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One requirement put forth by national and state-level policy (e.g., Every Student Succeeds Act) is that practitioners use educational research to inform their decisions and instruction. Mathematics district leaders have been identified as pivotal individuals for enacting change within school districts. Using a design-based research approach, an intervention meant to build the capacity of mathematics district leaders to engage with research was designed and implemented with four mathematics district leaders from four different school districts from across one southeastern state in the United States.

Findings indicated that mathematics district leaders' initial conceptualizations of research were varied as they tended to describe research in terms of their past experiences and beliefs. There were a number of different barriers that prevented them from accessing and using research. As the mathematics district leaders participated in the intervention, they became more discerning in the way they defined educational research, determined what makes it credible, and made their criteria explicit as they chose research or research-based articles to be credible. An outcome of the intervention was a co-designed tool to help facilitate the process of making sense of research. I share this tool and illustrate its potential for providing an opportunity for district-level leaders to examine research critically.

THE MATHEMATICS DISTRICT LEADER RESEARCH GROUP: BUILDING THE CAPACITY OF MATHEMATICS DISTRICT LEADERS TO ENGAGE WITH EDUCATIONAL RESEARCH

by

Franklin Paul Wonsavage Jr.

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Committee Chair

DEDICATION

To my wife, Brittni T. Wonsavage and eldest son, Carter Paul Wonsavage for making sacrifices so that I could pursue my professional dreams.

APPROVAL PAGE

This dissertation written by Franklin Paul Wonsavage Jr. has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

Committee Chair

Dr. P. Holt Wilson

Committee Members

Dr. Jacobs

Dr. Heredia

Dr. McCulloch

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CHAPTER I: INTRODUCTION

The passing of the No Child Left Behind Act ([NCLB], 2002) ushered in a wave of requirements for districts, schools, and practitioners to meet in order to receive funding from the federal government. One of those requirements included that practitioners use scientifically based research to support their decisions and courses of action. Although seemingly straightforward, practitioners' use of scientifically based research was challenging because it was defined to only include research from quantitative paradigms that used experimental or quasi-experimental designs (NCLB, 2002). Such a narrow definition made it difficult for practitioners to find appropriate evidence because it narrowed what counts and eliminated research from the qualitative realm (Liston et al., 2007).

The Every Student Succeeds Act ([ESSA], 2015) expanded NCLB's (2002) criteria for research by creating a tiered model of research evidence: strong evidence (I); moderate evidence (II); promising evidence (III); and demonstrate a rationale (IV). Much like its predecessor, ESSA (2015) gave preference to research from quantitative paradigms (Tiers I, II, III), but in its fourth tier of evidence, it provided the space for qualitative research to be used to demonstrate a rationale. In addition to expanded notions of research, ESSA (2015) also put the onus of determining what counts as high-quality research on the shoulders of practitioners who up until 2015 had not had the flexibility to make such decisions because interventions were limited to those deemed to be quality by strict quantitative measures (Yoshizawa, 2020).

Although these policy requirements apply to all practitioners, a specific type of practitioner that bears the brunt of it. These individuals are referred to as, mid-level managers, decision makers (Coburn et al., 2009), mid-level leaders (Coburn & Talbert, 2006), or district leaders. Such individuals are important nodes within districts for disseminating information and

wield considerable influence because their understanding of policy or programs gets privileged (Cobb & Smith, 2008; Coburn et al., 2008; Wilson et al., 2018; Spillane, 2000). This is especially true for district leaders in the mathematics domain who operate within a highly political realm influenced by historical reform efforts (e.g., new math, math wars, Common Core) and public opinion (Trujillo, 2013).

In this dissertation, I refer to these individuals as mathematics district leaders (MDLs) who by either formal or informal designation develop, implement, and influence district policy (Spillane, 2000). MDLs make a number of decisions that have significant implications for the districts in which they work. An example of one such decision might be whether or not to adopt a particular curricular program. Such decisions have to account for the support needed to design and implement the decision (Penuel et al., 2018) while attending to human, social, and physical capital costs (Spillane & Thompson, 1997). Using research to inform such a decision could offer fresh insights and ensures it is made on more than one's opinion.

Another example might be when making research-informed decisions about professional development offerings. Such decisions have to account for the human, social, and capital costs. They also require one to navigate barriers that prevent access, various notions of what is considered credible or relevant, and the larger context in which the decision is situated. This newfound latitude has made decisions challenging as it has brought an age-old problem—the disconnect between research and practice—back to the surface as practitioners attempt to access, make sense of, and use research in service of ESSA (2015).

MDLs' and practitioners' past experiences have largely been oriented to the practicality of working in classrooms, schools, and districts rather than towards research. They have typically had few experiences to engage with research in their professional training (Gore & Gitlin, 2004;

Korthagen et al., 2006), yet as stipulated by ESSA (2015), they must to use it to inform their decisions. In addition to having limited experiences with research, there are a number of factors that impede practitioners as they try to engage with research that are nested in the midst of what has come to be commonly referred to as the Research to Practice Gap (Silver & Lunsford, 2017; Broekkamp & van Hout-Wolters, 2007).

The Research to Practice Gap has many facets—which I unpack in Chapter II, but I provide a brief overview here to help frame the research problem. One such facet is how the word research takes on different meanings depending on the context or role of the person using it. It is common for someone to say they are doing research, but what they mean is that they are doing an internet search. This use of the word, research, is very different from the ways in which researchers use it. Research typically serves two purposes, 1) motivated by an intellectual interest in developing new knowledge that expands the existing knowledge base, and/or 2) inspiring one's research audience to take action or enact change based on their research findings. Merriam and Tisdell (2016) refer to the former purpose as basic research and the latter as applied research. An integral part of both of these meanings of research is that they are guided by a research question(s).

Although the distinction between these three meanings of the word research are clear, they are only a few of many that individuals, organizations, and policies use. For instance, policy (e.g., ESSA) and governmental agencies (e.g., Institute of Education Sciences, What Works Clearinghouse) subscribe to much narrower definitions and meanings of research that privilege quantitative research methodologies (e.g., randomized control trials, quasi-experimental studies) and discount research from other paradigms. Practitioners, on the other hand, tend to have much broader definitions of what counts as educational research (e.g., student achievement data,

practitioner knowledge, testimony from experts) (Honig & Coburn, 2008). Thus, it seems that the epistemological beliefs of policy makers, practitioners, and educational researchers about what "counts" as research are misaligned and deeply embedded in their respective cultures and organizations. Despite the confusion about what is and what is not research, the ESSA (2015) expectation set by still holds true—MDLs are required to use educational research to inform their decisions. It is in the efforts to meet this requirement that I situate my dissertation research.

Reflecting on the past three decades, educational researchers have generated a considerable body of knowledge concerning instruction and learning that has led to tremendous gains in improving students outcomes (e.g., Cognitively Guided Instruction (CGI); Mathematical Knowledge for Teaching (MKT); Mathematical Task Framework (Stein et al., 1996)); however, many classrooms across the United States remain unchanged and are replicas of what was experienced a half-century ago (Hiebert, 2013). This unsettling fact was the motivation behind this dissertation and spurred me to work with MDLs because of their pivotal role in school districts (Wilson et al., 2018). At a most basic level, I wondered if I built the capacity of MDLs to engage with research, might that disrupt the culture of research non-use that seems to be consistent throughout our education system? Such a question is beyond the scope of this dissertation; however, understanding the phenomenon in more detail by designing an intervention focused on improving research use among MDLs is something that I can explore.

Improving practitioners' use of research requires more than simply putting research into the hands of practitioners. Researchers have been trying to do that for decades by publishing research in practitioners journals, but as Silver & Lunsford (2017) discuss in their compendium chapter, research rarely reaches practitioner audiences. There is no single culprit for the disconnect as it is a culmination of physical barriers (NCTM Research Committee, 2006; Honig

& Coburn, 2008; Shkedi, 1998), structural influences (Hemsley-Brown & Sharp, 2003; Gore & Gitlin, 2004; Labaree, 2003; Shkedi, 1998; Nutley et al., 2007), and differences in epistemological beliefs about research (Behrstock et al., 2009; Cain, 2017; Coburn & Talbert, 2006; Fusarelli, 2008; Gore & Gitlin, 2004; Graves & Moore, 2018; Hemsley-Brown & Sharp, 2003; Honig & Coburn, 2008; Nelson et al., 2009; Nutley et al., 2007; Silver & Lunsford, 2017; Tseng, 2012; Vanderlinde & van Braak, 2010). In recent years, researchers have begun to traverse the divide between research and practice (e.g., Cain, 2017; Gore & Gitlin, 2004; Honig et al., 2017; Penuel et al., 2016; Rickinson et al., 2004), but much like a narrow, swinging rope bridge with missing boards along the way, existing structures for bridging the gap between research and practice leave much to be desired. As a result, researchers are beginning to turn to design-based perspectives to address the problem because they allow one to imagine what could be rather than being confined to what currently exists (Tseng, 2012).

Statement of Research Problem

The Research to Practice Gap has been well documented by researchers and practitioners (e.g., Cai et al., 2017; McIntyre, 2005; Nutley et al., 2007; Shkedi, 1998; Silver & Lunsford, 2017). Despite the disconnect between research and practice, ESSA (2015) still requires MDLs to use educational research to make decisions and inform their instruction. A focal point of the policy is practitioners' use of research that many researchers have worked to understand in more detail (Coburn & Talbert, 2006; Coburn et al., 2009; Farley-Ripple, 2012; Ion & Iucu, 2014; Palinkas et al., 2016; Penuel et al., 2018). Although these studies have provided considerable insights into practitioners' use of research, one of the limitations is that it is unclear of the extent to which the participants in such studies shared a common understanding of research with the authors.

For example, Penuel and colleagues (2018) defined research for their participants to establish a shared understanding of the term, research. Other studies have focused on understanding the factors that influenced practitioners' conceptions (Coburn & Talbert, 2006), developing an instrument to assess research use (Palinkas et al., 2016), or understanding what gets used as evidence and in what ways (Farley-Ripple, 2012). By focusing on use, it is unclear as to the criteria practitioners use when determining if something counts as research and to what extent they share a common understanding.

To develop a shared understanding of research, some researchers have created opportunities for conversations about research to occur within a community of learners (Edwards et al., 2007). While not specific to education, Edwards and colleagues' (2007) work was an early model from which others could build. For example, Anwaruddin (2014) suggested that a community of practice perspective might be productive for teachers to negotiate meaning of research through participation in a professional learning community. This notion came to fruition in Cain's (2015) work as he actively worked with a community of teachers who wanted to learn more about research focused on gifted and talented students. One outcome of this work was that Cain (2017) found that the teachers in the study contested research for various reasons consistent with the literature on the Research to Practice Gap. This comes as no surprise considering the gap between research and practice extends beyond individuals, permeating the educational system at large. It is within this space—at the intersection of district leaders being pivotal nodes within the educational system and the work being done to improve practitioners' use of research—that I situate this dissertation with the goal of developing MDLs' capacity to engage with research and promote a healthy skepticism of it. Such research is needed because the extant

literature does not provide a robust understanding of how this process unfolds for MDLs as they try to adhere to the policy requirements of using research and evidence to inform their decisions.

Overview of Methodological Approach

Using sensemaking (Maitlis & Christianson, 2014) and design-based perspectives (Cobb et al., 2003), I explore four mathematics district leaders' existing conceptualizations of educational research and how they revise their conceptualizations as they make intersubjective meaning of research with a group of their like-role peers. Specifically, this dissertation aims to answer the following questions:

1. *What are MDLs' existing conceptualizations of educational research?*
    a) *How do MDLs use research in their local district contexts?*
    b) *What are the barriers that prevent MDLs from using research?*
    c) *What are the criteria that MDLs use to determine if research is credible?*
    d) *What are MDLs' definitions of research?*
2. *What are MDLs' revised understandings of educational research after engaging in intersubjective meaning making with a group of their like-role peers?*

To answer the first research question and sub-questions, I employ a basic qualitative design (Merriam & Tisdell, 2016). I ask my four participants to answer a brief questionnaire, submit three artifacts of practice that are instances in which they have used research in their context, and then use a semi-structured stimulated recall interview technique to elaborate on their responses to the questionnaire and their submitted artifacts.

I use design-based perspectives (Cobb et al., 2003) to create the conditions to answer my second research question. Guided by a set of design principles, the literature surrounding practitioners' use of research, and my theoretical framework of sensemaking (Maitlis & Christianson, 2014), I designed an intervention meant to provide a space for MDLs to surface

their existing understandings of research through the process of making intersubjective meaning so that they could revise their understandings to more closely align with those held by the research community. For both research questions, the coding process occurred in multiple cycles and relied heavily on my knowledge of the literature to open-code the data using a constant-comparative method (Miles et al., 2020).

Significance of Study

My dissertation provides three contributions to both theory and practice. The first is that prior research has made sense of practitioners' engagement with research with the assumption that providing practitioners with a definition of research means they then have a shared understanding of what is meant by the term research. I argue that practitioners, specifically MDLs, have conceptualizations of research that are products of their past experiences, which are different from those held by researchers. As such, my first contribution provides insight into the conceptualizations of educational research for four MDLs from diverse districts across one state in the southeastern United States in the hopes of establishing a baseline from which future research can build.

My second contribution is noting how the four MDLs revised their conceptualizations of research in the hopes of becoming more closely aligned with those of the research community. They made distinctions between an article being research or research-based and surfaced criteria they drew upon when determining the extent to which they found an article credible. Over the course of the study, their conceptualizations of research became oriented more towards the research community. These new conceptualizations did not replace but instead were added to their existing understandings. By delving into the milieu of their conceptualizations using design-based perspectives and my theory of learning, I designed cues that triggered their sensemaking. As they made intersubjective meaning, I attended to how they revised their

conceptualizations. In response to observing these cycles of sensemaking, I provide recommendations for researchers trying to serve their potential practitioner audiences better.

Finally, my third contribution is providing a research reflection tool for mathematics district leaders, or district leaders in general, to use when making research-informed decisions. This tool was co-designed by four MDLs and me using an iterative process. The tool provides clarification as to the criteria that they consider as they classify an article as research or research-based, determine the extent to which the article is credible, and think about to what extent it meets ESSA's (2015) Tier IV of evidence.

Clarification of Terms Used Throughout the Dissertation

Throughout this dissertation there are many words that carry various meanings depending on the individual, community, or context in which they are used. To forestall any confusion around these terms, I offer my definition of *research*, *credible,* and *relevant.*

Research

Throughout this dissertation, I use the word research to mean "an activity in which people employ systematic, empirical methods to answer a specific question. Research bases its conclusions in investigations involving statistical data, interviews, observations, and case studies, or a combination of these" (NCRPP, 2016, p.3). This definition of research privileges empirical evidence in which conclusions are drawn from observable phenomena and experiences that can be measured using qualitative or quantitative data collection instruments. Such a definition excludes conceptual research that relies on theories and the existing literature to make logical arguments rather than drawing conclusions from observable and measurable phenomena.

I situate my definition of research within the constructivist paradigm in which truth is subjective and dependent on the individual as they make meaning of the world through their interactions (Creswell, 2014; Crotty, 1998). Answering research questions within this paradigm

requires understanding how individuals make sense of phenomena in relation to their social and historical perspectives. Researchers subscribing to this worldview claim their positionality and recognize that their interpretation of the data is influenced by their own experiences and backgrounds (Creswell, 2014) which counter the post-positivist belief that an objective reality exists and that a researcher should study it without bias. My definition of research also does not explicitly attend to issues of power, discrimination, oppression, or social justice, which are central tenets of transformative perspectives (Creswell, 2014).

Credible

I use the word credible throughout the dissertation study. I define it as the extent an individual believes what is being presented as they engage with a piece of research. A piece of research is not inherently credible, but it may be deemed credible by an individual if it is worthy of belief. This judgment is contingent upon the individual as they draw upon their past cultural and historical experiences and beliefs, making it quite possible for two individuals to come to different conclusions about the extent to which they find a piece of research credible. Thus, deeming a piece of research as credible is not universal and varies with the individual making the assessment. Throughout this dissertation, I use the words trustworthy, believable, and credible interchangeably.

Relevant

I define the word relevant as the extent to which a piece of research is applicable, appropriate, or pertinent to one's context or setting. Like assessing a piece of research as credible, the extent to which a piece of research is relevant is contingent upon the individual and their contexts. Thus, a piece of research that is relevant to one individual may not be relevant to another.

Overview of the Dissertation

This dissertation consists of seven chapters. Chapter II begins with a review of the literature and Chapter III details the methods used to answer the two research questions and sub-questions mentioned previously. The methods described are a subset of the larger dissertation design study. Chapters IV, V, and VI are written as stand-alone manuscripts meant for publication. Chapters IV and V portray the findings of my two research questions and Chapter VI presents a tool that was an outcome of Chapter V.

The first manuscript (Chapter IV) is titled, "What is educational research? The conceptualizations of four mathematics district leaders." This manuscript explores the initial conceptualizations of educational research for four MDLs prior to their engagement with the intervention. Participants were asked to submit artifacts of practice that embodied instances of research use within their role and context and then participated in semi-structured interviews using a stimulated recall technique. I found that MDLs' conceptualizations of educational research were defined in relation to their needs and context.

The second manuscript (Chapter V) is titled, "Making sense of educational research: The Mathematics District Leader Research Group." This manuscript explores the intersubjective meaning made by four MDLs as they engaged with one another over four months. In that time, participants individually read articles and then discussed them in a synchronous online meeting to determine if the articles were pieces of research and if they were credible. The findings suggest that the ways in which the MDLs made sense of research became more discerning as they came to have a clear, more sophisticated, shared definition of research and as they articulated their criteria for determining the extent to which they found an article to be credible.

The third manuscript (Chapter VI) is titled, "Making informed decisions is hard: A tool for district-level leaders to engage with research" and is meant for a practitioner audience. This

manuscript shares a reflection tool co-designed by the MDL participants and me. The tool was designed to be used by district leaders when making decisions to satisfy the requirements put forth by ESSA's (2015) Tier IV of Evidence—Demonstrate a Rationale. The tool was developed through a process of iterative design based on the MDLs' intersubjective meaning making. The final design of the tool provides criteria for MDLs to reflect on the extent to which an article meets the threshold of evidence needed to Demonstrate a Rationale.

Chapter VII is the closing chapter of the dissertation. I offer a summary of each of the manuscripts and make connections across them. I conclude by offering implications and recommendations for researchers, district-level leaders, mathematics teacher educators, and policy makers.

