students were better at seeing the problem with generalizations based on small samples when the conclusion portrayed their chosen vocation negatively, but did not as often note the logical flaw when the outcome was positive.

Pajares (1992) has also argued that the epistemic system, defined as the set of epistemic beliefs that an organization or group holds (Greene, 2016) is likely to be a strong driver of individual teachers' epistemic beliefs. He argued that the commonly held beliefs teachers have about education, for example, function as a set of shared values that provides cohesion, direction, a sense of belonging, and professional group identity. Once beliefs become central to identity (either of a person or group), they are especially resistant to change. Pajares cites Rokeach's

(1968) assumptions for belief systems as being especially pertinent to professional epistemic systems: the more beliefs are shared with or derived from others, the more intense and powerful they are and the more definitive they become of the group as a whole. These discussions are especially relevant to teachers' beliefs, which are focused on an extraordinarily wide array of ideas that include beliefs about self-efficacy, epistemology, learner attributes, content, and cognition.

Teacher Epistemic Beliefs

Student cognition—in particular, the ways that students receive and process information—is the primary purpose of teacher expertise. How students learn and understand, assimilate new concepts, the best practices for transmitting new information, and methods for fostering cognitive growth form the practical and theoretical bases of instruction. Therefore, part of the challenge for teachers is identifying students' needs and deciding the best instructional practices and tools to support the learning process. To make these decisions, teachers rely on epistemic beliefs about what it means to know and how to impart such knowledge (Gill & Fives, 2015).

Because fuzzy constructs and lack of agreement around terminology are hallmarks of epistemic cognition theory and research, it is no surprise that the term *teachers' epistemic beliefs* is often ill-defined and confusing (Fives & Buehl, 2012; Pajares, 1992). Reviewing several decades of research, Pajares (1992) found that the construct of teachers' beliefs had been referred to interchangeably in the literature as *practical knowledge, practical theories, professional knowledge,* and roughly a dozen other terms. Noting the contribution of Pajares, Hofer and Pintrich (1997) attempted to further establish theoretical boundaries, beginning with the most basic issue: they wondered whether the beliefs that teachers hold about learning and teaching

could rightly be considered *epistemic beliefs*. Certainly, they wrote, beliefs about pedagogy do not exactly align to more philosophical epistemic questions that relate to the nature of knowledge and knowing. The authors allowed, however, that "beliefs about learning and teaching are related to how knowledge is acquired," (p. 116) making them, by definition, epistemic beliefs.

Reviewing the body of research about the nature of teacher beliefs, Buehl and Fives (2016) noted the imbalance between the large volume of studies about students' epistemic beliefs and the scant number of published research on epistemic beliefs of teachers, which they found surprising, since teachers are tasked with "both learn[ing] and design[ing] contexts for the learning of others" (p. 248). Just as the epistemic beliefs of learners impact every part of the learning process, teachers' beliefs (availing and nonavailing) also play a pivotal role in either promoting student learning or preventing it (Duffy et al., 2016; Lunn et al., 2015; Trevors, Muis, Pedrun, Sinatra, & Muijselaar, in press).

Fives and Buehl (2008, 2010, 2012) described the voluminous amount of research describing teachers' beliefs about a variety of topics, including beliefs about classroom management, beliefs about subject matter, beliefs about their own identities as teachers, beliefs of self-efficacy, and beliefs about pedagogical practices. Surprisingly, in light of the myriad topics that have been explored, Greene (2016) wrote that fundamental aspects of teachers' pedagogical beliefs have been ignored:

> It would be intriguing to investigate how teachers make …source evaluations, how those evaluations influence their pedagogy, whether these evaluations have any influence upon how teachers instruct students in … epistemic cognition, and whether source evaluations are updated based upon additional information (e.g. if new information suggests that a source previously determined be reliable should be reclassified as unreliable). (p. 273)

This section of the literature will summarize aspects of the research about teachers' pedagogical beliefs that are relevant to this study, including the sources of those beliefs, and the nature of teachers' belief change.

Epistemic Beliefs about Pedagogy

The magnitude of the importance of teachers' beliefs for classroom practice has been examined across decades (Kagan, 1992). Gill and Fives (2015) have noted that while a good deal of study related to teachers' pedagogical beliefs has been in the context of a specific content area (e.g., epistemic beliefs of science teachers about the role of experience in knowing, mathematics teachers' beliefs about the value of talk-aloud practice), relatively little attention has been paid to domain-general or general pedagogical beliefs. Because there is evidence that teacher beliefs act as filters to limit the instructional practices teachers consider (Alger, 2009), and because a good deal of teaching practices are general pedagogy, (i.e., not bound by subject or content), understanding teachers' domain-neutral epistemic beliefs is important for gaining a better understanding of classroom practice (Barnes, Fives, & Dacey, 2015; Dolphin & Tillotson, 2015; Donaghue, 2003; Rubie-Davies, 2015).

In a meta-review of studies, Chiavola and her colleagues (2014) found that "beliefs influence practice, practice influences beliefs, beliefs and practice have reciprocal relationships, and practice and beliefs can be disconnected" (p. 13), a set of premises that I have categorized into *unidirectional relationships*, *reciprocal relationships* and *disconnected relationships* for organizational ease in this review.

Unidirectional relationships from belief to practice. Exactly how and to what extent teachers' epistemic beliefs influence their classroom practice has been a topic of ongoing debate. Fives and Buehl (2012) have argued that while there is a good deal of research showing a

connection, so have there been quite a few that have failed to tie teacher beliefs to student outcomes, raising questions about whether teachers enact the beliefs they espouse. However, it is possible that examining the effects of teachers' beliefs on student learning outcomes is not the ideal method for evaluating whether or not teachers enact their beliefs, since there are a great number of unrelated factors that may impact student learning.

Instead of using outcome measures, Brown and his colleagues (2012) questioned teachers about specific pedagogical beliefs, then followed up with self-report instrument to determine whether or not those beliefs were being enacted in instruction. They found that the availing beliefs the teachers held were significant predictors of what was used in practice, a conclusion that is supported by other studies across several contexts (Song & Looi, 2012; Wilkins, 2008). Specifically, Brown's team devised an instrument aimed at exploring teachers' conceptions of feedback, including its perceived benefits (e.g., student improvement, motivation, none), and another survey that asked each teacher to indicate from a list of 17 commonly used classroom practices which they used. Using structural equation analysis, the researchers found teachers in the sample (n = 518) generally enacted their beliefs about the value of feedback (especially for those teachers who believed that feedback increases and supports student autonomy). Interestingly, teachers who believed that feedback was useful for building students' self-esteem did not as often use the technique for this purpose.

Added to the importance of teachers' beliefs for instruction, the enacted beliefs that teachers hold contribute to a classroom's *epistemic climate* (Bendixen & Rule, 2004; Feucht, 2010; Muis & Duffy, 2013), which is defined as "facets of knowledge and knowing that are salient in a learning … environment" (Muis and Duffy, 2013, p. 213). Teachers beliefs influence the classroom epistemic climate in three direct ways: through the instructional methods that

teachers choose, via the texts and educational media selected by teachers, and through the ways that teachers conduct class discussions and collaborations with their students (Alger, 2009; Schraw & Olafson, 2002). Johnston and colleagues (2001) observed that teachers who viewed the nature of knowledge as fixed and authority as the best source of knowledge were more likely to use lecture in their own teaching, using worksheets and authoritative texts. Conversely, teachers who believed knowledge is changeable and self-constructed were more likely to report the use of collaborative and inquiry-based methods.

Hofer (2001) has indicated a belief that a one-directional relationship exists from teachers' epistemic beliefs to classroom epistemic climate to epistemic beliefs of students, but the extent to which epistemic climates in individual classrooms are transmitted to students is not completely clear, and there has been scant research investigating the idea. Assuming such a relationship exists, it appears to function both explicitly and implicitly, but little is known about the mechanism of the transmission, the extent to which the influence is unidirectional or reciprocal, the speed at which it occurs, or how long-lasting the effects might be (Feucht, 2010; Muis & Duffy, 2013). In an effort to establish whether students' epistemic beliefs changed as a result of epistemic climate, Muis and Duffy (2013) devised an experiment in which the instructor of a college statistics course fostered a constructivist epistemic climate (e.g. collaborative learning, discussion, and student inquiry). Compared to the control group (where no effort was made to effect an epistemic climate and the instructor used more traditional methods), students in the intervention class exhibited significant positive changes in their epistemic beliefs, including beliefs about the nature of knowing, the sources of knowledge, and effective strategies for acquiring knowledge; measurements of students' beliefs revealed shifts toward constructivism as quickly as 8 weeks into the intervention.

Although the research that supports a belief to practice connection is compelling, there is still some uncertainty around the strength of that relationship and whether other factors (e.g., administrative requirements, scheduling pressures, high stakes testing and pacing guides) impact the relationship. Studies of a quantitative nature have found statistically significant relationships, but relatively weak effect sizes. Qualitative studies that have relied on observations, lesson plan analyses, and reflective journaling have added to the evidence that beliefs are enacted in practice but cannot examine for factors and relationship strength on a large scale.

Unidirectional relationships from practice to beliefs. It is also clear that practice can influence teachers' epistemic beliefs; as one teacher observed, how to teach "is taught at the college level some but mostly *by getting in there and teaching—I learned best just doing it*" (Buehl & Fives, 2009, p. 383, italics in original). The influence of practice on epistemic beliefs is most obviously illustrated by classroom experiences and their connection to change in preservice teachers' beliefs in self-efficacy (Tshannen-Moran & McMaster, 2009), an idea which lies at the heart of the value of preservice teacher clinical experiences.

But there is also evidence that day-to-day teaching experiences can change beliefs, even among veteran teachers (Alger, 2009; Buehl & Fives, 2009). Alger (2009) asked 110 secondary teachers to reflect about how their current ideas of teaching different from their early career beliefs; she found that teachers reported that their beliefs had shifted from teacher-centered classroom practice to more student-centered pedagogy. Simmons and her colleagues (1999) also noticed such a shift, with first year teachers endorsing many more "teacher as the driver of learning" views than third year teachers, who were more likely to view the teacher as a guide for student learning.

Teachers' epistemic beliefs can also be influenced by the students they teach and have experience with. Pointing to previous research that suggested that teacher preparation courses can have profoundly negative influences on teachers' beliefs about special education, Swain and colleagues (2012) surveyed preservice teachers before and after a course that included a field component working with special needs students. They found that the experience had significant positive effects on teachers' beliefs, especially around the feasibility and value of inclusion of special education students in regular education classrooms. Taken together these results suggest that day-to-day classroom practices also influence what teachers believe about students, good teaching, and methods. These findings, coupled with the line of research showing that beliefs influence practice, foster a more plausible possibility: that the relationship between beliefs and practice is bi-directional or reciprocal.

Reciprocal relationships. Some researchers have criticized one-directional belief-practice conceptions as simplistic, noting that the relationship between beliefs and practices is usually interactive and dynamic (Fives & Buehl, 2012; Richardson, 1996). Richardson wrote that "beliefs are thought to drive actions; however, experiences and reflection on action may lead to changes in and/or additions to beliefs" (p. 106). Also, teachers may enter a particular school context with a set of beliefs that they enact in the classroom and change their opinions about what works depending on school context, the students they teach, and the curriculum.

For example, Southerland and colleagues (2011) discovered that when teachers characterized their students as difficult to manage or lacking motivation, they were less likely to believe that those students could learn science and therefore less likely to implement inquiry-learning practices. To investigate further, the researchers studied the thinking of practicing science teachers who were enrolled in a master's level course titled "Teaching Science in Diverse

Classrooms." Although the teachers in the course could agree that their students' challenges in science could be functions of non-dominant culture membership or SES bias; they vigorously resisted the professor's suggestion to consider their students through race-related or SES-focused lenses and teach science in ways that were more congruent with those group memberships. Teachers in the study characterized that idea as racist regardless of noble intentions; one student wrote that such practice could be "a crutch that limits our understanding of students as individuals" (p. 2201). After teaching in the south, however, that teacher came to write

> I have … sought to view my kids as individuals … instead of their commonality of race. But THEY (researchers' emphasis) do not see life that way. … (W)hether race is a physical or cultural attribute, the fact is in South Georgia, it is everything. (My students) define themselves through race; for me to deny it is to deny their values…. The mindfulness of (the importance of race identity) is an incredibly powerful tool for an educator. (p. 2201)

As one teacher in a study by Buehl and Fives (2009) explained it, "the knowledge of how to teach comes from experience. It comes from *synthesizing everything you've learned* and spitting it back into your environment" (p. 384, italics in original).

Disconnected relationships. A fourth alternative to one-directional (beliefs influence practice, practice influences beliefs) and reciprocal (beliefs and practice are interactive) relationships has been also noted: teachers can enact classroom practices that do not mesh with their own beliefs, and they can believe things that they do not enact into practice (Calderhead, 1996; Woolfolk Hoy et al., 2006). Because curricula, texts, and practices are often chosen by administrators and boards of education, teachers do not have complete control over the practices they enact; Pedersen and Liu (2003) found convincing evidence that teachers experience real

cognitive dissonance, which they attributed to administrative mandates requiring practices that conflicted with their beliefs. The teachers in Lee's (2009) study explained the disconnect through institutional factors or administrative pressures: school policies, principals' requirements, the pressure of testing schedules.

Lee argued that these given reasons may have been "mere excuses that teachers use to justify their practices," and urged researchers to ask teachers to explain the disconnect between their espoused beliefs and enacted practices (p. 19). Lee's recommendation was followed in this study; teachers whose beliefs and practice were discrepant (i.e., they believed in VAK but did not use in practice or vice versa) were explicitly asked to explain their reasons for enacting practices they did not believe or give an explanation about why they were not applying pedagogical theory they felt had validity.

Belief Sources

Teacher belief research spans more than a half century (Fives, Gill, & Ashton, 2014), but there is not a great deal of published investigations that focus on the sources of teachers' beliefs (Levin, 2015). It is evident that they are based in part on teachers' own previous experiences as students in K-16 classrooms (Kagan, 1992; Lortie, 1975), their formal teacher education including inservice professional development (Fives, Lacatena, & Gerard, 2015), and in their day-to-day teaching (as discussed earlier in this review; Calderhead, 1989; Tschannen-Moran & Hoy, 2007; Zahorik, 2005), but the relative importance of each of these for driving belief formation is still under study.

Attempting to describe pedagogical belief sources in preservice teachers, Levin and He (2008) quantified the degree to which teacher epistemic beliefs are derived from the preservice teachers' own K-12 educations (35%); their teacher preparation coursework (31%); and their

preservice clinical experiences (35%). Five years after the original study, Levin and her colleagues (2013) followed up, asking 22 of the original study participants (by that time inservice teachers) about the sources of their current beliefs. They found that the teachers' own K-12 educations (27%), their teacher education coursework (28%), and their classroom experiences (24%) still accounted for the bulk of their beliefs as teachers. Inservice professional development and observing other teachers together contributed the remaining roughly 20%, which may indicate that the longer beliefs are held by teachers, the more influential and resistant to change they are.

Buehl and Fives (2009) asked preservice and practicing teachers' questions about the sources of their epistemic beliefs about teaching, including "Where does the knowledge of how to teach come from?" (p. 375) After coding the open-ended responses, the authors identified six general areas most often named by teachers, including formal preparation; other sources of information (including internet resources, educational research, and books); observations of and collaborations with other teachers; personal experiences (e.g. their own schooling, their classroom experiences), and self-reflection. To validate and extend Buehl and Fives findings, these original belief sources were included in the instrument for this study.

The authors noted that the question they asked (about where knowledge of teaching comes from) was broadly phrased and did not request that teachers identify sources of specific classroom management beliefs or about particular teaching strategies. They proposed that future studies inquire directly about specific beliefs using concrete language and give teachers the option of naming formal information sources, individual experiences, or peer influences. That suggestion was adopted for this study, in which teachers were asked to give specifics about the

influences that shaped their current beliefs in VAK, and were asked to write in responses that were relevant but not listed.

Belief Change

The difficulty of activating epistemic belief change in teachers is well-documented, and researchers have noted that teachers generally disregard information that challenges beliefs derived from their own (or colleagues') personal experiences (Alger, 2009; Fives & Buehl, 2012; Wideen, Mayer-Smith, & Moon, 1998). Donnell and Gettinger (2015) examined 209 teachers' responses to a Wisconsin state-mandated education reform initiative (Response to Intervention, RTI) and found that teachers who held pre-existing beliefs that were generally congruent with RTI principles were more likely to accept the top-down reform initiative; the importance of belief congruence (Cronbach's $\alpha = .65$) was more importance for acceptance than teachers' self-efficacy about implementing RTI (Cronbach's $\alpha = .4$) or the amount of RTI professional development they had received (Cronbach's $\alpha = .4$).

Because teachers' beliefs influence teacher practices (Alger, 2009), it follows that inservice training or professional development that aims to change teachers' practice is unlikely to be effective without addressing their beliefs (Gill & Hardin, 2015). Even in preservice teachers, whose beliefs may not be well-formed or longstanding, Lortie (1975) warned that teacher education programs could not address prior misconceptions and nonavailing beliefs about practice without a thorough understanding of what teacher education students believe, the source of those beliefs, and a sense of their stability and malleability.

Teachers' heavy reliance of personal experiences to justify their beliefs is difficult to counteract. Kagan (1992) pointed to a body of evidence that suggested that teachers do not read

and apply scholarly research to their practice, especially if it conflicted with their beliefs. Even when teachers judged the new information to be reliable, they filtered it through their own beliefs and enacted it in ways that fit into their own pedagogy (Ashton, 2015; Kagan, 1992; Zembylas & Chubbuck, 2015). Kagan noted that the reliance on experiences and colleagues' experiences was so powerful for forming teacher beliefs that student teachers were more influenced by their supervising teachers in student teaching, than they are by their university professors and coursework.

The heavy reliance on personal experience to justify beliefs has practical implications that are important: if individuals believe that actual classroom teaching is the only reliable source of information about teaching, they are unlikely to attend to, believe, or implement the latest information about effective practice. Buehl and Fives (2009) worry that "preservice teachers may decide that they will learn what the really need to know when they … enter their own classrooms" (p. 402).

Beliefs that are based on personal experiences are difficult to counteract with argument—when teachers notice that a practice seems to work in a classroom context, there is little impetus to change regardless of educational research. Bondy and colleagues (2007) found that teachers were much more trusting of strategies that had been endorsed by their colleagues than ones that were informed by "a research basis." The relative lack of importance that teachers put on research has been cited to explain teachers' belief in practices that have face validity but lack empirical evidence to support their effectiveness; one category of these nonavailing ideas has been dubbed "neuromyths." Although they are derived from often groundbreaking neuroscientific discovery, they have been shown to be of little (or uncertain) use for education; they are discussed in the next section.

Neuromyths

Although the notion of a profound relationship between psychology and education seems obvious, scholars generally credit Edward L. Thorndike for being the first to connect empirical psychological research using contemporary statistical analysis to investigate and determine classroom best-practice (Hunt, 2007; Tomlinson, 1997). Working at Columbia University's Teacher's College, Thorndike believed that education was an applied science, and that the modern industrial needs of an educated labor force could be met most efficiently if teachers and schools used scientifically validated and quantifiable methods. Thomlinson (1997) has argued that Thorndike's labors contributed to a system in which teachers are viewed as practitioners who enact the top-down findings of research, without having had the ability to contribute their perspective on the research's practical usefulness.

In other cases, educators apply research that seems promising in a research setting but either has not replicated or is not yet ready for practical application. Although not a new phenomenon, educational applications of tentative research findings have exploded since the advent of state-of-the-art neuroimaging techniques and cognitive neuroscience (Bruer, 1997). While the ability to map brain structure to cognitive function may yet reveal crucial importance for what teachers should do in classrooms, as of now, according to Bruer, that connection is "a bridge too far" (p. 4).

In 2007, the Organization for Economic Cooperation and Development (OECD) issued a report that urged caution on prematurely applying the findings of cognitive neuroscience in classrooms. The authors used the word "neuromyths" and defined them as misconceptions that have origins in sound neuroscientific findings, making them difficult to refute; this study adopts that term "neuromyth" and its definition to refer broadly to nonavailing ideas that have basis in

neuroscientific research. But "as they are incomplete, extrapolated beyond the evidence, or plain false, they need to be dispelled in order to prevent education running into a series of dead ends" (p. 4). Warnings like these have not stopped—perhaps not even slowed—the rate of travel over Bruer's "bridge too far" (Goswami, 2004; OECD, 2007).

In 2006, Tokuhama-Espinosa convened a Delphi panel of 39 experts representing researchers in neuroscience and psychology, and educators. Their task was to determine how the three fields might intersect and inform one another, identify areas in which they could not, enumerate ways for better communication between the disciplines, and make suggestions about counteracting the wave of misinformation given to or being misapplied by teachers. The Delphi panel met again in 2007 and 2008 in further pursuit of those goals along with an evaluation of progress. In 2017, Tokuhama-Espinosa revisited the work with a new Delphi panel of 42 experts across neuroscience, education, and psychology. One of the expressed aims of that panel was "debunking myths that allow a lot of commercially-driven people to promote fake information among educators" (p. 239, 2017). The panel was discouraged to note little progress on transdisciplinary efforts and that the challenges of debunking neuromyths remained virtually unchanged since the first panel.

The Delphi panels recognized several neuromyths with noteworthy levels of support among educators. In each case, the myths were based on neuroscientific research findings that did not stand up to scrutiny or had simply been overstated or misapplied. That list was used as a starting point for the neuromyths that appear in the survey instrument for this study. In addition, to appear in the survey, the myth must have at least 10 years of peer-reviewed study that finds it to be invalid or unreliable. Finally, I limited the list to neuromyths that could be enacted in practice; although neuromyths like "people only use 10% of their brains" have been around a

long time, it is difficult to see how teachers would practically use such an idea for teaching. The neuromyths that best exemplified these criteria were right-brain/left-brain thinking, emotional intelligence, Gardner's Theory of Multiple Intelligences, and VAK learning styles.

Right-brain/Left-brain

Although the right-brain/left-brain myth was long ago discarded on theoretical, empirical, and physiological grounds by research scientists, Bruer (1999) opined that belief in the idea continues unabated and is broadly assumed true in popular culture. Like most neuromyths, it is rooted in fact that the brain is, physiologically, divided into right and left hemispheres and that those hemispheres control different functions. In most versions of this myth, however, people have a dominant hemisphere, and the side of that dominance determines a good deal about their cognitions, personality, and behavior. Right-brained people, it is said, are more creative, emotional, intuitive, and empathetic (OECD, 2007). Left-brained people, on the other hand, are marked by logical thought, analytical problem solving, and intellect. Instruments have been devised to measure hemisphere dominance (Connell, n.d.) and teachers are urged to make efforts to ensure that right-brained students can be successful in schools, which seemingly reward left-brain traits (Willingham, 2006). School challenges notwithstanding, assures psychologist Pink (2005) in a bestselling book, the new economy is rife with reward for right-brain thinkers, and they will, according to the book's title, "rule the future."

Jarrett (2012) traces the myth back to the 1960's, when researchers conducted studies on patients who had undergone surgery to have the corpus collosum (the bundle of fibers that connect the right and left brain hemispheres) severed. This treatment, a last-resort therapy for severe epilepsy, prevents the hemispheres from communicating. In a series of famous "split brain experiments," Nobel prize-winning Roger Sperry and his colleagues (1965) found that when they

presented stimuli to only one hemisphere in split-brain patients, the brain often responded differently than it had when the same stimuli was presented to the opposite side, including the ways the hemispheres processed information. For example, they found that the right hemisphere of the brain was better at remembering faces and images, while the left hemisphere was superior in speech and semantic memory. They concluded that brain hemispheres could perform different cognitive functions, and that one hemisphere might perform better on certain functions than others. These ideas—hemispheric specialization and hemispheric dominance—argues Jarrett (2012), were scaled up and translated into popular culture as explanatory for diverse cognitive processing styles and even personality trait differences.

Actual neuroscientific evidence in people with typically functioning brains, however, refutes those beliefs. In studies of people with intact corpus callosa, the brain hemispheres do perform somewhat different functions; for example, the speech comprehension area of the brain (Wernicke's area) is located in the left hemisphere while the speech production region (Broca's area) is located on the right. However, there are not stark divisions between hemispheric function; right and left hemispheres communicate through multiple networks and can even functionally compensate for one another when necessary.