Following Chapter VII, there are Appendices A-H that provide examples of interview protocols, meeting agendas, data collection instruments, and most notably the details of the Mathematics District Leader Research Group design (Appendix H). Appendix H includes my learning conjectures, the rationale for my design decisions, and my conjecture log of evidence to either support or refute my conjectures.

CHAPTER II: LITERATURE REVIEW

Research, What Is It?

There is a considerable amount of research or research-based materials and resources in education. Practitioners consistently have to make decisions and judgments about the extent to which such resources are high-quality as they determine whether or not to use them in their districts, schools, and classrooms. This decision making process can be challenging as resources often come with labels (e.g., *evidence-based*, *research-based*, *data-driven*) that can be deceptive and unclear about the details (Nicholson-Goodman & Garman, 2007) because the definitions of such terms are not well-defined (Asen et al., 2011) and vary with one's paradigm (Coburn & Talbert, 2006; Tseng, 2012).

According to the Institute of Education Sciences (IES), research is defined from a post-positivist perspective in which evidence of quality is directly tied to quantitative methodologies that use randomized controlled trials as the gold standard for comparison. As such, recommendations for programs are based on an improvement index that give an effect size for an intervention (IES, 2020). Reducing an entire intervention to a single number may give a false sense of quality as such a measure can potentially oversimplify a complex phenomenon. Moreover, the conditions under which such a measure is appropriate are sometimes overlooked leading to an over extension or application of research (Davis, 2007).

For example, many school districts are required to implement Response-to-Intervention plans or Multi-Tiered Systems of Support (MTSS) to ensure all students receive the support they need to achieve academically (ESSA, 2015). Such plans are grounded in the learning disability literature and operate under the assumption that only 80 percent of children can achieve with "normal" instruction and the remaining 20 percent of children need academic intervention (Stoiber & Gettinger, 2016). One intervention used in mathematics classrooms is the *gradual*

release of responsibility model in which the teacher models how to solve a problem, students practice solving the problem with the teacher, then the students practice solving the problems on their own (Jitendra & Dupois, 2016). This model was designed for learners with disabilities within the literacy domain. Yet, it has been taken up within mathematics classrooms as an evidence-based practice per the recommendation of the What Works Clearinghouse (WWC) despite the fact that organizations such as the National Council of Teachers of Mathematics (NCTM) or the National Research Council (NRC) have considerable evidence to the contrary (NCTM, 2014; Kilpatrick et al., 2001). Thus, the gradual release of responsibility model is a prime example of research that has been overextended beyond its intended audience.

Explanations for why research is misapplied often result in blaming individuals in both the practitioner and researcher communities. Practitioners frequently criticize the research community for producing knowledge that is too theoretical and far removed from the everyday practice of teaching (Behrstock et al., 2009; Gore & Gitlin, 2004; Hemsley-Brown & Sharp, 2003). Likewise, researchers criticize practitioners for ignoring the ideas of best teaching practice, dismissing recommendations despite the evidence presented, or misusing the research findings (Cooper & Levin, 2010). MTSS and the gradual release of responsibility model are examples of these critiques and could easily be construed as the fault of practitioners. Such blame is unfair and misplaced because it ignores the fact that practitioners operate within accountability systems (e.g., national, state, district) that often dictate their actions (Hemsley-Brown & Sharp; 2004).

Herein lies the issue: using research to inform decisions or one's instruction is a systems-level problem requiring a systems-level solution. Within the literature, there have been a number of studies focused on understanding the problem (e.g., Dagenais et al., 2012; Finnigan et al.,

2013; Honig & Coburn, 2008; Rorrer et al., 2008). One of the commonalities among these studies is that district-level leaders are important for enacting change because of their position within the educational system. Their position is such that they make decisions and promote teaching practices that can impact an entire school district (Cobb & Smith, 2008; Coburn et al., 2008; Spillane, 2000). Navigating such responsibilities is no easy feat, especially for mathematics district leaders (MDLs) as it often means doing so within political contexts and set against a background of historical reform contexts (e.g., new math, math wars, Common Core) and public opinion (Trujillo, 2012). Given the highly political nature of MDLs' position within districts, there is an increased need to ensure programs and instruction are backed by relevant and appropriate research (Penuel et al., 2018). Herein lies the problem, the disconnect between research and practice prevents or severely impedes an MDLs' ability to do so (Penuel et al., 2018). As such, MDLs find themselves working to individually overcome what many consider to be an insurmountable systemic problem (Silver & Lunsford, 2017).

The Research to Practice Gap

The Research to Practice Gap is complicated and has plagued both practitioners and researchers for years (Korthagen, 2007). Both parties have come to recognize that a disconnect exists between the two, and many have come to accept it as inevitable. Moreover, as evidenced by the various metaphors describing the gap (Silver & Lunsford, 2017), the disconnect has been reified to provide the language by which to talk about the disconnect, but in doing so it has strengthened the systemic participation patterns that caused it. This is not to say that the metaphors are not productive for understanding the issue. Collectively, the set of metaphors allow multiple barriers and influences to be surfaced that extend beyond mere physical access to research—the *pipeline* metaphor. For instance, the *translation* metaphor calls attention to the need to address the accessibility of the written language of research—academic jargon. Both of

these metaphors address barriers related to practitioners' use of research but do little to attend to the extent practitioners find research to be useful and/or relevant.

Pasteur's Quadrant on the other hand, raises an epistemological need for research to address both theory and practice to address the issue of research lacking practicality (Fusarelli, 2008; Gore & Gitlin, 2004; Hemsley-Brown & Sharp, 2003; Nelson et al., 2009; Nutley et al, 2007; Penuel et al., 2018; Silver & Lunsford, 2017; Vanderlinde & van Braak, 2010). This metaphor suggests that research can be dual-purposed to benefit both types of researchers as they generate theoretical knowledge and practitioners looking for research to be applicable and useful (Silver & Lunsford, 2017). Although being applicable and relevant is important for research use, such a metaphor does not guarantee that it will be applied as it was intended. As the *osmosis* metaphor highlights, research has the potential to permeate the practitioner world even when researchers are not there to facilitate the process (Silver & Lunsford, 2017). Finally, the *border crossing* metaphor calls for a more active approach to sharing research by having members of either community cross the boundary between research and practice in the hopes of learning the cultural practices of the opposing community.

Although each of these metaphors is helpful for thinking about particular aspects of the Research to Practice Gap, none of them are all-encompassing, and all of them leave something to be desired. For example, the *pipeline* metaphor assumes that by making research physically accessible, practitioners can access and use it (Bauer & Fischer, 2007). Physical access is only one of many barriers that perpetuate the disconnect between research and practice (Behrstock et al., 2009; Hemsley-Brown & Sharp, 2003; Nutley et al., 2007; Silver & Lunsford, 2017). Treating it as the sole barrier, a complex problem is oversimplified and ignores other structural and epistemological barriers.

Consider the *border crossing* metaphor, in which individuals at the boundaries of research and practice are able to operate on either side of the divide between research and practice. These individuals might be researchers who have an eye for working directly with practitioners, or they might be MDLs who have professional ties to university faculty (e.g., graduate programs, professional development, professional organizations). A strength in this metaphor is that it allows for the bidirectional flow of information from research to practice, or vice versa (Silver & Lunsford, 2007) through the use of boundary objects (e.g., curricular materials, standards documents). Boundary objects allow members from multiple communities with potentially varied understandings to interact with one another (Star, 2010; Star & Griesemer, 1989; Wenger, 1998). These objects hold different meanings for the individuals in the different communities; however, the objects provide a point of commonality for these individuals to engage jointly with members of the opposite community and collectively negotiate meaning. One shortcoming of this metaphor is that it does not account for the differences in language between communities making negotiated meaning more difficult (Silver & Lunsford, 2007). As Labaree (2003) noted, this is common as practitioners tend to orient towards utility or putting recommendations into action; whereas researchers are more interested in developing theory.

Each of the metaphors has their strengths, but trying to metaphorize the divide fails to depict the complexity and multifaceted nature of the issue accurately. Despite this criticism, the metaphors do share a common thread that has been helpful for the Research to Practice gap; they all try to describe the ways practitioners acquire research in service of using it. Although implicit, research use is foundational within each of these metaphors. As an illustration, take the *osmosis* metaphor in which research is assumed to permeate the practitioner world over time in

intended or unintended ways (Silver & Lunsford, 2017). Use is inherent in this metaphor is use; the action is "practitioners taking up research." The same can be said for the *translation* metaphor in which practitioners interpret research and then apply it to their context. Given the implicit attention to research use within these metaphors and the more explicit focus of use or non-use within the Research to Practice Gap, I would be remiss if I did not unpack *research use* in more detail.

Research Use

Research use is an active process that is set within a web of social, organizational, and political ecologies (Tseng, 2012). As such, the decision to use research is not only a question of "Yes or No", but it also includes, "For what purpose?" Within the literature, researchers have identified a variety of purposes for use and have categorized them into five broad categories: *instrumental*, *conceptual*, *symbolic*, *imposed*, and *process*.

Instrumental

The prototypical image of research use is instrumental, in which an individual is presented with a problem or needs to make a decision and turns to a specific piece or collection of research to find a solution or inform the decision (Nutley et al., 2007; Tseng, 2012). Under this type of use, the piece of research would dictate the course of action to be taken. Such use might be the case if an MDL noticed a disproportionate number of students of color in remedial mathematics classes and then found research recommendations on how to reduce or eliminate tracking in high school mathematics in their district.

Conceptual

Conceptual use of research, on the other hand, is considerably less popular and harder to attribute to a specific piece of research because it is often tied to multiple indirect influences. This type of research use occurs when research changes or influences the way an individual thinks about an issue or problem by offering a new perspective or outlook (Nutley et al., 2007; Tseng, 2012). This type of research use might occur after an MDL has been participating in conversations and attending conferences focused on equity issues in mathematics to earn continuing education credits for licensure renewal. Prior to participation, the MDL might have thought that equity was the same as equal, but over time, they shifted their stance to realize that equal is not synonymous with equitable.

Symbolic

Unlike the previous two types of research use, symbolic use occurs after a decision has been made to provide additional support or credence to what an individual says. This post hoc use of research is sometimes referred to as political use because it is used to justify a course of action, often with political implications (Nutley et al., 2007; Tseng, 2012). For example, an MDL might have to make a quick decision about whether or not to adopt a particular curricular program. They might decide based on their own opinion, but when presenting the decision to the school board might find research evidence to support their course of action.

Imposed

The previous three types of research use hinge upon the individual who is using the research. In contrast, imposed use is when an individual or organization is compelled to use research because its use is a stipulation of receiving funding (Tseng, 2012). For example, Weiss

and colleagues (2005) discuss how districts' adoption of the D.A.R.E. drug prevention program was directly tied to receiving federal funds.

Building from this definition of imposed use, I expand imposed use to include mandated use, which occurs when an individual is forced to use research because their superiors mandate it. In other words, an individual is stripped of their agency to decide whether or not to use research because the individual's supervisor makes the choice, and the individual is merely carrying out the decision. An example of mandated use would be if an MDL was not privy to the decision making process to adopt a Multi-Tiered Support System (MTSS), but was expected to train their teachers within the district on implementing the support system.

Process

The last type of research use is process use, in which an individual or organization actively participates in or conducts their own research (Tseng, 2012). This type of research use is common among practitioners conducting action research as they are producing research knowledge rather than taking previous research and applying it. Another example of this type of use would be if an MDL decided to participate in a research study about the effectiveness of a professional development to improve their own knowledge and help a researcher develop new knowledge. The six types of research use are summarized in Table 2.1 below.

Table 2.1. Types of Research Use

Type of Use	Description
Instrumental	An individual uses a specific piece of research to inform a yet to be made decision.
Conceptual	Research changes an individual's perspective about an issue or problem; often indirect and hard to track to a specific piece of research.
Symbolic	An individual makes a decision, then uses research after the fact to support the decision.
Imposed	Funding is contingent upon the use of a piece of research

Mandated	An individual is forced to use a specific piece of research or take a particular course of action
Process	An individual actively participates in producing research

Factors that Influence Practitioners' Use of Research

Research use is complicated by social, organizational, and political ecologies in which potential users of research operate (Tseng, 2012). Within the milieu, there are a set of factors that influence the extent to which research is taken up. These factors play an important role for practitioners as they make decisions about using research and influence the ways in which it gets applied to their contexts. The literature around research use and the Research to Practice Gap go into great detail about the subtleties; however, I have categorized them here in terms of four broad categories—*barriers to access*, *the extent to which research is credible*, *relevant*, and one's *role and context*—in the hopes of synthesizing the literature in such a way that captures the nuances without being bogged down in the minutia.

Barriers to Access

Barriers to access are those obstacles that prevent the transmission of research and are often thought of in terms of tangibility—the ability to find a piece of research and have the opportunity to read it (Shkedi, 1998). This is the primary barrier that the *pipeline* metaphor captures. Examples of this barrier include the high cost of journal articles or a lack of access to research databases. Barriers to access also include feelings of being overwhelmed from the volume of research available and the chore of sorting through it (Gore & Gitlin, 2004; Hemsley-Brown & Sharp, 2003; Nelson et al., 2009; Nutley et al., 2007; Rickinson, 2005; Sin, 2008). Furthermore, the language of research, which requires practitioners to decipher the academic jargon (Fusarelli, 2008; Gore & Gitlin, 2004; Hemsley-Brown & Sharp, 2003; Honig & Coburn, 2008; Rickinson, 2005; Shkedi, 1998) of lengthy and dense research articles prevents them from

accessing it. The *translation* metaphor addresses this latter barrier as it calls for changing the language in which research is written so that it is more accessible to practitioner audiences (Silver & Lunsford, 2017). Researchers and academia have tried to address this issue by creating and writing for journals aimed at practitioner audiences (e.g., Mathematics Teaching and Learning: PK12; Mathematics Teacher Educator); however, many of these are cost prohibitive (Behrstock et al., 2009) as they often require paid memberships or subscriptions in order to read them.

The Extent to Which Research is Credible

The second factor, *the extent to which research is credible*, consists of a variety of criteria that practitioners use to determine the extent to which they believe what research says. Although the National Research Council (Shavelson & Towne, 2002, p.52) put forth six markers for measuring research quality (Figure 2.1), practitioners tend to have their own set of criteria for evaluating research. These criteria include the actual content of the piece of research (Honig & Coburn, 2008; Silver & Lunsford, 2017) and extend beyond it to include the source from which one receives the piece of research (Behrstock et al., 2009; Gore & Gitlin, 2004; Honig & Coburn, 2008; Nutley et al., 2007).

Figure 2.1. Markers of Research Quality

1. Pose significant questions that can be investigated empirically.
2. Link research to relevant theory.
3. Use methods that permit direct investigation of the question.
4. Provide a coherent and explicit chain of reasoning.
5. Replicate and generalize across studies.
6. Disclose research to encourage professional scrutiny and critique.

In terms of evaluating the quality of research, the National Research Council (2002) is keenly focused on the qualities and content of the research itself. As seen in Figure 2.1, any

potential user of research is noticeably absent from the markers of quality. For example, determining if a piece of research satisfies the quality marker, "Use methods that permit direct investigation of the question" (NRC, 2002, p. 62) depends solely on what is written in the article and any potential user—in theory—has no bearing on the research being credible. In contrast, many of the criteria used by practitioners are contingent upon the individual who is reading the research. One such criterion that carries considerable weight for practitioners is the source from which the piece of research was received (Gore & Gitlin, 2004; Honig & Coburn, 2008; Nutley et al., 2007). If research is received from a trusted source (e.g., a trusted colleague, professional organization), practitioners find the research more credible (Behrstock et al., 2009; Honig & Coburn, 2008). Practitioners also rely on the extent to which the research matches their personal experience (Zeuli, 1994). Research that seems to elicit a positive "gut reaction" from practitioners tends to get taken up more frequently (Honig & Coburn, 2008), while research that does not tends to be discounted (Coburn, Honig, & Stein, 2009).

The Extent to Which Research is Relevant

The extent to which research is relevant is the third factor and accounts for the degree that research is seen as appropriate, worthwhile, and pertaining to the issues and work of practitioners. This factor is highly subjective and dependent on the individual potential user of research. It was noticeably absent from the Markers of Quality (NRC, 2002) mentioned previously, yet plays a big role for practitioners as they think about potentially using research. More recently, Gutiérrez and Penuel (2014) called attention to the need for research to be relevant. They argued that it should be a criterion of rigor by which research quality is measured because the work of practitioners is steeped in district, school, and classroom contexts that require research to be applicable (Behrstock et al., 2009; Coburn et al., 2009; Gore & Gitlin,

2004; Shkedi, 1998; Zeuli, 1994) and actionable (Behrstock et al., 2009; Gore & Gitlin, 2004; Honig & Coburn, 2008; Zeuli, 1994).

Practitioners use such criteria to evaluate a piece of research as being relevant because the fast-paced environments in which they work require easy application. This means that they tend to look closely at the contexts under study and determine the extent to which they align with their own (Behrstock et al., 2009). A common belief among practitioners is that research is done in contexts that do not match reality (Shkedi, 1998), it is unhelpful (Gore & Gitlin, 2004), and is undeserving of merit for lack of classroom applicability (Hemsley-Brown & Sharp, 2003). Such beliefs are understandable given the context in which practitioners work; they see their individual classrooms as unique and unless the context of a piece of research matches their own, the research recommendations may not apply (Cain, 2017; Gore & Gitlin, 2004). Collectively, the perception that research is irrelevant may explain as to why practitioners turn to other sources for information (e.g., colleagues, peers; their judgment) before looking to research (Behrstock et al., 2009; Coburn & Talbert, 2006; Honig & Coburn, 2008). The underlying issue seems to be epistemological in nature. What counts as knowledge or in this case, *research*, seems to be rooted heavily in the role and context in which practitioners work (Labaree, 2003).

Role and Context

Finally, one's role and context are factors that extend beyond individuals trying to bridge the Research to Practice Gap as they are deeply ingrained in the daily operations of schooling. Individuals operate within a system, and their role within that system dictates their use and conceptualizations of research. Within the literature, many practitioners report not having time to engage with research because the way in which the school day is structured leaves little to no time for practitioners to engage with research (Behrstock et al., 2009; Cain, 2017; Hemsley-

Brown & Sharp, 2003; Nelson et al., 2009; Nutley et al., 2007). In the event they do find time for engaging with research, it typically occurs in addition to practitioners' other duties (Hemsley-Brown & Sharp, 2003; Gore & Gitlin, 2004; Labaree, 2003; Shkedi, 1998; Nutley et al., 2007) and/or is in service of an advanced degree (Hemsley-Brown & Sharp, 2003).