Importantly, in individuals with normally connected hemispheres, there is no evidence that either side takes dominance or influences personality. A recent study by Nielsen and colleagues (2013) used magnetic resonance imaging (MRI) to study the brains of more than 1,000 individuals between 7 and 29 years of age. After examining more than 7,000 brain regions to compare activation between hemispheres, the authors found that brain function was similar in both the left and right sides, regardless of individual personalities or gender. In other words, there

was no difference in brain hemisphere activation during various tasks, whether the subject was an engineer or avant garde performance artist.

Emotional Intelligence

As with right-brain/left-brain ideas, there are several versions of this neuromyth, with some referring to the construct as Emotional Quotient (EQ; Bar-On, 2000), or Emotional Intelligence (EI; Goleman, 1996) depending on which commercial enterprise is selling instruments to measure it. Generally, the idea is that the usefulness and reliability of conventional intelligence (IQ or *g*) have been overstated, and that it is EI that is a better predictor of academic and personal success. The ability to understand one's own emotions and motivations, the emotions and motivations of others, and to relate well to a variety of people in diverse environments are hallmarks of high EI, which can be improved through training and education (OECD, 2007; Tokuhama-Espinosa, 2017). What followed was strong sales of EI curricula and testing instruments, with "entire educational systems (e.g., the state of Rhode Island)… restructuring curricula to produce emotionally intelligent students" (Landy, 2005, p. 420).

The definitive source of EI theory has been difficult to establish; Mayer and Salovey were writing about EI in the 1990's, but Bar-On (2002) has insisted he used the term well before that in an unpublished doctoral dissertation that "has proven difficult to track down" (Matthews, Zeidner, & Roberts, 2002, p. 11). Nevertheless, it is the work of Goleman that has been most instrumental in advancing the notion of EI, which has faced a great deal of criticism by his peers. Psychological and neuroscientific researchers have concluded that the construct's definition is overinclusive, the neurological foundations have not stood up to further scrutiny, the measurement of the construct has proven untenable, and there is no meaningful correlation between emotional intelligence and academic performance (Matthews et al., 2002; Landy, 2005;

Sternberg, 2002), causing researchers (including Salovey and Mayer) to caution that "emotional intelligence" is an idea that was commercialized to educators long before it was ready (Landy, 2005; Mayer & Cobb, 2000; Sternberg, 2002).

Gardner's Theory of Multiple Intelligences

Although Tokuhama-Espinosa (2010) has acknowledged that Howard Gardner does not explicitly assert neuroscientific basis for his theory that there are many kinds of intelligence (rather than a hierarchical "general intelligence" or *g*), the Delphi panel she convened found roots in early neuroscience findings that "mental activities are parceled out into various regions of the brain, and are more autonomous from one another than previously thought" (Traub, 1999, p. 56). Gardner's initial 1983 Theory of Multiple Intelligences (TMI), in line with that assumption, asserted that there were seven intelligences (verbal, interpersonal, interpersonal, physical, musical, spatial, and logical-mathematical), and that individuals could be highly intelligent in one or two intelligences while of below average intelligence in others. Subsequently, Gardner added naturalistic intelligence, and then in 2009, existential and moral intelligences. In 2016, in a *Big Think* online interview, he indicated that he was considering pedagogical and existential intelligences.

These kinds of ad hoc inclusions point to the fundamental criticism of TMI: that Gardner defines the word "intelligence" so broadly (and changes the definition often enough) that it is essentially meaningless within this theoretical framework (Traub, 1999; Waterhouse, 2006; Willingham, 2004). There are other significant problems too; the theory enjoys almost no empirical support (Waterhouse, 2006; Willingham, 2004; Traub, 1999) nor has any instrument to measure it been validated by psychometrists (Gottfredson, 2004). Problematically for TMI, a meta-review of empirical data by 130,000 researchers concluded that there is, indeed, a

hierarchical model for intelligence (*g*) and there was no good evidence for independent areas of intelligence within the brain (Carroll, 1993).

That has not stopped schools from implementing the idea in classrooms. Books for teachers about how to use the multiple intelligences to differentiate instruction are common (Gottfredson, 2004; Willingham, 2004).

> To teach a unit about photosynthesis, for example, a teacher might have all students read a description of photosynthesis to provide an entry point for the linguistically intelligent, have the class compare plants grown with and without sufficient light to reach children with naturalist intelligence, engage the logical-mathematical students by asking the class to prepare a timeline for the steps of photosynthesis, require painting those steps to aid the visually-spatially inclined, have students role-play the "characters" in photosynthesis to help the bodily-kinesthetic child—and so on, until all eight intelligences have been accommodated. (Gottfredson, 2004, p. 37)

Gardner (1999) himself has criticized the idea of using TMI in classrooms, explaining that the idea was not intended for use as a pedagogical tool nor should all intelligences be represented in formal schooling. He condemned what he considered trivialization of his theory by educators. Nevertheless, Gardner has written prefaces for such commercial books for teachers, causing critics to question his motives (Willingham, 2004).

Visual, Auditory, and Kinesthetic Learning Styles

Perhaps no neuromyth has had a better run in popular culture than has learning style theory (Kirschner & van Merriënboer, 2013; Sharp, Bowker, & Byrne, 2008). Coffield and colleagues (2004) found more than 170 variations on the theme that individual processing

methods or “styles of learning” account for much of the variation in student achievement. The most popular notion of learning style preference is based on sensory modality: visual, auditory, or kinesthetic. In particular, adherents of VAK learning style theory endorse the notion that individuals are inherently disposed to learn best through either visual information, auditory stimuli, or through activity and touch, and that teachers should present information in ways that align to individual students’ modality preferences. In other words, learning and knowledge transfer for auditory learners is most successful when those students hear the information; visual learners learn best by seeing, and so on, an idea called “meshing.”

Logically, in order for learning styles theory to have viability as a pedagogical tool, an empirical standard must have three features: there must be confirmation that people really do have innate styles of learning, reliable instruments to determine an individual’s learning style modality can be developed, and there must be evidence that people learn best when delivery of the material and learning style mesh; none of these expectations have been met (An & Carr, 2017; Coffield, Moseley, Hall, & Ecclestone, 2004; Henson & Hwang, 2002; Massa & Mayer, 2006). In a meta-analysis of 51 rigorous studies conducted by Pashler and colleagues (2009), the authors looked for studies that demonstrated that when students are grouped and taught according to their assessed learning style, they learned the material better than students who were taught without regard to their assessed learning style. They concluded that there was no evidence that instructional meshing results in improved student learning; in fact, some high-quality studies found that students who were taught in ways that meshed with their style scored *worse* on post-tests than the control group. The researchers concluded that “. . . there is no adequate evidence base to justify incorporating learning-styles assessments into general educational practice” (p. 105).

Popular belief in learning styles. The last two decades' worth of research delegitimizing learning styles has had seemingly no impact on popular belief, however. Surveys conducted in the United States, Asia, Europe and Latin America show that about 85-95% of people (Coffield et al., 2004; Dekker et al., 2012; Gleichgerrcht et al, 2015; Nancekivell, Shah, & Gelman, 2019) believe in VAK. A survey of 393 Americans conducted by Nancekivell and her colleagues (2019) suggested that a majority of the general public consider learning styles to be predisposed at birth (66%), detectable from childhood (87%), continuous throughout the lifespan (57%), and due to physiological brain differences (77%). As a practical matter, most participants agreed that "people with different learning styles are different kinds of people" (66%) and that those learning style differences between individuals predicted their careers (68%), school success (92%), and the kinds of teachers they should have (90%; Nancekivell et al., 2019, p. 4).

As a reflection of popular belief, the learning styles idea is popular in both news and entertainment media. The popular satirical news site *The Onion* ran a "story" in 2000 with the headline "Parents of Nasal Learners Demand Odor-Based Curriculum." "Every day, I witness firsthand my son Austin's struggle to succeed in a school environment that recognizes the needs of visual, auditory, tactile, and kinesthetic learners but not him," the fictional parent complained (para. 2). Learning styles were also a topic when (now) United States Education Secretary Betsy DeVos revealed in her confirmation hearings before the U.S. Senate Committee that she was "a visual learner" (Nomination of Betsy DeVos, 2017). During her tenure as Education Secretary, DeVos visited schools as part of a "Rethink School" tour to ensure that "all children can have access to the education that fits their learning style" (U.S. Department of Education, "U.S. Secretary of Education Betsy DeVos Embarks," para. 3), despite an online video training for

teachers by the Department of Education debunking learning style theory (Chmiel, M., Flanagan, J., & Fedrizzi, N., n.d.).

Teacher belief in learning styles. Considering its prevalence in popular culture, it's not surprising that researchers have also found that teachers broadly support the learning styles idea. Studies of teachers in first-world countries find a belief rate among K-16 educators around 90-95% (Alekno, 2012; Dekker, et al., 2012; Lethaby & Harries, 2016; Tardif, Doudin, & Meylan, 2015), and that belief seems to hold steady in spite of completion of educational psychology coursework during preservice preparation (Im, Cho, Dubinsky, & Varma, 2018; Macdonald, Germine, Anderson, Christodoulou, & McGrath, 2017); training in educating special populations (Lethaby & Harries, 2016; Ruhaak & Cook, 2018); and subject area of expertise (Bailey, Madigan, Cope, & Nicholls, 2018; Newton & Miah, 2017; Ruhaak & Cook, 2018).

Several reasons have been put forth to account for the popularity of various neuromyths among teachers. Teachers are not often familiar with the latest educational research (Kagan, 1992; McIntyre, 2005; Olivero, John, & Sutherland, 2004; Slavin, 2008). Geake (2008) has suggested that the current high-stakes educational environment has encouraged educators to look for quick fixes or "life rafts" for efficiently educating classrooms of non-standardized students to excel on standardized tests (p. 124). Others have noted the popularity and easy availability of poorly researched educational writing and commercial instructional materials, especially measurement instruments for categorizing students and commercialized educational interventions (Dekker, Lee, Howard-Jones, & Jolles, 2012: Pashler, McDaniel, Rohrer, & Bjork, 2008).

Beliefs in neuromyths are held by teachers across cultures (Dekker et al., 2012; Gleichgerrcht, Luttges, Salvarezza, & Compos, 2015; OCED, 2007; Rato, Abreu, & Castro-

Caldas, 2013), putting them in line for no small amount of criticism (Geake, 2008). Zembylas and Chubbuck (2015) argued that educators' beliefs that are born of anecdote and affect could negatively influence public perceptions of schooling, a worry that has led some education researchers to become impatient with the disconnect between research and practice, and the lack of success connecting them. Slavin (2008) has frustratedly opined that "throughout the history of education, the adoption of instructional programs and practices has been driven more by ideology, faddism, politics, and marketing than by evidence" (2008, p. 5). Clearly, the topic of neuromyth belief in teachers has gotten contentious, with teachers feeling looked down upon by researchers and researchers feeling frustrated by teachers' scant familiarity with current research (Toppo, 2019).

VAK in higher education and research. Several explanations could account for the lack of research literacy in teachers, including articles locked behind journal paywalls, the dearth of research courses in teacher preparation programs, and lack of time in the typical teacher workday. Pasquinelli (2012), however, has pointed out that even when there is available and disseminated research evidence to the contrary, most people generally still find it difficult to abandon certain neuromyths. She cited the finding by psychologists in 1993 that playing Mozart to adults could boost IQ by several points. The study results could not be replicated, nevertheless "the Mozart effect" idea spread far and wide. In 1998, the Florida legislature enacted a requirement that day-care centers play Mozart for the children under their care. The same year, the Georgia governor's office spent more than $100,000 (in 1998 dollars) to buy classical music cassette tapes for new parents. Even after the Mozart effect was debunked repeatedly and publicly, 80% of people surveyed were familiar with it and products touting the Mozart effect sold in the millions of dollars. Pasquinelli suggested that the public is so fascinated with brain

science and puts so much store in brain science credibility that the phenomenon deserves a name, *neurophilia.*

More importantly, in the case of learning styles, there is a considerable amount of misleading or poor-quality learning style information available—even in academic journals. Newton (2015) chided editors of education research journals after he conducted a search in PubMed and Eric databases on "learning styles" and found that 94% of papers analyzed presented a positive view of learning styles. A large majority (89%) of those education research articles endorsed the utility of VAK for higher education classrooms, causing Newton to opine that "the current research literature is full of papers which advocate [learning style] use. This undermines education as a research field and likely has a negative impact on students" (p. 5). He noted that if teachers are expected to be savvy consumers of research and to apply evidence-based practices, the academic community should provide them with sound and critically evaluated peer review, noting:

> The presence of these papers in the pedagogical literature demonstrates that an educator, attempting to take an evidence-based approach to education, would be presented with a strong yet misleading message that the use of Learning Styles is endorsed by the current research literature. This has potentially negative consequences for students and for the field of education research." (p. 1)

As Kirschner (2017) admonished his fellow researchers "we want to urge ourselves as scientists to get our act together" (p. 170).

Additionally, although K-12 teachers have been criticized for believing in learning styles, they should perhaps not be assigned full responsibility by smug academics: Newton and Miah (2017) surveyed faculty at universities in the United Kingdom and found that 58% believed in

the neuromyth of VAK. After reading research that first invalidated the idea and then enumerated possible educational harms of using VAK in practice, 64% of university faculty agreed that they had learned that there is no compelling practical or research basis for the idea. Nevertheless, a surprisingly large number of the academics surveyed (32%) indicated that they would continue to use learning styles accommodations in their own instructional delivery, complicating the belief/practice relationship discussed earlier in this review and furthering Buehl and Beck's (2015) observation that belief change does not necessarily lead to changes in classroom practice.

VAK and K-12 classroom practice and implications. As was true with the university professors in Newton and Miah's study (2017), there is research to suggest that learning style belief also impacts K-12 teacher practice; Alekno (2012) asked elementary, middle, and high school teachers in the Midwestern United States to indicate their agreement with the statement "I adapt my teaching in accordance with students' visual, auditory, or kinesthetic learning styles" (pp. 123-124). Sixty-eight percent of respondents indicated agreement or strong agreement with the prompt, while only about 20% disagreed. Using regression analyses, Murtaugh (2016) found a statistically significant relationship between teachers' belief in learning styles and their use of instructional practices that align to the theory (Cohen's d = .79), and that beliefs in neuromyths in general could account for about 18% of the variance in instructional practices related to those myths.

Put into practical context, teacher belief and use of learning styles is not so surprising. A crucial piece of educator belief in learning styles is that they *seem* to work; differentiating instruction for individual learning styles by presenting information in varying ways is solid educational practice, leading teachers to assume that it was the learning style-focused instruction that resulted in heightened student learning but in reality presenting information in varying ways

is beneficial given our cognitive system (Willingham, 2006). Because teachers base their beliefs so strongly in what is observed in their own classrooms (Calderhead, 1989; Tschannen-Moran & Hoy, 2007; Zahorik, 2005), it is perhaps inevitable that they would be strong proponents of VAK. And, as Reiner and Willingham (2010) point out, there are clearly individual differences in the way students learn, including preferences for some types of delivery, differing amounts of background knowledge about a subject, individual interests, varying levels of motivation, and ability, that teachers should pay attention to.

Critics of learning styles detractors have contended that when teachers vary instructional delivery methods—even if they do so because they believe their students have discrete learning styles—the result is simply good and effective teaching, and that end result is more important than teachers' motivation (Horvath, Donoghue, Horton, Lodge, & Hattie, 2018). But Reiner and Willingham (2010) worried about instances when teachers feel compelled to plan instruction around finding videos to engage visual learners or podcasts for auditory students.

> "While including multimedia may be a good idea in general…we should realize that the value of the video or audio will be determined by how it suits the content that we are asking students to learn and the background knowledge, interests, and abilities that they bring to it. Instead of asking whether we engaged the right … learning mode, **we should be asking, what did students think about while they were in class?"** (emphasis added, p. 35).

In other words, it's problematic when teachers stop focusing on the differences that really *do* matter for student learning to chase the red herring of an idea that some students have the natural *ability* to learn by listening, for example, while others mostly do not (Willingham, n.d.). The focus on learning styles can obscure understanding about how to effectively teach for

student learning by highlighting that which is inconsequential (learning styles) over that which is important (student cognition/thinking).

Newton and Miah (2017) found that educators in the UK could explicate several potential harms of learning style instruction. Chief among them were concerns about pigeonholing students into essentially meaningless categories. Alekno (2012) found that teachers often use learning style modality to group students, supporting the grounds for that worry. Kirschner and van Merriënboer (2013) also wrote about the effect on students who had been tracked into learning styles classifications, without valid instruments (Stahl, 1999), reliable self-report (Massa & Mayer, 2006; Veenman, Prins, & Verheij, 2003) or theoretical support (Dekker et al., 2012) for such a decision. Kirschner (2017) pointed out that separating people into distinct groups on almost *any* criterion, even sex/gender, is generally impossible— "most differences between people on whatever dimension one might think up are gradual and nominal" (p. 167). An and Carr (2017) worried that grouping children and teaching children according to learning style ignores, rather than addresses, processing or skills weaknesses, a hesitation that Sharp and his colleagues (2006) shared.

Neuromyth researchers have lamented the use of VAK as a waste of time and money in already resourced-starved classrooms (Dekker et al., 2012; Lethaby & Harries, 2016; Pashler et al., 2008; Reiner & Willingham, 2010), and a quick Google search returns thousands of marketed products for measuring, understanding, teaching, and communicating with students of specific learning styles. But it seems the real cost of educators' belief in learning styles is that of human potential. After Nancekivell and her colleagues found that the general public endorsed some troubling implications of individual learning styles (see above), they repeated the study with educators (n = 383). The results were disturbing, with 62% of educators believing that different

learning styles are different kinds of people, 75% believing that a student's learning style predicts his eventual career, 93% of educators believing that learning styles predict school success, and 93% who agreed that a student's learning style predicted which teachers he should have. These findings support researchers' worries about pigeonholing students on the part of teachers, but in ways that have far greater implications than schemes for grouping students for class projects.

This study will more closely examine classroom implications for teachers' belief in VAK and the extent to which they believe in neuromyths and implement neuromythic ideas into their teaching practices. The research is also designed to examine the sources and justifications for those beliefs. A primary question guided the research design: what sources do teachers use when adopting pedagogical beliefs, how are those beliefs evaluated, and how do they influence practice? Answering that question will require inferences from a number of research sub-questions, organized into two major themes:

A. Descriptive information about teachers' views of nonavailing beliefs using VAK as case
    - To what extent do teachers believe in learning styles?
    - To what extent do teachers use VAK ideas in instruction?
    - Is endorsement of VAK associated with endorsement of other nonavailing beliefs?
    - Have teachers heard conflicting accounts of learning styles but still endorse? Why?
B. Sources of belief in and factors associated with teachers' use of VAK in classroom
    - Which original information source(s) influence teachers' present-day learning style beliefs (i.e., preservice training, continuing development, peer or administrator influence, classroom experiences)?
    - How do teachers who believe in VAK justify that belief?

- What factors influence teacher use of VAK in practice (i.e., external influences, information source)?
- What school- and teacher-level traits are most associated with learning style belief and pedagogical application (i.e., experience, licensure route, grade level taught, school rating)?

CHAPTER III

METHODOLOGY

Sampling Procedure

To estimate minimum required sample size that would yield sufficient power for regression analysis, the researcher used G*Power with the following assumptions for a regression test: odds ratio of 1.5, collinearity of dependent variables (covariates), using R^2 as the estimate of .4, and a power expectation of .8 (Hsieh, 2010; Hsieh, Bloch, & Larsen, 1998); with those parameters, the a priori analysis recommended a sample of at least 340.

To recruit participants for this study, an email was sent to all principals in the state who appeared on the Department of Education's principal spreadsheet for the 2019-2020 school year; the email introduced the purpose of the study and asked principals to forward the email containing a survey link to teachers at their schools (script appears as Appendix A). To incentivize participation, a $125 gift card was offered to a randomly selected teacher who completed the survey, and another $125 gift card to the principal that forwarded the email to the selected teacher. The survey was hosted on SurveyMonkey.com and was estimated to take about 10 minutes.

Survey data were downloaded and analyzed using IBM SPSS v. 26 statistical analysis software. Following recommendations by Hair, Black, Babin, and Anderson (2010) cases with more than 50% missing data were deleted, along with cases that had missing data for the

dependent variables, resulting in a sample of 660 retained of 791 original respondents. Because the remaining 660 cases were complete, methods for imputing data were unnecessary.

Participants

Survey respondents were public school teachers of grades pre-Kindergarten through 12 from a single state in the southeastern United States. The personal data section of the survey began with basic demographic information. The majority of respondents were female (n = 565; 85.6%), and a majority self-identified as White or Caucasian (n = 507; 76.8%). These numbers are roughly in line with teacher demographics for the state as a whole; an estimated 73% of Mississippi's teachers are white, and about 80% female (Skinner, 2019). A plurality of survey participants was between the ages of 35 and 44 (n = 207; 31.4%). (See Table 1).

Table 1

Participants' Demographic Information (N = 660)

Gender	*N* (%)	Age	*N* (%)
Male	84 (12.7)	Under 25	38 (5.8)
Female	565 (85.6)	26 – 34	175 (26.5)
Prefer not to answer	11 (1.7)	35 – 44	207 (31.4)
Race		45 – 54	165 (25.0)
White	507 (76.8)	55 – 64	71 (10.8)
Black/AA	117 (17.7)	Over 65	4 (< 1)
Other/No answer	36 (5.5)		

Next, respondents were asked questions about their teaching experiences and route to licensure. Almost half the sample (46%) reported teaching for 10 or fewer years, and almost two-thirds (65%) having 15 or fewer years of experience. When asked to indicate the grand band they had taught for the majority of their careers, only about 10% of the teachers who completed the survey indicated they had most experience in pre-Kindergarten or Kindergarten, while the rest of

the sample was closely split between elementary (grades 1-6, 43.6%) and middle/high school grades (46.5%).

Participants were asked to indicate how they had obtained a teaching license. The majority of teachers (64%) had obtained a teaching license through a traditional undergraduate teacher education program, and another 32% had gone through an alternate route to licensure, in this study defined as a Master of Arts in Teaching program, vocational teacher induction program, or state teacher corps licensure. Roughly 3% of the teachers who completed the survey reported not having a teacher license and were either serving as a paraprofessional teacher assistant (n = 8) or were teaching with an emergency credential (n = 10). See Table 2 for details of respondents' professional information.

Table 2

Participants' Professional Information (N = 660)

Years' Experience	*N* (%)	Licensure Pathway	*N* (%)
Fewer than 5	123 (18.6)	Undergraduate	423 (64.3)
5 – 10	182 (27.6)	Alternate Route	213 (32.4)
11 – 15	122 (18.5)	Teach for America	4 (>1)
16 – 20	113 (17.1)	Other	18 (2.7)
21 – 25	63 (9.6)		
More than 25	57 (8.6)		
Grade Band Taught			
PreK-K	65 (9.9)		
1 – 3	161 (24.4)		
4 – 6	127 (19.2)		
7 – 8	121 (18.3)		
9 – 12	186 (28.2)		

The final items of the demographic section asked teachers to give information about their school context. About half (52%; n = 344) of the sample said their school was in a rural area, with the remaining half roughly split between urban (23%; n = 151) and suburban (25%; n =

165). These data are generally in line with a 2017 Hechinger Report that estimated that about 44% of Mississippi's schools classify as rural, the highest in the nation (Mader, 2017).

To get a sense of school context, teachers were asked to estimate the percentage of their students whose families are poor; answers ranged from 3% to 100%, with a median of 68 and a mean of 65.18 (*SD* = 21.8). Finally, teachers were asked to indicate their school's most recent grade rating on the Mississippi District and School Performance Accountability Rating System; that system considers how well a school's students perform on statewide assessments, four-year graduation rates, and student growth in math and English language arts. Most teachers indicated their schools had B ratings (*n* = 225; 34.1%). The accountability frequencies of the sample are reflective of state accountability rates; according to information published by the Mississippi Department of Education (MDE), about 32% of schools in the state received a B rating in 2019, and all accountability rating categories were represented within 5% of official MDE reporting levels. If teachers could not answer, they were given an option to list the name of the school so that the researcher could find the information, leaving very few undeterminable responses (*n* = 4). Table 3 summarizes school-level details.

Table 3

Participants' School-level Information (N = 660)

School Setting	*N* (%)	School Rating	*N* (%)
Urban	151 (22.9)	A	172 (26.1)
Suburban	165 (25.0)	B	230 (34.8)
Rural	344 (52.1)	C	118 (17.9)
		D	85 (12.9)
		F	50 (7.6)
		Undetermined	4 (<1)

Instrument

To investigate the epistemic beliefs of teachers and the ways those beliefs influence classroom instruction, the study instrument was a survey that contained a number of open-ended and multiple-choice questions. Although researchers in both areas of epistemic cognition and teacher beliefs have noted the difficulty of measuring often implicitly held theories of teaching and learning, Pajares (1992) and Greene (2015) have argued that surveys are generally an effective way to investigate specific beliefs about particular educational constructs. In this study, teachers were asked to indicate their beliefs about several specific educational practices and concrete ideas. The survey used page skip logic to route respondents to relevant questions depending on how they answered certain questions (e.g., belief in specific neuromyths, use of VAK in the classrooms). This section summarizes the major topics covered by survey questions, grouped by category: neuromyths, belief sources and justification, belief strength and resistance to change, and extent to which beliefs were enacted in the classroom. The full survey instrument (with demographic questions) is included as Appendices A through G.

Neuromyths

After a confirmatory survey question regarding participant consent to participate in the study, teacher participants ($N = 660$) were presented with a brief introduction to the survey instrument and its format:

> Teachers choose classroom practices for a variety of reasons, and they form their own opinions about the ideas that are useful in the classroom and those that are a waste of time. Occasionally, teachers use ideas that they aren't convinced have merit, or discontinue a practice that has worked in the past to try something new. A variety of

instructional ideas and practices appear on the next few pages. Please tell how you feel about them.

To minimize social desirability biases among respondents, both availing and nonavailing educational ideas were presented in the survey. Availing beliefs included classroom discussion, scaffolding, visual presentation of lesson objectives for students, and collaborative group work. Nonavailing beliefs, as explicated in the literature review chapter, were VAK learning styles, brain hemispheric dominance, EQ, and Gardner's multiple intelligence theory. For each, teachers were asked to indicate the extent to which they agreed with the idea, and then to specify, regardless of belief, whether or not they used the concept as part of their classroom practice. Respondents who confirmed both belief in and use of an idea where next asked to estimate how often they used the idea in their classroom practice; the scale ranged from 1% (Rarely) to 100% (Almost always), and included a caption for "About half the time" at the 50% mark to help teachers visualize that the scale functioned as percent of classroom time.

Belief Sources and Justification

To get a better understanding of where neuromyths originate, all teachers (VAK believers and nonbelievers) were asked to recall where they had first heard about learning styles. Choices included undergraduate teacher preparation programs, graduate programs, professional development or training, and other educators. Next, teachers were presented with items to investigate ways they justified belief/nonbelief in VAK. Teachers who endorsed learning styles were asked to indicate "which of the following led you to this belief." Choices included including teacher preparation programs, inservice professional development, school administrators, peers, independent reading, and personal experience. Respondents could also

write additional justifications in an optional text box. Similarly, teachers who indicated they did not believe in learning styles were asked to indicate why not. Choices investigated for the influence of peers, teacher preparation or graduate coursework, professional development, independent reading, administrators, and personal experience that the idea appears to have no validity in classroom practice.

Belief Strength and Resistance to Change

Respondents who indicated belief in VAK were asked two questions to gauge how strongly they held the belief. The first asked them to indicate (on a sliding scale) how certain they were that the idea had importance for student learning, ranging from 1 (low certainty) to 10 (high certainty). The second asked teachers to indicate the extent to which they agreed that a students' preferred learning style is something that could change with instruction. Likert-type answers ranged from "Strongly disagree" to "Strongly agree" for this item. Learning style believers were asked whether they had been presented with information that suggests that VAK has no validity, and if so, how they reconciled such information with their continued belief. Options for continued belief were "I learned about them in my teacher preparation or trainings" and "I know they work in my classroom." Respondents could check either or both. VAK nonbelievers, on the other hand, were asked whether they had told other educators that learning style theory does not have research support, and if so, to indicate whether or not their peers had believed them.

Belief Enactment

Five items were written to determine the extent to which, and how, VAK beliefs were enacted in practice. The first simply asked teachers to select reasons that they considered

students' visual, auditory, and kinesthetic learning styles when they delivered instruction. Choices included peer influence, principal requirements, student/parent expectations, classroom effectiveness, saving instructional time, and saving planning time; an optional text box was included for other reasons. Next, teachers were asked to indicate how often they targeted learning styles in their classroom teaching, on a sliding scale from 0 (*Rarely*) to 10 (*Nearly always*). A third item asked teachers whether or not they had given a learning styles inventory to their students, and the fourth asked respondents to indicate what factors they considered when determining collaborative groups in their classrooms (with learning style as one option). Finally, teachers were asked an open-ended question, "How do you use learning styles to differentiate instruction in your classroom?" Those answers were coded using Dedoose, a cross-platform qualitative software application.

Research Design

Although there is a sub-question of this study that is related to whether teachers who endorse VAK were more likely to believe in other nonavailing pedagogical beliefs (Q2), the first function of the instrument was to sort teachers into four subgroups, listed here and represented in Figure 2.

- **Doesn't Believe/Doesn't Use (DB/DU):** teacher rejects both belief in, and use of VAK in practice
- **Doesn't Believe/Uses (DB/U):** teacher rejects belief in VAK, but uses it in practice
- **Believes/Doesn't Use (B/DU):** teacher endorses belief in VAK, but does not use in practice
- **Believes/Uses (B/U):** teacher endorses both belief in, and use of VAK in practice

	Does Not Use VAK to Plan Instruction	Uses VAK to Plan Instruction
Does Not Endorse VAK	DB/DU	DB/U
Endorses VAK	B/DU	B/U

Figure 2. Belief/usage subgroups.

Once teachers were subgrouped by the survey logic, they landed on a page with quantitative and qualitative questions that were tailored to their belief/use answers; each of those pages are explained in the following two paragraphs.

For two subgroups, belief and use in the classroom align—that is, if they believed in VAK, they used it, and if they did not believe VAK had validity, they did not incorporate it into practice. Teachers who both believe and use learning styles in the classroom (B/U) were asked to identify epistemic sources for the belief, the certainty of the belief, whether information inconsistent with VAK had been weighed, and the extent to which the beliefs influenced classroom practices. Similarly, teachers in the DB/DU subgroup (nonbelief aligned with nonuse) were asked to identify the epistemic source(s) that informed the rejection of VAK. This subgroup was also asked whether they had ever tried to tell a colleague that VAK lacks research support, and if so, what the outcome was.

In the case of the other two subgroups—Believes/Doesn't Use (B/DU) and Doesn't Believe/Uses (DB/U)—epistemic belief and classroom practice did not align. For both, the survey probed for factors related to the inconsistency. Teachers in the DB/U subgroup (who reported that they use VAK to plan instruction, although they don't believe the practice is valid) were directed to questions that probe the reasons for VAK use, including peer influence, student

expectations, parent expectations, and administrator mandate. The second discontinuous subgroup, Believe/Don't Use (B/DU), indicated that they believed VAK has validity but do not use the idea to plan instruction. Questions for this subgroup investigate why VAK beliefs do not influence practice. Additionally, because the B/DU subgroup is characterized by endorsement of VAK, respondents are asked to select the source(s) of the belief and whether conflicting information had been considered.

Data Analysis

Survey data were analyzed quantitative methods using a combination of descriptive statistics, zero-order correlation analyses, chi-squared tests, and regression techniques. When necessary (items which permitted participants to write in responses), qualitative coding was conducted using Dedoose. Although several of the research questions for this investigation could be answered using descriptive analysis, a look at the predictors of VAK belief and use classrooms is best accomplished using regression techniques. Those methods give insight into which traits of teachers and schools are most correlative with VAK belief and use, as well as the strength of the information sources in fostering such beliefs.

Because the research questions that examine influencers of belief and use investigate a single outcome variable with two levels (belief/nonbelief and use/nonuse of VAK, respectively) by examining several predictor variables, multiple logistic regression was an appropriate choice. According to Pohar, Blas, and Turk (2004), logistic regression does not depend on such assumptions of normality and is also less sensitive to sample size constraints. Finally, to investigate predictors for belief/use subgroup membership, a multinomial logistic regression study was planned to determine the extent to which years of experience, education, source of VAK information, school factors, and peer and school influences.

CHAPTER IV

RESULTS

This chapter presents results of the survey instrument, organized along two primary areas of interest for this study, epistemic beliefs and the influence of those beliefs on practice:

A. Descriptive information about teachers' views of nonavailing beliefs using VAK as case
    - To what extent do teachers believe in learning styles?
    - To what extent do teachers use VAK ideas in classroom instruction?
    - Is endorsement of VAK associated with endorsement of other nonavailing beliefs?
    - Have teachers heard conflicting accounts of learning styles but still endorse? Why?
B. Sources of belief in and factors associated with teachers' use of VAK in classroom
    - Which original information source(s) influence teachers' present-day learning style beliefs (i.e., preservice training, continuing development, peer or administrator influence, classroom experiences)?
    - How do teachers who believe in VAK justify that belief?
    - What factors influence teacher use of VAK in practice (i.e., external influences, information source)?
    - What school- and teacher-level traits are most associated with learning style belief and pedagogical application (i.e., experience, licensure route, grade level taught, school rating)?

Survey Results for Beliefs

After a brief narrative descriptions of overall response patterns for each epistemic belief included in the survey (availing ideas presented first, then nonavailing), Table 4 summarizes responses for belief/use subgroups, arranged by popularity; ideas that were classified as nonavailing appear in the chart in italics.

Class Discussion

Respondents were first asked to indicate whether or not they believed that, "Class discussion is a powerful teaching tool." A large majority (more than any other surveyed belief, n = 649, 98.3%) agreed, indicating "I believe this." Only one respondent indicating being unfamiliar with the idea, and a small number (n = 10, 1.5%) disagreed that class discussion was of particular use for student learning—the smallest outright rejection rate of any idea in the survey. The next item began with a statement stem, "Whether I believe in the value of class discussion nor not…" followed by three options: "I regularly use class discussion in my classroom," "I don't regularly use class discussion in my classroom," or "Not applicable/I'm not familiar with this idea." A majority of teachers (n = 591, 89.5%) indicated that they used classroom discussion methods in their own classroom practices. When those teachers (n = 591) were asked to "Slide the circle below to estimate how often you use class discussion in your classroom," the mean response was 71.9% of time (SD = 22.29), with a median of 75% of time.

Display of Lesson Objectives

This item was phrased, "Displaying the lesson objective on the whiteboard or other display helps students learn the material." Only about half (n = 386, 58.5%) of teachers endorsed this availing belief (with n = 75, 11.4% answering that they were unfamiliar with the idea); this

was the lowest belief rate of any idea included in the survey. Regardless of belief, a majority (n = 537, 81.4%) still use the idea in their classrooms; frequency of use was the highest of any surveyed, with a mean of 88.7% of time (SD = 25.22), and a median of 100. The apparent paradox between lowest belief rate and highest rate of use in classrooms is relatively easy to explain: many principals in the state require the display of the daily lesson objectives on classroom whiteboards as part of Mississippi's teacher rating system requirements. It is evident from teacher responses, however, that most do not see the value of such a requirement by principals.

Collaborative Group Work

When teachers were asked whether or not they believed that, "Group work helps students learn the material and how to work with others," they endorsed the idea strongly (n = 616, 93.3%). No teachers said they were unfamiliar with group work (the only idea surveyed besides VAK that had 100% familiarity). A slightly lower rate of teachers (n = 575, 87.1%), however, said they used group work regularly with their own students; rate of use among those teachers was almost three-quarters of the time (M = 71.2, SD = 22.8, Mdn = 75).

Scaffolding

After class discussion, scaffolding was the most popularly believed availing idea in the survey, with 620 (93.9%) of teachers agreeing that, "Scaffolding the content is important for learning." Only about 3% of teachers (n = 23) were unfamiliar with the concept, and its usage was relatively popular, with about 90% (n = 595) of teachers answering that they used scaffolding regularly in their own classroom instruction. Except for the use of lesson objectives displays (discussed above), scaffolding was the most frequently used surveyed belief. Teachers

reported that they scaffold content delivery about 83% of classroom time (SD = 18.64, Mdn = 89).

Emotional Intelligence (EQ)

Teachers had less familiarity with EQ than any other idea surveyed. One quarter of respondents (*n* = 165, 25%) answered that they had not heard of EQ, suppressing the apparent overall belief rate (*n* = 461, 69.8%). However, when those unfamiliar with EQ are removed (leaving *n* = 495), a large majority (93.1%) believed that "Emotional intelligence (sometimes called EQ) is as important to success as IQ." Only 34 teachers who took the survey rejected EQ outright (5.2% of overall responses). Whether or not they believed in EQ, about 45% of teachers (*n* = 300) said they used the idea in their own classroom practice, with a usage rate of about 66% of the time (*SD* = 25.53, *Mdn* = 67).

Brain Hemispheric Dominance

The format of the questions for all subsequent beliefs was aligned to the first set about class discussion. For hemispheric dominance, teachers were asked to tell whether or not they believed that, "Some people are right-brained and some people are left-brained, and that shows in how creative or logical people are." Nearly three-quarters of teachers agreed with the statement (n = 486, 73.6%) and 52 (7.9%) said they were not familiar with the right-brain/left-brain idea. Whether or not they believed in hemispheric dominance, fewer than half of respondents (n = 253, 38.3%) said they used the idea in their classroom instructional practice, the lowest use rate of any belief appearing in the survey. For teachers who did report using hemispheric dominance ideas in practice, the frequency of use was also low, about half the time (M = 58.35, Mdn = 55).

Gardner's Theory of Multiple Intelligences

Besides belief in VAK learning styles, Gardner's theory was the most popular nonavailing belief. Approximately 87% (n = 575) of teachers surveyed agreed with the idea that "As suggested in Gardner's Theory of Multiple Intelligences, all students are gifted in some way." Relatively few teachers had not heard of Gardner's work (n = 49, 7.4%), and even fewer (n = 36, 5.5%) rejected the idea outright. The importance of Gardner's work for classroom practice was evident, with teachers answering that they used multiple intelligences about 73% of the time in their own classrooms to tailor instruction (SD = 23.67, Mdn = 77).

VAK Learning Styles

Finally, teachers were asked whether nor not they agreed with the statement, "Some students are visual learners, some are auditory learners, and some are kinesthetic learners, and we should teach them according to their learning style." A large majority (n = 624, 94.5%) agreed with the idea; no teachers were unfamiliar with learning styles. The near 95% endorsement rate for VAK was the highest for nonavailing beliefs and second only to belief in the value of class discussion among all beliefs surveyed. Further, when teachers were asked (regardless of whether they believed in VAK or not) whether they used VAK in their own classroom instructional practices, more than 87% (n = 576) responded positively; that usage rate ranked VAK as the third most popularly used practice (of eight surveyed). When compared to the other nonavailing beliefs in the survey, however, VAK was used in practice by far more teachers than Gardner's theory (used by 67.1% of teachers), EQ (used by 45.5% of teachers), and hemispheric dominance theory (only 38.3% of teachers).

Table 4

Descriptive Statistics for Epistemic Beliefs, Teacher (N = 660) Endorsement and Classroom Use

Item		Believe	Don't believe	Not familiar	Overall Freq. of Use
Class discussion is a powerful teaching tool.					
	Use	589 (89.2%)	1 (0.2%)	1 (0.2%)	71.9%
	Don't use	55 (8.3%)	8 (1.2%)	0	
	Not sure	5 (0.8%)	1 (0.2%)	0	
Some students are visual learners, some are auditory learners, and some are kinesthetic learners, and we should teach them according to their learning style.					
	Use	*559 (84.7%)*	*17 (2.6%)*	*0*	*75.7%*
	Don't use	*65 (9.8%)*	*19 (2.9%)*	*0*	
	Not sure	*0*	*0*	*0*	
Scaffolding the content is important for learning.					
	Use	589 (89.2%)	6 (0.9%)	0	83.0%
	Don't use	28 (4.2%)	10 (1.5%)	0	
	Not sure	3 (0.5%)	1 (0.2%)	23 (3.5%)	
Group work helps students learn the material and how to work with others.					
	Use	559 (84.7%)	16 (2.4%)	0	71.2%
	Don't use	51 (7.7%)	27 (4.1%)	0	
	Not sure	6 (0.9%)	1 (0.2%)	0	

Table 4 (continued)

Item		Believe	Don't believe	Not familiar	Overall Freq. of Use
According to Gardner's Theory of Multiple Intelligences, all students are gifted in some way.					
	Use	433 (65.6%)	7 (1.1%)	3 (0.5%)	73.3%
	Don't use	134 (20.3%)	26 (3.9%)	1 (0.2%)	
	Not sure	8 (1.2%)	3 (0.5%)	45 (6.8%)	
Some people are right-brained, and some people are left-brained, and that shows in how creative or logical people are.					
	Use	241 (36.5%)	12 (1.8%)	0	58.4%
	Don't use	228 (34.5%)	101 (15.3%)	3 (0.5%)	
	Not sure	17 (2.6%)	9 (1.4%)	49 (7.4%)	
Emotional Intelligence (sometimes called EQ) is as important to success as IQ.					
	Use	298 (45.2%)	2 (0.3%)	0	65.9%
	Don't use	145 (22%)	28 (4.2%)	2 (0.3%)	
	Not sure	18 (2.7%)	4 (0.6%)	163 (24.7%)	
Displaying the lesson objective on the whiteboard or other display helps students learn the material.					
	Use	346 (52.4%)	191 (29%)	0	88.7%
	Don't use	37 (5.6%)	76 (11.5%)	1 (0.2%)	
	Not sure	3 (0.5%)	4 (0.6%)	2 (0.3%)	

The first of the two main areas of investigation for this research centered on teachers' nonavailing epistemic beliefs, using VAK as case; topics in this section include nature and strength of belief, the extent to which belief influences practice, belief justification and nonavailing belief trends overall.

To What Extent Do Teachers Believe in Learning Styles?

To investigate strength of belief in learning styles, teachers who endorsed VAK (n = 624, henceforth called *VAK Believers*) were asked, "How certain are you that visual, auditory, and kinesthetic learning styles are important for student learning?" A slider appeared for answers ranging from 0 (Not very certain, but I think they probably are factors) to 10 (I'm sure that learning styles are important for student learning). Although the mean average was 8.54 (SD = 1.97), the median was 9, and the mode was 10, with 49.0% (n = 306) of VAK Believers indicating that they were "very certain" that learning styles are important for student learning. A frequency histogram for strength of certainty appears as Figure 3.

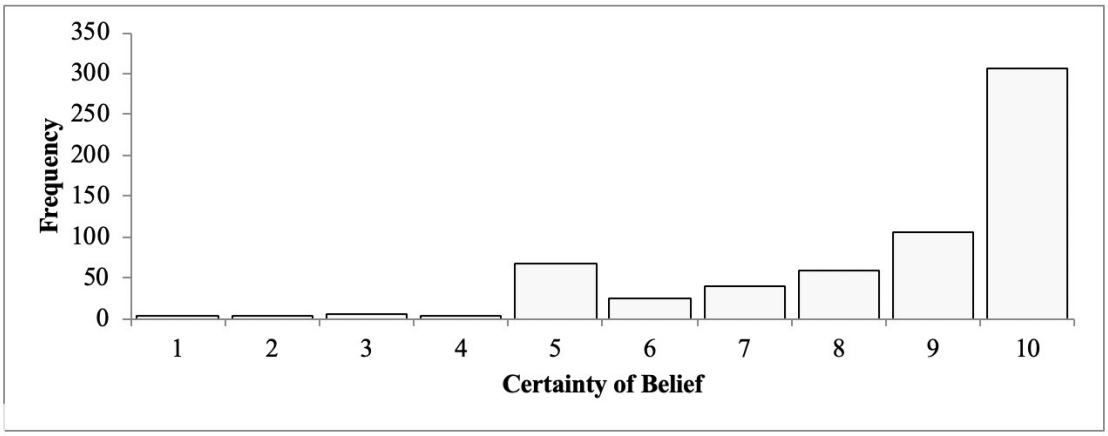

Figure 3. Certainty of belief in the importance of VAK for student learning, among VAK believers.

To gain more insight into how VAK Believers view "meshing" (the notion that instruction should be tailored to students' individual sensory modality preference for optimal learning), they were asked the extent to which they agreed with the statement, "A student's preferred learning style is something that can change with instruction." The majority (n = 360, 57.7%) of VAK Believers agreed that students' styles could change in response to classroom methods (Table 5), suggesting that although belief in the VAK idea was strong, most teachers also thought an individual's preferred learning style is at least somewhat malleable.

Table 5

Teachers' Belief in Malleability of Students' VAK Learning Styles

	N	%
Strongly disagree	43	6.9
Disagree	196	31.4
Agree	360	52.4
Strongly agree	25	4
Total	624	100%

To What Extent Do Teachers Use VAK in Classroom Instruction?

Next, all participants were asked to indicate whether they use VAK ideas in classroom practice. The survey item was phrased "Whether I believe in the idea of learning styles or not, I (regularly/don't regularly) use learning styles in my classroom." A large majority reported regularly using learning style theory in the classroom (87.3%, $n = 576$). Teachers were categorized into four subgroups, depending on belief in and use of VAK in practice:

- Doesn't Believe/Doesn't Use (DB/DU): teacher rejects both belief in, and use of VAK in practice
- Doesn't Believe/Uses (D/BU): teacher rejects belief in VAK, but uses it in practice
- Believes/Doesn't Use (B/DU): teacher endorses belief in VAK, but does not use in practice
- Believes/Uses (B/U): teacher endorses both belief in, and use of VAK in practice

Descriptive statistics for belief/use subgroups appear below as Table 6.

Table 6

Belief/Use Subgroup Descriptive Statistics for Surveyed Sample (N = 660)

		Usage	
		Does not use VAK	*Uses VAK*
Belief	*Does not believe in VAK*	DB/DU $n = 19$ (2.9%)	DB/U $n = 17$ (2.6%)
	Believes in VAK	B/DU $n = 65$ (9.8%)	B/U $n = 559$ (84.7%)

Teachers who reported using VAK in practice (DB/U and B/U subgroups, $n = 576$, together referred to as *VAK Users* henceforth) were presented with a series of follow up questions to get a sense of how they have adopted learning styles in their classroom teaching. The first simply asked, "How often do you target students' learning styles in your teaching?" Using a slider to indicate percentage of time (where 1 meant "Rarely," and 10 represented "Nearly Always"), VAK Users' answers ranged from 6% of the time to 100% (Figure 4), with a mean answer of 75.5 ($SD = 20.1$), meaning that VAK Users report using learning style-sensitive instruction about three-fourths of teaching time on average, more than they use class discussion ($M = 71.9$, $SD = 22.3$) or subgroup work ($M = 71.2$, $SD = 22.8$).

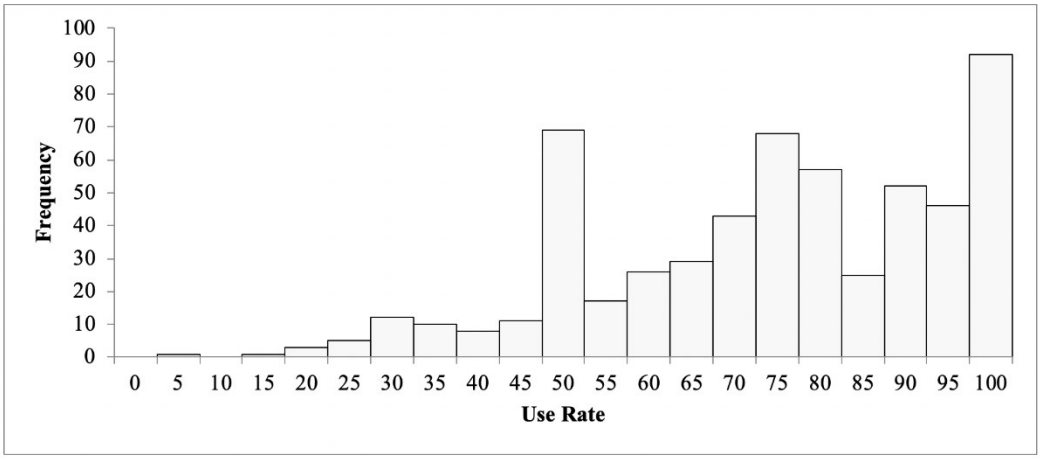

Figure 4. Teachers' usage of VAK ideas in classroom practice (as a percent of instructional time).