In addition to not having time to engage with research, the structure of schools is such that practitioners work in isolation from their peers as common planning times are hard to schedule with the constraints of student schedules and available classroom space. They often work in isolation from their peers because of the highly compartmentalized nature of schools (Spillane, 1998) and districts, thus making collaboration challenging. Given that research use is a social process (Tseng, 2012), professional isolation is crippling and helps breed the culture of competition that has permeated classrooms, schools, and districts within the era of accountability brought on by the No Child Left Behind legislation (2002).

The other set of influences within this factor are epistemological and are referred to indirectly in the literature (Hemsley-Brown & Sharp, 2003; Honig & Coburn, 2008; Vanderlinde & van Braak, 2010). These influences account for the values and beliefs an individual has about knowledge and what counts as knowledge. Set within the Research to Practice Gap, the paradigms of practitioners and researchers are in conflict as both parties have distinct epistemological beliefs that are deeply ingrained in their respective contexts and roles. In Labaree's (2003) work with practitioners in pursuit of doctoral degrees, he called attention to this paradigmatic tension by describing it in terms of four conflicts existing on a continuum, *a) from normative to analytical, b) from personal to intellectual, c) from particular to universal,* and *d) from experiential to theoretical*—I unpack these conflicts in detail below.

The Practitioner Worldview

Generally speaking, the practitioner's worldview is deeply rooted in relationships and context. Teaching is a relational profession in which the relationships one forms with their students directly impact the learning that occurs in classrooms. It requires practitioners to value students as individuals and foreground their needs. In this sense, teaching is *personal*. The extent to which practitioners develop healthy working relationships with their students heavily influences the development of a learning community. Doing so requires practitioners to pay close attention to the *particulars* of the students, the context, and the teacher themselves. As such, every class has a distinct personality, which means that practitioners have to continually adapt their instruction to fit the needs of their students. It is only natural to feel isolated in this process because teachers are typically limited to the experiences of their own classrooms and teaching schedules. A sense of individualism develops as practitioners navigate their classrooms, making them experts on the uniqueness of their setting. Practitioners draw heavily on their past experiences to guide their future actions. Often one's practitioner experience will trump research because only a practitioner knows the nuances of their own classroom; in this sense their worldview is *experiential*. Finally, practitioners have a *normative* orientation that foregrounds students and positive outcomes. Practitioners are responsible for facilitating student learning; thus, they are particularly focused on doing what is best for their students (Labaree, 2003).

The Researcher Worldview

The researcher's worldview in comparison to the practitioner is vastly different. While practitioners are focused heavily on their specific classroom context, researchers have a broader view. Their focus extends beyond individual students in order to look for commonalities across many classrooms and students. This *universal* view accounts for individual classrooms and

students by using qualitative methods; however, the goal is to look for ideas that span many contexts and apply in multiple settings. Generating ideas and theories have considerable value. Moreover, the extent to which an idea is new or innovative is the measure by which researchers are judged. Practitioners see this *intellectual* view as being cold or impersonal because it does not put the highest value on students, but rather ideas. Researchers try to understand the nature of problems and make sense of phenomena using theories from past research to explain and describe the learning they observe through data collection. This *analytical* process is focused heavily on theory, rather than practice. Finally, researchers recognize that classroom experience is but one of many perspectives. Taking a *theoretical* stance, researchers look to see how theories can explain the phenomenon of many classrooms. This necessarily means that there will be less depth regarding a particular classroom, but it allows for a broader scope and generation of theory that can potentially explain phenomena across contexts (Labaree, 2003).

Labaree's (2003) work is helpful for thinking about the factor, one's role and context. In particular, it explains practitioners' perception of not having time to engage with research; it is a reification of practitioners' epistemological beliefs that privilege the particulars of a situation by relying on experience and normative views of student success (Labaree, 2003). It also offers a frame of reference for understanding practitioner skepticism of research that tends to devalue educational research (Behrstock et al., 2009; Cain, 2017; Coburn & Talbert, 2006; Fusarelli, 2008; Gore & Gitlin, 2004; Graves & Moore, 2018; Hemsley-Brown & Sharp, 2003; Honig & Coburn, 2008; Nelson et al., 2009; Nutley et al., 2007; Silver & Lunsford, 2017; Tseng, 2012; Vanderlinde & van Braak, 2010) and privilege other sources of knowledge (Behrstock et al. 2009; Cain, 2017; Coburn & Talbert, 2006; Gore & Gitlin, 2004; Honig & Coburn, 2008; Nutley et al., 2007; Tseng, 2012). In this sense, educational research is one of many competing

influences vying for attention. Unfortunately, research is often relegated to the back burner. This is not intentional, but rather, it is the byproduct of systemic influences such as a lack of incentives (e.g., recognition, pay, resources; Hemsley-Brown & Sharp, 2003), professional isolation and district compartmentalization (e.g., being the sole district person in an MDL role; Spillane, 1998), quick timelines for action and implementation (Nelson et al., 2009), cultures of non-research use (Coburn & Talbert, 2006), and/or the myriad barriers to access mentioned previously.

Addressing the Gap Between Research and Practice

The literature is robust regarding valuable and nuanced insights about how teachers and district-level leaders interact with research (e.g., Coburn et al., 2009). Looking across the collection of studies, one of the commonalities that has risen to the surface is the importance of district-level leaders (Coburn & Talbert, 2006; Daly et al., 2014; Spillane, 2000). Imagine an hourglass with sand moving from the top bulb to the bottom through the waist—the skinny part of the hourglass connecting the two bulbs. Sometimes referred to as mid-level Influencers (e.g., mathematics district leaders, instructional coaches, lead teachers), district-level leaders are the waist of the metaphorical hourglass; as policy and research (the sand in the top bulb) move into practice (the bottom). As such, district-level leaders regulate the flow of information within the educational system by bridging the gap between upper and lower-level employees (Coburn & Talbert, 2006) as they interpret and implement policy and research (Daly et al., 2014; Spillane, 2000). Their position at the waist of the figurative hourglass has spurred researchers to see them as essential to reform efforts (Rorrer et al., 2008; Wilson et al., 2018).

There have been many studies that describe how practitioners define research (Gore & Gitlin, 2004), how it is perceived (Cousins & Leithwood, 1993; Graves & Moore, 2018; Penuel et al., 2017), where they look for it (Palinkas et al., 2016; Penuel et al., 2017), use it in their

contexts (Penuel et al., 2017), and how it could be improved (Gore & Gitlin, 2004; Hemsley-Brown & Sharp, 2003). Using questionnaires, interviews, and focus groups were common among these studies and offered insight into the perceptions of practitioners and the realities in which they operate. For example, Coburn and Talbert (2006) used these three data collection instruments to find that practitioners' perceptions of research were influenced by policy and the role in which they work. Similarly, Gore and Gitlin (2004) used questionnaires to understand how preservice and in-service teachers described research and barriers to its use. Although these studies offer a robust understanding of the lay of the land, researchers recently have called for studies that move beyond self-report data collection (Honig & Coburn, 2008; Levin, 2013; Penuel et al., 2017).

In response to the call from the literature, some researchers have responded by capitalizing on research recommendations that promote research use and engagement as a social process, heavily rooted in relationships (Amara et al., 2004; Nelson et al., 2009; Tseng, 2012). For instance, Cain (2015; 2017) studied a group of teachers as they engaged with research for almost two years. He served as a research intermediary in which he provided the teachers with research articles focused on gifted and talented students. In another study, Graves and Moore (2018) came across a more organic community that relied on social media (e.g., Twitter) as they interviewed district-level leaders how they access, engage with, and use research. They found that social media provided district-level leaders with access to research and connected them with other practitioners from far-off geographic locations. A strength of this organic community was that it allowed for social interaction, but as was noted by Graves and Moore (2018), the community consisted primarily of practitioners and did not allow for the bi-directional flow of information between their researcher counterparts.

The authors of the studies mentioned above (Cain, 2015; Graves & Moore, 2018) saw strength and value in district-level leaders (formal or informal) having opportunities to engage in dialogue with peers, make sense of research, and develop trust through sustained social interactions. Other researchers seem to agree that such social interactions are fertile ground for cultivating practitioners' capacity to engaging with research (Amara et al., 2004; Penuel & Coburn, 2014), but doing so requires support (Kochanek & Clifford, 2014; Nelson et al., 2009).

Based on the recommendations put forth in the literature, the current study aims to provide the needed support by incorporating the strengths of past research into the design of the MDLR Group intervention (e.g., research intermediary, organic community, online social interactions) (Cain, 2015; Graves & Moore, 2018). To guide this process, I use a theory of learning—sensemaking (Maitlis & Christianson, 2014)—that was productive for other researchers focused on privileging practitioners' conceptions of research and evidence (Coburn & Talbert, 2006). I conclude this chapter by elaborating on this theoretical perspective that guided many design choices and the data analysis throughout the dissertation study.

Sensemaking

Engaging with research is a social process involving practitioners drawing on various resources (e.g., relationships, past experiences, local context) as they define, search for, make sense of, and use research (Tseng, 2012). Although few scholars have subscribed to sensemaking perspectives (Weick, 1995) to study how practitioners interact with research (e.g., Coburn & Talbert, 2006), it is a productive lens for doing so because it privileges the social nature of research and its use. In this dissertation, I subscribe to sensemaking perspectives that view meaning making as an intersubjective social process in which individuals co-construct meaning with others (Maitlis & Christianson, 2014; Weick, et al., 2005).

Within this social constructionist approach, sensemaking is a cyclical process that begins when individuals' realities deviate from their expectations to such a degree that it encourages them to seek an explanation for the discrepancy between the two actively. Some researchers believe that the meaning making process can be navigated internally (e.g., Klein et al., 2006; Louis, 1980); however, I believe that sensemaking unfolds between individuals as they engage in social interactions with others. This perspective aligns closely with that of Weick and colleagues (1995, 2005) and more recently, Maitlis and Christianson (2014).

The sensemaking process involves three cyclical stages that begin with an event, issue, or situation that deviates from one's expectation and triggers the sensemaking process. Referred to as a *cue*, this discrepant event, issue, or situation motivates the individual to seek an explanation and clarify the ambiguity surrounding the cue. This process is intersubjective as it occurs with others who offer interpretations of the cue and test their provisional understandings. As individuals test their provisional understandings, they introduce new potential cues that may resolve the initial ambiguity surrounding the cue and/or fuel new cycles of sensemaking. This three-stage cycle is a process by which individuals actively enact order on the phenomenon they are trying to understand (Maitlis & Christianson, 2014; Weick, et al., 2005). In what follows, I elaborate on each stage of sensemaking—*cue*, *intersubjective meaning making*, and *taking action*.

Cue

Sensemaking begins with a cue which is an event, issue, or situation that disrupts one's expectation and because of that disruption the individual is unsure of how to respond (Maitlis & Christianson, 2014). The cue creates uncertainty and/or ambiguity to such an extent that they are motivated to seek clarification of the cue. Not all events, issues, or situations trigger

sensemaking because cues are subjective and dependent on the individual. A cue that triggers sensemaking for one individual might not do so for another. Thus, a cue has to deviate significantly enough from one's expectation so that they are spurred to clarify the manner in which they should respond (Maitlis & Christianson, 2014).

An example of a cue for an MDL might occur when conducting high school classroom visits at a school that serves students from primarily minority backgrounds. Their expectation might be to see mathematics classes that represent the larger school population; however, when visiting an honors mathematics class, they notice that almost all of the students in the classroom are white. This observation about the students in this one classroom not being representative of the larger school population might serve as a cue that triggers the sensemaking process for the MDL as they try to make meaning of their observation. Although such an observation might cue the sensemaking process for the MDL, it may go unnoticed by the teachers and/or principal of the school.

Intersubjective Meaning Making

After a cue triggers the sensemaking process, an individual engages in a social process by which they interpret and think about the appropriate response to the cue. This process unfolds between individuals as they co-construct meaning of the cue. This stage in the sensemaking process is referred to as intersubjective meaning making as the individuals involved create a shared understanding or explanation of the cue through mutual engagement with one another (Maitlis & Christianson, 2014). This stage in the sensemaking process surfaces multiple ideas as the provisional understandings of each individual are shared. In doing so, there is potential for individuals to be introduced to new perspectives that they might not have been exposed to had they not engaged in making intersubjective meaning.

To revisit the example above, the MDL might turn to their colleagues at the central office or their peers in other school districts to better understand what they observed. The intersubjective meaning making process might begin with questions such as, “Have you seen something similar in your district? In other curricular domains?” or “What is the process for creating class rosters?” The intersubjective meaning making process might conclude with a realization that tracking is deeply ingrained in the existing school structures and perpetuates systemic inequalities.

Taking Action

The last stage in the sensemaking process is taking action. It is fundamental to the sensemaking process as it serves two main purposes. The first of which is that it provides feedback on the sense that was made. Taking action allows the individual to test their provisional understanding of a cue and see how the environment responds. The second purpose is that by taking action, an individual provides new material from which new cues can emerge (Maitlis & Christianson, 2014; Weick, 1988). Individuals necessarily change the environment to become more orderly as events, issues, or situations no longer serve as cues by acting on the sense made. Additionally, there is potential for events, issues, or situations that previously did not serve as cues to trigger future sensemaking (Maitlis & Christianson, 2014; Weick, 1988, 1995).

In the example about student tracking above, taking action might mean that the MDL takes steps to eliminate tracking processes in their district. Such action would change the environment because all classes would now have student populations that reflected the larger school population. In doing so, new events, issues, or situations might arise that could serve as future cues.

The Current Study

The current dissertation study aims to build from the existing literature about practitioners' understandings and use of research by looking at a specific type of practitioner, MDLs. In the following chapters, I present an intervention meant to support four MDLs in building their capacity to engage with research and help them meet the requirements set by ESSA (2015) to ensure that their decisions are supported and informed by educational research. Through a set of designed activities and purposefully chosen articles that I hoped would serve as cues for the MDLs, I introduced them to notions of research that more closely align with those held by the research community.

CHAPTER III: METHODS

This study is rooted in the tradition of design-based research ([DBR], Cobb et al., 2003) for the two-fold purpose of generating knowledge about MDLs' conceptualizations of educational research and building the capacity of four MDLs to engage with research. In this chapter, I highlight my theoretical perspective and detail the data collection and analysis process for answering the following research questions and sub-questions.

1. *What are MDLs' existing conceptualizations of educational research?*
    a. *How do MDLs use research in their local district contexts?*
    b. *What are the barriers that prevent MDLs from using research?*
    c. *What are the criteria that MDLs use to determine if research is credible?*
    d. *What are MDLs' definitions of research?*
2. *What are MDLs' revised understandings of educational research after engaging in intersubjective meaning making with a group of their like-role peers?*

The methods described in this chapter are representative of the entire dissertation in which Chapters IV and V are a subset. The methods described in Phase 1 and 2 of this chapter also appear in Chapters IV and V, respectively.

Theoretical Perspective - Sensemaking

Engaging with research is a social process involving practitioners drawing on a variety of resources (e.g., relationships, past experiences, local context) as they define, search for, make sense of, and use research (Tseng, 2012). Although few scholars have subscribed to sensemaking perspectives (Weick, 1995) to study how practitioners interact with research (e.g., Coburn & Talbert, 2006), it is a productive lens for doing so because it privileges the social nature of

research and its use. In this dissertation, I subscribe to sensemaking perspectives that view meaning making as an intersubjective social process in which individuals co-construct meaning with others (Maitlis & Christianson, 2014; Weick et al., 2005).

Within this social constructionist approach, sensemaking is a cyclical process that begins when individuals' reality deviates from their expectations to such a degree that it encourages them to actively seek an explanation for the discrepancy between the two. Some researchers believe that the meaning making process can be navigated internally (e.g., Klein et al., 2006; Louis, 1980); however, I believe that sensemaking unfolds between individuals as they engage in social interactions with others. This perspective on sensemaking aligns closely with that of Weick and colleagues (1995, 2005) and, more recently, Maitlis and Christianson (2014).

The sensemaking process involves three cyclical stages that begin with an event, issue, or situation that deviates from one's expectation and triggers the sensemaking process. This discrepant event, issue, or situation, referred to as a *cue*, motivates the individual to seek an explanation and clarify the ambiguity surrounding the cue. This process is intersubjective as it occurs with others; offering interpretations of the cue and testing provisional understandings. As individuals test their provisional understandings, they introduce new potential cues that may resolve the initial ambiguity surrounding the cue and/or fuel new cycles of sensemaking. This three stage cycle is a process by which individuals actively enact order on the phenomenon they are trying to understand (Maitlis & Christianson, 2014; Weick, et al., 2005). In what follows, I elaborate on the sensemaking stages—*cue*, *intersubjective meaning making*, and *taking action*.

Cue

Sensemaking begins with a cue which is an event, issue, or situation that disrupts one's expectation and because of that disruption the individual is unsure of how to respond (Maitlis &

Christianson, 2014). The cue creates uncertainty and/or ambiguity for the individual to such an extent that they are motivated to seek clarification of the cue. Not all events, issues, or situations trigger sensemaking because cues are subjective and dependent on the individual. A cue that triggers sensemaking for one individual might not do so for another. Thus, a cue has to deviate significantly enough from one's expectation so that they are spurred to clarify the manner in which they should respond (Maitlis & Christianson, 2014).

An example of a cue for an MDL might be as they were doing high school mathematics classroom visits at a school that serves students from primarily minority backgrounds. Their expectation might be to see mathematics classes that represent the larger school population; however, when visiting an honors mathematics class they notice that almost all of the students in the classroom are white. This observation about the students in this one classroom not being representative of the larger school population might serve as a cue that triggers the sensemaking process for the MDL as they try to make meaning of their observation. Although such an observation might cue the sensemaking process for the MDL, it may go unnoticed by other practitioners within the school.

Intersubjective Meaning Making

After a cue triggers the sensemaking process, an individual engages in a social process by which they interpret and think about the appropriate response to the cue. This process unfolds between individuals as they co-construct meaning of the cue. This stage in the sensemaking process is referred to as intersubjective meaning making as the individuals involved create a shared understanding or explanation of the cue through mutual engagement with one another (Maitlis & Christianson, 2014). This stage in the sensemaking process surfaces multiple ideas as the provisional understandings of each individual are shared. In doing so, there is potential for

individuals to be introduced to new perspectives that they might not have been exposed to had they not engaged in making intersubjective meaning.

To revisit the example above, the MDL might turn to their colleagues at central office or their peers in other school districts to better understand what they observed. The intersubjective meaning making process might begin with questions such as, "Have you seen something similar in your district? In other curricular domains?" or "What is the process for creating class rosters?" The intersubjective meaning making process might conclude with a realization that tracking is deeply ingrained in the existing school structures and perpetuates systemic inequalities.