As a follow up, and to help validate the answers to the previous question, VAK Users were asked, "Have you given a learning style inventory to your students?" Of the 576 teachers in the B/U and DB/U subgroups, 355 (61.6%) responded that they had administered such an instrument, and 221 (38.4%) said they had not. A Chi square analysis was performed to look for

meaningful group differences between both teachers who believed in VAK and those who didn't (but still use in instruction) in terms of administering learning style inventories to teachers. There was not a statistically significant result for group differences, with χ^2 (1, N = 576) = 3.1, p = .08.

To further explore the ways and extent to which teachers use VAK learning styles to teach their students, all 660 participants, regardless of belief/use category membership, were asked about the criteria they used to determine student collaborative groups in their classrooms. Teachers were asked to choose as many as were applicable and provided an optional "Other" textbox for open-ended responses or methods not mentioned. Results show that grouping by ability and then learning styles are the most popular schemes teachers who use VAK employ for grouping students (Table 7). Open-ended answers were relatively few (n = 38) and could be coded into two categories: student behavior (n = 21, 3.6%) and student personality (n = 13, 2.3%).

Table 7

VAK Users' Methods for Grouping Students (n = 576)

Grouping Method	B/U (%)	DB/U (%)	Total VAK Users (%)
Interest	263 (47%)	8 (47%)	271 (47%)
Ability	428 (76.7%)	12 (70.6%)	440 (76.4%)
Learning styles	327 (58.5%)	2 (11.8%)	329 (57.1%)
Grades	182 (32.6%)	4 (23.5%)	186 (32.3%)
Student choice	226 (40.4%)	10 (58.8%)	236 (41%)
Random	240 (42.9%)	8 (47%)	248 (43.1%)
Total	559	17	576

By contrast, teachers in the DB/DU and B/DU subgroups (n = 84) who did not report using learning styles in their practice (labeled *VAK Nonusers,* hereafter) were asked how they

grouped students. Results (Table 8) resembled those of VAK Users in that ability was the most popular grouping method; after that, however, there was a fairly even distribution of grouping schemes between interest, grades, student choice. Learning styles still accounted for nearly 17% of responses; perhaps that's explained by one teacher's comment: "I don't typically group by learning styles, but some students ask for it."

Table 8

Student Grouping Methods for VAK Nonusers (n = 84)

Grouping Method	B/DU (%)	DB/DU (%)	Total VAK Nonusers (%)
Interest	19 (29.2%)	4 (21%)	23 (27.4%)
Ability	43 (66.2%)	13 (68.4%)	56 (66.7%)
Learning styles	13 (20%)	1 (5.3%)	14 (16.7%)
Grades	21 (32.3%)	3 (15.8%)	24 (28.6%)
Student choice	18 (27.7%)	4 (21%)	22 (26.2%)
Random	32 (49.2%)	6 (31.6%)	38 (45.2%)
Total	65	19	84

The final item aimed at investigating how teachers use VAK in practice was an open-ended question that asked VAK Believer teachers, "How do you use learning styles to differentiate instruction in your classroom?" Responses were coded using Dedoose; because some responses were coded into more than one category, the total responses equal more than the number of teachers responding (n = 576). Frequency data are presented below for three categories that received a higher than 3% response rate, along with a representative quote for each (Table 9); all answers to this question appear as Appendix I.

Table 9

Qualitative Data, "How do you use learning styles to differentiate instruction in your classroom?" (n = 576)

Category	Frequency *n* (%)	Quote
Content delivery tailored to VAK style	397 (68.9%)	"Dependent on assignment. May give students a concept and have [an] activity for each learning style. Students previously identified by that style are assigned that station."
		"According to the learning style inventory I gave my students, I was able to see that I needed to use activities like scavenger hunts that allowed for student collaboration and added interest to the content and allowed them to learn through movement and touch."
Assessment tailored to VAK style	*90 (15.6%)*	"We take a learning styles inventory at the beginning of the year and study what it means to be each kind of learner. From there, I embed it in my teaching and give each type of learner strategies to best learn…. Students like learning about what kind of learner they are and will ask how to best do something for their learning type. They are also allowed to complete summative projects in science based on their learning style (i.e. kinesthetic learners can come up w/a song and dance and teach it to the class or a visual learner can make a poster)."
		"Some students have more hands-on assessments while others have reading or visual activities covering the same material."
Grouping assignments	84 (14.6%)	"I try to group students together who have similar learning styles so that I can give them the instruction that they need. This helps me to differentiate in my classroom."
		"I group my students accordingly and search for resources to help them learn the material."

Is Endorsement of VAK Associated with Endorsement of Other Nonavailing Beliefs?

To determine the relationship between belief in VAK and the other surveyed nonavailing beliefs, Pearson correlations between belief in Gardner's Theory of Multiple Intelligences,

Emotional Intelligence (EQ), brain hemispheric dominance (right-brain/left-brain), and VAK learning styles were examined. Results indicated statistically significant relationships at the $p < .05$ level for belief in hemispheric dominance and Gardner's TMI with EQ, and statistically significant correlations at the $p < .01$ level for belief in VAK and hemispheric dominance and also for belief in Gardner's theory (Table 10). Belief in VAK was not significantly correlated with EQ. It may be notable here that EQ had the lowest familiarity rate of any other belief surveyed, perhaps explaining relatively low correlations with others.

Table 10

Pearson Bivariate Correlations for Endorsement of Nonavailing Beliefs

Belief	1	2	3	4
1. EQ	–			
2. Hemispheric dominance	.11*	–		
3. Gardner's TMI	.05	.09*	–	
4. VAK	.07	.33**	.16**	–

* $p < .05$; ** $p < .01$

Have Teachers Heard Conflicting Accounts of Learning Styles but Still Endorse? Why?

Teachers who indicated belief in learning style theory were asked a follow up question "Have you heard about or seen research that suggests that visual, auditory, and kinesthetic learning styles are myths?" Of the 624 who indicated VAK belief, a majority ($n = 442$; 70.8%) answered that they had not heard about research invalidating the idea. The remaining 182 teachers (who indicated they had encountered information that disputed VAK) were routed to a page that asked about belief in spite of unsupportive research findings. Two options were given, and teachers could select one or both reasons. Nearly four-fifths of VAK Believers justified their

continued belief (in spite of exposure to conflicting evidence) by their own classroom experiences; responses appear in Table 11.

Table 11

"Have you heard about or seen research that suggests that visual, auditory, and kinesthetic learning styles are myths?" among VAK Believers (n = 624)

		N (%)
No		442 (70.8%)
Yes		182 (29.2%)
Of respondents answering Yes (*n* = 182)		*N* (%)
	…but I don't believe they are myths because I learned about them in trainings or my teacher preparation coursework.	54 (29.7%)
	…but I don't believe they are myths because I know they work in my classroom.	145 (79.7%)

Because Bondy and colleagues (2007) found that teachers often trusted their colleagues more than research to choose pedagogical strategies, teachers in the two VAK Nonbeliever groups were asked, "Have you tried to tell other educators that learning style theory isn't valid?" Of the 36 nonbelievers, the majority (*n* = 23, 63.9%) answered that they had not mentioned to colleagues that there was a lack of evidence around VAK (Table 12), and those who *had* tried said they were not usually believed.

Table 12

"Have you tried to tell other educators that learning style theory isn't valid?" among VAK Nonbelievers (n = 36)

	N (%)	
No, I've never told anyone else	23 (63.9%)	
Yes	13 (36.1%)	
		N (%)
Of respondents answering Yes (*n* = 13)	…but they didn't believe me, or mostly didn't.	10 (76.9%)
	…and they believed or mostly believed me.	3 (23.1%)

This concludes the section of descriptive analyses related to what teachers believe and how those beliefs are enacted in practice. The second broad focus area investigated issues around sources of nonavailing beliefs (using VAK as the case), including an evaluation of which sources were most strongly associated with both belief and use. This section also reports the results of analyses related to traits of teachers and schools that are most associated with application of VAK in classroom practice.

Which Original Information Source(s) Influence Teachers' Present-Day Learning Style Beliefs (i.e., Preservice Training, Continuing Development, Peer or Administrator Influence, Classroom Experiences)?

Most often, teachers reported that they had been introduced to VAK theory during their undergraduate teacher preparation programs (*n* = 458, 69.4%, Table 13). To see whether there was a relationship between original information source and whether a teacher currently believes VAK or uses those ideas in practice, multinomial logistic regression was performed. SPSS returned a warning for singularities in the Hessian matrix, due to very small or missing data in some cells, indicating that some groups were too small for a robust multinomial regression

analyses. The warning was not surprising, given the extreme imbalance group frequencies; for example, only two teachers in the DB/U group said they had heard about VAK in graduate school. The presence of these data limitations results in a prompt by SPSS to exclude or merge categories.

Table 13

Initial Exposure to VAK Learning Styles, All Subgroups (N = 660)

Information Source	B/U (%)	DB/U (%)	B/DU (%)	DB/DU (%)	Total (%)
Undergraduate	394 (70.5%)	12 (70.6%)	41 (63.1%)	11 (57.9%)	458(69.4%)
Graduate	61 (10.9%)	2 (11.8%)	7 (10.8%)	2 (10.5%)	72(10.9%)
PD/training	71 (12.7%)	3 (17.6%)	11(16.9%)	2 (10.5%)	87(13.2%)
Other educators	33 (5.9%)	0	6 (9.2%)	4 (21.1%)	43(6.5%)
Total	559	17	65	19	660

As a result of these data limitations, the four subgroups were collapsed into two broad groups, VAK users/nonusers and VAK believers/nonbelievers. Consequently, two binary logistic regression analyses were performed: first to determine whether relationships exist between original source and current belief (regardless of use) in VAK, and then to look for associations between original source and current use of VAK by teachers (regardless of belief). To look for statistically significant relationships between the original source of VAK information and current belief, the Hosmer-Lemeshow test was run to determine goodness of fit of the model; results yielded $\chi^2(2)$ of .001 and were insignificant *(*$p = 1.0$), indicating that the model was fit to the data well. Model results for Block 1 were not significant ($p = .749$).

The second regression analysis sought to determine whether relationships existed between original source of information and current use of VAK in classroom practice. The

Hosmer-Lemeshow test showed that the data fit the model well [$\chi^2(2) = 1.0$]; overall model significance, however, was $p = .191$. Taken together, results suggest that, for teachers, the original source of VAK information does not predict whether they will continue to believe or use learning styles methods in practice.

How do Teachers who Believe in VAK Justify That Belief?

Next, teachers in the Believer group were asked, "You indicated that you believe in the idea of teaching students according to their visual, auditory, and kinesthetic learning styles. Which of the following led you to this belief?" Respondents were asked to choose all answer choices that applied; results appear in Table 14. Interestingly, in light of the previous discussion of regression analysis for relationships between continued belief and original source, a large number of Believers ($n = 462$, 74%) said their belief in VAK was spurred by what they had learned in their teacher preparation programs. Most important to teachers for justifying learning style belief, however, was its perceived value in classroom practices, with more than three-fourths ($n = 485$, 77.7%) of VAK Believers saying their belief in VAK was justified by its effectiveness in classroom practice.

An "Other" option was provided, along with a textbox for open-ended responses. Of the 55 teachers who chose to supply their own justification, 40 of those responses (73%) referred to teachers' personal experiences with their own perceived learning style. Representatives quotes include "This isn't new; I learned I was a kinesthetic learner a long time ago" and "Because I'm a visual learner and I understand how it feels." No other qualitative coding category was represented by more than 2 responses.

Table 14

VAK Belief Justifications for VAK Believers (n = 624)

Belief Justification	B/U (%)	B/DU (%)	B/U + B/DU (%)
I learned about these in my teacher preparation program.	415 (74.2%)	47 (72.3%)	462 (74%)
I have attended inservice professional development about learning styles.	275 (49.2%)	23 (35.4%)	298 (47.8%)
My school administrators are/have been proponents of learning styles.	158 (28.3%)	4 (6.2%)	162 (30%)
Other educators that I trust have told me about these.	186 (33.3%)	14 (21.5%)	200 (32.1%)
I've seen these work in my classroom.	463 (82.8%)	22 (33.8%)	485 (77.7%)
I've read about learning styles.	407 (72.8%)	43 (66.2%)	450 (72.1%)
Total	559	65	624

What Factors Influence Teacher Use of VAK in Practice (i.e., External Influences, Information Source)?

Teachers who indicated that they used students' learning styles in instruction (VAK Users, *n* = 576) were asked to explain their reasons. For teachers in the B/U subgroup, the question was worded, "You also indicated that you consider students' visual, auditory, and kinesthetic learning styles when you deliver instruction. Why?" For DB/U teachers, the stem began, "Although you don't believe in learning styles, you indicated that you *do* consider them when you plan instruction. Why?" Respondents were encouraged to choose all applicable options; consistent with previous results, the overwhelmingly popular justification teachers gave for using learning styles in their instructional delivery was the apparent effectiveness of those methods (*n* = 507, 88%). Results appear in Table 15.

Table 15

VAK Use Justifications for VAK Users (n = 576)

Justification for Use	B/U (%)	DB/U (%)	B/U+ DB/U (%)
Other teachers use them, and I want my practices to mirror theirs.	75 (13.4%)	1 (5.9%)	76 (13.2%)
My principal requires that we include learning styles in our instructional planning.	77 (13.8%)	3 (17.6%)	80 (13.2%)
Students and/or parents expect it.	55 (9.8%)	2 (11.8%)	57 (10%)
Teaching to my students' learning styles works in my classroom.	504 (90.2%)	3 (17.6%)	507 (88%)
Including learning styles in my plans saves planning time.	98 (17.5%)	2 (11.8%)	100 (17.4%)
Including learning styles in my practice saves instructional time.	220 (39.4%)	2 (11.8%)	222 (38.5%)
Total	559	17	576

Chi square was performed to examine whether meaningful differences existed between the B/U and DB/U subgroups, which both use VAK in practice, but differ in belief. There were statistically significant differences between the ways VAK believers and VAK nonbelievers justify VAK use in practice. In particular, believers were significantly more likely than nonbelievers to say they used VAK in practice because it worked in their classrooms [χ^2 (1, N = 576) = 82.28, $p < .001$]. Nonbelievers, on the other hand, were more likely than believers to say they used learning styles in their classrooms because it saved instructional time [χ^2 (1, N = 576) = 5.30, $p < .05$].

A similar set of analyses was performed for teachers who reported that they did not consider VAK when planning instruction (n = 84): "You said you don't consider students'

visual, auditory, and kinesthetic learning styles when you plan instruction. Why not?" For teachers in the DB/U subgroup (who don't believe in VAK but said they use it anyway), the question was slightly altered to read, "You said you don't consider students' visual, auditory, and kinesthetic learning styles when you plan instruction, in spite of your belief in them. Why not?" Respondents were asked to select as many answers as applied; summary data appear as Table 16. An optional "Other" box was provided; 6 teachers answered, with four of those answers involving constraints of content that make learning style differentiate difficult. For example, "I teach computer science so that makes the content hard to teach to learning styles since it's all kinesthetic."

Table 16

Justifications for VAK Nonusers (n = 84)

Justification for Non-Use	B/DU (%)	DB/DU (%)	B/U+ DB/DU (%)
I haven't found the practice of teaching to student learning styles to be helpful for student learning.	14 (21.5%)	9 (47.4%)	23 (27.4%)
Principal discourages this practice.	0	0	0
Other teachers discourage this practice.	0	0	0
Including learning styles in my plans takes too much planning time.	23 (35.4%)	4 (21.1%)	27 (32.1%)
Including learning styles in my plans saves instructional time.	19 (29.2%)	5 (26.3%)	24 (28.6%)
I'm not really sure how to incorporate learning styles in my teaching.	38 (58.5%)	3 (15.8%)	41(48.9%)
Total	65	19	84

Chi square was performed to look for significant differences existed between the B/DU and DB/DU subgroups; neither subgroup uses VAK in practice, though the B/DU subgroup espouses belief. Meaningful dissimilarities were found; unsurprisingly, the DB/DU was statistically significantly more likely to say they don't use VAK in instruction because they have not found such practice to advance student learning [χ^2 (1, N = 84) = 4.93, p < .05]. Those who believe that VAK practices help students learn, but don't use them in their own classrooms (the B/DU subgroup), on the other hand, were more likely to explain nonuse by a simple lack of knowledge about how to apply VAK practices in their classrooms [χ^2 (1, N = 84) = 10.72, p < .01]. Nonbelievers, on the other hand, were more likely than believers to say they used learning styles in their classrooms because it saved instructional time [χ^2 (1, N = 576) = 13.45, p < .01].

What School- and Teacher-level Traits are Most Associated with Learning Style Belief and Classroom Use (i.e., Experience, Licensure Route, Grade Level Taught, School Rating)?

Multinomial logistic regression was performed to model the teacher and school traits that best predicted subgroup membership (in B/U, B/DU, DB/U, and DB/DU subgroups). Unsurprisingly, given the large imbalance between subgroup sizes and missing or low counts in several cells, SPSS again returned a warning for singularities in the Hessian matrix. Multiple successive iterations, with categories removed or collapsed, did not yield data that were suitable for robust multinomial logistic regression analysis. Since the data were suitable for binary logistic regression analysis, however, separate tests were performed. The first examined for teacher and school level differences for VAK belief/nonbelief, the second test looked at teacher and school level differences that could predict use/nonuse of VAK in practice. Results of those analyses are discussed in this section. For these analyses, teacher-level predictor variables were gender, race/ethnicity, age, years of experience, grade band taught, and path to licensure. School-

level variables in this study were Mississippi's Statewide Accountability System rating, school poverty levels, and setting (rural, urban, suburban). Table 17 presents the descriptive data for each of those variables by belief/use category (i.e., B/U, B/DU, DB/U, and DB/DU subgroups).

Table 17

Descriptive Data for Trait Variables by Use/Subgroup Classification (N = 660)

Predictor Variable	B/U (%)	DB/U (%)	B/DU (%)	DB/DU (%)	Total
Teacher Level Variables					
Gender					
Female	488	13	55	9	565
Male	61	4	9	10	84
Race/Ethnicity					
White	426	16	46	19	507
Black/African American	104	1	12	0	117
Hispanic/Latino	4	0	1	0	5
Asian/Asian American	1	0	1	0	2
Native American	1	0	1	0	2
Other/prefer not to answer	23	0	4	0	27
Age					
Under 25	29	2	5	2	38
26 – 34	148	6	13	8	175
35 – 44	179	5	20	3	207
45 – 54	140	4	17	4	165
55 – 64	59	0	10	2	71
65 or older	4	0	0	0	4
Years of Experience					
Fewer than 5 years	100	7	13	3	123
5 – 10	151	6	16	9	182
11 – 15	109	3	9	1	122
16 – 20	98	1	10	4	113
21 – 25	50	0	6	1	57
More than 25 years					
Path to Licensure					
Undergraduate program	361	10	40	12	423
Graduate/Alternate Route	174	10	21	8	213
Teach for America	3	0	1	0	4
Other	16	0	2	0	18

Table 17 (continued)

Predictor Variable	B/U (%)	DB/U (%)	B/DU (%)	DB/DU (%)	Total
Grade Band Taught					
Prekindergarten - Kindergarten	57	3	4	1	65
Grades 1 – 6	249	4	30	5	288
Grades 7 – 8	106	1	10	4	121
School Level Variables					
School Setting					
Urban	131	3	14	3	151
Suburban	138	5	17	5	165
Rural	290	9	34	11	344
School Accountability Rating					
A school	146	5	14	7	172
B school	192	9	23	6	230
C school	98	1	15	4	118
D school	73	1	9	2	85
F school	45	2	3	0	50
School Poverty Rate					
0 – 25%	31	2	2	0	35
26 – 50%	141	3	12	4	160
51 – 75%	210	3	22	9	244
76 – 100%	177	9	29	6	221

Predictors for Belief in VAK

Due to the large number of independent variables (each with multiple levels), and the considerable imbalance of belief/nonbelief groups, selecting the most meaningful input variables was of great importance. To that end, a series of univariate regression analyses was conducted to determine the predictor variables retained for the final model investigation. Since the goal is not hypothesis testing, but selection of all predictor variables that could have possible importance to the final model, the threshold for retention for further modeling was $p < .20$ (Mickey & Greenland, 1989; Ranganathan, Pramesh, & Aggarwal, 2017); Table 18 summarizes the exploratory univariate results.

Using the nonbelief category as a reference, only gender, years of experience, and grade band taught were retained for the final model, which found statistically significant positive relationships only between belief in VAK and gender ($p < .01$); women were about four times more likely to believe in learning styles. Grade band taught did not meaningfully predict belief in learning styles ($p = .22$), but it is perhaps notable that high school teachers were somewhat less likely than Prekindergarten through 8th grade teachers to endorse VAK (Table 19).

Table 18

Summary of Exploratory Univariate Regression Results for Traits Predicting Belief in VAK

Predictors		B (SE)	Wald	df	*OR*
Gender (*Ref: Male*)					
	Female	1.6 (.37)	19.17	1	4.94**
Race/Ethnicity (*Ref: Other)*			4.46	4	
	White	-18.60 (28421)	0	1	0
	Black	-16.45 (28421)	0	1	0
	Hispanic/Latino	0 (33628)	0	1	1.0
	Asian	0 (40193)	0	1	1.0
Age (Ref: > 65)			5.8	5	
	< 25	-19.06 (20098)	0	1	0
	25 – 34	-18.76 (20098)	0	1	0
	35 – 44	-17.99 (20098)	0	1	0
	45 – 54	-18.23 (20098)	0	1	0
	55 – 64	-17.66 (20098)	0	1	0
Experience (Ref: > 25)			8.05	5	
	< 5	-1.6 (1.1)	2.27	1	.20*
	5 – 10	-1.62 (1.04)	2.39	1	.20*
	11 – 15	-.64 (1.13)	.32	1	.53
	16 – 20	-.95 (1.11)	.74	1	.39
	21 – 25	.10 (1.43)	.01	1	1.11
Grades Taught (Ref: 9-12)			9.15	3	
	PreK, Kindergarten	.49 (.57)	.74	1	1.63
	1 – 6	1.2 (.42)	8.18	1	3.32 **
	7 – 8	.91 (.52)	3.07	1	2.49*
Licensure Path (Ref: TFA)			4.02	2	
	Undergraduate	-18.10 (17973.91)	0	1	0
	Grad/Alternate Route	-18.8 (17973.91)	0	1	0

Table 18 (Continued)

Predictors		B (SE)	Wald	df	*OR*
Rurality (Ref: Rural)			.84	2	
	Urban	.4 (.48)	.71	1	1.49
	Suburban	-.04 (.4)	.01	1	.957
Poverty Rate (Ref: 76-100%)			1.25	3	
	0 – 25%	.18 (.78)	.06	1	1.20
	26 – 50%	.47 (.47)	.98	1	1.59
	51 – 75%	.34 (.4)	.74	1	1.41
School Accountability Rating (Ref: F schools)			2.59	4	
	A schools	-.20 (.67)	.09	1	.81
	B schools	-.04 (.66)	0	1	.96
	C schools	.58 (.78)	.54	4	1.78
	D schools	.55 (.84)	.43	1	1.73

Table 19

Final Regression Model Results for Traits Predicting VAK Belief

Predictors		B (SE)	Wald	df	*OR*
Gender (*Ref: Male*)					
	Female	1.42 (.42)	11.26	1	4.14**
Experience (Ref: > 25)			7.26	5	
	< 5	-1.49 (1.07)	1.93	1	.23
	5 – 10	-1.51 (1.05)	2.04	1	.22
	11 – 15	-.57 (1.14)	.25	1	.57
	16 – 20	-1.02 (1.12)	.83	1	.36
	21 – 25	.36 (1.44)	.07	1	1.43
Grades Taught (Ref: 9-12)			5.02	3	
	PreK, Kindergarten	-.55 (.63)	.01	1	.95
	1 – 6	.74 (.47)	2.5	1	2.01
	7 – 8	.91 (.54)	2.88	1	2.48

Note. $N = 660$. *OR* = odds ratio. *$p < .05$. ** $p < .5$

The Hosmer-Lemeshow test was run to determine goodness of fit of the model; results yielded $\chi^2(3)$ of 5.12 and were insignificant *(p* > .05), indicating that the model was fit to the data well. Nagelkerke's pseudo R^2 equaled .13, suggesting that the model explains roughly 13% of the VAK belief outcome; however, as has been an issue with other regression analyses using this study data, the believer/nonbeliever imbalance was large (624/36), necessitating caution when interpreting regression results for predictive potential (Peng, Lee, & Ingersoll, 2002). Notably, the classification tables returned by SPSS showed Block 0 (beginning block) predictive ability at 94.5%, and Block 1 prediction rates also of 94.5%. Nevertheless, it is reasonable to assume that the statistically significant covariate of gender (Table 19) should be interpreted as a predictor of belief in VAK.

Predictors for Use of VAK in Practice

As with the logistic regression for belief, due to the large number of independent variables proposed for the model and imbalanced use/nonuse groups, care was given to selecting the predictor variables that would improve the model. Therefore, multiple univariate analyses were performed (each predictor with the outcome variable of use), again setting the cutoff significance *p* value at .20 (Mickey & Greenland, 1989; Ranganathan, Pramesh, & Aggarwal, 2017). Table 20 summarizes the results of those tests.

Based on the above data for guidance regarding predictor variable selection, gender, race/ethnicity, grade taught, poverty level, and accountability rating were retained for the final model analysis (Table 21). The Hosmer-Lemeshow statistic for goodness of fit of the model was $\chi^2(8) = 2.32$, and insignificant *(p* > .05), indicating that the model was fit to the data well. Nagelkerke's pseudo R^2 equaled .07, suggesting that the model explains only about 7% of the VAK use outcome; however, as has been an issue with other regression analyses using this study

data, caution should be used when interpreting these for predictive potential (Peng, Lee, & Ingersoll, 2002). Nevertheless, it is reasonable to assume that the statistically significant covariates of gender and school accountability rating should be interpreted as predictors of use of VAK in teachers' classroom practice. Women were more likely than men to report planning instruction with students' learning styles in mind, while teachers in C-rated and D-rated schools were less likely to use VAK for planning and instruction.

The following chapter synthesizes and discusses the results presented in this chapter to gain insight into the broad query that was at the foundation of this research: what are the sources and influencers of teachers' beliefs in relation to VAK as neuromyth, and how much do those beliefs influence practice?

Table 20

Summary of Exploratory Univariate Regression Results for Traits Predicting Use of VAK in Practice

Predictors		B (SE)	Wald	df	*OR*
Gender (*Ref: Male*)					
	Female	.83 (.29)	8.0	1	2.29**
Race/Ethnicity (*Ref: Other)*			4.58	4	
	White	1.92 (1.42)	1.82	1	6.8*
	Black	2.17 (1.45)	2.25	1	8.75*
	Hispanic/Latino	1.39 (1.8)	.59	1	4.0
	Asian	0 (2.0)	0	1	1.0
Age (Ref: > 65)			2.74	5	
	< 25	-19.72 (20096.09)	0	1	0
	25 – 34	-19.21 (20096.09)	0	1	0
	35 – 44	-19.12 (20096.09)	0	1	0
	45 – 54	-19.28 (20096.09)	0	1	0
	55 – 64	-19.61 (20096.09)	0	1	0
Experience (Ref: > 25)			4.59	5	
	< 5	-.07 (.48)	.02	1	.94
	5 – 10	-.13 (.46)	.08	1	.88
	11 – 15	.45 (.52)	.74	1	1.57
	16 – 20	-.01 (.49)	0	1	.99
	21 – 25	-.52 (.52)	1.01	1	.6
Grades Taught (Ref: 9-12)			3.58	3	
	PreK, K	.84 (.51)	2.73	1	2.31*
	1 – 6	.33 (.27)	1.5	1	1.39
	7 – 8	.39 (.35)	1.23	1	1.47
Licensure Path (Ref: TFA)			.48	2	
	Undergraduate	.61 (1.13)	.29	1	1.84
	Grad/Alternate Route	.49 (1.14)	.19	1	1.63
Rurality (Ref: Rural)			.39	2	
	Urban	.17 (.30)	.32	1	1.19
	Suburban	-.02 (.28)	.01	1	.98

Table 20 (Continued)

Predictors		B (SE)	Wald	df	*OR*
Poverty Rate (Ref: 76-100%)			4.38	3	
	0 – 25%	1.13 (.75)	2.28	1	3.11*
	26 – 50%	.53 (.32)	2.68	1	1.69*
	51 – 75%	.26 (.27)	.93	1	1.29
School Accountability Rating			4.32	4	
(Ref: F schools)	A schools	-.71 (.64)	1.21	1	.49
	B schools	-.84 (.63)	1.78	1	.43*
	C schools	-1.18 (.64)	3.38	1	.31*
	D schools	-.95 (.67)	2.02	1	.39*

Table 21

Final Regression Model Results for Traits Predicting VAK Use in Practice

Predictors		B (SE)	Wald	df	*OR*
Gender (*Ref: Male*)					
	Female	.93 (.34)	7.41	1	2.53**
Race/Ethnicity (*Ref: Other)*			5.23	4	
	White	1.62 (1.45)	1.25	1	5.04
	Black	1.75 (1.47)	1.43	1	5.76
	Hispanic/Latino	1.04 (1.86)	.31	1	2.82
	Asian	-1.21 (2.1)	.33	1	.3
Grades Taught (Ref: 9-12)			2.33	3	
	PreK,			1	1.78
	Kindergarten	.58 (.54)	1.14		
	1 – 6	.26 (.31)	.7	1	1.3
	7 – 8	.50 (.38)	1.77	1	1.65
Poverty Rate (Ref: 76-100%)			5.18	3	
	0 – 25%	1.35 (.86)	2.45	1	3.86
	26 – 50%	.7 (.36)	3.7	1	2.01
	51 – 75%	326 (.3)	1.46	1	1.43
School Accountability Rating				4	
(Ref: F schools)			4.32		
	A schools	-1.42 (.74)	3.65	1	.24
	B schools	-1.37 (.71)	3.76	1	.25
	C schools	-1.56 (.71)	4.87	1	.21*
	D schools	-1.45 (.73)	3.95	1	.23*

Note. N = 660. OR = odds ratio. *p < .05. ** p < .01

CHAPTER V

DISCUSSION

The current study examined teachers' (nonavailing) epistemic beliefs through the lens of VAK learning styles, centering around three major areas: nature and prevalence of belief, source and source justifications of belief, and the extent to which those beliefs are enacted in classrooms. It also sought to draw conclusions about the factors associated with teachers' use of VAK in classroom practice. In the following sections, the important findings that align to those ideas and the related body of research will be discussed, followed by implications, study limitations, and suggestions for future research.

Nature and Prevalence of Belief

One of the clearest conclusions supported by the study is that teachers still strongly endorse the most popular neuromyths, in spite of nearly two decades of work by educational psychologists to dispel those ideas (Dekker, Lee, Howard-Jones, & Jolles, 2012; Henson & Hwang, 2002; Goswami, 2004; Pashler, McDaniel, Rohrer, & Bjork, 2008; OECD, 2007; Reiner & Willingham, 2010). The teachers in this sample indicated that VAK learning styles (with a 94.5% belief rate) were more often believed than the plausibility of scaffolding (93.9% belief rate), the value of group work (93.3% belief rate), and informing students of the lesson objectives before beginning instruction (58.5% belief rate). The rate of response for learning style belief is in line with the 90 to 95% range found by other researchers (Alekno, 2012; Dekker, et al., 2012; Lethaby & Harries, 2016; Tardif, Doudin, & Meylan, 2015), reflecting little

progress on the part of educational psychologists' research, evidence-based teacher trainings, and social media efforts to dispel the myth.

Not only does the large majority of teachers believe that VAK styles are important for instruction and learning, they believe it strongly. On a 1 to 10 scale (with 10 meaning certainty), teachers in this study rated their belief on average as high (8.54, *SD* = 1.97); 49% of believers answered that they were "very certain" (a score of 10) that they were important for student learning. Levin and her colleagues (2013) have suggested that the longer teachers hold a belief, the stronger it may be. This idea was investigated in this study; teachers (regardless of whether they believed in VAK) were asked to tell where they had first heard about learning styles. Respondents who had answered that they were "very certain" that VAK learning styles were important were also more likely to say they had learned about VAK in their own K-16 experiences (*n* = 450, 72.1%). However, a regression analysis aimed at predicting use or belief according to original source (i.e., undergraduate education, graduate school, other educators, professional development or trainings) failed to find that any source was more predictive than the others; again, these results should be interpreted with caution given the large imbalance of belief/nonbelief and use/nonuse.

Belief in the learning styles idea was common and strong, but teachers also generally agreed with the idea that an individual's learning style could change depending on teachers' instruction methods. When Nancekivell et al. (2019) surveyed the general public, they found that the majority of Americans conceptualized learning styles as present from birth (66%) and fixed through the lifespan (57%), and when they asked teachers in particular, 93% of the sample thought that a student's learning style should determine what kind of teacher s/he should have. The majority (*n* = 395, 63.3%) of VAK believers in this sample, however, generally agreed that a

student's learning style could change depending on a teacher's instructional style. It's notable, however, than almost twice as many strongly disagreed ($n = 43$) with that idea than those who strongly agreed ($n = 25$) that learning styles are malleable.

In the current study, a key part of the original research design was multinomial logistic regression to identify both the school-level factors and individual traits that could predict belief in and use of VAK learning styles. The data were so skewed toward belief and use, however, that the results of these analyses were difficult to interpret with confidence. There was a statistically significant effect for gender on belief, with females exhibiting higher rates of belief-group membership, and the final regression model yielding gender significance at $p < .01$. For teachers who considered student learning styles to plan and deliver instruction (VAK use), females were again more likely to predict group membership, and teachers in low-performing schools were slightly less likely to use VAK ideas in practice. However, it's most noteworthy that for multinomial regression analyses in this study, the output null model (Block 0) shared prediction success rates with the full model (Block 1). In essence, simply being a teacher in Mississippi predicted belief in and use of VAK learning styles ideas to deliver instruction as well as any set of additional factors at the individual or school level.

Finally, bivariate regression results suggested that teachers who believe that VAK learning styles are important for student learning were also more likely to endorse other neuromyths, especially brain hemispheric dominance ($r = .33$, $p < .01$) and Gardner's theory of multiple intelligences ($r = .16$, $p = .01$). The full regression model indicated that belief in Gardner's theory and hemispheric dominance could explain about 26% of the belief outcome (belief in EQ did not contribute significantly to the model). The tendency of teachers to believe several neuromyths simultaneously needs further study, but the most facile explanation is the

easy availability of commercial educational materials profiting off these myths and the ease of download of free instruments designed to sort students into categories like left-brained, intrapersonally gifted, or kinesthetic learner (Dekker, Lee, Howard-Jones, & Jolles, 2012; Pashler, McDaniel, Rohrer, & Bjork, 2008), coupled with poorly researched popular education writing offering easy "life rafts" to teachers (p. 124, Geake, 2008).

Source and Justification of belief

That argument by Geake was supported by the current research: 72% of VAK believers (n = 450) mentioned their own reading as source justification for belief in learning styles. Teachers also said their VAK beliefs were a product of their teacher preparation programs (n = 462, 74%); VAK ideas studied in undergraduate education courses were overwhelmingly the most common answer when participants were asked where they had first encountered the learning styles idea, and were again cited by teachers as especially important for present-day belief, regardless of years' experience or teacher age.

Extending previous research that found that neither psychology coursework (Im, Cho, Dubinsky, & Varma, 2018; Macdonald, Germine, Anderson, Christodoulou, & McGrath, 2017) nor training in educating special populations of students (Lethaby & Harries, 2016; Ruhaak & Cook, 2018) lessened belief in VAK learning styles, notably, in this study several teachers mentioned those courses as meaningfully contributing to the belief. When asked about learning styles belief source, one respondent simply wrote, "I am a psychology graduate," while another explained "I have a degree in psychology and special education."

The finding that university special education coursework and psychology class material were explicated as neuromyth drivers adds new importance to work by Newton and Miah (2017) that found that 58% of university faculty in the United Kingdom espoused VAK learning styles,

and Newton's (2015) research that showed a full 94% of academic articles about learning styles were positive. If teachers' belief in VAK is to eventually be dispelled, it appears reasonable to conclude that such efforts cannot be confined to teachers in K-12 settings, and that some of the work should begin with college professors.

Levin and her colleagues (2013) have also written that everyday classroom practices are important for teachers' belief formation, and that conclusion was also supported by the findings of the current study. The majority of teachers surveyed indicated that their endorsement of VAK was based on their own positive classroom experiences using learning styles to advance student learning (n = 485, 77.7%). These results were in line with a wealth of teacher belief literature arguing that everyday classroom experiences have a strong impact on teachers' epistemic beliefs (Alger, 2009; Buehl & Fives, 2009; Chiavola et al., 2014); however, the precise nature of the experience/belief relationship has been elusive, leading Buehl and Beck (2015) to call for more research that investigates belief/practice relationship nuances.

To that end, and to confirm the relationship between classroom experiences and teacher beliefs, a regression analysis was conducted to predict which source justifications (e.g., undergraduate learning, apparent effectiveness in individual classrooms, school administrator proponents) most predicted current belief in VAK learning styles. As expected, the output revealed statistically significant positive results for apparent VAK instructional effectiveness ($p < .01$) as a predictor of teacher VAK belief. Unexpectedly, however, there was also a statistically significant relationship between administrator belief ($p < .01$) in VAK and teacher belief.

The apparent influence of school administrators on epistemic beliefs merits further research. Interestingly, elsewhere in the survey, the idea that administrators have strong influence on what teachers believe appears doubtful. When teachers were asked whether they

believed that posting the lesson objectives prior to teaching were important for student learning, only a slim majority (58.5%, the lowest of any belief surveyed) agreed. For the next survey item, however, which asked how often they used the idea in practice, more than 81% indicated that they did. That relatively few teachers believe in posting objectives while so many do it anyway is easily explained: principals in Mississippi generally require that lesson objectives be posted on whiteboards. Reasons are twofold: first, classroom observations for Mississippi's teacher rating and accountability system are easier for principals to conduct when they can clearly see the objectives being taught; second, there is evidence doing so enhances student learning (Banilower, Cohen, Pasley, & Weiss, 2010; Twyman, McCleery, & Tindal, 2006). Nevertheless, principal endorsement of this idea has not seemed to increase rates of teacher belief, in contrast to what the findings of this research suggested regarding VAK.

Conflicting Evidence and Epistemic Belief Change

To further investigate the sources and source justifications around nonavailing beliefs, teachers who reported that they did not believe in VAK were asked to explain what sources of information had led them to the conclusion that learning style theory is without merit, and what justifications they used to discard the VAK idea. Although the sample of nonbelievers was small (n = 36), interesting trends were apparent in the data. As was the case for VAK believers, undergraduate coursework was the most reported initial epistemic source, with 23 of the 36 (63.8%) reporting that they had first heard of the idea there. When asked to explain why they did not believe in VAK, however, only eight teachers said that their graduation program coursework had served to debunk VAK. Most nonbelievers said they had rejected the idea out of personal experience, either reading for themselves (52.8%) about the lack of empirical support or finding that it did not seem to increase student learning (41.7%).

These results importantly mirror those of believers in terms of sources that are deemed reliable for forming epistemic beliefs: for both groups, personal research or reading and classroom experience played major roles in the eventual belief outcome. And for both groups, undergraduate programs were the initial source of information about VAK, but nonbelievers were at least somewhat likely (about 22% of the time) to attribute their current disbelief of VAK to new information they had learned in their own graduate programs.

VAK believers were asked whether they had heard about research or evidence that VAK learning styles were "myths." The majority (70.8%) said they had never heard such information, but of those who had encountered (and then discarded) arguments about the nonavailing nature of learning styles ($n = 182$), almost 80% justified their continued belief in VAK by its apparent classroom effectiveness for student learning. One teacher simply wrote, "Even if the research says it doesn't work, it works." These results are not too surprising, given decades of belief perseverance research in social psychology that has found that discrediting evidence is most likely to be ignored when: (1) the original belief seeks to explain or attribute cause for some salient phenomenon that an individual has witnessed (Anderson, Lepper, & Ross, 1980; Kelly, 1993), and (2) if the belief is related to individuals' abilities in a specific domain (Anderson, Lepper, & Ross, 1980; Ross, Lepper, & Hubbard, 1975). In other words, learning styles—because they are handy for both explaining student learning success (or failure) and people's innate abilities to acquire knowledge, may be especially perseverant.

The large number of teachers who said they had never heard counterinformation seems surprising, given the years of work by some educational psychologists and neuroscientific researchers to squelch VAK application in education. However, Bondy and her colleagues (2007) have written that, when it comes to choosing instructional strategies, teachers generally

trust their own colleagues more than research; in this study, the small number of teachers who said they didn't believe in learning styles (n = 36) also answered by nearly two-thirds margin that they had never told their colleagues that learning styles theory isn't valid. It seems reasonable that if nonbelievers are not communicating the problems with VAK, and believer teachers are seemingly not being exposed to countering information, VAK belief will continue to enjoy popularity.

Relationships Between Epistemic Beliefs and Practice

When examined holistically, these findings add to the discussion about the nature of experience/epistemic belief relationships. Chiavola and her colleagues wrote in their meta-review that over dozens of studies, it appeared that "beliefs influence practice, practice influences beliefs, beliefs and practice have reciprocal relationships, and practice and beliefs can be disconnected" (p. 13). Each type of relationship was uncovered in the present study. The unidirectional influence of beliefs on practice is supported by the large number of VAK believers who said they endorsed the VAK idea because they had learned about it in their own K-16 educations; those teachers went on to say that they used student learning styles in their own instructional planning and delivery more than 92% of the time.

Illustrative of unidirectional relationships in the opposite direction (experiences influence epistemic beliefs), teachers indicated that they believed that the VAK idea had merit because they had seen it work in their own classrooms (n = 485, 77.7%). Although many teachers (n = 375, 60.1%) checked that they believed in learning styles both because of their undergraduate coursework *and* because they had seen it work in classrooms (indicative of the reciprocal relationship between belief and practice), some teachers (n = 110, 16.7%) only selected "I've

seen this work in my classroom," supporting the idea that some epistemic beliefs can be based on experience without pre-existing influences.

Finally, there was ample evidence that the relationship between epistemic beliefs and experience can be disconnected. Calderhead (1996) and Woolfolk-Hoy and her colleagues (2006) have noted that teachers' practices do not always reflect what they believe, and sometimes they believe things they do not use in their classrooms. Lee (2009) found that teachers whose beliefs and practices are discrepant often blamed administrative pressures, testing schedules, or poor school policy for the misalignment. She argued that these may have been "mere excuses" (p. 19) and urged researchers to continue to ask teaches to explain why their espoused beliefs were not being enacted, or why practices were not rooted in personal belief.

Teachers in this study whose beliefs and practice did not align (B/DU subgroup, $n = 65$, and DB/U subgroup, $n = 17$; 12.4% of overall sample) were asked about the disconnect, and then given options that matched those Lee (2009) found (i.e., administrative pressures, instructional time pressures, planning constraints). None of these reasons, however, was the most popular choice for the participants in this study. Teachers who believed in but did not use VAK in practice (B/DU subgroup) were most likely ($n = 38$, 58.5%) to attribute nonuse to simple lack of knowledge about application: "I'm not really sure how to incorporate learning styles in my teaching." None said that their principal discouraged the practice, but constraints on planning time (35.4%) and instructional time (29.2%) were mentioned by some.

The second discontinuous set, teachers who did not believe in VAK but still said they used the idea to teach students (DB/U subgroup), agreed less about why they used practice they did not believe in. There was not a majority or even plurality of responses, though administrative pressures was one of the answers with a relatively large percentage (17.5%) of agreement: "My

principal requires that we include learning styles in our instructional planning." Taken together, the reasons teachers gave for the lack of alignment between practice and belief did reflect the external pressures Lee (2009) has found. More so, however, the most popular answer was a lack of knowledge about how to translate epistemic beliefs into practice, an idea that will be fully explored in the next section of this chapter.

Enactment of Beliefs into Classroom Practice

The extent to which teachers use VAK practices in classrooms (and whether it matters for students) has been the topic of some debate. Critics of neuromyth detractors have argued that differentiating instruction—whether by knowledge, ability, interest, or learning style—can be good practice regardless of teachers' motivation for doing so, since it necessarily results in a variety of instructional delivery methods, which advances student learning (Horvath, Donoghue, Horton, Lodge & Hattie, 2018). But according to some researchers, planning instruction around false "differences" can track students into categories that have little meaning, and result in classroom teaching that has been engineered for appeal to fictional learning style needs, rather than for maximum effectiveness and interest (Reiner & Willingham, 2010).

To gain insight into how teachers use VAK in their classrooms, the current research first simply asked teachers whether they "regularly use learning styles" in their own practice. Deliberately, neither a practical definition of VAK teaching nor examples of learning style practices were given, because the researcher was first interested in whether teachers considered their own practices to be VAK-driven. Most of the sample (n = 576, 87.3%) indicated that they did consider their regular practice to include differentiating or planning instruction according to their students' learning styles, and this prevalence rate was statistically unrelated to age, years of experience, school rating, or grades taught. Females were more likely to use VAK practice in

their own classrooms, but since the rate of use was so large, it's nearly as meaningful to say being a teacher in Mississippi predicts use of VAK learning styles in instructional practice almost nearly 90% of the time.

In addition to a high prevalence of use, the survey revealed large frequencies for rates of usage of learning style instructional techniques. When asked to estimate the percentage of instructional time they targeted student learning styles in their classrooms, the average was about three-fourths of time (75.5%), which was more often than they said they used class discussion (71.9% of the time). The mode for the responses was 100% of the time, representing nearly 16% of the sample.

To get more information, and to help validate the extent to which the teachers in the VAK User group were actually applying what they considered VAK concepts, the survey asked whether they had given a learning style inventory to their students. Almost two-thirds (61.6%) indicated that they had spent time having students complete that instrument; these responses lend support to the argument that teachers were not simply agreeing that they used learning styles because they believed them to be viable practice (but not actually using them as much as they indicated); indeed, a notable majority of teachers in this research study had systematized that use, employing an inventory aimed at categorizing students for differentiating instruction.

Researchers who have worried about the effects of pigeonholing students into essentially meaningless categories for group work (Kirschner & van Merriënboer, 2013; Sharp et al., 2006) appear to have a grounds for concern: in this study sample, a majority of teachers (57.1%) who were VAK Users said they grouped students by their learning styles; this scheme for grouping was second only to ability grouping (76.4%), raising concerns about how teachers categorize students for instructional delivery and classwork. And when asked in an open-ended question

how they used student learning styles to differentiate instruction, answers were clear: VAK categories were used throughout the instructional cycle. Teachers planned with VAK in mind, delivered content in ways that were tailored to VAK styles, wrote and administered assessments that were aligned to students' learning styles, and formed student collaborative groups with learning styles as the sorting method.

With this data in mind, and considering the findings of Nancekivell and her colleagues (2019) that found that teachers think of students with different learning styles in different ways (e.g., that they are suited for different careers, different kinds of teachers, and will achieve disparate levels of school success), there exists a compelling case that "teaching to learning styles" isn't as benign as some education researchers have suggested.

Contributions and Implications

In spite of the decades' worth of research on teacher epistemic beliefs and their influence on classroom practice, Greene (2016) wrote that basic questions have been overlooked in the literature. Those include uncertainty around how teachers form and update their epistemic beliefs. What information sources most impact teachers? What kind of countervailing research or information is sufficiently compelling for teachers to change what they believe? What factors influence whether they enact those beliefs in the classroom? And, what is the interaction between belief and practice? This current study has helped to further understanding and answer those questions about teachers' epistemic thinking, using a nonavailing epistemic belief (VAK learning styles) as the case of interest.

Sources and Justifications of Teachers' Epistemic Beliefs

Confirming earlier studies, the respondents in this sample derived their VAK beliefs overwhelmingly from their own K-16 schooling and justified those beliefs by their day-to-day teaching experiences; it was evident that some teachers were taught about their own learning styles as early as elementary school, and exposure to learning style VAK classroom methods in their pre-service teacher preparation programs had solidified their beliefs. Since most had not heard about any contradictory research about learning styles, and because VAK methods appeared fruitful in classrooms, they saw no need to investigate sources that may lead to belief change. Teachers' subjective experiences with apparent learning style instructional success was the strongest justification for its continued use.

Even when they had heard about the lack of research basis or other conflicting evidence, the participants in this study were likely to discard the new information. It seems likely that belief in VAK has become part of some teachers' personal and professional identities: they have held the belief since their own grade school years, could identify what kind of learner they were, and that belief had been reinforced by everyday experiences and the shared adoption of colleagues. One teacher wrote about his own learning style (kinesthetic), and said that his personal experiences of being a kinesthetic learner had led him to becoming a Physical Education teacher. This study was important in that it illuminated a potent blend of beliefs—perceptions about personal self, professional identity, and practical utility; the strength of that combination has served to maintain VAK's high endorsement rate among teachers over decades.