Taking Action

The last stage in the sensemaking process is taking action. It is fundamental to the sensemaking process as it serves two main purposes. The first of which is that it provides feedback on the sense that was made. Taking action allows the individual to test their provisional understanding of a cue and see how the environment responds. The second purpose is that by taking action, an individual provides new material from which new cues can emerge (Maitlis & Christianson, 2014; Weick, 1988). By acting on the sense made, individuals necessarily change the environment to become more orderly as events, issues, or situations no longer serve as cues. Additionally, there is potential for events, issues, or situations that previously did not serve as cues to trigger future sensemaking (Maitlis & Christianson, 2014; Weick, 1988, 1995).

In the example about student tracking above, taking action might mean that the MDL takes steps to eliminate tracking processes in their district. Such action might change the environment so that all classes have student populations that reflect the larger school population. In doing so, new events, issues, or situations might arise that could serve as future cues.

Context of the Study

Starting in the fall of 2016, one southern U.S. state adopted and began to implement new mathematics standards for K-12 students. This four-year process began with the first three high school mathematics courses, followed by K-5 and middle grades mathematics, and concluded with the fourth year of high school mathematics. Unlike previous standards adoption and implementation efforts, adoption and implementation were grounded in statewide partnership between practitioners, researchers, and the state education agency.

Past standards adoptions (e.g., Common Core) in this state had been highly segmented leaving individuals within districts and schools to develop implementation resources and provide professional development for teachers independently. The disconcerted and isolated efforts of individual districts exacerbated social, economic, racial, and cultural inequities. Much like an orchestra without a conductor, each district was able to implement the standards, but their efforts were disjoint and varied considerably from one district to another. This was especially true when looking at large urban districts compared to smaller rural ones, as larger districts typically had more resources and human capacity to devote to implementation. Thus, the systemic incoherence of past standards adoptions created inequities that had implications for districts, schools, teachers, and most importantly, students. Recognizing the need to address geographic inequities, the state education agency, educational researchers, mathematics district leaders, and mathematics teachers from across the state embarked on a joint effort to implement the new standards and improve the implementation process by developing resources and online support for all mathematics practitioners within the state (Bryant et al., 2017; McCulloch et al., 2017; Wilson et al., 2017).

One of the outcomes of the statewide partnership was that a group of MDLs from urban, suburban, and rural districts across the state organically formed a collaborative network in which

they would freely share information. This grassroots collaboration began as an email chain and over time evolved into a community that participated in a series of face-to-face meetings, conversations, and a joint effort to develop resources to support the implementation process. It was within this community that researchers inside the partnership found that MDLs are pivotal to implementation efforts because of their centrality in the infrastructures of school districts (Wilson et al., 2018). This finding aligns with previous literature around district leaders in general, who were found to be uniquely positioned on the boundary of policy and practice and have been shown to play a significant role in enacting change (Cobb & Smith, 2008; Coburn et al., 2008; Spillane, 2000). It is within this existing MDL community-at-large that I situate this dissertation and aim to answer my two research questions.

Selection of the Cases

As part of a previous research project, mathematics teachers, instructional coaches, and district-level personnel from across one southeastern U.S. state provided their contact information as part of their interest in the previous project. Using this database, I searched for individuals who met the initial criteria of being an MDL, which I defined as, "district administrators, curriculum specialists, and lead teachers who, by virtue of formal position or informal role, are actively involved in developing and implementing district policies, partially in response to state and national standards, about mathematics education" (Spillane, 2000, p.142). This search provided an initial list of potential participants, from which I purposefully selected 13 based on their geographic location (geographic region 1-4) and classification (e.g., urban, rural, suburban) because I wanted a diverse group of participants that represented the various locations and demographics of the state. Each of these 13 individuals were from different school districts within the state.

In order to meet the requirements of the Institutional Review Board, I emailed district office personnel (e.g., superintendents, supervisors) in each of the 13 school districts to get permission for their respective MDL to participate in the study. If I received permission from the district, I emailed the MDLs to see if they were interested in participating in the study. Of the 13 school districts, I received no reply from four districts; three districts declined to provide permission; and two district leaders declined to participate, leaving only four participants who agreed to participate. The recruitment process spanned three and a half weeks in September 2020.

The four participants who agreed to participate were from four different geographic regions from across one southeastern US state. They were separated by considerable distance and were from either rural or suburban areas. Although I refer to all of the participants as MDLs for the purpose of this study, two of them were mathematics instructional coaches and the other two were mathematics district supervisors within their respective districts. I briefly describe each participant below. All participants and districts were given pseudonyms.

Christine

Christine is from a school district in Geographic Region 3 which serves over 20,000 students from rural, suburban, and urban locations across 41 schools. This school district is one of the larger districts in the state (in the top 20% for student population size). Christine works with a team of four mathematics instructional coaches but is the primary mathematics instructional coach for high schools in her district. Christine has worked in education for 11-15 years and has spent the past 6-10 years in her role as a mathematics instructional coach. Christine serves as a liaison between the school and district level, provides classroom support to teachers,

and helps facilitate PLC discussions. She has an undergraduate degree in secondary mathematics education and described her experiences with research as limited to her practicum courses.

Meredith

Meredith works in Geographic Region 4 and serves as a mathematics instructional coach for high school. She works in a suburban school district—in the top 20% for student population size—that serves about 25,000 students at 45 schools and works with a team of six instructional coaches (K-12) and one K-12 mathematics director. Meredith has worked in education for over 20 years with the last 6-10 years in her role as a mathematics instructional coach. Her duties include facilitating professional development with teachers, providing instructional support, and identifying instructional resources. Meredith has an undergraduate degree in secondary mathematics education, two graduate degrees—one in secondary mathematics education and the other in school administration,—and is a National Board Certified Teacher. In addition to her duties as a mathematics instructional coach, Meredith consults for a private educational company. She has held leadership roles as an affiliate of NCTM, for a number of years.

Leah

Leah is an MDL in a smaller rural district from Geographic Region 1; however, her district seems well-equipped with resources and support from nearby higher education institutions. Leah's district serves around 8000 students across 18 schools—in the top 50% for student population size. Leah's district does not have a formal team of mathematics instructional coaches, but she does have a team of informal teacher leaders that she relies on regularly. Leah, who has been in an MDL role for 20 years, is a mathematics and science district supervisor. Her responsibilities include developing instructional resources, facilitating professional development, analyzing district and school data, and giving presentations to various district stakeholders. Leah

has an undergraduate degree in middle grades education focusing on mathematics and science and a graduate degree in school administration. Leah's experiences with research in her graduate work involved using past research to support her ideas, but she was not actively involved in conducting research.

Beth

Beth is a mathematics supervisor in Geographic Region 2 which is in the top 20% for student population size. She is the only person at central office dedicated to K-12 mathematics in her district; however, she does have a team of similar role individuals for other subjects (e.g., english supervisor) in which she collaborates. She has worked in education for over 20 years, but only 6 to 10 of those have been in an MDL role. Beth works in a rural school district serving just over 22,000 students at 36 schools. In her role, she provides professional development offerings, conducts classroom observations, and offers targeted support to teachers as needed. Sometimes these duties expand beyond mathematics and include working with teachers in other content areas. Beth has an undergraduate degree in secondary mathematics education and a graduate degree in educational leadership. Her research experiences in her graduate program were limited.

Data Collection and Analysis

Data collection for this dissertation occurred in two sequential phases. For Phase One, data was collected prior to the first MDLR Group meeting. Phase Two began with the first meeting. The initial data analysis was done to answer the first research question, *What are MDLs' existing conceptualizations of educational research?* and the accompanying sub-questions. A detailed description of Phase One of the data collection and analysis appear below and again in Chapter V.

The data collected during the second phase were analyzed to answer the research question, *What are MDLs' revised understandings of educational research after engaging in*

intersubjective meaning making with a group of their like-role peers? The methods presented in this section are also shared in Chapter VI.

Within this chapter, I describe the data collection and analysis process in its entirety for Phase One and then follow with the process for Phase Two.

Phase One Data Collection and Analysis

For Phase One of data collection, participants were first asked to complete an initial questionnaire (Appendix C). The questionnaire included demographic information (e.g., years in education, official role, degree) and a set of questions asking what makes research credible, trustworthy, and the source from which they receive research. These questions were adapted from an existing survey instrument for research use (NCRPP, 2016). They had been used as pilot data previously on a statewide survey of mathematics practitioners in the state. After taking the survey, the participants were asked to submit three artifacts of instances in which they had used research in their role (Appendix D). They then participated in a semi-structured interview that used an adapted stimulated recall technique (Vesterinen et al., 2010) (Appendix E) to present each participant with their questionnaire responses and artifact submissions. With the artifacts and questionnaire responses in front of them, I had the participants elaborate on their rationale behind their submission choices through a series of open-ended questions.

A total of four interviews were conducted; one with each participant on a video conference platform with the average length being 51 minutes. Each interview was structured to ask questions about the three submitted artifacts and the evidence within the artifact that signaled to the MDL that the artifact was a piece of research. I then asked each MDL about their responses to a particular question on the questionnaire about what makes research credible. Within this structure, I tailored the questions to fit the content of the submitted artifacts. For

example in Appendix B, Leah shared a slide deck for a training that cited John Hattie's work and said that Hattie's work was an instance of research. During the interview, I asked her questions about why she considered Hattie's work to be research.

The interviews occurred prior to the intervention to ensure that the MDLs' responses were not influenced by engagement with the intervention. They were recorded and transcribed using a transcription service and then manually cleaned up to get a verbatim transcript. The specific instructions provided to participants for the three artifacts are shown in Figure 3.1.

Figure 3.1. Instructions for Providing Three Artifacts of Research Use

MDLs use research in a variety of different ways within school contexts as they interact with teachers, schools, parents, communities, and district-level administrators. In an effort to understand how MDLs use research within these interactions, I am asking that you provide three artifacts from your practice that are supported by research. More specifically, please provide one artifact from each of the categories listed below:
Provide an artifact supported by research (pick 3 from 4 options) that represents an instance in which…

- You were interacting with teachers
- You were making decisions at the school or district level
- You were interacting with a parent, community member, or school board
- You interacted with research for your own learning

**Artifacts might include, but are not limited to a PowerPoint presentation that you used during a PD, an email to a colleague, a video you created, evaluation rubrics, curricular resources, etc.*
***If the artifacts have any identifiers on them (e.g., email addresses, names) please remove them prior to sharing them with me.*

The transcripts were the primary source of data used in the analysis. The other data sources (e.g., artifacts of practice, questionnaire responses) were used to inform each MDLs' interview and served as secondary data to clarify and contextualize the transcripts. The four transcripts were loaded into qualitative data analysis software and were coded using codebooks specific to each of the research sub-questions (e.g., research use, barriers to access, extent to which it is credible, definition). My unit of analysis for the data was a thematic unit (Rourke et

al., 2001) because as the participants talked about the ways in which they used and understood research, there were multiple nested ideas that could not be adequately captured by a talk turn.

Coding for Research Use

I began the coding process by operationalizing the various types of research use (Nutley et al., 2007; Tseng, 2012) identified in Table 2.1. The five theory-driven codes for research use were, *Instrumental*, *Conceptual*, *Symbolic*, *Imposed/Mandated*, and *Process*. I coded the four interview transcripts and queried the quotations for each code. I then used a two-way frequency table to calculate the number of codes per participant and recorded the frequency. I pulled a report for each code per participant and wrote an analytic memo for each. An example of the coding process for two of the MDLs for the Instrumental code is below (Table 3.1).

Table 3.1 Instrumental Research Use Quotations and Analytic Memo

Quotation	Analytic Memo
"I had, or have some schools that have been identified as not growing their EL population. So specifically, within their school improvement plans, they had to put strategies forth of how they were going to help ELs and support them. … So there was just a lot of decisions and conversation around how do we help students, our EL students in mathematics?" (17:4 Meredith)	Here is a rich example of Meredith being presented with a problem about not addressing the needs of the EL population in her district, so using the math language routines was in response to that problem.
Christine 11:54 - Yeah, so [name of professor] had hooked us up with him when we asked him like, Is there anybody that talks about this there in practicum classes or whatever? And he was like, actually, there is somebody that's doing some research on that right now. And so we had him just come talk….	Christine tells the story of how she reached out to someone she trusts at the university level (Name of professor) and was looking for a solution to a problem—addressing math anxiety in their district. *Interesting, Christine felt it would be more credible, have more weight, and believe it if an actual person

Paul 12:23 - So did I hear you say that this was kind of prompted by like, y'all wanting to address math anxiety, but just you wanted some expert knowledge to come in? Is that...?
Christine 12:32 - yes

came to talk rather than them reading an article about math anxiety.

Coding for Extent to Which Research is Credible, Barriers, and Definition

In answering my research sub-questions 1b, 1c, and 1d, I began by coding the transcripts using three broad categories based on the literature—*Barriers to Access*, *Extent to Which Research is Credible*, and *Definition*. The code category descriptions are in Table 3.2.

Table 3.2. Codebook Descriptions for Coding Barriers to Access, Extent to Which Research is Credible, Definition

Code Categories	Description
Barriers to Access	Coded anytime the MDLs described something as preventing them from engaging with or accessing research; Could also be the case that the MDL describes the absence of something either facilitating or impeding access to research. E.g., academic jargon, relevant to context; actionable; paid subscription; unsure of what counts as research; culture of research use or non-use; professional isolation
Extent to Which Research is Credible	The extent to which something is trustworthy or believable; may be explicitly or implicitly stated; Coded anytime an MDL says something increased or decreased their belief in what was being presented. E.g., aligns with their beliefs; supported by other research; hearing similar messages; done in actual classrooms; usefulness; data; etc.
Definition	Coded anytime an MDL says, "research is…."; coded when the MDL describes a characteristic or criteria that must be present for them to say something is research; will often occur after a prompt about defining research

After I identified all instances of Barriers to Access, Extent to Which Research is Credible, and Definition, I queried the quotations for each and downloaded the three reports. I then loaded them into a new file in the qualitative data analysis software.

I used a constant comparative method (Glaser, 1965; Corbin & Strauss, 2008) to open code for the Extent to Which Research is Credible and Barriers to Access. There were 23 and 21

initial codes respectively for the two codebooks. Examples of initial codes for the Extent to Which Research is Credible that were then collapsed into the pattern code, *Alignment* are shown in Table 3.3.

Table 3.3. Collapsing Extent to Which Research is Credible Initial Codes into the Pattern Code, Alignment

Initial Codes	Code Count	Analytic Memo per MDL	Example Quotation
Aligns with my Beliefs	5	**Leah -** Leah has a strong belief about what she considers to be good mathematics instruction; built on relationships. So when she is determining credibility, she looks to see the extent to which it matches that belief and considers research to be solid when it aligns. The research she shares with her teachers supports her belief that all students can learn. **Beth -** Beth has a belief that the way you go about teaching impacts the amount of learning that happens in the classroom.	"And then as I went in and read it, and looked into it, the research that they were quoting or, you know, using to support their work. It was solid to me, it was it.... I don't want to say it aligned to what I believe, but it aligns to what I believe." (Leah, 10:12)
Matches my classroom experiences	3	**Christine -** the things that the research is saying are things that Christine could imagine hearing kids say in her own context. **Leah -** The things that research is saying are important tend to match the things that Leah has found are important in her own work in the classroom. **Beth -** Beth does a lot of observations of teachers and the things that the research article was saying align with the things she sees when observing teachers.	**Christine 10:40 -** Right? Yeah. It's not just it's not a white paper telling me, "Here was the study and this happened." You know, it's like actual kids. And then the way they're answering it, you're like, "yep, that's what my kids would say."… **Paul 10:56 -** so it matched your experience? **Christine 10:57 -** Yeah, yeah, it was. Yeah, it was very approachable. (Christine, 6:23)
The context of	2	**Christine -** Christine works in a district that has a lot of different contexts in regard to resources,	"I need to see that they tried to go in an inner city, or they were in a rural area,

the research matched that of the MDLs' context	class sizes, rural, more urban, etc., so she looks at the context of the study to see if it addresses a lot of varied contexts. Christine is also looking heavily at the context to see if it applies to high school since that is where her work is situated.	or there were class sizes that were busting at the seams and here's class sizes that were 10. … I guess it's more so coming from the county that I'm in that our county is so diverse. And I feel like I need to see all those things." (Christine, 8:14)

Pattern Code	Code Count	Analytic Memo
Alignment	10	**Leah -** Leah has a strong belief about what she considers to be good mathematics instruction; built on relationships. So when she is determining credibility, she looks to see the extent to which it matches that belief and considers research to be solid when it aligns. The research she shares with her teachers supports her belief that all students can learn. The things that research is saying are important tend to match the things that Leah has found are important in her own work in the classroom. **Christine -** the things that the research is saying are things that Christine could imagine hearing kids say in her own context. Christine works in a district that has a lot of different contexts in regard to resources, class sizes, rural, more urban, etc., so she looks at the context of the study to see if it addresses a lot of varied contexts. Christine is also looking heavily at the context to see if it applies to high school since that is where her work is situated. **Beth -** Beth has a belief that the way you go about teaching impacts the amount of learning that happens in the classroom. Beth does a lot of observations of teachers and the things that the research article was saying align with the things she sees when observing teachers.

I wrote analytic memos (Corbin & Strauss, 2008) for each of the initial codes to capture the understanding of each MDL across all of their quotations tagged with the specific initial code. The codes were not mutually exclusive because it was possible for a quotation to receive multiple codes for *Extent to Which Research is Credible* and/or *Barriers to Access*. I then used a pattern coding process to group the 23 and 21 initial codes respectively into five and four broader pattern codes (Miles et al., 2020). An example of this process is in Table 4.3 in which three initial *Extent to Which Research is Credible* codes were collapsed into the broader pattern code, *Alignment*. I then wrote an analytic memo to capture the understanding of each MDL for the entire pattern code.

For the last report, *Definition*, I coded for each MDL rather than looking across the four of them because their definitions of research were the culmination of their past experiences and are unique to each of them. I pulled the quotations for each MDL within the *Definition* code report and wrote an analytic memo in response to their quotations. An example of this process is shown in Table 3.4.