Enactment of Beliefs into Practice

Teachers in this study regularly enacted their beliefs into their classroom practice, with two noticeable exceptions. First, and importantly, they used the ideas they believed in their own

classrooms unless they weren't certain how to apply them. When belief in an idea was held and there were obvious ways of incorporating those ideas into practice, they did so with high frequency; scaffolding, for example, had roughly a 94% belief rate and a 90% use rate. Similarly, class discussion's belief/use ratio was about 98% to 90%. On the other hand, when asked about beliefs that are more difficult to apply in classroom instruction (right-brain/left-brain hemispheric dominance, for example), use rates fell relative to belief rates; in each of those cases, teachers indicated that they weren't quite sure whether they were enacting those ideas or not, and explained the discrepancy by their own uncertainty about methods for meaningful classroom application.

The second notable impinger on the belief/practice relationship was administrator influence. Although school principals did not seem important for teachers' belief systems (participants in this study mostly did not cite administrators as either an epistemic source or belief justification), they did use ideas that they did not agree with in their own classrooms, when those practices were mandated by administrators. The idea of displaying lesson objectives, for example, received the lowest support of any concept in this study, but was used more than 80% of the time (at least in part due to administrative pressures). The suggestion of a one-way nature of administrators' influence on the belief/enactment relationship was one of the unique contributions of this study.

Theoretical Implications

Investigating the results of this study using Hofer and Pintrich's (1997) Multidimensional Epistemological Framework yields additional insight into the nature of teachers' epistemic beliefs and the teachers in this sample. The model is useful for examining individuals' understandings along two broad areas: the *nature of knowledge* itself, and the *nature of knowing.*

According to the framework, individuals' epistemic development generally moves from relatively simplistic thinking in these areas to more sophisticated, and occurs in ways that are contextual and often asynchronous. Biology teachers may hold sophisticated epistemic beliefs around the nature of knowing in the biological sciences, while simultaneously endorsing relatively naïve ideas about the nature of knowing for general classroom pedagogy. For example, the teacher may believe both that science knowledge is externally derived from experts, while eschewing educational psychology research as a reliable source in favor of their own subjective teaching experiences.

Nature of Knowledge

The framework's *nature of knowledge* section is subdivided into two dimensions, certainty of knowledge (whether it is absolute or tentative) and simplicity of knowledge (the extent to which it is a collection of discrete facts or interrelated and constructed). This study sheds some light on teachers' ideas about both of these. Survey respondents were very likely to say that they were absolutely certain that learning style theory was both valid and useful. Many respondents had been introduced to the idea early (some as children), accepted and internalized the belief that VAK is an important individual learning trait, and had not seen a reason since to update their knowledge with current science. Knowledge around VAK for most of the teachers in this study was absolute: learning style theory is true, good, and useful, and there's no reason to investigate further. This marks a less sophisticated epistemic stance.

Insight into teachers' views about the simplicity or complexity of knowledge (through the lens of epistemic beliefs related to learning styles) can also be gained from the current research. As Reiner and Willingham (2010) have argued, students learn in ways that are dynamic, contextual, and individualized; they can prefer certain delivery methods, possess varying

amounts of background knowledge, motivation levels, interests, and abilities. In short, student learning is a complex, messy process and sophisticated epistemic stances around student learning acknowledge those complexities. By contrast, ascribing important individual differences in student cognition and learning to VAK learning styles oversimplifies matters and offers a facile (but not useful) method for sorting students into false and prescriptive categories. In other words, as Kirschner (2017) eloquently pointed out, sorting students into learning style categories, while simple and convenient, is naïve because it ignores the complexities of the learning process and individual cognitive variation.

Nature of Knowing

Hofer and Pintrich's (2007) Multidimensional Epistemological Framework delineates two dimensions that describe the nature of knowing: *source of knowledge* and *justification for knowing.* Teachers' ideas about both of these dimensions was examined in the current research, while acknowledging Greene's (2007) criticism that the *justification for knowing* dimension lacks some specificity. In light of the lack of theoretical development (Hofer and Pintrich dedicate only two sentences to its description), for this study, justification for knowing was defined as the ways that teachers justify belief in VAK learning styles in their present-day teaching (rather than original source justification). Specifically, *source of knowledge* was investigated through questions about original source of VAK understanding or exposure, while *justification for knowing* was examined through questions about the ways that teachers justify *continued belief.*

In spite of the careful a priori delineation by this researcher between the two dimensions, Greene's criticism about their underdeveloped nature gains standing when the data are applied to the framework. According to the Hofer and Pintrich model (1997) and other developmental

epistemic cognition theories before it, the idea that authorities are the most reliable sources of knowledge is described as being less sophisticated than a belief that one can construct his/her own truths. In this study, the original sources that most VAK Believers cited for learning style information was their own schooling, especially their undergraduate teacher education programs; this reliance on authority, under the framework, is a more naive epistemic stance.

On the other hand, as a justification for knowing (and continued belief), teachers relied strongly on their own experiences, rather than scientific research or authoritative figures who have spent the past two decades attempting to dispel learning style theory. As one teacher wrote, "I don't care much about the so-called experts…." According to traditional epistemic cognition developmental models and positions, these teachers' rejection of authority sources (and reliance on personal experiences) for knowledge formation is a hallmark of more sophisticated epistemic development. The inability of those established frameworks to account for context justifies researchers' calls for its further development (Greene, 2007), including contextual distinctions about when self-reliance is preferable to trusting in authorities, and when it can be nonavailing. In particular, it seems clear that simple categorizations of "naïve" or "sophisticated" epistemic cognition stances are perhaps themselves overly simplistic.

Limitations

There were a few limitations to the current research; most notable was the extremely imbalanced distribution in the data of VAK believers to nonbelievers, and VAK users to nonusers. Although previous research had found that a majority of teachers believed in learning styles, it was ventured that more rigorous recent efforts to discredit the idea may have had an impact. That optimism now seems unlikely, given the near 95% belief rate found by this study. Additionally, because earlier research had questioned the extent to which teachers actually enact

their beliefs into practice, this study's methodology included categorizing teachers into four subgoups (BU, B/DU, DB/U, and DB/DU). When the results were tabulated, however, there were simply not a sufficient number in either the VAK Nonbelievers or the VAK Nonusers categories to draw meaningful conclusions from any of the logistic regression models. In fact, for every model prediction, SPSS indicated that the null model (with no predictor variables) was as or nearly as effective at predicting group membership as the full model. In short, simply being a teacher in Mississippi predicts with greater than 90% accuracy that one both believes in and uses VAK in practice.

Second, with roughly 32,000 K-12 teachers in Mississippi, the survey response number of 660 is simply too small to extrapolate these findings with certainty to the larger population. It is also possible that principals who distributed the survey link to their faculty differed in some meaningful way from those who did not (i.e., administrative style, school size, number of licensed to emergency-licensed teachers); and of course, teachers who completed the survey may have differed in meaningful ways from those who did not, as well.

There were several instrument limitations for this study. In light of previously discussed psychometric shortcomings for available epistemic cognition measures, and because the current study was designed to explore specific teacher beliefs and the extent to which teachers were (or were not) enacting those beliefs, an exploratory survey instrument was created. The survey does not lend itself to psychometric validation for reliability and validity, and is not meant to serve as a measurement with theoretical application for any current epistemic cognition model. Additionally, survey items about all practices (availing and nonavailing) were worded positively, and belief rates were high for all, suggesting that social desirability bias may have positively influenced responses. Finally, some past research on epistemic beliefs and the enactment of

beliefs into practice has combined initial survey or interview data with direct observation of teacher practice to validate teacher reports of belief enactment; this research aimed to get a broad sense of trends about specific beliefs, did not include classroom observations on a large scale to determine whether teachers' responses were reliable.

Although there were survey items designed to probe the extent to which teachers really were using VAK in classrooms ("Have you given a learning style inventory?" "How do you use VAK to differentiate instruction?") is possible that teachers are not enacting VAK beliefs as often as reported. Importantly, although learning style teaching practices was deliberately left ill-defined, it is possible that teachers have differing ideas about what it means to teach students according to their individual learning styles.

Recommendations

Recommendations for Research

There are many opportunities to improve and extend this research, beginning with a fuller investigation related to belief enactment, and the methods that teachers use when they target learning styles in instruction. Learning style detractors have themselves been criticized for engaging in what some consider an essentially meaningless (and possibly harmful) campaign (Horvath, Donoghue, Horton, Lodge, & Hattie, 2018). VAK quashers have been seen as gratuitous teacher-critics who needlessly undermine the professionalism of educators in an effort to showcase the relevance and rigor of educational psychology. Horvath and colleagues (2018) have contended that when teachers target learning styles, the result is varying instructional delivery, which is a best-practice outcome in itself.

But it is unclear exactly what teachers' methods for targeting learning styles are, and although this study was able to shed some light onto the ways teachers target VAK (i.e., through

grouping, varied delivery, assessment design), there is still much to learn about how this really looks in classrooms. A series of classroom observations, lesson plan analyses, and an investigation into purchased materials and VAK guidebooks would yield important information about exactly what teachers are doing in the name of "using VAK in the classroom." Notably, teachers in this study reported targeting student VAK styles almost three-fourths of their instructional time. That percentage rate seems impractical, and calls for a closer look at *what* teachers categorize as VAK instruction, and whether those practices are simply good-practice differentiation or meaningless student pigeonholing.

Although VAK debunking is now into its second decade, belief rates have not changed much. It would be interesting to track belief in learning styles (and other prevalent neuromyths) over time. Such longitudinal data might be of interest for researchers who wish to determine factors and events that affect neuromyth belief. It would be especially interesting to track university faculty and K-12 teacher belief separately, to examine for possible relationships and group differences.

This study was the first (known to this author) that asked teachers whether they thought students' learning styles could change over time, and found that most teachers did believe learning styles are malleable. This finding could have potential effects on the ways that teachers think about and form opinions about students based on their preferred learning style, as Nancekivell and her colleagues (2019) have discussed. Specifically, if teachers believe students' learning styles can change, it may be that the traits they ascribe to students also change over time. Additionally, there are possible theoretical implications about belief change or persistence, especially around the sources of evidence teachers use when they update beliefs.

This study was designed to investigate predictors for belief and use, especially at the teacher- and school-level. As discussed, the data were severely imbalanced, and the results of those multinomial regression analyses were not as robust as expected. Nevertheless, gender was an important factor for both belief and use (with women more likely to endorse and use VAK in practice than men). However, although women make up the majority of the teacher workforce in lower grades, there was not a significant effect for the grade band predictor; an investigation of grade by gender interaction could yield interesting insights.

The data also beg some follow up questions. Although the source of VAK belief was examined, it would be interesting to ask participants about the sources of all the beliefs that appeared in this study. Do teachers rely primarily on their own K-12 experiences to derive epistemic beliefs, as Lortie (1975) has suggested, or are professional development and inservice trainings effective at introducing new ideas and contemporary understandings? Additionally, since a good portion of the qualitative responses emphasized individual differences in learning, it might be interesting to examine whether less individualistic cultures place a similar emphasis on learning styles and multiple intelligences classifications, or if those beliefs are more typically European American.

Finally, the current research attempted to isolate the origin of teachers' VAK beliefs. The survey asked them to remember to the best of their ability where they had first heard about learning styles, and offered undergraduate college experiences as an option (the most popular response). In the "other" write in box, however, many referred to their own K-12 schooling as the origin of their VAK belief; this makes sense considering the number of teachers in this sample who reported having given a learning style inventory to their own students this school year, thereby perhaps introducing or reinforcing VAK ideas in their own students. Survey open-

ended responses indicated that these research participants are teaching students about their own (student) learning styles, including ways to study, how to take notes, and which assessments are best. Levin and her colleagues (2013) wondered whether teachers' beliefs grow stronger the longer they are held, and that could be supported by investigating how many teachers have believed in the value of learning style differences since their own grade-school years.

Recommendations for Practice

There are practical implications for this research that relate to teacher training and professional development. Although educational psychologists have written broadly about the lack of value and empirical support for learning styles (and other popular neuromyths), the message clearly is not getting through to teachers, as belief rates have remained relatively unchanged for at least a decade. Several explanations seem plausible: teachers generally do not stay abreast of new educational research (Kagan, 1992; McIntyre, 2005; Olivero, John, & Sutherland, 2004; Slavin, 2008), which is often locked behind journal paywalls; unsurprisingly, then, teachers more often turn to poorly researched but easily found commercial instructional materials and educational writing (Dekker, Lee, Howard-Jones, & Jolles, 2012; Pashler, McDaniel, Rohrer, & Bjork, 2008), which sell neuromyths as magical "quick fixes" that are easily enacted. Finally, as the current research has indicated, teachers will reject research that does not align to or support their own classroom experiences, making it difficult to change teachers' beliefs once they are well-established (Kagan, 1992).

In light of those attitudes, it is clear that changing teachers' nonavailing beliefs will not be accomplished using a top-down authoritative approach. Not only has those efforts by researchers failed to change the minds of most practitioners, it can lead to the belief that educational research is an ivory tower—of limited use for real-world classrooms and conducted by university faculty

that often have no (or not recent) day-to-day experience in K-12 education. Zembylas and Chubbuck (2015) have worried that educators' nonavailing beliefs could negatively influence public perceptions of schooling. However, it seems equally plausible that public perceptions about the value of research could result from the inability of educational psychologists to meaningfully translate research (including its limitations) for practitioners.

As the instructional leaders of schools and districts, principals, coaches, and academic officers are tasked with providing reliable information to teachers about classroom best-practice, and for keeping abreast of educational research that has implications for pedagogy. Those positions, however, are often responsible for an array of tasks that can take precedence over reading research; additionally, it is often only large and relatively well-funded districts that send administrators to major educational research conferences or will pay for research journal subscriptions. Consequently, purveyors of "quick fixes" like learning style strategy books, software based on poorly research theory, and other neuromyths have stepped in: they sell easy-to-implement, attractive products that ostensibly have some research or conceptual basis to support them. In the accountability era, these have come to fill the void between good quality educational research and practice; importantly, as we have seen with VAK, once those ideas are embedded they are extremely difficult to replace with more availing beliefs.

Authentic conversations and collaborations are necessary, so that researchers understand (1) what teachers believe and why, and (2) how those beliefs are supported by classroom experiences. Similarly, researchers should be careful that they do not oversimplify the research to "Teaching to learning styles doesn't work." Teachers have seen evidence that those techniques *do* seem to work, and they reject outright a categorical discrediting of their own professional experiences. Instead, researchers should continue their dedication to learning *what* methods seem

to teachers to work best, understand *why* those practices show promise, and then explaining *how* to extend and improve those strategies to enhance teacher effectiveness.

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APPENDIX A

RECRUITMENT EMAIL SCRIPT

Hello,

My name is Dana Seymour, and I am a doctoral student in Educational Psychology at Mississippi State University.

Principals, I am writing to request your help disseminating to your school's teachers a survey investigating what teachers think and believe about various classroom instruction strategies. The information I gather from this study will help me and others provide more effective professional development to teachers and get a better sense of what teachers need to know about classroom practice.

Teachers, participation in this survey is completely voluntary and you may opt out at any time. The survey should take no more than 10 minutes to complete, and all responses will be kept confidential.

To participate, please click on the following link: [survey link]

Teachers that complete the survey will be entered into a random drawing to win a $125 Amazon gift card. Because I'm asking principals to forward this email to teachers, the winning teacher's principal will also get a $125 Amazon gift card.

If you have any questions about this survey, or difficulty in accessing the site or completing the survey, please contact Dana Seymour at [email address].

Thank you in advance for providing this important feedback.

Sincerely,
Dana Seymour

APPENDIX B

DEMOGRAPHIC QUESTIONNAIRE

1. What is your gender?

- Female
- Male
- Prefer not to answer

2. Which below best describes your race or ethnicity?

- White or Caucasian
- Black or African American
- Hispanic or Latino
- Asian or Asian American
- Native Hawaiian or other Pacific Islander
- American Indian or Alaska Native
- Other, or prefer not to answer

3. How old are you?

- Under 25
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

4. How many years of teaching experience do you have? Include the current school year.

- Fewer than 5 years
- 5-10
- 11-15
- 16-20
- 21-25
- More than 25 years

5. Please indicate the grade band you've taught for the majority or your career.

- Early childhood through K
- First through 3rd grade
- 4th through 6th grade
- 7th or 8th grade
- High school

6. Would you consider your school to be…?

- In an urban area
- In a suburban area
- In a rural area

7. Please estimate the percentage of your students who are poor.

0% of my students could be considered poor

50% of my students could be considered poor

100% of my students could be considered poor

8. Please indicate your school's most recent accountability rating.

- A school
- B school
- C school
- D school
- F school
- Not sure (type your school name below)

9. How did you receive your teaching license?

- Undergraduate coursework
- Alternate route program
- Teach for America
- Other (please specify)

APPENDIX C

EPISTEMIC BELIEFS QUESTIONNAIRE

Teachers choose classroom practices for a variety of reasons, and they form their own opinions about the idea that are useful in the classroom and those that are a waste of time. Occasionally, teachers use ideas that they aren't convinced have merit, or discontinue a practice that has worked in the past to try something new.

A variety of instructional ideas and practices appear on the next few pages. Please tell how you feel about them.

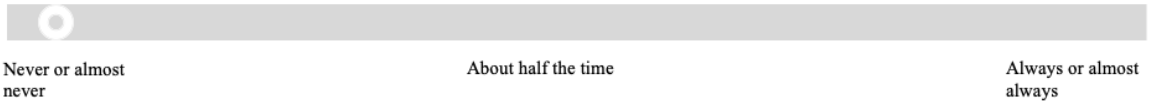
1. Class discussion is a powerful teaching tool.

    - o I believe this.
    - o I don't believe this.
    - o I'm not familiar with this idea

2. Whether or I believe in the value of class discussion or not…

    - o I regularly use class discussion in my classroom.
    - o I don't regularly use class discussion in my classroom.
    - o Not applicable (I'm not familiar with this idea).

3. Slide the circle to indicate how often you use class discussion in your classroom.



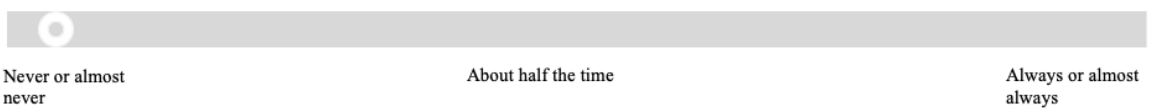
4. Some people are right-brained and some people are left-brained, and that shows in how creative or logical they are.

    - o I believe this.
    - o I don't believe this.
    - o I'm not familiar with this idea

5. Whether or I believe in the idea of right-brain and left-brain thinking or not…

    - o I regularly use class discussion in my classroom.
    - o I don't regularly use class discussion in my classroom.
    - o Not applicable (I'm not familiar with this idea).

6. Slide the circle to indicate how often you use right-brain/left-brain ideas in your classroom.



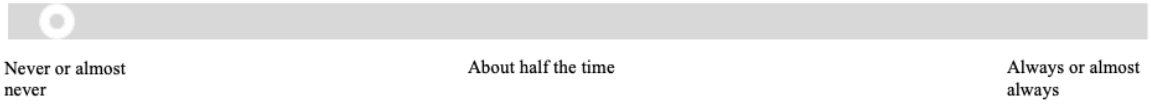
7. Displaying the lesson objective on the whiteboard or other display helps students learn the material.

- I believe this.
- I don't believe this.
- I'm not familiar with this idea

8. Whether or I believe in the value of displaying the objective or not…

   - I regularly use class discussion in my classroom.
   - I don't regularly use class discussion in my classroom.
   - Not applicable (I'm not familiar with this idea).

9. Slide the circle to indicate how often you display lesson objectives in your classroom.



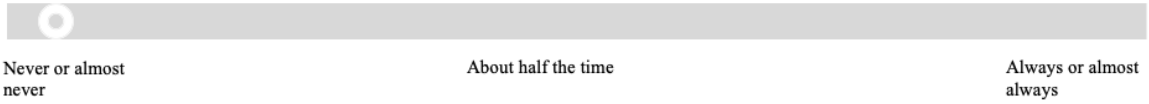
10. Group work helps students learn the material and how to work with others.

    - I believe this.
    - I don't believe this.
    - I'm not familiar with this idea

11. Whether or I believe that group work is valuable or not…

    - I regularly use class discussion in my classroom.
    - I don't regularly use class discussion in my classroom.
    - Not applicable (I'm not familiar with this idea).

12. Slide the circle to indicate how often you use group work in your classroom.



13. Emotional intelligence (sometimes called EQ) is as important to success as IQ.

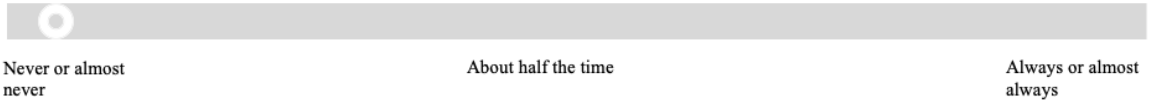
    - I believe this.
    - I don't believe this.
    - I'm not familiar with this idea

14. Whether or I believe in the idea of Emotional Intelligence or not…

    - I regularly use class discussion in my classroom.
    - I don't regularly use class discussion in my classroom.

- Not applicable (I'm not familiar with this idea).

15. Slide the circle to indicate how often you use Emotional Intelligence ideas in your classroom.



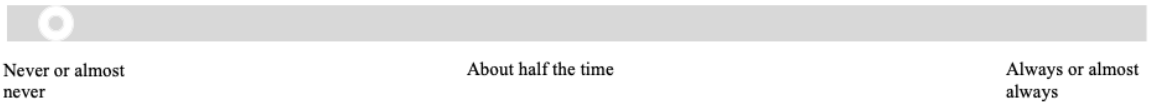
16. Scaffolding the content is important for learning.

- I believe this.
- I don't believe this.
- I'm not familiar with this idea

17. Whether or I believe in the value of scaffolding or not…

- I regularly use class discussion in my classroom.
- I don't regularly use class discussion in my classroom.
- Not applicable (I'm not familiar with this idea).

18. Slide the circle to indicate how often you use scaffolding in your classroom.



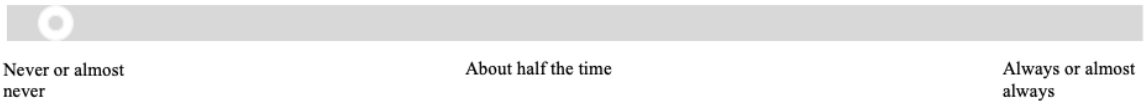
19. According to Gardner's Theory of Multiple Intelligences, all students are gifted in some way.

- I believe this.
- I don't believe this.
- I'm not familiar with this idea

20. Whether or I believe in the Multiple Intelligences or not…

- I regularly use class discussion in my classroom.
- I don't regularly use class discussion in my classroom.
- Not applicable (I'm not familiar with this idea).

21. Slide the circle to indicate how often you use group work in your classroom.



22. Some students are visual learners, some are auditory learners, and some are kinesthetic learners, and we should teach them according to their learning style.

    - I believe this.
    - I don't believe this.
    - I'm not familiar with this idea

23. Whether I believe in the idea of learning styles or not….

    - I regularly use learning styles in my classroom.
    - I don't regularly use learning styles in my classroom.

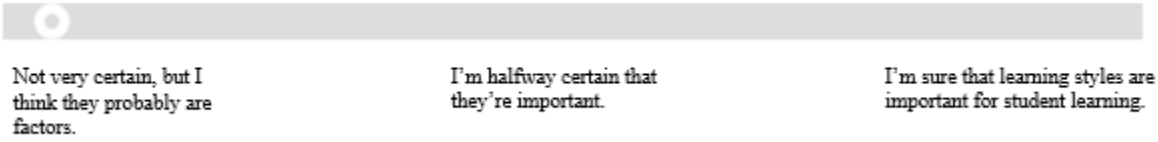
APPENDIX D

SURVEY ITEMS FOR BELIEVE/USE GROUP

1. You indicated that you believe in the idea of teaching students according to their visual, auditory, and kinesthetic learning styles. Which of the following led you to this belief? (Choose all that apply.)

    - o I learned about these in my teacher preparation program.
    - o I have attended inservice professional development about learning styles.
    - o My school administrators are/have been proponents of learning styles.
    - o Other educators that I trust have told me about these.
    - o I've seen this work in my classroom.
    - o I've read about learning styles.
    - o Other (please specify)

2. How certain are you that visual, auditory, and kinesthetic learning styles are important for student learning?



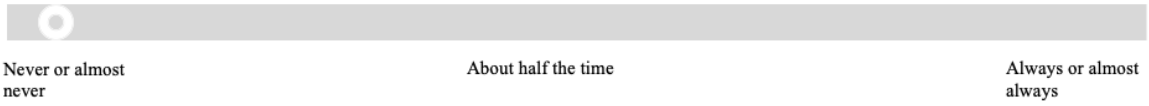
3. To the best of your recollection, where did you first hear about learning styles?

    - o Undergraduate program
    - o Graduate program
    - o Professional development or training
    - o Other educators

4. You also indicated that you consider students' visual, auditory, and kinesthetic learning styles when you deliver instruction. Why? (Choose all that apply.)

    - o Other teachers use them, and I want my practices to mirror theirs.
    - o My principal requires that include learning styles in our instructional planning.
    - o Students and/or parents expect it.
    - o Teaching to my students' learning styles works in my classroom.
    - o Including learning styles in my plans saves planning time.
    - o Including learning styles in my practice saves instructional time.
    - o Other (please specify)

5. Slide the circle to indicate how often you target students' learning styles in your classroom.



6. Have you given a learning style inventory to your students?

   - Yes
   - No

7. What do you use to determine student collaborative groups in your classroom? Choose all that apply.

   - Interest
   - Ability
   - Learning style
   - Grades
   - Student choice
   - Random
   - Other (please specify)

8. How do you use learning styles to differentiate instruction in your classroom?

9. A students' learning style is something that can change with instruction.

   - I strongly disagree.
   - I disagree.
   - I agree.
   - I strongly agree.

10. Have you heard about or seen research that suggests that visual, auditory, and kinesthetic learning styles are myths? (Check all that apply.)

    - Yes, but I don't believe they're myths because I learned about them in trainings or my teacher preparation.
    - Yes, but I don't believe they're myths because I know they work in my classroom.
    - No, I have not heard this.

APPENDIX E

SURVEY ITEMS FOR DON'T BELIEVE/USE GROUP

1. You indicated that you don't believe in the idea of teaching students according to their visual, auditory, and kinesthetic learning styles. Why not? (Choose all that apply.)

    - My teacher preparation program taught me this idea isn't true.
    - My graduate coursework included research that suggests this idea isn't true.
    - I have attended professional development sessions that debunked this idea.
    - My principal has said the idea is not true.
    - Other teachers have told me this idea isn't true.
    - I tried the practice of teaching to student learning styles, but didn't find that it increased learning.
    - I've read for myself that this idea isn't true.

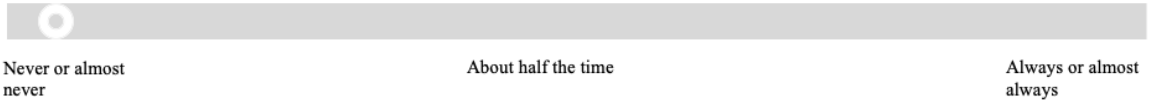
2. To the best of your recollection, where did you first hear about learning styles?

    - Undergraduate program
    - Graduate program
    - Professional development or training
    - Other educators

3. Although you don't believe in learning styles, you indicated that you DO consider them when you plan instruction. Why? (Choose all that apply.)

    - Other teachers use them, and I want my practices to mirror theirs.
    - My principal requires that include learning styles in our instructional planning.
    - Students and/or parents expect it.
    - Teaching to my students' learning styles works in my classroom.
    - Including learning styles in my plans saves planning time.
    - Including learning styles in my practice saves instructional time.
    - Other (please specify)

4. Slide the circle to indicate how often you target students' learning styles in your classroom.



5. Have you given a learning style inventory to your students?

   - Yes
   - No

6. What do you use to determine student collaborative groups in your classroom? Choose all that apply.
   - Interest
   - Ability
   - Learning style
   - Grades
   - Student choice
   - Random
   - Other (please specify)

7. A students' learning style is something that can change with instruction.

   - I strongly disagree.
   - I disagree.
   - I agree.
   - I strongly agree.

8. Have you tried to tell other educators that learning style theory isn't valid?

   - Yes, and they believed me, or mostly believed me.
   - Yes, but they didn't believe me, or mostly didn't.
   - No, I've never told anyone else.

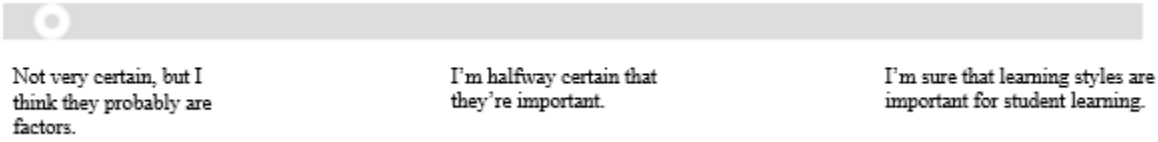
APPENDIX F

SURVEY ITEMS FOR BELIEVE/DON'T USE GROUP

1. You indicated that you believe in the idea of teaching students according to their visual, auditory, and kinesthetic learning styles. Which of the following led you to this belief? (Choose all that apply.)

   - o I learned about these in my teacher preparation program.
   - o I have attended inservice professional development about learning styles.
   - o My school administrators are/have been proponents of learning styles.
   - o Other educators that I trust have told me about these.
   - o I've seen this work in my classroom.
   - o I've read about learning styles.
   - o Other (please specify)

2. How certain are you that visual, auditory, and kinesthetic learning styles are important for student learning?



3. To the best of your recollection, where did you first hear about learning styles?

   - o Undergraduate program
   - o Graduate program
   - o Professional development or training
   - o Other educators

4. You said you don't consider students' visual, auditory, and kinesthetic learning styles when you plan instruction, in spite of your belief in them. Why not? (Choose all that apply.)

   - o I haven't found the practice of teaching to student learning styles to be helpful for student learning.
   - o My principal discourages this practice.
   - o I'm not really sure how to incorporate learning styles in my teaching.
   - o Other teachers discourage this practice.
   - o It takes too much planning time.
   - o It takes too much instructional time.
   - o Other (please specify)

5. What do you use to determine student collaborative groups in your classroom? Choose all that apply.

   - o Interest
   - o Ability
   - o Learning style
   - o Grades
   - o Student choice
   - o Random
   - o Other (please specify)

6. How do you use learning styles to differentiate instruction in your classroom?

7. A students' learning style is something that can change with instruction.

    - o I strongly disagree.
    - o I disagree.
    - o I agree.
    - o I strongly agree.

8. Have you heard about or seen research that suggests that visual, auditory, and kinesthetic learning styles are myths? (Check all that apply.)

    - o Yes, but I don't believe they're myths because I learned about them in trainings or my teacher preparation.
    - o Yes, but I don't believe they're myths because I know they work in my classroom.
    - o No, I have not heard this.

APPENDIX G

SURVEY ITEMS FOR DON'T BELIEVE/DON'T USE GROUP

1. You indicated that you don't believe in the idea of teaching students according to their visual, auditory, and kinesthetic learning styles. Why not? (Choose all that apply.)

    - My teacher preparation program taught me this idea isn't true.
    - My graduate coursework included research that suggests this idea isn't true.
    - I have attended professional development sessions that debunked this idea.
    - My principal has said the idea is not true.
    - Other teachers have told me this idea isn't true.
    - I tried the practice of teaching to student learning styles, but didn't find that it increased learning.
    - I've read for myself that this idea isn't true.

2. To the best of your recollection, where did you first hear about learning styles?

    - Undergraduate program
    - Graduate program
    - Professional development or training
    - Other educators

3. You said you don't consider students' visual, auditory, and kinesthetic learning styles when you plan instruction, in spite of your belief in them. Why not? (Choose all that apply.)

    - I haven't found the practice of teaching to student learning styles to be helpful for student learning.
    - My principal discourages this practice.
    - I'm not really sure how to incorporate learning styles in my teaching.
    - Other teachers discourage this practice.
    - It takes too much planning time.
    - It takes too much instructional time.
    - Other (please specify)

4. What do you use to determine student collaborative groups in your classroom? Choose all that apply.

    - Interest
    - Ability
    - Learning style
    - Grades
    - Student choice
    - Random
    - Other (please specify)

5. Have you tried to tell other educators that learning style theory isn't valid?

    - Yes, and they believed me, or mostly believed me.
    - Yes, but they didn't believe me, or mostly didn't.
    - No, I've never told anyone else.

APPENDIX H

INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

MISSISSIPPI STATE UNIVERSITY

Office of Research Compliance

Institutional Review Board for the Protection of Human Subjects in Research
P.O. Box 6223
53 Morgan Avenue
Mississippi State, MS 39762
P. 662.325.3294

www.orc.msstate.edu

NOTICE OF DETERMINATION FROM THE HUMAN RESEARCH PROTECTION PROGRAM

DATE: September 06, 2019

TO: Anastasia Elder, PhD, Counseling Ed Psyc & Foundations, Carolyn Adams-Price;Devon Brenner;Tianlan Wei

Carolyn Adams-Price, Psychology, Dana Seymour, Counseling Ed Psyc & Foundations, Devon Brenner, Vice President for Research, Tianlan Wei, Counseling Ed Psyc & Foundations

PROTOCOL TITLE: Examining Teachers' Epistemic Beliefs Through the Lens of Learning Style Theory

PROTOCOL NUMBER: IRB-19-371

Approval Date: September 06, 2019 Expiration Date: September 05, 2024

EXEMPTION DETERMINATION

The review of your research study referenced above has been completed. The HRPP had made an Exemption Determination as defined by 45 CFR 46.101(b)1, 2. Based on this determination, and in accordance with Federal Regulations, your research does not require further oversight by the HRPP.

Employing best practices for Exempt studies is strongly encouraged such as adherence to the ethical principles articulated in the Belmont Report, found at www.hhs.gov/ohrp/regulations-and-policy/belmont-report/# as well as the MSU HRPP Operations Manual, found at www.orc.msstate.edu/humansubjects. As part of best practices in research, it is the responsibility of the Principal Investigator to ensure that personnel added after this Exemption Determination notice have completed IRB training prior to their involvement in the research study. Additionally, to protect the confidentiality of research participants, we encourage you to destroy private information which can be linked to the identities of individuals as soon as it is reasonable to do so.

Based on this determination, this study has been inactivated in our system. This means that recruitment, enrollment, data collection, and/or data analysis **CAN** continue, yet personnel and procedural amendments to this study are no longer required. **If at any point, however, the risk to participants increases, you must contact the HRPP immediately. If you are unsure if your proposed change would increase the risk, please call the HRPP office and they can guide you.**

If this research is for a thesis or dissertation, this notification is your official documentation that the HRPP has made this determination.

If you have any questions relating to the protection of human research participants, please contact the HRPP Office at irb@research.msstate.edu. We wish you success in carrying out your research project.

Review Type: EXEMPT

IRB Number: IORG0000467

APPENDIX I

QUALITATIVE RESPONSES TO METHODS FOR DIFFERENTIATION ITEM

1. Students with the same learning style work well on tasks together. They also learn from one another.
2. Write the problem or read the problem to the student.
3. I give the vocabulary and let kids figure out the meaning by the context.
4. Give instructions different ways.
5. By grouping similar students together so that centers can focus on that area but at play centers putting students with different learning styles together to help each other explore different ways of learning.
6. I use teddy bear counters and cubes during Math. Each of my students has an iPad they may use. I have a Reading Center where I have a variety of books for my students to access. I have an Art Center, a sand table, and a Playdough Center. I read the story of the week to my students; I also display the story on my board.
7. I have the students rotate through different group activities including tangible activities for kinesthetic learners, completion of graphic organizers for visual learners, rhymes and songs for auditory learners, etc.
8. Showing different ways to do things.
9. By setting different expectations/products for the completion of task based upon individual styles.
10. Music, movement activities, visuals.
11. By creating heterogenous and homogenous groups to improve my instructional time.
12. During a week I plan for several different activities that will meet the needs of different learning styles, but ultimately address the same objective or parts of a learning goal.
13. At the first-grade level I plan centers that incorporate all learning styles.
14. We make sure to use/meet each learning style daily. Kindergarteners NEED this to help them be successful.
15. Students sometimes get a choice in their assignment according to their style of learning.
16. Finding out a child's learning style helps me know how to approach the lesson.
17. I try to incorporate everyone's learning style so everyone has an opportunity to understand the lesson.
18. We take a learning styles inventory at the beginning of the year and study what it means to be each kind of learner. From there, I embed it in my teaching and give each type of learner strategies to best learn/practice those standards. Students like learning about what kind of learner they are and will ask how to best do something for their learning type. They are also allowed to complete summative projects in science based on their learning style (i.e. kinesthetic learners can come up w/a song and dance and teach it to the class or a visual learner can make a poster...).
19. Groups and ways to present information. I try to present information we are studying in a variety of ways so it fits each student.
20. By displaying information through the three different learning styles.
21. Give choices to students.
22. I pull students by groups and allow for activities that coincide with their learning style.
23. I use it as a motivational tool for optimum learning and for grouping students.
24. I incorporated different activities in my centers that appeal to each of my students. I try to include something that will appeal to each style.

25. I use multi-sensory approaches to learning so that each learner has the opportunity to excel.
26. Centers.
27. Playing to the strengths of your teammates is one way skilled leaders work collaboratively. I feel like using modes of instruction that appeal to specific students' strengths makes instruction accessible for my students and helps me to be an effective leader for our classroom team.
28. They can choose how to complete an assignment.
29. Most of the time through centers, reading groups, and math.
30. Multiple choices in delivery, independent work types, and group work types.
31. Provide appropriate materials for the styles.
32. Clock appointments.
33. I use it to motivate students to do their best and for grouping.
34. The instruction is based on the learning style!
35. Multiple intelligence survey, choices with projects.
36. To meet individual student's needs.
37. Knowing the students' various learning styles allows me to switch things up in the classroom.
38. Direct instruction and inquiry-based learning occurs most often. We do, however, use learning styles to make the students feel more comfortable and help them to learn how they like to learn.
39. Groups.
40. I try to incorporate songs and chants. I create anchor charts, and incorporate learning games and activities and involve movement in the classroom.
41. By giving choices whenever feasible.
42. I teach special needs preschool so this is the best way to teach them.
43. According to their IEP.
44. Projecting work on SmartBoard, incorporating pictures with vocabulary words, listening to stories read aloud, reciting vocabulary words aloud, etc.
45. Planning lessons that present content using the learning styles and groups work that engages the various learning styles.
46. Grouping BY learning styles to review material taught.
47. My students do "Lightbulb Lab," a way of doing centers. Each center is geared towards a different learning style/multiple intelligence.
48. It helps me with classroom management because I can put students together for instruction by learning style.
49. Projects and choice boards have options for different learning styles.
50. I try to address them all with carpet time and center time.
51. I have times where we do chants for language, hand motions for vocabulary, and dances to encourage each other or to get out of a rut while we are in class.
52. I make sure to include multiple learning styles in my lesson planning to reach all learners.
53. I have verbal instruction, written instruction, whiteboard interaction, and completed examples of all projects.
54. Students are able to choose based on learning styles.
55. Providing activities that are specific to those learning styles.

56. I often give many options for different projects, all relating to different learning styles. Also, I bring in different activities in which students can show knowledge in a variety of ways.
57. I try to present a lesson in different ways to help meet the needs of my students.
58. I will introduce material in many different ways to meet the learning styles of all my students.
59. Group work.
60. Music while working; interactive PowerPoints; discussion; online quizzes and games.
61. I put up a visual on the board or create one, explain the meaning of the project verbally, and have the students work through their problems as they create their art.
62. Create my small groups.
63. I go over the same material, but explain it in different ways.
64. I draw examples on the board, I try to use as many manipulatives when applicable.
65. Types of centers, remediation for students.
66. Delivery of instruction, assessment, grouping, and practice.
67. In the presentation of material.
68. I use many anchor charts to reinforce my instruction. I also model how to do things and use think alouds.
69. One day, I will show a video. Another day, we will do a hands-on activity. The next day, it will be lecture.
70. All students will be exposed to content in a way that they are comfortable and in a way that is easier for them to understand.
71. I teacher special education and I use learning styles to guide my instruction. I also use learning styles when creating seating charts for my classroom.
72. Differentiated activities at learning stations and cooperative groups.
73. Incorporate more than one mode of instruction: combine the use of visual, auditory, and hands on learning activities when appropriate.
74. I try to include a variety of presentation methods.
75. I present material and instruction in multiple formats/ways and I believe in project learning as well.
76. As a speech teacher I group my students according to how well they know sounds and the best ways for them to retain new information.
77. Choices are given in how they may respond to an assignment.
78. Every new lesson is introduced and reviewed with technology components, handwritten, auditory with white boards and markers, books and body movements.
79. If I know a child can show or demonstrate opposed to putting it on paper, I prefer to use this as a way of assessing for understanding. It also is a definite way to make a child want to learn and give their best when learning.
80. I create group lessons that apply to each learning style or I create lessons that apply to all so that students with multiple learning styles can have them all.
81. Podcasts, Vocabulary Menu and Projects.
82. Through learning styles, students are able to be effectively grouped for centers so that each center's content can be most effective for each group.
83. I group students by learning styles frequently to do group work.
84. Content delivery and student response delivery.

85. I use learning styles in how I present information as well as in the options/assignments I give to students.
86. Different activities to match the learning style.
87. I use auditory and visual practices for reading text.
88. I group my students accordingly and search for resources to help them learn the material.
89. I use choice boards in centers that give students a choice of how they learn the material.
90. I create my lessons based on my scholars' learning styles.
91. Grouping.
92. I involve these during instruction by making sure I hit each style.
93. Small groups.
94. Books on tape, PowerPoint, group work, and centers.
95. I try to group students together who have similar learning styles so that I can give them the instruction that they need. This helps me to differentiate in my classroom.
96. Using visual or kinesthetic tools.
97. Centers.
98. I use song and tunes for auditory, PowerPoints, dancing and moving, a lot of patterns, hands-on activities, allowing the students to pair and share, and even quiet time of journaling or reading.
99. It helps me choose what manipulative I use. It's also helps me determine lesson activities.
100. Centers.
101. Verbal answers and physical workout.
102. By knowing the students' style and developing lessons to reach them.
103. Resource building used in lessons, presentation of lessons, grouping students in collaborative groups.
104. Placing students in groups.
105. I try to show things multiple ways that touch on different learning styles when I am teaching so that all students can learn.
106. I make sure I have alternate assessments that take into account different learning styles
107. I use visual, auditory, and kinesthetics styles in my room. When I teach, I explain, show it on the board, and use a gesture for the concepts.
108. I try to include activities which fit each learning styles in my daily schedule.
109. I use the style that is the best for each student to instruct on his or her goals.
110. When planning activities to teach.
111. According to the learning style inventory I gave my students, I was able to see that I needed to use activities like scavenger hunts that allowed for student collaboration and added interest to the content and allowed them to learn through movement and touch.
112. Many of my kinesthetic students learn best by using manipulatives, so with them I have them in small groups with manipulatives.
113. For my visual learners, we use a lot of visual models to organize the information given to them.
114. I build activities based off of student's learning style.
115. Instructional techniques for each group vary depending on the learning style.
116. Some students have more hands-on assessments while others have reading or visual activities covering the same material.
117. Read aloud and flipped learning.

118. I have given choice board for students.
119. I always try to have all types of learning styles covered when teaching a lesson. I try to have a visual, a video, and something they can hold/use to cover all bases if possible.
120. I have material available in different mediums. I make information available different ways to target all learners.
121. Use different strategies for different students.
122. I provide instruction and work based on the need for all 3.
123. I often present information using videos (visual), lecture (auditory), or either hands on center activities (kinesthetic).
124. Balancing visual with auditory and hands-on activities.
125. Various centers so that they incorporate all learning styles and are applicable to all students.
126. I make sure to cover all.
127. Centers and work is prepared according to their style.
128. Oral summaries, group discussion, read aloud, written answers, writing on the smartboard.
129. Delivery of information, student choice on assignments.
130. I teach Special Education. I differentiate instruction by providing instruction that addresses all learners/learning styles.
131. Through whole group demonstration on the board with multiple examples, guided practices with hands on manipulatives, then oral discussions of what we learned and why.
132. I use learning styles to differentiate instruction by doing hands-on activities, group work, displaying specific material on the Promethean board, discussion, and handouts.
133. When I pull for small group it is based on their learning style to insure the information sticks/clicks with the student.
134. I present material based on learning style.
135. I have the same activity for the students, but I have differentiated it to be a little different based on learning styles. I then allow all of the students to break off in groups.
136. I am able to reach all students where they are.
137. I make sure to include all styles in my instruction.
138. Activities based on each learning style for each objective taught.
139. I try different methods to make students understand the material, visual, kinesthetic, aural, etc.
140. Multiple modes of lesson delivery throughout.
141. Incorporate different teaching strategies that address each learning styles.
142. The beginning of the year I start off with learning styles by asking them about how they like to learn and allowing them to discuss the types of learning styles and how they like to learn.
143. I present lessons by explaining, allowing reading time, and providing guided practice.
144. Some students learn better by visual, so we put it up on the mondo pad. We also incorporate technology to those visual learners to maintain the focus.
145. I use learning centers (modules) with different activities in each module.
146. Some students learn through given instruction, and some learn from hands-on activity, but some need one on one instructions.
147. To strengthen student's strengths and weaknesses in groups.

148. When presenting my lesson, I incorporate all learning styles in the presentation.
149. I change up how we approach novels and other forms of literature we go over.
150. They help cater to individual student.
151. Editing and group work.
152. I included each style in the lessons.
153. Small group instruction.
154. Almost daily, I ensure the instruction is delivered in a variety of ways to ensure I reach each student.
155. Based on the learning style of the students, I change my delivery of the lesson.
156. Based on learning styles, I am able to plan remediation and provide activities specific to each student. This is an everyday practice as an inclusion teacher.
157. Maps and interactive games to boost mastery of standards.
158. I use a variety of different methods to teach a lesson.
159. I use physical activities for students that may not be strong academically in their subjects.
160. When grouping students for differentiation, I provide different ways of learning the skill so that it works for the different learning styles.
161. I group students based on like interest and like learning styles.
162. I present the same information in multiple ways (mostly visual and auditory) to target more different kinds of learners. It's not individualized presentation, but it does help.
163. I use a variety of methods for both teaching content and assessing student knowledge.
164. Prepare varying activities to reach various learning styles.
165. I use videos, hand-on activities and listening activities.
166. Choice boards.
167. I plan to include different learners in the class.
168. I use many forms of differentiated instruction which is determined by different learning styles.
169. Dependent on assignment.
170. May give students a concept and have activity for each learning style. Students previously identified by that style are assigned that station.
171. Reading passages different levels.
172. For some students, they need to have a read-aloud option. In this case, I will read to the whole class. That's one example; however, in general, I use multiple styles in each lesson. I will teach a lesson on a PowerPoint--watch a video to explain the same information in a quick format--have students "act" out the lesson--then model the lesson.
173. The assessments often reflect the different styles; students can show their knowledge via an essay or a presentation or a playlist with explanation.
174. I try to bring similar styles together and have them collaborate.
175. Trying to incorporate multiple learning styles in the same lesson. Teaching the same thing various ways.
176. I am an Exceptional Education teacher (SPED) and learning style is used often to differentiate instruction within my classroom as well as in their general education classrooms.
177. Change the rigor for different styles because sometimes visual learners are higher than other students.