Table 3.4. Sample Analytic Memo for the Definition Category

MDL	Analytic Memo	Example Quotations
Beth	One of the big defining features of educational research for Beth is that research cites other research. For Beth, educational research involves working with teachers and studying phenomena across multiple classrooms for the purpose of improving instruction.	"I would say a lot of times when I would look at it and see, references here tells me they went through and read a lot of stuff and work and put it all together to come up with the article." (Beth, 13:9) "and when I think of research, I think of...I think of them studying different classrooms studying different, you know, not just one classroom, but a bunch of different classrooms and, and thinking about the way things work and how all of them are similar, how it works, and what doesn't work and that kind of thing." (Beth, 13:10)

Paul 20:11 – Do you consider what Jo Boaler shares in her book to be research? Why or why not?
Beth 20:17 - Yeah, yes. … she uses a lot of different books and articles in the book itself, but also because she has done a lot of in person research herself, looking at multitudes of classrooms, working with teachers… (Beth, 14:8)

Phase Two Data Collection and Analysis

Phase two of data collection occurred during the MDLR Group meetings. It consisted of the MDLs' annotated articles, their annotation guides, Google Slides presentations, nine hours and 23 minutes of video recordings of the MDLR Group meetings, and the accompanying six transcripts—one for each meeting. The transcripts were the primary source of data used in the retrospective analysis. The other data sources were used during the ongoing analysis to inform the design of the meetings and guide the conversation within each meeting. They also served as secondary data in the retrospective analysis to clarify and contextualize the transcripts. In what follows, I share the processes for both the ongoing and retrospective analysis.

Ongoing Analysis

After each MDLR Group meeting, I reviewed the meeting recording and noted instances within the meeting that afforded or limited the MDLs' intersubjective meaning making in my conjecture log. I then used my conjecture log and evidence from the meeting recordings to iterate the design of the upcoming meeting to reflect my conjectures by selecting a new focal article, updating the annotation Appendix H.

Retrospective Analysis

The six transcripts were loaded into qualitative data analysis software and were coded in two cycles. In the first coding cycle, I started with a priori codes that were identified for each

individual MDL based on their initial interviews and then I open coded the transcripts using a constant comparative method (Glaser, 1965; Corbin & Strauss, 2008). This process yielded four codebooks—one for each MDL. I coded the contributions of each individual MDL because they each brought a set of experiences and beliefs that I wanted to capture in the coding process. Similar to the coding process done in Phase One, the unit of analysis was a thematic unit (Rourke et al., 2001) and codes were not mutually exclusive. The cumulative coding process was purposeful as it was meant to capture the revisions to each MDLs' understandings of educational research. This meant that the codebook for each MDL grew larger as new ideas surfaced over the six MDLR Group meetings.

Over the course of the meetings, there were 18 codes for Beth, 20 codes for Christine, 24 codes for Leah, and 20 for Meredith. Each of these codes were specific to the individual MDL; however, there were similarities across them. For example, each of the MDLs had a code, *[MDL Name - Citations]* that was assigned anytime an MDL talked about citations either within the focal article or more generally.

In the second coding cycle, I used a pattern coding process (Miles et al., 2020) to group the 82 initial codes into 21 broader categories that represented all four participants. This was done for the purpose of looking for patterns across the MDL cases (Miles et al., 2020) and as a data reduction technique. An example of the initial code reduction to a single pattern code is shown in Table 3.5 and illustrates how the initial codes for the four MDLs were collapsed into a single pattern code, *Methods*, that spanned all four individuals.

Table 3.5. Collapsing Initial Codes into the Pattern Code, Methods

Initial Codes	Meetings					
	Meeting 1	Meeting 2	Meeting 3	Meeting 4	Meeting 5	Meeting 6
[Christine – Methods]	0	4	0	4	N/A	1

[Leah – Methods]	N/A	1	1	N/A	1	3
[Beth – Methods]	0	0	2	3	0	1
[Meredith – Methods]	2	4	9	8	4	2
[Leah – Systematic]	N/A	0	2	N/A	1	3
			Pattern Code			
Methods	2	9	14	15	6	10

Note. N/A means that the MDL was absent during a given meeting.

Ten of the initial 82 codes did not fit within the 21 pattern codes and only had a few occurrences across all four participants. These codes were dropped from the data analysis for a lack of sufficient data.

I then queried the pattern codes and downloaded the report for each. I read through each of the reports and documented the number of code occurrences for each pattern code per meeting because I wanted to document the change in the number of codes over time. For example, in Table 3.5 above, the *Methods* pattern code was much more prevalent in Meetings 3 and 4 when compared with Meeting 1 which can be explained by the lack of methods in the Meeting 3 focal article and the explicit detail given to the methods in the focal article for Meeting 4.

Using my theoretical framework of looking for revisions to their understandings of research after engaging in intersubjective meaning making (Maitlis & Christianson, 2014). I wrote analytic memos for each pattern code for each meeting (e.g., Methods for Meeting 1) (See Table 3.6 for an example).

Table 3.6. Analytic Memo for the Methods Pattern Code for Each Meeting

Meeting	Focal Article	Memo
Meeting 1	Jung & Brady (2020)	Meredith only; a process to collect data; what was the process to analyze data?
Meeting 2	Rehn et al. (2018)	Christine, Leah, Meredith; Methods in general, different ones; a process for collecting data; using data to answer a question; what was the method? Wanting specific info and details about what happened; ethical and moral issues about data collection (in response to the design)

Meeting 3	Morge et al. (2020)	Meredith, Beth, Leah; SYSTEMATIC shows up and seems to be a landmark event; can the research be DUPLICATED; what did the authors do? a way of collecting and analyzing data; The design was such that the methods were not present in the article

I then created an analytic memo for each pattern code across Meetings 1-6 (see Figure 3.2 for an example) and looked for revised understandings within the MDLs' quotations for each pattern code over the six meetings.

Figure 3.2. Analytic Memo for the Methods Pattern Code Across All Meetings

Over the 6 meetings, we see methods get taken up by all of the participants in varying ways. Meredith started the conversation in Meeting 1 and the other MDLs took it up over the next 5 meetings. In Meeting 3 there is a shift in the way methods get talked about; the idea, "systematic" and "duplicated" show up to describe a need for methods to be present in an article in enough detail so that the reader knows what the authors did and could repeat the process. In meeting 4, the article had a defined "Methods" section which seemed to be much appreciated by the MDLs and became a part of their eval tool. Christine began to raise the issue of does methods belong with definition or credibility. She is the only MDL to really take this idea up. In meeting 5, Leah tried to impose the word organized rather than systematic just as a way to make sense of the methods, making sure that it was clear; however, this word switch did not get taken up. In meeting 6, it seems to be that systematic methods paired with the descriptor, "authentic" are now a subset of the word, "Methodology" which means to the MDLS that there was a thorough description of the methods which involve the collection and analysis of novel data.

Assessing Research Quality

One of the hallmarks of high quality research is the extent to which it is valid and reliable. Different paradigms (e.g., quantitative, qualitative, design research) have different terms for describing the extent to which a study is valid and reliable. Quantitative studies privilege internal and external validity while qualitative research uses terms like credibility and transferability. Although there are paradigmatic distinctions between the terms, at their core the terms refer to the extent to which an individual can trust the process by which someone conducts a study (internal validity) and the extent to which the findings of a study apply to other contexts (external validity). DBR studies tend to use the terms *replicability* and *trustworthiness* when

describing research quality. In what follows, I share how I attended to both of these criteria during the design and implementation of this dissertation study.

This DBR study was guided by five overarching design principles that guided my work throughout the study. In terms of replicability, these principles were not created to provide a script for others to follow, but rather my intention was to allow for others to take up the main ideas and have the flexibility to adapt my intervention to fit their contexts (Bakker, 2018).

A prime example is the content of the MDLR Group discussions being focused on online learning. For other designers taking up this intervention, online learning was a specific need of the MDLs of this study and I would go as far to say, the focus on online learning is inconsequential. The focus of this intervention could have easily been done on some other topic that is important to the participants. Thus, for other designers looking to replicate this study I would encourage them to adapt the intervention accordingly but keep the five design principles central to their adaptations.

In terms of trustworthiness, I member-checked throughout the study. During the meetings, I would use questioning strategies such as, “Leah, I heard you say…., did I understand that correctly?” or “Meredith, when you said…, did you mean…?” Outside of the meetings, I emailed the participants to clarify their annotations or responses to the annotations guides when they were unclear. For example, the MDLs would fill out the reflection tool for each focal article and designate the article as research, based on research, or advice. Sometimes the MDLs would leave a part of the reflection tool blank. When this happened I would email for clarification.

During my data analysis, I would have regular conversations with another mathematics education researcher about the interpretations of what I saw in the data. These conversations involved sharing data from transcripts and discussing the data analysis process to ensure that I

was accurately representing the data. Additionally, the meetings were digitally and audio recorded to ensure that I accurately captured what was being said during the meetings.

Stance of the Researcher

This dissertation study is heavily rooted in the design-based tradition (Cobb et al., 2003) and was influenced by previous research that emphasizes the benefits of researching in collaboration with participants (e.g., Cobb, 2000; Coburn & Penuel, 2016). The design of this study is such that I, the researcher and designer of the intervention, am an *observer as participant* (Adler & Adler, 1998; Merriam & Tisdell, 2016) of the MDLR Group. Assuming such a peripheral role means my design and participation choices impact the MDLs' opportunities for sensemaking within the MDLR group. Because of that, it is necessary that I claim my positionality and make my definition of educational research explicit. More specifically, my design choices, either implicitly or explicitly have been influenced by my positionality, subjectivity, and personal definition of educational research. I would be remiss if I did not make my position transparent for myself and for future research because it is a strength of this research—a necessary component in a compelling story of one way to build the capacity of four mathematics district leaders to engage with educational research.

At the core of who I am, I consider myself to be a mathematics educator who recently left the 9-12 setting to embark on a journey through graduate courses and research opportunities to become a full participant in the mathematics education research community. At the start of this journey, I considered myself to be a mathematics practitioner. However, through my experiences in Academia, I found myself on the periphery of my former practitioner community and a full participant of the research one. I have spent the past six years immersed in academic research culture, reading, engaging with, conducting, and evaluating educational research. The culmination of these experiences has led me to conceptualize research that includes both

empirical and theoretical perspectives; however, for this dissertation study I purposefully chose to privilege empirical research because of its utility for working with my MDL participants. As put forth by Penuel and colleagues at the National Center for Research in Policy and Practice (NCRPP, 2016), research is “an activity in which people employ systematic, empirical methods to answer a specific question. Research bases its conclusions in investigations involving statistical data, interviews, observations, and case studies, or a combination of these" (p.3). This definition of research helped guide my design choices as I helped the MDLs distinguish between research and non-research.

In particular, I wanted to make the point that research is done in service of answering a question. Research should expand the existing knowledge base by asking a question for which the answer is unknown and then using a systematic process of data collection guided by theory and/or prior research to find an answer to one’s question empirically. The standard by which this process is measured varies with one’s paradigm; however, the National Research Council ([NRC], Shavelson & Towne, 2002) has put forth six markers of quality that I rely on heavily when determining if a piece of research is actually research (see Figure 2.1). In addition to these six markers of quality, I add one more pertaining to the issue of research needing to be relevant to educational practice or policy (Gutiérrez & Penuel, 2014). My rationale for including this additional marker of quality is that this dissertation study is focused on building the capacity of MDLs to engage with research. Inherent in that goal is utility for practitioners. In my problem statement I mentioned how today’s mathematics classrooms are not too far removed from those of old; thus, I believe research needs to be relevant to the work of practitioners if it stands a chance at being put into practice.

CHAPTER IV: WHAT IS EDUCATIONAL RESEARCH? THE CONCEPTUALIZATIONS OF FOUR MATHEMATICS DISTRICT LEADERS

Abstract: Practitioners, and more specifically, district-level leaders are required by national and state-level policy (e.g., Every Student Succeeds Act) to use educational research to inform their decisions and the work they do with teachers. This is challenging for a variety of reasons commonly attributed to the Research to Practice Gap. Using a basic qualitative research design (Merriam & Tisdell, 2016), I interviewed four mathematics district leaders (MDLs) using a stimulated-recall technique and analyzed their interview transcripts to understand better the ways in which they use and evaluate research, the barriers that impede their access, and how these facets dictate their definitions. Findings indicated that MDLs' conceptualizations of research are varied. They tend to describe research in terms of their past experiences and beliefs which serve as a lens by which they find research credible. Additionally, there are a number of different barriers that prevent them from accessing and using research. Implications for researchers focused on improving practitioners' engagement with research are discussed.

Introduction

The disconnect between research and practice is a well-known problem in education that has plagued practitioners and researchers for years (Korthagen, 2007; Silver & Lunsford, 2017; Vanderlinde & van Braak, 2010). In a world where the Research to Practice Gap did not exist, there would be a bi-directional flow of information between researchers and practitioners. Unfortunately, it is rare for such an exchange to flow freely as the Research to Practice Gap is littered with obstacles that perpetuate a blockade between researchers and practitioners (Hemsley-Brown & Sharp, 2003). This is problematic for many reasons, but a more pressing problem is that the No Child Left Behind Act (NCLB; 2002) and its subsequent legislation (e.g.,

Every Student Succeeds Act, ESSA, 2015), have put considerable pressure on practitioners to use research that has proven to be effective (U.S. Dept. of Education, 2004).

Requiring research use to inform decisions seems straightforward; however, NCLB was plagued by narrow definitions of what constitutes effectiveness which made it difficult for practitioners to find and use research (Yoshizawa, 2020). ESSA (2015) improved upon the limitations of NCLB by creating tiered levels of evidence—strong, moderate, promising, and under evaluation—that allowed more flexibility for practitioners to identify what works (REL Midwest, 2019). One of the problems that have arisen from ESSA (2015) is that decision makers within districts need to be able to make sense of research and evidence, but their pedigrees are often practitioner oriented and less focused on research (Gore & Gitlin, 2004; Korthagen et al., 2006). Thus, applying research to one's practice is considerably more difficult than it seems (Spillane et al., 2002) as those tasked with enforcing the policy have had limited experiences with research and have been forced to do the best they can with the resources available. This may be one of the reasons that ESSA (2015) has fallen short of its goals; practitioners have been mandated to use research and evidence to support their decisions, yet the support needed to do so is limited.

Within school districts, the burden of ensuring compliance with ESSA and supporting decisions with evidence often falls on the shoulders of superintendents, school boards, and other central office administrators who put forth mandates and create local policy (Coburn & Talbert, 2006). A number of studies that have looked at the ways in which these decision makers have put such requirements into action (e.g., Coburn et al., 2009; Coburn & Talbert, 2006; Daly et al., 2014). These studies have been helpful for understanding the decision-making process. However, it is the formal and informal district-level leaders that operate under these decision makers who

really wield influence (Wilson et al., 2018). These mid-level influencers (e.g., mathematics district leaders, instructional coaches, lead teachers) are key nodes within the professional networks of school districts for introducing new ideas. As such, their interpretation and understanding of research gets privileged as they operate under the microscope of high-stakes accountability models and attempt to meet the demands of national, state, and local policy. Herein lies the problem. Mid-level influencers are required to use research, research-based and/or evidence-based materials, and make data-driven decisions to ensure that multi-level policy requirements are being met; however, they typically have few experiences engaging with research leaving them to primarily draw from their practitioner expertise.

In surveying the literature, there has been a considerable amount of work done trying to understand the conceptualizations held broadly by practitioners (e.g., teachers, district leaders, social workers, central office administrators, principals; Nicholson-Goodman & Gorman, 2007; Palinkas et al., 2016; Vanderlinde & van Braak, 2010). However, only few studies have specifically looked at mid-level influencers in the domain of mathematics (Penuel et al., 2018). For the purpose of this study, I refer to these mid-level influencers as mathematics district leaders (MDLs) who—by either formal or informal designation—develop, implement, and influence district policy (Spillane, 2000). Given the paucity of the literature specific to MDLs, this study aims to contribute by answering the following research question and sub-questions:

1. *What are mathematics district leaders' conceptualizations of educational research?*
    a. *How do MDLs use research in their local district contexts?*
    b. *What are the barriers that prevent MDLs from using research?*
    c. *What are the criteria that MDLs use to determine if research is credible?*
    d. *What are MDLs' definitions of research?*

Literature Review

Much research has been conducted for the purpose of understanding the ways in which practitioners make sense of and use research; however, very little research has been done with MDLs specifically. In my review of the literature, Penuel and colleagues (2018) conducted one of the few studies that looked specifically at MDLs. This study is in response to their call to action that called for a "more nuanced understanding of the differences between leaders' conceptions of research evidence and researchers' conceptions identified in earlier research" (Penuel et al., 2018, p.557). Because of the lack of literature that focuses specifically on MDLs' understanding and use of research, I share practitioners' conceptions more generally as MDLs are a subset of this population. Here I present the literature on how practitioners use research, the barriers that prevent them from using it, how they determine research to be credible, and how multiple stakeholders within education define research.

Research is Used in a Variety of Ways

Much research has been done to understand and reduce the gap between research and practice (e.g., Nutley et al., 2007). A common perspective among these studies is that engaging with and using research is a social process heavily rooted in relationships (Amara et al., 2004; Nelson et al., 2009; Tseng, 2012). A number of researchers have tried to capitalize on the social nature of research engagement and use by recommending that practitioners need opportunities to develop trusting relationships (Kochanek & Clifford, 2014; Nelson et al., 2009), use intermediaries to locate, sort, and prioritize research (Nelson et al., 2009), be afforded opportunities to translate research into practice (Penuel & Coburn, 2014), and do so through sustained and intense interactions (Amara et al., 2004). One of the common threads across these various recommendations is the use of research. Using research is not a straightforward process

as a number of researchers have identified uses of research that extend beyond prototypical images of research in which an individual is presented with a problem and turns to a specific piece or collection of research to find a solution (e.g., Nutley et al., 2007; Rickinson, 2005; Tseng, 2012). The different types of research use are shown in Table 4.1.

Table 4.1. Types of Research Use

Type of Use	Description
Instrumental	An individual uses a specific piece of research to inform a yet to be made decision
Conceptual	Research changes an individual's perspective about an issue or problem; often indirect and hard to track to a specific piece of research
Symbolic	An individual makes a decision, then uses research after the fact to support the decision
Imposed	Funding is contingent upon the use of a piece of research
Mandated	An individual is forced to use a specific piece of research or take a particular course of action
Process	An individual actively participates in producing research

As shown in Table 4.1, the various types of research use are helpful for beginning to understand the complexity surrounding practitioners' conceptualizations of research; however, using research is just one facet of a complex problem. To get a comprehensive view of the other facets, it is imperative to understand the many influences that dictate the ways in which practitioners are denied access to research, what makes it credible, and how they define it.

Factors that Influence Practitioners' Use of Research

There are many factors that influence the extent to which research is understood and taken up. One of the most common is a lack of access to research. Research is often locked behind paid subscriptions to databases or journals, thus making it cost prohibitive (Behrstock et al., 2009). Research is also inaccessible due to the language in which it is written. When practitioners engage with research they often have to read lengthy and dense articles littered with

academic jargon (Fusarelli, 2008; Gore & Gitlin, 2004; Hemsley-Brown & Sharp, 2003; Nelson et al., 2009; Nutley et al., 2007; Rickinson, 2005; Sin, 2008; Rickinson, 2005; Shkedi, 1998). Taken together, a lack of these various forms of access severely restricts the extent to which practitioners can even begin to engage with research.

Another factor that influences how research is taken up and understood is the extent to which practitioners believe what research says. Practitioners tend to have a set of criteria for evaluating research that is very different from that of researchers. These criteria include the actual content of the piece of research (Honig & Coburn, 2008; Silver & Lunsford, 2017), the source from which one receives it (Behrstock et al., 2009; Gore & Gitlin, 2004; Honig & Coburn, 2008; Nutley et al., 2007), and the extent to which the research matches their personal experience (Zeuli, 1994). Research that aligns with one's beliefs tends to be taken up more frequently (Honig & Coburn, 2008), while research that does not is discounted (Coburn et al., 2009).

Practitioners also look at the extent to which research is appropriate, worthwhile, and about issues relevant to them (Behrstock et al., 2009; Coburn et al., 2009; Gore & Gitlin, 2004; Shkedi, 1998; Zeuli, 1994). A common belief among practitioners is that research is done in contexts that do not match reality (Shkedi, 1998), is unhelpful (Gore & Gitlin, 2004), and is undeserving of merit for lack of classroom applicability (Hemsley-Brown & Sharp, 2003). Such beliefs are understandable given the context in which practitioners work; they see their individual classrooms as unique. Unless the context of a piece of research matches their own, the research recommendations may not apply (Cain, 2017; Gore & Gitlin, 2004). Collectively, the perception that research is not relevant may offer an explanation as to why practitioners turn to

other sources for information (e.g., colleagues, peers) before looking to research (Behrstock et al., 2009; Honig & Coburn, 2008).

The last factor, one's role and context, is systemic and dictates practitioners' use and conceptualizations of research. Within the literature, many practitioners report not having time to engage with research because the of the way in which the school day is structured (Behrstock et al., 2009; Cain, 2017; Hemsley-Brown & Sharp, 2003; Nelson et al., 2009; Nutley et al., 2007). They often work in isolation from their peers because of the highly compartmentalized nature of schools (Labaree, 2003; Coburn & Talbert, 2006; McIntyre, 2005) and districts, thus making collaboration challenging. Implicit within these infrastructures is an epistemological stance that devalues research and privileges practitioner experience and knowledge (Behrstock et al., 2009; Cain, 2017; Coburn & Talbert, 2006; Fusarelli, 2008; Gore & Gitlin, 2004; Graves & Moore, 2018; Hemsley-Brown & Sharp, 2003; Honig & Coburn, 2008; Nelson et al., 2009; Nutley et al., 2007; Silver & Lunsford, 2017; Tseng, 2012; Vanderlinde & van Braak, 2010). Such a perspective has bred research skepticism among practitioners and deficit views from researchers about practitioners' lack of research uptake.

Defining Research

The word *research* means vastly different things depending on one's role and context. In one's everyday language, research is frequently used to describe a search for information on an internet search engine. Within academia, researchers tend to have a much different definition of research that tends to involve the process of employing "systematic, empirical methods to answer a specific question" (NCRPP, 2016, p. 3). Both of these definitions are much broader than those used within the context of federal policy (e.g., ESSA) and governmental agencies (e.g., Institute of Education Sciences, What Works Clearinghouse) who define research narrowly to only

include studies that employ quantitative methodologies (e.g., randomized control trials, quasi experimental studies). Practitioners, on the other hand, tend to have much broader definitions of what counts as educational research (e.g., student achievement data, practitioner knowledge, testimony from experts; Honig & Coburn, 2008). One of the issues that arises from having a one-to-many relationship in which the word, research pairs to many different definitions is that it is difficult to come to a shared understanding of what constitutes research when people come from different contexts.

When conducting research about the ways in which practitioners make sense of and understand research, researchers typically will either ask the participants to define research in their own words (e.g., Gore & Gitlin, 2004), or they will provide a definition for their participants (e.g., Penuel et al., 2018). Both approaches to understanding practitioners' use of research have their strengths and weaknesses; however, one of the limitations that accompanies providing a definition is that the researcher privileges their understanding of research with the assumption that the practitioner participants will adopt the definition as their own. This was the case in Penuel and colleagues' (2018) study in which they surveyed MDLs about their use of research. As they called attention to in their limitations, this potentially means that there may be other things that MDLs consider to be research that were not captured, and as such, this study aims to get a more robust understanding of the conceptualizations of MDLs by looking at the ways in which they define and use research within their contexts.

Methods

This study is situated within a more extensive dissertation study focused on building the capacity of MDLs to engage with and promote healthy skepticism of research. Participants were four MDLs from four different geographic regions from across one southeastern U.S. state. These participants were selected based on the criteria that they worked as an MDL (e.g.,

mathematics district supervisor, mathematics instructional coach) in a public school district and their district gave them permission to participate in the study. For this study, each of the participants were asked to complete an initial questionnaire (Appendix C). The questionnaire that asked them to provide demographic information and describe their experiences with research (e.g., what makes research credible and/or trustworthy, where they search for it) through short answer and multiple selection style questions. These questions had been used previously in pilot work on a statewide survey of mathematics practitioners in the state and were adapted from an existing survey instrument focused on research use (NCRPP, 2016).

Following the questionnaire, the MDLs were asked to submit three artifacts of instances in which they had used research in their role (Appendix D). As can be seen in Figure 4.1 below, the word *research* was purposefully left undefined for the MDLs so that they would provide artifacts that met their criteria for research. As such, the artifacts shared by the MDLs may or may not fit the canonical view of research held by researchers. After the MDLs completed the questionnaire and submitted their artifacts, they participated in a semi-structured interview that used an adapted stimulated recall technique (Vesterinen et al., 2010) (Appendix E) to get each participant to elaborate on their responses to the questionnaire and the artifacts they submitted. Each interview was conducted virtually on a video conference platform and lasted an average of 51 minutes. The interviews were recorded and transcribed using an online transcription service. They were then manually cleaned up to get a verbatim transcript. The specific instructions for the three artifacts provided to participants are shown in Figure 4.1.

Figure 4.1. Instructions for providing three artifacts of research use

MDLs use research in a variety of different ways within school contexts as they interact with teachers, schools, parents, communities, and district-level administrators. In an effort to understand how MDLs use research within these interactions, I am asking that you provide three artifacts from your practice that are supported by

research. More specifically, please provide one artifact from each of the categories listed below:

Provide an artifact supported by research (pick 3 from 4 options) that represents an instance in
which…

- You were interacting with teachers
- You were making decisions at the school or district level
- You were interacting with a parent, community member, or school board
- You interacted with research for your own learning

**Artifacts might include, but are not limited to a PowerPoint presentation that you used during a PD, an email to a colleague, a video you created, evaluation rubrics, curricular resources, etc.*
***If the artifacts have any identifiers on them (e.g., email addresses, names) please remove them prior to sharing them with me.*

Prior to the interview with each participant, I reviewed their questionnaire responses and artifacts for the purpose of tailoring the interview protocol to the specific details of each MDL. A total of four interviews were conducted, one with each participant.

Participants

This dissertation study was a consequence of a larger statewide partnership between researchers and practitioners that in recent years had worked to jointly improve access to research. Drawing from professional contacts from that partnership, I recruited four MDL participants from four geographic regions from across one southeastern U.S. state. All participants were formally appointed MDLs who are in charge of "developing and implementing district-level policies" (Spillane, 2000, p.142) within the mathematics domain. Their demographic information is shared in Table 4.2. All participants' names are pseudonyms.

Table 4.2. Demographic Information for the Four MDL Participants

Name	Title	Geographic Region & Description	Number of Students and schools in the District	Years of Experience in Role	Degree(s)
Christine	9-12 Math Instructional Coach	Region 3 - Suburban	~20,000 students across 41 schools	Less than 10 years	Undergraduate degree in secondary mathematics education
Meredith	9-12 Math Instructional Coach	Region 4 - Suburban	~25,000 students across 45 schools	Less than 10 years	Undergraduate degree in secondary mathematics education; master's degree in secondary mathematics education; master's degree in school administration
Leah	K-12 Math/Science District Supervisor	Region 1 - Rural	~8000 students across 18 schools	20 years	Undergraduate degree in middle grades education; master's degree in school administration
Beth	K-12 Math District Supervisor	Region 2 - Rural	~22,000 students across 36 schools	Less than 10 years	Undergraduate degree in secondary mathematics education; master's degree in educational leadership

Data Analysis

The transcripts were the primary source of data used in the analysis. The other data sources (e.g., artifacts of practice, questionnaire responses) were used to inform each MDLs'

interview and served as secondary data to clarify and contextualize the transcripts. The four transcripts were loaded into qualitative data analysis software and were coded using codebooks specific to the research sub-questions.

Coding for Research Use

In answering research sub-question 1a, I coded the transcripts for the various types of research (Nutley et al., 2007, Tseng, 2012) use identified in Table 2.1. I used a thematic unit (Rourke et al., 2001) as my unit of analysis for the data because, as the participants talked about the ways in which they used and understood research, there were multiple nested ideas that could not be adequately captured by a talk turn.

I first coded the transcripts for research use using the five codes, Instrumental, Conceptual, Symbolic, Imposed/Mandated, and Process, and then queried the quotations for each code. I then used a two-way frequency table to juxtapose participant and type of research use to determine the frequency of type of research use per MDL. I then pulled a report for each cell within the two-way frequency table and wrote analytic memos for each. An example of the instrumental coding process for two of the MDLs is below (Table 4.3).

Table 4.3. Instrumental Research Use Quotations and Analytic Memo

Quotation	Analytic Memo
"I had, or have some schools that have been identified as not growing their EL population. So specifically, within their school improvement plans, they had to put strategies forth of how they were going to help ELs and support them. … So there was just a lot of decisions and conversation around how do we help students, our EL students in mathematics?" (17:4 Meredith)	Here is a rich example of Meredith being presented with a problem about not addressing the needs of the EL population in her district, so using the math language routines was in response to that problem.
Christine 11:54 - Yeah, so [name of professor] had hooked us up with him when we asked him like, Is there anybody that talks about this there in practicum classes or whatever? And he was like, actually, there is somebody	Christine is telling the story of how she reached out to someone she trusts at the university level (Name of professor) and was looking for a solution to a

that's doing some research on that right now. And so we had him just come talk…. **Paul 12:23 -** So did I hear you say that this was kind of prompted by like, y'all wanting to address math anxiety, but just you wanted some expert knowledge to come in? Is that...? **Christine 12:32 -** yes	problem--addressing math anxiety in their district. *Interesting, Christine felt as though it would be more credible, have more weight, and believe it if an actual person came to talk rather than them reading an article about math anxiety.

For each quotation, I would write a brief analytic memo that captured the content of what the MDL shared and add my thoughts/interpretations of what they shared.

Coding for Extent to Which Research is Credible, Barriers, and Definition

In answering my research sub-questions 1b, 1c, and 1d, I coded the transcripts using three broad categories based on the literature—Barriers to Access, Extent to Which Research is Credible, and Definition. Similar to the coding done for *Research Use*, my unit of analysis was a thematic unit (Rourke et al., 2001) (see Table 4.4 for code descriptions). I then queried the quotations for each code and loaded the reports into a new file within the qualitative data analysis software.

Table 4.4. Codebook Descriptions for Coding Barriers to Access, Extent to Which Research is Credible, Definition

Code Categories	Description
Barriers to Access	Coded anytime the MDLs described something as preventing them from engaging with or accessing research; Could also be the case that the MDL describes the absence of something either facilitating or impeding access to research. E.g., academic jargon, relevance to context, actionable, paid subscription, unsure of what counts as research; culture of research use or non-use, professional isolation
Extent to Which Research is Credible	The extent to which something is trustworthy or believable; may be explicitly or implicitly stated; Coded anytime an MDL says something increased or decreased their belief in what was being presented. E.g., aligns with their beliefs; supported by

	other research; hearing similar messages; done in actual classrooms; usefulness; data; etc.
Definition	Coded anytime an MDL is saying, “research is….”; coded when the MDL is describing a characteristic or criteria that must be present for them to say something is research; will often occur after a prompt about defining research

A constant comparative method (Glaser, 1965; Corbin & Strauss, 2008) was used to open code the Extent to Which Research is Credible and Barriers to Access reports. There were 30 and 21 initial codes respectively for the Extent to Which Research is Credible and Barriers to Access codebooks; seven of the 30 Extent to Which Research is Credible codes were removed for lack of sufficient data, thus, leaving 23 and 21 initial codes. Examples of initial codes for the Extent to Which Research is Credible that were then collapsed into the pattern code, Alignment are shown in Table 4.5.

Table 4.5. Collapsing Extent to Which Research is Credible Initial Codes into the Pattern Code, Alignment

Initial Codes	Code Count	Analytic Memo per MDL	Example Quotation
Aligns with my Beliefs	5	**Leah -** Leah has a strong belief about what she considers to be good mathematics instruction; built on relationships. So when she is determining credibility, she looks to see the extent to which it matches that belief and considers research to be solid when it aligns. The research she shares with her teachers supports her belief that all students can learn. **Beth -** Beth has a belief that the way you go about teaching impacts the amount of learning that happens in the classroom.	"And then as I went in and read it, and looked into it, the research that they were quoting or, you know, using to support their work. It was solid to me, it was it.... I don't want to say it aligned to what I believe, but it aligns to what I believe." (Leah, 10:12)
Matches my classroom experiences	3	**Christine -** the things that the research is saying are things that Christine could imagine hearing kids say in her own context. **Leah -** The things that research is saying are important tend to match the things that Leah has found are important in her own work in the classroom. **Beth -** Beth does a lot of observations of teachers and the things that the research article was saying align with the things she sees when observing teachers.	**Christine 10:40 -** Right? Yeah. It's not just it's not a white paper telling me, "Here was the study and this happened." You know, it's like actual kids. And then the way they're answering it, you're like, "yep, that's what my kids would say."… **Paul 10:56 -** so it matched your experience? **Christine 10:57 -** Yeah, yeah, it was. Yeah, it was very approachable. (Christine, 6:23)
The context of the research matched	2	**Christine -** Christine works in a district that has a lot of different contexts in regard to resources, class sizes, rural, more urban, etc., so she looks at the context of the study to see if it addresses a lot of varied contexts. Christine is also	"I need to see that they tried to go in an inner city, or they were in a rural area, or there were class sizes that were busting at the seams and here's class sizes that were 10. … I

that of the MDLs' context		looking heavily at the context to see if it applies to high school since that is where her work is situated.	guess it's more so coming from the county that I'm in that our county is so diverse. And I feel like I need to see all those things." (Christine, 8:14)

Pattern Code	Code Count	Analytic Memo
Alignment	10	**Leah -** Leah has a strong belief about what she considers to be good mathematics instruction; built on relationships. So when she is determining credibility, she looks to see the extent to which it matches that belief and considers research to be solid when it aligns. The research she shares with her teachers supports her belief that all students can learn. The things that research is saying are important tend to match the things that Leah has found are important in her own work in the classroom. **Christine -** the things that the research is saying are things that Christine could imagine hearing kids say in her own context. Christine works in a district that has a lot of different contexts in regard to resources, class sizes, rural, more urban, etc., so she looks at the context of the study to see if it addresses a lot of varied contexts. Christine is also looking heavily at the context to see if it applies to high school since that is where her work is situated. **Beth -** Beth has a belief that the way you go about teaching impacts the amount of learning that happens in the classroom. Beth does a lot of observations of teachers and the things that the research article was saying align with the things she sees when observing teachers.

As can be seen above, I wrote an analytic memo for each initial code that captured the understanding of each MDL across all of their quotations tagged with the specific initial code. It was possible for the quotations within each category to receive multiple codes as some quotations had more than one instance of Extent to Which Research is Credible or Barriers to Access. I then used a pattern coding process to group the 23 and 21 initial codes respectively into five and four broader pattern codes (Miles et al., 2020). An example of this process is in Table 4.5 in which three initial Extent to Which Research is Credible codes were collapsed into the broader pattern code, Alignment. I then wrote an analytic memo to capture the understanding of each MDL within the pattern code.

The data analysis for the Definition category was different in the sense that I coded for the individual MDL rather than looking across the four of them. The MDLs' definitions of research are the culmination of their past experiences and are unique to each of them. As such, I marked the instances in the Definition report in which each MDL talked about their definition of research and then wrote an analytic memo in response to their quotations. An example of this process is shown in Table 4.6.

Table 4.6. Sample Analytic Memo for the Definition Category

MDL	Analytic Memo	Example Quotations
Beth	One of the big defining features of educational research for Beth is that research cites other research. For Beth, educational research involves working with teachers and studying phenomena across multiple classrooms for the purpose of improving instruction.	"I would say a lot of times when I would look at it and see, references here tells me they went through and read a lot of stuff and work and put it all together to come up with the article." (Beth, 13:9) "and when I think of research, I think of...I think of them studying different classrooms studying different, you know, not just one classroom, but a bunch of different classrooms and, and thinking about the way things work and how all of them are similar, how it works, and what doesn't work and that kind of thing." (Beth, 13:10)

Paul 20:11 – Do you consider what Jo Boaler shares in her book to be research? Why or why not?
Beth 20:17 - Yeah, yes. … she uses a lot of different books and articles in the book itself, but also because she has done a lot of in person research herself, looking at multitudes of classrooms, working with teachers… (Beth, 14:8)

Findings

Here I present the findings from my analysis of the data with respect to the research question, "What are MDLs' conceptualizations of educational research?" and the accompanying sub-questions focused on Barriers to Access, the Extent to Which Research is Credible, and Defining Research. As was stated in Chapter I, use of the words *credible* and *relevant* are from the perspective of the MDL participants and reflect their judgment of research rather than an inherent quality of the research itself. The order of the findings presentation is purposeful as MDLs' conceptualizations necessarily were situated within a practitioner paradigm of taking action. I begin by presenting the ways in which the MDLs used research, and how their conceptions of research were colored by barriers that prevented access, and by their notions of what makes research credible. I conclude this section by sharing the definitions of research for each MDL.