178. I use multiple ways to deliver content through print, video clips, music, auditory, writing, etc.
179. Prepare to teach content that hits all learning styles.
180. Knowledge level and learning style.
181. I typically use auditory for my lower learners and more hands on with those who are higher due to behavior.
182. Incorporate as many different techniques to help as many students as possible.
183. Develop various guided practice activities.
184. For struggling students, we break the material down for them and teach with activity. We give advanced problems to our top students who can solve problems.
185. I make sure I tailor each lesson for all learners.
186. Depending on learning style is how they practice skill and are assessed.
187. Pictures, discussion, peer tutoring, videos, movement playing review games.
188. Students use a menu to choose the activity.
189. Peer tutoring and manipulatives.
190. Some students draw the material, some write about it, and some act it out.
191. Lessons are presented in various learning styles.
192. Project choices are offered that are varied for learning styles.
193. By allowing students to demonstrate learning in styles that are comfortable and familiar to him/her.
194. I always include various activities for them to do/choose.
195. I present lessons in multiple ways to appeal to different learning styles.
196. I seek to present content in multiple different ways to cater to each learning style.
197. Along with the student's interest I find activities that fit their learning styles in as many learning centers as possible.
198. Different types of instruction.
199. Teaching a passage: We read it silently and we read out loud and very often act the scenes out. Notes are taken in the Cornell Method, but with adaptations. Students are also allowed to do sketch notes in the Cornell format, use of colored pens and pencils and highlighters are encouraged. Not only do they take notes from seeing the notes on the board they also here them and frequently must move about the room to collect notes for different subjects. Typically I approach teaching everything through sight, sound, and movement that way nearly everyone will get it the first time. Groups also definitely assist in students matching strengths in understanding.
200. In planning my lessons.
201. Songs, videos, art/graphics, writing, group discussion, acting all used to get the objective met.
202. Movement around the room, small groups, art and STEM.
203. I use a combination of various techniques that incorporate the learning styles (dance, movement, music, tactile techniques) to appeal to all of my students.
204. I assess students informally to see what style they are and then I teach groups differently.
205. Process and product.
206. Design lessons, group work and assessments based on learning styles
207. I use the learning styles to instruct math and language stations.
208. In the delivery.

209. Presentation of information according to learning styles and increased opportunities to use their learning style to learn.
210. I try to use visuals on the board for visual learners.
211. I provide manipulatives for kinesthetic group and audio books for auditory group.
212. By using a variety of instructional lessons that uses different learning styles.
213. By hopefully presenting information to students in a way that they can learn and understand it.
214. I make sure I cover all learning styles in my room with my lesson.
215. Use different activities at different times to cover the same concept.
216. I give the students an assignment and allow them choice in the research and presentation of the work.
217. Special needs students are usually kinesthetic so I plan a lot of those things.
218. Doodle Notes for visual learners as well as learning charts; Kagan methods to movement (and social) for kinesthetic learners; and songs and videos for auditory learners.
219. To plan lessons and practice.
220. It helps me know which kids will be behavior issues.
221. I try to touch on all the styles during a lesson.
222. A wide variety of assignments and activities.
223. Talk it, Walk it, Do it.
224. I use them all as often as I can!
225. Grouping.
226. I group students according to their learning style.
227. Students are allowed to choose how they want to demonstrate their understanding of an objective; students unfamiliar with an objective are allowed to complete similar activities on lower levels that are kinesthetic; students who have mastered the objective complete actives on a higher level; multiple methods are used to deliver lessons.
228. Sometimes I have to group students together with different styles to help them better understand multiple objectives within a lesson
229. Group work.
230. I teach the kids how to understand what their best learning style is and to use it to their advantage. I also use writing, reading, games and hands on to teach throughout the day.
231. Different types activities and how information is conveyed to students.
232. Give students choice of output.
233. Each lesson I try to incorporate various aspects of learning style. For instance, often times we will break a typical work session into individual computer work, a classroom discussion, and then group work that focuses on kinesthetic learning. So with visual digital reference, auditory class discussion and hands on kinesthetic group work.
234. Once I learn the student and how the student learns best, I target that learning style during center time throughout the year. I try to make sure that each learning style is available for them to learn the content in their own way.
235. I try to do it daily.
236. I offer visuals in my PowerPoints and hands on activities.
237. For grouping students based on their learning style.
238. Different delivery methods.

239. I let students draw while I teach or give them sensory items (stress balls, etc). I let them listen to music during independent work. I turn the lights off sometimes or let them sit in different types of chairs. I put them in groups according to learning styles.
240. I try to give students choices when applicable.
241. Assignments and instruction based on learning style.
242. Authentic assessment, projects.
243. I give different options for turning work in. I include audio in most lessons and allow students to take notes.
244. By providing multiple ways students can learn key information.
245. Everyday.
246. I use learning styles to determine how my scholars will show evidence of mastery. I also teach lessons in multiple ways (PowerPoints, lectures, videos, technology, etc.) to address each learning style.
247. Centers.
248. I present material in varying ways.
249. Kindergarten is easy to make use of learning styles. I use it in setting up centers to include something for most children.
250. I use the learning styles to differentiate how I introduce concepts, how the students practice concepts, and how the students show their understanding of a concept by giving them a choice of end product for activities and projects.
251. Groupings.
252. Videos, discussion, draw and label projects, semester projects.
253. I give students multiple forms of instruction (I.e. drawing an anchor chart, working on a computer, print copies, and video/audio materials.)
254. I have a book of activities that relates to students learning style.
255. I try to change up my method of teaching from day to day so that I can reach all types of learners. Sometimes it's a video, my teaching, hands on, moving around, or even working on their own.
256. My centers vary greatly. I have visual centers such as reading, kinesthetic centers such as word building and a trampoline, and my whole group instruction is a mixture of all 3 types of learning.
257. Different opportunities on topics.
258. I make sure I include an activity in all 3 learning styles when I introduce a new topic.
259. I use whole learning in my room. Hands-on, visual, audible, group, and one on one.
260. At times students can present the material how they would like to -- PowerPoint presentation, written report, 3D model, etc.
261. I lecture, use power point and use audio.
262. I included hands on activities, interactive notes as well as traditional notes.
263. Objectives are taught using multiple learning styles.
264. I'm an exceptional Ed teacher. Some students use communication devices if they are auditory.
265. It helps me determine group placement and activities that I use in my class (whether to use notes one day, group activities, art projects, or a gallery walk in class.
266. Pair students together.
267. To plan instruction.

268. I provide notes with math steps; I work problems on board as well as explain the math vocally. I use mini white boards and white board tables in the classroom. We practice by doing. For students who like touching, we do activities where they may have to cut and paste, or manipulate items.
269. Each student has a preferred learning style, as well a current ability level. By addressing both, students should be more interested and motivated to perform at a higher level.
270. I am an interventionist and a lot of my students are visual or kinesthetic.
271. I make sure that every unit includes something from each different learning styles. There is a lecture for each unit, videos, hands on demonstration and guided inquiry labs.
272. Try and use multiple types of learning styles in classroom activities, give students homework options that, while not explicitly labeled as for a certain learning style, offer a multitude (over 20) of homework options that include various learning styles.
273. Media materials, reading aloud, performances, research presentations.
274. I can deliver information in a variety of ways whether it is written, visual, or auditory.
275. With games, lecture, independent work, models.
276. I use learning styles to help me plan different activities and my lessons.
277. Methods of teaching.
278. Student led activities.
279. All of my students have learning needs so I have schedules made to indicate days and times during which my instruction will focus on specific students' learning styles.
280. Learning styles allow me to better instruct my students and better utilize both their time and my own time.
281. I have students demonstrate how they found an answer and explain it to the class step by step.
282. Different activities that get kids interested, notes, games, art.
283. I teach, review, and do labs and activities using all learning styles.
284. A little of everything on a day to day basis.
285. For example: If I were teaching place value using base ten, I would make sure my kinesthetic learners had physical blocks, my visual learners would have picture representations of the number, and my auditory learners can hear me speak as I give examples of finding place value with base ten.
286. Differentiate types of project-based learning.
287. Use a mixture of art projects, reading projects, and writing projects.
288. Peer tutoring.
289. During group rotations.
290. By grouping students of like styles.
291. I don't just lecture or only have visual aids. I try to incorporate two or more styles into most lessons.
292. Anchor charts, other printed materials, and auditory programs in math.
293. Reteaching based on their specific needs and style.
294. Visual aids, auditory learning.
295. I use stations or peer partners, or cooperative groups.
296. The students took a survey for their style and then I have centers set up for that style some days.
297. To choose activities.

298. Use of various resources and teaching styles.
299. In center time and in small group most often, sometimes in large group.
300. I try to put my better note takers (auditory) with students who are more visual.
301. I teach music class. We use all styles individually and simultaneously as a component of our performance practice.
302. Homogeneous grouping and inquiry-based learning
303. I teach art, regularly create flexible instruction to allow for students unique learning styles. Flexibility is key and it is important to not create a concrete view of what is valid practice. We also need to address screen time and the effects on the human brain.
304. I try to use at least 2 in a lesson.
305. Choice boards are an effective tool to allow students to choose a practice activity according to their learning styles.
306. Using the different learning styles helps to review the material for low performing students and puts the subject matter in a new perspective for the higher performing students.
307. By allowing student choice and presenting the standards in different ways.
308. I use Cooperative Learning to include all student in learning.
309. Present the information in multiple ways; hands-on learning.
310. Making sure there are always visual, auditory, and tactile options available for learning.
311. In my Music class, we almost always sing, play, (auditory) and move (kinesthetic). There is also a visual component when I model behavior or incorporate other visuals such as illustrations.
312. Computer assignments and labs.
313. Games to accommodate kinesthetic, modeling for visual, walking through steps for auditory.
314. I provide visuals with handouts and PowerPoint, labs for the kinesthetic learners, speaking for my auditory learners.
315. I often pair gifted and struggling learners, so it's enrichment for the gifted student (who is having to reteach) and review for the struggling student. A lot of times the gifted student can learn in more than one way but the struggling student can only learn in one.
316. I try to deliver all.
317. They determine the process and products in my instructions.
318. Providing audio visual videos, kinesthetic reviews, and multiple formats of instruction.
319. Role play.
320. By trying it with different students' assignments.
321. Groups.
322. Centers.
323. We learn songs to go with our standards, we make hands-on projects, and we discuss every standard.
324. Small group instruction
325. I use learning styles to differentiate instruction in my classroom through various learning activities that may require you to speak out, show your creativity, move around etc. throughout my instruction.
326. Groups, independent work.
327. I try to place at least 3 different learning styles in one group.

328. It depends on the particular scholar's learning style.
329. Allowing the students to choose their activities.
330. I basically try to include each style in my presentation of the lesson.
331. When working in group activity.
332. Comes through in the different delivery instruction methods.
333. Varied instruction to address all styles.
334. I incorporate hands-on, real world experience for them to interact instead of simply listening to lecture.
335. Some like to see it (whiteboard) and hear (verbally speak it).
336. Students are given project-based assignments.
337. Different ways to get through the lesson.
338. Different centers with different activities.
339. By targeting the students' strengths and weakness.
340. All the time.
341. Give a variety methods of completing tasks.
342. I plan different activities based on the diverse learning styles of my students. Some activities may be hands on, some may be auditory, etc.
343. Delivery of instruction and practice.
344. By delivering material in different ways to be sure of each student's comprehension.
345. I teach the students on levels where they can learn.
346. I generally provide visual, written, auditory, and kinesthetic components to nearly all of my lessons. I tend to integrate the other learning styles a little less frequently.
347. Small group.
348. I explain a lot for auditory students, I provide visuals and written information for my visual learners, and I require my kinesthetic learners to demonstrate understanding and practice skills.
349. Peer tutoring.
350. I provide many different resources so that all my students learn.
351. I mainly focus on giving a visual and auditory presentation of information, with manipulatives whenever possible for the kinesthetic learners.
352. Each center is a different learning style. Another way is to be cautious of how you group students into groups for centers.
353. Each lesson I give, I will have something for every single style of learning.
354. As ACT Prep teacher, computer based and/or group.
355. Basketball is almost all kinesthetic but we add group discussion in meeting room
356. I place students in groups where lower level learners have more support, and higher-level learners are pushed ahead.
357. I try to cater to all and include different types of instruction.
358. Videos.
359. I try to offer different options for projects that include different learning styles.
360. I try to provide as many different activities as possible and present information that appeals to multiple intelligences.
361. During small groups, it allows me to do different activities. During whole group while learning something, we do something with movement, then we watch something and they hear it from me and others.

362. If I am trying to figure out what needs to be done/taught, I will teach it in different ways to ensure it gets taught to everyone.
363. By using different types of ways to give instructions in the classroom.
364. Tailor it to the student.
365. I group my students accordingly to how they learn.
366. I make sure and deliver every lesson in a multiple of ways to ensure all students can understand the material. I also have their individual work sorted in the different styles.
367. For example with the alphabet. We read the letter, say (sing) the letter(s), and have a hand movement for the letter. I also use sensory bags or other media when practicing writing the letters.
368. Half the time.
369. I incorporate it into my carpet time (anchor charts, videos, class volunteers to demonstrate) and also at their daily centers (examples of work, QR Codes, scissor/glue) - and more.
370. My using models, pictures and videos.
371. Visual graphs and pictures integrated into verbal lectures.
372. In a lesson, I often try to incorporate different styles, such as a visual, auditory, and tactile component.
373. Small groups.
374. Giving choices in ways to complete task or practice a skill.
375. I use learning styles to provide different ways to achieve the objectives.
376. I try to provide hands-on, visuals, group work, independent activities, etc. to have something for every learner.
377. I teach skills several different ways to reach all learners.
378. Various forms of presenting material.
379. I will say things, as well as have it typed on the board and offer several drawings to display what I am saying as well.
380. I try to present things in a number of ways.
381. Centers are based off learning style test results.
382. About half the time.
383. Visual and auditory learning styles are targeted daily due to the fact that the majority of my students are visual or auditory learners. Kinesthetic is targeted at least once a week.
384. I incorporate different learning styles within the center activities.
385. Group work, lectures, videos, problem solving, mapping skills, draw vocabulary sometimes, etc.
386. By teaching and using different learning styles when teaching.
387. Students are always given a written example. Manipulatives are used for hands-on experiences. Students are given the opportunity to collaborate with each other to come up with solutions.
388. Activities that involve Dance. Whole brain learning. Art
389. Visual maps, class discussion.
390. The curriculum I use targets visual, auditory, and kinesthetic practices.
391. Choice boards.

392. I make sure I have multiple activities for the students to do that address their different learning styles. Because the learning styles are different it allows me to introduce or teach the skills on different levels and in different ways to reach them.
393. I have multiple learning centers that accommodate all types of learners. I try to always include hands on activities and have visuals for my different types of learners.
394. I put students in groups by their learning styles.
395. Grouping.
396. I give some students different options on ways to complete tasks.
397. By addressing all types of learners throughout instructional time
398. Groups.
399. I play music and we listen for the auditory learners. For the kinesthetic learners, we get up and move our bodies to the steady beat. For the visual learners, I assign them to observe and report about who they think was the best listener and whose body movements best represented the style of music.
400. I provide students alternate routes to learn the same content. Content mapping in scientific process.
401. Enhances collaboration.
402. Groups.
403. The mode of instruction.
404. Vary types of activities in centers to allow conversation and varied hands on activities.
405. I allow students to complete assignments in different ways. Writing, orally, and by incorporating movement.
406. Ability grouping and style grouping.
407. To shape lesson plans and projects.
408. Student choice boards.
409. Providing student choice on some assignments.
410. Center time and whole group time.
411. I make sure each learning style is addressed at least once if not multiple times in each school day and throughout the week.
412. By offering a variety of methods in which to receive and interpret the instruction.
413. Hands-on projects vs worksheets.
414. We take notes in a variety of ways, we use concrete and abstract items to learn the material, and we use rhymes/songs to learn the motions of solving problems.
415. Centers.
416. Use of different teaching styles.
417. I like to give different project options so that students can work in a way that best fits them.
418. Speaking to auditory learners, writing on the board for the visual learners and have the tactile learners come up.
419. I make it a point to address all learning styles.
420. I use their learning styles to decide which type of activity they'll complete with the lesson.
421. Teaching it in a visual- whiteboard, showing a video and foldables. Also allowing students to move about the room to answer questions.

422. I use learning styles to reach all learner by offering a variety of centers instead of one type repeatedly.
423. I use different means of instruction whether it be power points with interactive activities, videos, hands-on activities, or discussion.
424. Hands on activities, centers with different strategies at each station.
425. I use PowerPoint to introduce concepts and video and hands-on work to re-enforce them.
426. I try to present using a variety of styles to hit the three learning styles.
427. Group/Lit Circles.
428. Discussions, promethean board, handouts, hands-on projects.
429. I used different types of resources to deliver the same content or information.
430. Especially with difficult concepts, I try to reach all four types of learners.
431. I try my best to incorporate activities that appeal to each learning style during the day, whether in small groups or during whole group instruction.
432. Because I am in a computer lab, I vary my instruction in regards to verbal command or written commands. Almost all activities are hands on, so that meets the needs of all students most of the time.
433. Centers.
434. Group work, lessons geared for each learning styles, student led discussion and teaching.
435. Projects will include all of the learning styles.
436. I prepare activities based on individual learning styles.
437. Videos for visual learners.
438. I include them by creating a PowerPoint for my visual learners and an auditory lecture for those learners.
439. I give the students options to complete work based upon this and I present information in multiple ways so that I am meeting the needs of all learners.
440. Tell instructions, show and tell, show.
441. Planning and instruction.
442. I try to cover all the sensory bases.
443. I make sure to have something manipulative every week.
444. My 'lecture' includes auditory and visual elements.
445. Visuals, manipulatives, computer-based programs for auditory learners.
446. Always
447. Design lessons based on it and let them work at their own pace.
448. I attempt to use different parts of the lesson to appeal to different learning styles. Hopefully specific aspects of a lesson will contain elements of several different styles.
449. I offer a variety of opportunities when teaching a lesson. We have “brain breaks” with motor engagement for kinesthetic appeal, we have auditory discussion for auditory reinforcement, we have coloring and foldables for a more tactile approach.
450. I give handouts such study guides, audio of the certain passages & hands on activities during centers.
451. Class participation.
452. All the time.
453. I use it to make sure each child has the opportunity to learn at his/her level using the style most enjoyable for them.
454. Choice Boards.

455. The students' interest in class work shows in their learning style so I have to pay attention to that.
456. I use puppets, songs and videos to differentiate.
457. I just break it down further and give the students multiple ways to memorize things.
458. Center time.
459. I allow students to write, draw, act out or even sing to give an explanation to a problem to show their understanding.
460. Through videos, movements while learning, quiet areas.
461. Focus walls, music, acting out stories, reading.
462. They help me to determine in what way I want to bring the lesson to my students. I use a mixture of learning styles in my classes.
463. Group exercises with stations. Try to target different learning styles within lessons. Use the think-share-pair strategy.
464. When delivering a lesson and giving assignments, I try to adhere to my students' learning styles.
465. I try to include my learning styles throughout my lessons such as hands on activities, listening to stories, acting things out, etc.
466. Usually each of my centers have work for a different learning style.
467. Group Projects.
468. Have a group leader with the same learning style as the other students in the group.
469. Assignments vary with how they are presented; teaching is printed, online, and a visual.
470. I provide students with choice boards that they can choose which activities to complete.
471. By using several different delivery styles like lecture, groups, student teaching.
472. Asking questions.
473. Try to include different styles throughout the lesson. Sometimes I may use different styles at different times, depends on the lesson.
474. By organizing small groups into different activities.
475. Everyday.
476. I teach in different ways for different learners.
477. I include a variety of activities based on my students' learning styles to help each student learn the content successfully. By including all learning styles, students are also exposed to activities that may present a challenge to help them acquire new skills.
478. See, hear, read, write, touch.
479. To give options.
480. Lesson plan choices.
481. One project or assignment may have multiple options for ways to complete.
482. I offer choices and a variety of methods for attaining the objective. The majority of my students are kinesthetic so I attempt to add some type of project they must create to display their understanding.
483. Grouping by abilities, flexible seating by learning style.
484. I try to find different ways to present the material.
485. Write, talk, videos.
486. Stations is an easy one.
487. Various mediums to teach content.
488. Centers.

489. Differentiated Centers: for example, listening center for phonics, Epic Read to Me, playdough for spelling words, phonemic awareness (Heggerty), tangrams, bead slides, etc.
490. Design lessons based on learning styles, grouping of students, include hands-on activities, provide study guides, ...
491. I use visuals, hands on approach, and a lot of read alouds in small groups.
492. I use the different styles went I teach whole group and in group work.
493. I group according to style and ability.
494. I use whole group discussion, small group, use manipulatives, use work for independent practice.
495. I use active learning for kinesthetic and the other groups (visual, auditory) can get it through lecture.
496. Small groups.
497. Centers.
498. By allowing students to choose how to research and report.
499. Daily.
500. Depends on the unit, but I try to incorporate several different learning style activities during the week.
501. Differentiated assessment
502. I use different strategies in analyzing text to help them find what works for them.
503. Centers are differentiated to reach the different learning styles.
504. Try to include different activities so all students can learn.
505. Lecture - auditory; PowerPoints & videos - visual; group and individual work and problem-solving – kinesthetic.
506. Students are given a choice of method of publishing the material.
507. Half the time.
508. I make sure that students can see and hear as I give instructions on assignments.
509. Lab stations of tactile vs reading, making things.
510. To determine small groups/centers; lesson scaffold and other activities.
511. I try to engage all styles when planning my lessons. We discuss topics, I show visuals that go along with it, and the students do an activity or practice to reinforce the idea/topic.
512. I use the learning style inventories to help me determine this.
513. My centers use different styles.
514. I've collected a list of different strategies for different styles and I refer to that.
515. Including all three in teaching.
516. I use video for visual learners, color coding notes for visual, auditory styles are address in video clips and through music such as raps I allow students to stand instead of sitting, For kinesthetic learners we also move frequently in my science labs.
517. I use the interactive white board for visual learners.
518. I use it to base my groups.
519. Interactive notebooks, doodle notes, small group, discussion, etc.
520. I teach the same thing in different ways.
521. Centers
522. I use the learning styles during Carpet Time instruction.
523. I help students understand their style so they can develop study strategies that suit them.

524. My students like knowing their style, and it helps me reach every one.
525. I try to show videos for the auditory students and have text fot eh visual ones.
526. We work on the whiteboard to reach all three—they can see, hear, and come and show.
527. I try not to give too many worksheets because that benefits only my visual learners.
528. I team teach with an assistant and so we can make sure our kinesthetic learners get to act things out.
529. My visual students like prose and my auditory students like poetry, I've noticed, so I try to keep that in mind when I teach.
530. Video/ Listening centers/clay etc.
531. Try to incorporate hands on when possible, use pictures for vocabulary, writing words.
532. Graphic organizers.
533. By differentiating stations to the different learning styles.
534. By their assessment or student work.
535. If we are completing a workbook page then I also project it so the visual learners can see it while the auditory learners hear it. I try to incorporate some type of movement in each concept for the kinesthetic learners.
536. Projects.
537. Grouping, whole class, and small group.
538. To include what's needed for each child.
539. Visual learners may need more illustrations, while kinesthetic learners need manipulatives.
540. I am the interventionist so differentiating to a learning style is sometimes the only way to get a student to understand a concept.
541. Almost every lesson must target different learning styles.
542. Different representation.
543. SmartBoard.
544. I have allowed students to choose assignments.
545. I present materials in a variety of ways for all students to be included in all learning styles.
546. During center time students are able to use either or to help with the skills being taught.
547. In planning a lesson.
548. I use auditory and visual strategies in my classroom daily.
549. Activities are individualized.
550. I differentiate the lesson accordingly. Different tools, and methods of delivery the material.
551. For one thing, I've noticed that they behave differently, so I try to keep that in mind when I'm designing activities for each group.
552. I'm a kinesethetic learner and it helps me keep those students engaged if I plan with my learning style in mind.
553. Groups and centers.
554. I give students assessments according to their style.
555. It's useful for peer tutoring and also student projects.
556. Grouping.
557. Variety is good, and having manipulatives for a lot of lessons helps.
558. I address every style nearly every day.

559. I teach PE and so most of the things I teach are kinesthetic but I try to keep in mind that reading instructions or hearing coaching helps others learners excel.
560. I plan with learning styles in mind.
561. I target every style when I teach.
562. By using different types of ways to give instructions in the classroom.
563. Tailor it to the student.
564. I group my students accordingly to how they learn.
565. I just try to reach every student and ability.
566. I teach gifted students, and most of them have all three styles so it's easier than some.
567. Delivery of instruction.
568. We take breaks and move during lectures and I also provide notes so that all my students are ready to learn.
569. I do everything I can to reach every student.
570. My students know their learning style and how to study, and it helps them do well on assessments.
571. Assessment choice for projects.
572. Activities are planned that reach all types of intelligences.
573. My classes know that they can choose from a list of activities and I help them pick the ones that fits their style.
574. Group assignments.
575. I try not to give as many tests so my students with different learning styles can shine.
576. It is my job to reach all my students so I teach all the objectives in a variety of ways.
577. Stations and centers.
578. Art is a lot of visual, but I try to explain and let students move to describe the paintings and art we discuss.
579. Groups and activities.
580. Projects.
581. Choice boards.
582. The teachers on my team start the year by giving a learning style quiz and we plan together to reach students in each category.
583. Grouping and planning.
584. Varying instruction.