How MDLs Use Research

Across the MDLs, they provided a number of examples in which they had used research in various capacities within their role and context. Although there were a few exceptions, the MDLs primarily used research in three ways, instrumental, mandated, and symbolic. Instrumental use of research was common across all four MDLs; however, the other two most common uses were role-specific. As shown in Table 4.7 below, the two mathematics

instructional coaches accounted for all but one instance of mandated use and the two K-12 district leaders accounted for all instances of symbolic use.

Table 4.7. Number for Instances of Research Use per MDL

MDL	Types of Research Use				
	Instrumental	Mandated	Symbolic	Conceptual	Process
			Mathematics Instructional Coaches		
Christine	3	4	0	0	0
Meredith	5	4	0	1	1
			District Level Mathematics Supervisors		
Leah	8	1	8	0	0
Beth	3	0	1	0	0
			Total		
	19	9	9	1	1

Instrumental Use of Research

Instrumental uses of research were the most prevalent type of use. Within instrumental use, the MDLs tended to do so in three different ways. The first of which was in service of helping the teachers they serve (n=7). An example of such instrumental use was when Beth recognized a problem among her K-3 teachers—they were less confident in their ability to teach mathematics compared to other subjects. In response, she turned to an article she designated as a piece of research, *Fostering Mathematical Thinking and Problem Solving: The Teacher's Role* (Rigelman, 2007), and developed a professional development around it. In talking about her purpose for using the article, Beth said, "we wanted to try to help our teachers.... give them some activities and strategies that they could use immediately that work" (13:4 CB 10:58). Beth went on to say that the two vignettes within the article helped her address the problem she was seeing in her district.

Christine also used research in instrumental ways to help the teachers she serves improve their practice. She talked about how her district had been struggling with promoting vertical

collaboration across grade levels and turned to an expert researcher who researched the importance of vertical collaboration. Based on what Christine learned from the researcher, she said, “this is what we're going to do with our teachers. We need to show them why it's so important to collaborate vertically, and why there's a need for it in our county” (5:2 Christine 02:29). In both of these examples, the MDLs shared instances in which they used research in instrumental ways to help make informed decisions about how to help their teachers improve. Such instrumental use of research was common for the MDLs as they sought out specific resources and materials to help their teachers.

Another common instrumental use of research by the MDLs was when they turned to research to inform decisions (n=6). A prime example was when Meredith talked about how she had become familiar with the Mathematical Language Routines (Zwiers et al., 2017) through her work improving the performance of English Learners (EL) on the Math End-of-Course tests in her district. In talking about the problem, Meredith said, “So there was just a lot of decisions and conversations around, ‘How do we help our EL students in mathematics?’” (17:4 Meredith). The solution that Meredith and her fellow mathematics instructional coaches came up with was to use the Mathematical Language Routines (Zwiers et al., 2017) to design and implement professional development where “teachers could learn each routine, practice it in their classroom, get some feedback on that, and hopefully make it part of their regular practice” (Meredith 18:16). For Meredith, the research on Mathematical Language Routines was a solution to her problem of helping EL students improve their academic performance.

The other way in which MDLs instrumentally used research was when they wanted to expand their knowledge base (n=5). In talking about her Artifact #1, Meredith described her personal journey for making sense of one of the Mathematical Teaching Practices presented in

NCTM's publication, *Principles to Actions* (2014). Specifically, Meredith had questions about building procedural fluency from conceptual understanding. In relaying the story of her learning, she said that she started with questions like, "How do we know that that's the development? And what does that mean? Like, how do you go from building conceptual understanding to the actual procedures themselves" (16:1 Meredith)? Much like Meredith described above, instrumental use of research was common when MDLs were trying to expand their personal knowledge base.

Mandated Use of Research

Unlike instrumental use that was common across all four MDLs, mandated use of research was more specific to the two mathematics instructional coaches who accounted for all but one of the instances. As such, the data analysis suggests that the MDLs' role was a big determining factor for mandated use. Mandated use seemed to be at the forefront for Christine, who mentioned,

> Because a lot of the way my county uses us is, we are the presenters of the thing. And not necessarily the thing that we want, or... I don't know, I don't want to say believe in, but don't feel like that we own it…. because it's just like, "Oh, you need to do this next week." (5:1 Christine 1:03)

A lot of the research that Christine uses in her role is imposed or mandated by her superiors. Decisions are often made above her without her input and she is expected to implement the decided course of action. This often occurs on a short timeline that does not allow Christine to dig into the research behind the decision.

Meredith also described using research in ways that were mandated by her district, the organization she consults with, and/or tied to grant funding. During our conversation about her

second artifact, Meredith described being introduced to the Mathematical Language Routines (Zwiers et al., 2017) on two fronts by saying,

> One was that our middle school grades 6-8 were part of the pilot for Illustrative Math's middle grades curriculum. And within that they had embedded the math language routines, which I really didn't know anything about... The second thing that was going on was, I consult with an organization and they had embedded the Math Language Routines within our Institutes that we do, that I help facilitate. And so I had to learn about them. Because they brought them forward. (17:1, 17:3 Meredith)

In both instances, Meredith was required to promote and learn about the Mathematical Language Routines. Although she was required or mandated to use them, Meredith did not have the same criticisms that Christine expressed when being required to implement a top-down initiative. Instead, she described the Mathematics Language Routines as credible, saying that, "first off, it came out of Stanford, which I believe is a credible Institute" (17 Meredith 20:59) and

> then some of the authors I've actually... have met Zwiers, and I had to talk with him, sort of know his background a little bit. And so I feel like he has invested in this, then it speaks a lot to its credibility (17 Meredith 21:09).

Symbolic Use of Research

Similar to how mandated use of research was role-specific, such was the case for symbolic use of research; Leah and Beth were the only MDLs to use research in this way. Within the data set, Leah accounted for all but one occurrence of symbolic use of research. She mentioned that she often uses research to justify a position or decision that had been previously made. Leah's symbolic use of research spanned all of her shared artifacts and typically occurred when working with the teachers in her district. A prime example was in reference to Leah's first

artifact, when she said, “when I do trainings, I always go back and try to make sure that I'm being thoughtful about what I'm getting ready to tell other people is the quote, unquote, ‘right way to do things’” (9:1 Leah 1:35). Justifying her position with evidence or research is a practice that Leah regularly engages in. Later in our conversation she said,

> it not just “Leah says we're doing this”, but “hey, this is why we're doing this.” And I felt that the Acceleration Guide was a good way to really target that conversation and focus it and make sure that I had some umph and some research to support why I was asking them to look at it...(10:2 Leah)

As is evident in Leah’s quotations, research seems to add additional credence to Leah’s message to her teachers.

Barriers that Prevent MDLs from Accessing Research

Barriers to practitioner use of research are well-documented in the literature. In talking with the four MDLs in this study, they too recognized that research is hard to access and use. In particular, the contexts in which MDLs work, the ways in which research is presented, the lack of physical access, and the lack of opportunities for them to engage with it are a reality that the four MDLs discussed in much detail.

Tensions Between School District Culture and Using Research

The four MDLs described being pulled in different directions as the practice of using research is often in tension with their school districts’ culture, values, and contexts. Each of the four MDLs work in very different district contexts, and as such, each of them navigates tensions unique to their context. One such tension that surfaced for Christine was her lack of agency with regard to choosing what gets taken up in the name of research in District 3. She often operates on short timelines from the time she is given a mandate to actual implementation. For her, being

excluded from the decision-making process hindered her ability to engage with research. This was evident in our conversation when Christine said,

> because I don't feel like I know enough about this. Just not having the exposure, not being part of making decisions and being able to do these things as much as I'd like to, then I don't get the time to immerse myself in that culture. (Christine, 8:17, 9/17/20)

Although Christine felt as though her agency to implement and engage with research was diminished by her context and district culture, she still talked about implementing a number of well-resourced initiatives and paid programs, all of which were district sanctioned.

Beth's context is considerably different; she works in a district that has been hit hard by unforeseen circumstances in the past few years (e.g., hurricanes, flooding). As such, the rebuilding efforts to get back to some semblance of normalcy have taken precedence over concerns for professional development or using research. This necessarily means that Beth is looking actionable research that takes minimal effort to implement because she and the teachers in her district are already working at full capacity. In her own words, Beth said,

> if it's something that is going to take me months to get ready to do, I don't have that kind of time to worry about doing that. I need something that you know, is….backed up to show that it actually is beneficial. (Beth, 15:2, 10/7/20)

Time was a major constraint for Beth and the individuals in her district, but despite such pressures, Beth mentioned she still looks for research.

One way in which Beth accesses research is through her district's partnership with other regional districts; which she refers to as a regional consortium. At times, the consortium will find grant money that they pass on to individual districts through material resources or professional

development offerings. One such resource was a set of books, *Mathematical Mindsets* for the middle grades teachers in Beth's district in which she said,

> Our, um, our [name of] Consortium. ….I think they had gotten a grant or something. Anyway, they bought all the 6-8 math teachers in our consortium, these books. And they just gave them to us. There was nothing, you know, there was nothing done with them…. So I, so when I got them, I thought, you know what, if I give these out, they're not going to do anything with them. So I've held on to them, actually, for a couple years. (Beth, 14:5, 10/7/20)

As evidenced above, the issue was not physical access to the research but rather the lack of support from the consortium on how to go about using the books. Thus, the onus fell entirely upon Beth to figure out what to do in a district already operating at capacity.

Although the district context is considerably different for Leah, she too feels pressure to support her teachers. One such pressure is disrupting a culture of accessing teaching resources that have not been vetted. In talking with Leah, she said,

> So instead of you going to Teachers Pay Teachers, "Bluh" [makes face of disgust], or some other place, and ... finding it, let's do it as a system, and here's a really good task that will help you identify if your kids have this material or if you need to spend some extra time with it. (Leah, 10:10, 9/23/20)

For Leah, it was evident that she recognized her teachers were doing their best to find resources, but ease of access to resources, such as Teachers Pay Teachers, was a part of her district's culture and was the impetus for her pushing research.

Action Oriented, Relevant to Practitioners' Context, and Written Without Academic Jargon

In my conversations with the four MDLs, it was apparent that research needs to be action-oriented, relevant to their work context, and written without academic jargon. Some shared examples of research that met these needs were books such as the, *5 Practices for Orchestrating Productive Mathematics Discussions* (Smith & Stein, 2018), online resources and videos (e.g., Robert Kaplinsky's website and resources), or the ability to have conversations with researchers or other practitioners who have used the research previously. These examples were talked about in ways that privileged usefulness. In Meredith's words,

> Rarely do I ever look at that research. Um, because I'm primarily looking at things that... how do we take what you've learned in your research and apply it in the classroom? That's where like, the five practices comes in, right, like, this is how I apply it in the classroom. This is how I can help my teachers apply what I consider to be best practices. (Meredith, 17:5, 10/1/20)

For Meredith, she is less interested in details of the research study and more focused on the implications. She wants to know the bottom line of what research says so that she can put it into practice. To aid in that process, Meredith often turns to the practitioner journals published by NCTM because "they also connect again, the, the research is being done to the classroom teacher, like, I get the magazine, right?" (Meredith, 16:12, 10/1/20).

Restricted Access to Research

It is no surprise that accessing research is cost-prohibitive as many databases, journal subscriptions, and articles come with hefty price tags for individuals outside of university settings. Meredith was very vocal in voicing her frustrations as she described her process for finding research or more appropriately, not finding research. She said,

> So that's where I'm frustrated. Like, when I was in graduate school, I had access to databases, and I could just type it in and I could go find it. I don't have access to those databases. So primarily, it was through Google. I google it,... I wish I could search the ERIC database or other databases. (Meredith, 16:13, 10/1/20)

As one can imagine, the search process Meredith described is lengthy and, at times, unproductive.

Restricted access to research was felt by all of the MDLs; however, their responses to such restrictions varied. Meredith resorted to scavenging the internet, but other MDLs seemed to rely on research/resources that were easier to access. Such was the case for Christine who said, "So our problem is a lot of his [Robert Kaplinsky] stuff cost money. So we have to go with the free stuff" (Christine, 6:19, 9/17/20). Leah, on the other hand, talked about initially learning about research through trends in education. She described,

> sometimes just trends in education to pick where you go to find things. Um, like, what comes up when you when you are googling, you know, or, um, what's in your, your Ed journal that you just saw, or that podcast,...and then you go back, and if you hit it, and you dig a little bit deeper than that's where it is. (Leah, 11:11, 9/23/20)

As shown in the quotations, MDLs have to get creative and draw on all of their social, material, and personal resources to gain access to research.

Unsure of What Counts as Research

The four MDLs had varied experiences and opportunities to engage with research. Meredith seemed the most comfortable and confident when talking about what is and what is not research, which seems to be related to her experiences with research through her graduate studies and reading NCTM publications. The other three MDLs; however, were more hesitant to say if

an article was in fact a piece of research and were transparent in saying that they were unsure. For Christine, the hesitation came from not having opportunities to engage with it. In her response as to why she used air quotes when talking about "research" and "quality research" she said,

> Yeah, I think it's because that's when you reached out that was something that I feel like, I need more clarification for myself on. I don't...I don't know if I look at things appropriately, or I have the checkmarks when I look at something that's been researched to really, if I'm making the right decisions, either. (Christine, 8:8, 9/17/20)

Christine was aware of her inexperience with research and mentioned that she saw participation in the larger dissertation study as an opportunity to grow professionally. Leah and Beth offered similar accounts of not having had opportunities to engage with research and being unsure of what counts as research.

What MDLs Use to Judge Research as Being Credible

Opportunities to Interact with People from the Research Community

Across the four MDLs, interactions with organizations, colleagues from higher education institutions, famed individuals in the mathematics education community, and/or their published work played a significant role in the extent to which research was deemed credible. One of the more popular organizations discussed was the National Council for Teachers of Mathematics (NCTM). In talking with the MDLs, it seemed that NCTM's endorsement of a piece of research improved the extent to which they found it to be credible. For example, Leah said,

> With NCTM. I think it is a national organization, it has been around for a long time, it has so many different affiliations. And...it again, has proven itself to....focus on areas

> of....supporting teachers and supporting mathematics instruction as a whole. (Leah, 12:10, 9/23/20)

Leah sees NCTM as credible because of its lengthy tenure as an organization focused on supporting mathematics teachers. The other MDLs echoed Leah's sentiments and seemed to value NCTM because of their history of providing credible research on mathematics education with a focus on helping practitioners.

Another criteria that the MDLs used as they made a passed judgment on a piece of research was an endorsement from their colleagues from higher education institutions. Working with and developing professional relationships with faculty at higher education institutions played an important role in accessing research and determining if it is credible. Christine described how she had reached out to a professional friend of hers, a professor at a nearby university, to ask for recommendations for someone who could talk about math anxiety. In talking about the exchange, she said,

> Yeah, so [name of professional friend] had hooked us up with him when we asked him like, "Is there anybody that talks about this there in practicum classes or whatever."... Because the things we had, we didn't feel confident that if we just said, here's this article about this, that teachers, you know, would gobble that up, they, they would just be like, okay, whatever, I'll read this thing and pass it. So we really wanted somebody who was working in and at the time. (Christine, 6:15/6:25, 9/17/20)

Christine trusted the recommendation because of her past experiences with the university professor, but as evidenced above, Christine thought that having an actual person come and speak would be more credible than if she had had her teachers read an article. The other MDLs talked about deeming research to be credible in a similar fashion by giving examples of

professional relationships with math consultants at the State Education Agency (SEA) and colleagues in neighboring school districts.

The four MDLs also described research as credible when it comes from an individual who has acquired fame in the mathematics education community. A few of the names mentioned by the MDLs included Robert Kaplinsky, Jo Boaler, Dylan William, Steve Leinwand, John Hattie, Doug Clements, or Carol Dweck. In talking about why Beth believed Jo Boaler and her work to be credible, she said,

> I guess I consider it to be credible because she is a professor at a college and she has written, you know, a few books. She has the YouCubed website set up and so many people actually reference her in different areas. So yeah, I think I think she's credible. (Beth, 14:9, 10/7/20)

For Beth, she saw Jo Boaler's work as credible because of the institution at which she works, the professor title, her publication record, her professional website, and the frequency of hearing Jo Boaler's name referenced. The other MDLs shared similar perspectives as such individuals boosted the extent to which they trusted and believed what was being presented.

Multiple Sources, Length of Time, and Continuing Research

In my conversations with the MDLs, it was clear that they were more apt to give credence to something that they had heard from multiple sources, over time, and when research continues to be conducted on the topic. Leah and Meredith both described wanting to hear the same message coming from multiple sources when judging something to be credible. Specifically, Leah talked about serving as a regional vice president of the NCTM state affiliate, saying,

> And, you know, like, just because somebody brings it to the table does not mean it's the end all be all. But if it is something that people have checked, and it's credible, and things like that, then I'm more apt. And I hear it from different people within the organization that I ... that I kind of trust. Then I'm more apt to say, okay, it's credible. (Leah, 12:7, 9/23/20)

Leah relied on hearing similar messages from different people, which was common across the MDL interviews and went on to include the extent to which claims were supported by other research.

In her interview, Meredith spent a considerable amount of time talking about wanting to see claims supported by previous research and authors committing to an agenda of research on a particular topic, rather than a one-off publication. For example, I presented Meredith with the article by Zwiers et al. (2017) that she had referenced in her second artifact. Together we skimmed through the article, and Meredith identified parts of the article she found to be credible. One of which was when she said,

> So you know, some of the things I may not look them up, but you know, we've got citations, ones that I recognize, you know, I did study Vygotsky a long time ago. So, you know, that, to me,....indicates that they're pulling from some other research that was done, or some summaries were done on that. (Meredith, 19:8, 10/1/20)

Meredith looked for in-text citations that let her know that the authors were pulling from previous research. She also looked closely at the reference section and commented on her familiarity with the citations. In talking about the references and looking for other research to support the claims being made, Meredith was very familiar with the names and publications of

researchers. The other MDLs seemed to be less familiar with who was being cited; however, they did attend to the presence of citations.

Alignment with Classroom Experience, Local District Context, and My Beliefs

When determining a piece of research to be credible, the MDLs often relied on the extent to which the research aligns with their classroom experiences, district context in which they work, and their professional beliefs. In talking with the MDLs, three of them found research credible in terms of these three facets. One conversation in particular involved Beth who shared that she does a lot of teacher observations and offers feedback based on what she observes. Concerning the research article embedded in the first artifact, she found it credible by saying,

> I guess because um, I've kind of seen some of it in practice. It's a I do have to observe a lot of teachers. And so I could see some... I guess I could see some of our teachers.... I could save a lot of our teachers and not so good part, and some teachers in the, Yeah, I can see how we have teachers to actually do this sort of thing. Um,...I think that's why. (Beth, 13:12, 10/7/20)

For Beth, the research matched what she had observed first-hand in classrooms, and because of that, it was credible. Leah and Christine both shared similar experiences.

One of the big deciding factors for Christine was the extent to which research matched her district's context. Christine works in a district that serves students from urban, suburban, and rural settings, and as such, she looks closely at the context under study. In her own words, she said,

> I don't want it to be a cookie cutter example. So I need to see that they tried to go in an inner city, or they were in a rural area, or they were, you know, they were class sizes that were busting at the seams. And here's class sizes that were 10. And I mean, I guess it's

more so coming from the county that I'm in that our county is so diverse. And I feel like I need to see all those things. (Christine, 8:14, 9/17/20)

Christine feels strongly about the context in which research was conducted and the extent to which it aligns with her context. Her need for research to match her context carries considerable weight when she determines research to be credible. Of the four MDLs, Christine was the only one to talk about the need for the research context to match one's local context.

Practitioner Friendly, Conducted in Actual Classrooms, and Useful

For the four MDLs, educational research needs to be practitioner-friendly in the sense that it is conducted in actual classrooms and provides actionable items that can be applied and used in districts and classrooms. Meredith talked about research being done with actual teachers in actual classrooms. She offered an example of an article, *The Opportunity Myth* (TNTP, 2018) in which she said, "they went into hundreds of classrooms, hundreds of classrooms and collected data. They looked at over 1800 middle school assignments…" (Meredith, 19:4, 10/1/20). For Meredith, the quantity of data was important, but too, the data came from actual classrooms and in turn strengthened the extent to which Meredith saw the article as credible.

Christine also talked about wanting to see research being conducted in actual classrooms. As she talked about the research that Robert Kaplinsky had done, she said,

> Um, I see some of it like he will do some videos with students so that you can see reactions or with teachers. He'll post some actual "In practice" videos, ...And so that's, that's where I see like, obviously, you know, what I'm seeing in front of me, but also when I'm listening to him talk, you know, it's been done. And so there's not, you know, a question about it….It's not just it's not a white paper telling me. Here was the study. And this happened. You know, it's like actual kids. And then the way they're answering it,

> you're like, yep, that's what my kids would say. And then him addressing it like, yep, that's what they say. And this is why. (Christine, 6:21, 9/17/20)

Christine looks to see actual classroom videos of what the research says. She wants to see the evidence, rather than just reading about it, and in doing so, she finds the research to be more credible.

In addition to being conducted in actual classrooms, research also needs to be useful. Beth talked about the usefulness of research with regard to both of her artifacts. Specifically when talking about the article by Rigelman (2007) she said,

> Yes, because like I said, we wanted to try to help our teachers.... We wanted two-fold I guess, we wanted to, first of all, give them activities and strategies, we wanted to show them that, you know, math is not bad. Everybody can do math, it's just a matter of a mindset really, so I wanted to give them some activities and strategies that they could use immediately that, that work. (Beth, 13:8, 10/7/20)

As evidenced above, as Beth interacts with research, she is looking for the extent to which the research is useful for classroom teachers and tangible. The other MDLs shared similar perspectives.

How MDLs Define Research

Prior to the interview with each MDL, they were asked to take a brief questionnaire (Appendix C). One of the questions on the questionnaire asked them, “In no more than one sentence, how would you define research in education?” During the interview with each MDL, I had them talk in more detail about their response to the questionnaire. In what follows, I share each MDLs’ response to the questionnaire set within the context of their interview.

Beth

Beth's definition of research was, "I feel that best practices have endured as major research topics through the years with technology changing how we present information to students and how researchers present information to us" (Beth, questionnaire response). During our conversation, she went on to say that, "It's usually about how best to present math to students. Hmm. Um, so I guess I was thinking of best practices are usually the topics that I see most often" (Beth, 15:1, 10/7/20). For Beth, research had an action-oriented frame. As evidenced in her written definition and ensuing description, research is about providing information about best teaching practices. Beth's understanding of research seems to have direct ties to her context and role. She is responsible for helping teachers provide the best mathematics instruction possible to their students and research is meant to aid in that process.

Leah

Leah defined educational research as, "Research in education can be found to support any idea or belief that one has; therefore, it can be confusing" (Leah, questionnaire response). As can be seen in her written definition, Leah defined research in terms of symbolic use. Research is done in service of making a point or supporting a particular claim. To help me better understand her definition, Leah gave an example of a recent assignment her son was given in an AP human geography class. She said,

> they have to have some sort of debate. And so again,...there's not necessarily a right or wrong. And he may be given something to debate that he adamantly disagrees with, or agrees with, but at the same time, he can find supportive facts or research or things that have been done to kind of support that. (Leah, 12:3, 9/23/20)

As illustrated in the quotation above, Leah foregrounds symbolic use of research in her definition and seems to hold a sense of skepticism that research can be found to support any claim.

Christine

Christine's definition of research centered around barriers that prevent her from engaging with research. On the initial questionnaire, she defined educational research by saying,

> The sheer volume of "research" makes it difficult to identify and implement methods with fidelity for the targeted issue; education seems to move onto the next best thing rather than really let the method play out and have "quality research." (Christine, questionnaire response)

As evidenced in her response, Christine defined research in terms of two barriers, the first of which was the volume of research available. Christine uses research in instrumental ways, often looking for research in response to a problem she is experiencing in her district. For Christine, this typically means searching the internet; however, she talked about this process being overwhelming as, "there's just so many things out there. And I feel like sometimes I have a hard time narrowing down like, okay, what would, what would be most effective for the thing, the problem that I have?" (Christine, 9/17/20).

The second part of her definition seemed to stem from her experience using research in mandated ways in which products claiming to be backed by research have been adopted and implemented. For Christine, the details are essential, but this is rarely the case as she said,

> Like, a lot of times, you'll see that, you know, it was like, "Oh, we spent one or two years and look at all these scores that went up." But you don't always know the full story that there were other programs going on at that time. ...And so like, how can you really narrow down that it was this specific item in question that helped?... I think it's really

> hard to weed through... what is quality research, and what is just for the sake of making our product sound good? (Christine, 9/17/20)

Meredith

Meredith's definition of educational research was, "Research in education is about asking questions on teaching and learning, collecting and analyzing data, and summarizing the findings to provide guidance to educators" (Meredith, questionnaire response). For her, research starts with a question that needs to be answered. A variety of data is collected which can include qualitative, quantitative, or anecdotal data. Once the data is collected, it is analyzed to determine what the data says and then summarized in a way that provides guidance for educators.

Unlike the other MDLs, Meredith's definition seemed to hinge upon two pieces: the need for a research question, and the other being, the extent to which the research offers guidance. In talking with Meredith, these two pieces repeatedly surfaced when talking about what counts as research. The existence of a research question was the distinguishing factor for making the distinction between something that is research and research-based. For example, Meredith shared that the book, *Principles to Actions* by NCTM (2014) was,

> ...based on research, like they're trying to pull together what the research has said, but it's not necessarily, have gone out and posed a question, investigated that question, collected qualitative and quantitative data on it, and then summarized it and brought it back. I think that they looked at research that has done that and sort of summed it together to make it more fashionable. (Meredith, 16:8, 10/1/20)

As shown above, *Principles to Actions* was not a piece of actual research but rather a summary of past research condensed into a single package. Although Meredith did not consider the book

to be research in its own right, she considered it useful because the book offered actionable guidance—the second part to her definition of research.

Providing guidance seemed to be of particularly important for Meredith when determining if something was research as it made the distinction between evidence to support a claim and mere data. In our conversation, she said, "And then the, summarizing those findings, like it's not enough to go in and collect all this data. But let's walk away with some sort of summary" (Meredith, 19:2, 10/1/20). As one can see in the quotation, the extent to which research is actionable is something Meredith expects to see when engaging with research. She went on to describe offering guidance as serving two purposes. One of which was offering advice for what she should have taken away from the study itself, but two, it allows for new questions to surface and the process of research to continue.

Discussion and Implications

The analysis of my conversations with the four MDLs suggests three key findings related to the ways in which they conceptualized educational research. First, the data analysis implies that the MDLs' role and context significantly impact how they conceptualize educational research. Across the four MDLs, there was considerable variation in the contexts in which they work. On one end of the spectrum there is Meredith who works with a team of mathematics specialists in a district that is well-resourced. On the opposite end, there is Beth who works as the sole mathematics specialist in a district hard hit by natural disasters and rebuilding efforts. The variation in MDLs' role also seemed to contribute to the variation in conceptualizing research. As was the case with Christine, much of her research interactions stemmed from mandated use from her superiors. In direct contrast, Leah had the agency to decide what should be taken up and the manner in which it should be done. Taken together, the MDLs' role and

context heavily dictated their ability to conceptualize research as each of them operates within the confines of a system that may or may not privilege research.

Second, the MDLs defined educational research in relation to their needs. They were comfortable providing instances in which they had used research and talking about what they relied on to determine a piece of research to be credible. They were also very aware of the barriers that prevented them from accessing and using research but providing a definition of educational research was much more challenging. Specifically, the MDLs have not had a need to explicitly define research in terms of a textbook definition because their contexts require a more practical one—one steeped in actions, examples, and non-examples. This was apparent in Beth's definition as she broadly described educational research as providing insights for best instructional practice.

Such a definition works well for the MDLs, but it does present some challenges in regard to ESSA (2015) when trying to distinguish between research recommendations backed by empirical support and those recommendations supported by one's opinion or anecdotal experiences. The policy—ESSA, 2015—requires decisions to be supported by *high-quality research*, but it is less clear about what is meant by the term. The ambiguity is a double-edged sword as it has the potential to be leveraged for the benefit of MDLs and the districts they serve (e.g., research from non-quantitative paradigms). However, it also has the potential for ideas or recommendations that lack empirical support to be taken up in the name of research. It does raise an interesting question. How often do recommendations claiming to be research, but who lack empirical support, get enacted, and at what cost to our students, teachers, schools, and/or districts? Although the answer to such a hypothetical question is unknown, the question alone is enough to call for MDLs to have an opportunity to develop a robust definition of research, so

that when they make recommendations that require time, money, and human capital, such recommendations are grounded in empirical evidence. From the data analysis, I found the MDLs' current definitions of research to be a product of their contexts that were steeped in actions, examples, and non-examples. I also found that the MDLs recognized the need to develop a more robust definition of research and welcomed the opportunity to do so.

Finally, the findings provide further evidence that organizations and their recommendations carry value for MDLs as they engage with research. In the data, one of the most prominent organizations was the National Council for Teachers of Mathematics (NCTM). NCTM was founded in 1920 and has a mission of advocating "for high-quality mathematics teaching and learning for each and every student" (NCTM.org, 2017). From their strategic framework, it is clear that one of their main purposes is to support practitioners in teaching and learning by providing "guidance and resources for the implementation of research-informed and high-quality teaching" (NCTM.org, 2017). For the MDLs, NCTM fits the bill as they talked about turning to and trusting NCTM because of its reputation, long-standing history, and the MDLs' past experiences. In talking with Meredith, she was quick to say that she receives NCTM's practitioner publication, *Mathematics Teacher: Learning and Teaching PK-12* regularly, and as I looked at the MDLs' bookshelves, they are replete with NCTM publications or authors endorsed by NCTM. All of this is to say, NCTM and organizations like them are trusted sources of information for MDLs. It is because of that trust that MDLs take what NCTM says as fact, supported by research, and are confident in their recommendations.

When the organization is NCTM, such trust is warranted because they have robust standards and processes for what gets published. They partner with researchers and practitioners to ensure that their publications meet a certain quality standard. However, other, often private,

organizations in education are less stringent in what they publish and tend to rely on the support of white papers and non-peer reviewed publications. As such, MDLs have to be wary of the organizations they rely upon to avoid taking up ideas and recommendations that could unintentionally do more harm than good.

This research on MDLs' conceptualizations of educational research provides the lay of the land for future work. MDLs are not uniform; their contexts, role, and experiences seem to heavily dictate the ways in which they define research and their capacity to engage with it. Despite these variations, there are some commonalities such as defining research in terms of taking action or using examples and non-examples to craft a prototype to aid in future judgments about research. Although some may see this as problematic, I prefer to see their practical definitions as fertile ground for a joint effort between MDLs and researchers. As was the case for the four MDLs in this study, they could pinpoint areas of personal growth with respect to their research conceptualizations; however, taking on such an endeavor was beyond the capacity of any one person. Thus, this study provides more evidence to support the call to action put forth by prior research concerned with bridging the gap between research and practice (e.g., Amara et al., 2004; Nelson et al., 2009; Nutley et al., 2007; Tseng, 2012). Put simply, if researchers and those in academia extend a hand in partnership, MDLs are willing to accept it.

Conclusion

In this article, I have shared the ways in which four MDLs conceptualize educational research with regards to use, barriers to access, the extent to which research is credible, and research definition. The evidence suggests that their conceptualizations are steeped in the ways they use research within their contexts, and they rely heavily on relational trust when assessing research to be credible. There are a number of contextual, physical, and paradigmatic barriers that contribute to their practical definitions of educational research. These findings are similar to

the literature focused on practitioners more generally; however, I want to explicitly note that many of the ideas surfaced in my conversations with the MDLs were things I agree with as a researcher. Although the MDLs may talk about research from a practitioner perspective, they still have conceptualizations of research and notions of quality that should not be dismissed. I mentioned previously that much of the literature surrounding practitioners' engagement with research was framed from deficit perspectives that point blame at practitioners, but from the data analysis of my conversations with the MDLs, it seems that these perspectives should be re-framed as fertile ground, ready for an opportunity to emerge. Given the context and pressure of ESSA (2015) to ensure one's decisions are supported by research, now is an optimal time to reach out and support them.

One way to do that is by developing the capacity of MDLs to engage with and promote a healthy skepticism of educational research. Other researchers have highlighted collaboration between researchers and practitioners through partnership as a productive way to tackle problems too big for one individual on their own (e.g., Penuel et al., 2015; Tseng et al., 2017). Design-based approaches to research have become popular in recent years and offer a seemingly productive way to support MDLs in developing their capacity to engage with research. The current study sets the stage for further research as it provides evidence of the current lay of the land in terms of MDLs' conceptualizations of educational research. This contribution to the literature base is valuable because it provides a foundation from which future work focused on developing MDLs' capacity for engaging with research can begin to build.

CHAPTER V: MAKING SENSE OF EDUCATIONAL RESEARCH: THE MATHEMATICS DISTRICT LEADER RESEARCH GROUP

Abstract: One requirement put forth by national and state-level policy (e.g., Every Student Succeeds Act) is that practitioners use educational research to inform their decisions and instruction. Mathematics district leaders (MDLs) have been identified as pivotal individuals for enacting change within school districts. Using a DBR approach, an intervention meant to build the capacity of MDLs to engage with research was designed and implemented with four MDLs from four school districts across four geographic regions of one southeastern state in the United States. Findings indicated that MDLs became more discerning in the way they defined educational research, determined what makes it credible, and the criteria they used to determine if an article was credible was contingent upon the article being research or being research-based. Implications for building the capacity of district-level leaders to engage with research are discussed.

Introduction

Since the passing of the landmark policy, No Child Left Behind Act (2002) and its subsequent legislation (e.g., Every Student Succeeds Act, ESSA, 2015), there has been renewed emphasis on describing teaching practice using a variety of terms such as, “research-based,” “evidence-based,” or “data-driven.” At face value, such policies require practitioners to adopt teaching practices that have been shown to produce positive outcomes for students. This requirement seems straightforward; however, applying research to one’s practice is considerably more difficult than it seems (Spillane et al., 2002). Much like a person walking the aisles of a grocery store looking at food labels (e.g., organic, all natural, made from the finest ingredients), practitioners have to decipher and evaluate the quality of curricular programs, instructional strategies, and technology. This is no easy feat as labels can be deceptive as loaded words such

as “evidence-based”, “research-based”, and/or “data-driven” are all loosely defined (Asen et al., 2011). These labels are used as a persuasive tool that is unclear about the details (Nicholson-Goodman & Garman, 2007), and contingent upon one’s paradigm (Coburn & Talbert, 2006; Tseng, 2012).

Within school districts, district-level leaders are key individuals for enacting policy and initiatives (Wilson et al., 2018). These individuals, by either formal or informal designation, are actively involved in making decisions that influence and dictate the ways in which initiatives are taken up within schools (Spillane, 2000). It is their unique position on the border between policy and practice that allows them to potentially enact change for an entire school district (Cobb & Smith, 2008; Coburn et al., 2008; Spillane, 2000). There is considerable pressure on these individuals to ensure that their decisions are supported and informed by research (Penuel et al., 2018). This is especially true for mathematics district leaders (MDLs) who work in contexts shaped by historical reform efforts (e.g., “new math”, “math wars”, Common Core) that require them to navigate politics and public opinion regularly (Trujillo, 2012). MDLs are mid-level influencers (e.g., district supervisors, instructional coaches, lead teachers) within the mathematics domain who, since the passing of the Every Student Succeeds Act (ESSA) (2015), have had to make many decisions about how to best serve their students in both mathematics and STEM domains. Unlike its predecessor (NCLB, 2002), ESSA (2015) puts the onus on states to develop action plans and give them more autonomy. Such freedoms mean that MDLs face tremendous challenges to ensure their districts measure up to a number of accountability indicators (e.g., academic achievement, academic progress, graduation rates, college readiness) as they do their best to support their decisions with evidence and research (ESSA, 2015).

One of the challenges with ESSA (2015) and all policies that require practitioners to use research and evidence is that practitioners have limited experiences with research because their professional training is primarily practitioner focused (Gore & Gitlin, 2004; Korthagen et al., 2006). It is within this problem space that I situate the current study. MDLs—a specific type of practitioner—are required to use research and evidence to support their decisions, but MDLs' experiences with research are limited and so are the existing support structures (Wonsavage, Chapter IV, 2021).

A number of studies have tried to understand practitioners' relationship with research by looking at the ways in which they define it (Gore & Gitlin, 2004), how it is perceived (Cousins & Leithwood, 1993; Graves & Moore, 2018; Penuel et al., 2017), where practitioners look for it (Palinkas et al., 2016; Penuel et al., 2017), and how practitioners' understandings of research can be improved (Gore & Gitlin, 2004; Hemsley-Brown & Sharp, 2003). Common to these studies is that research and its use are ambiguous for practitioners. Other studies have put forth recommendations for building the capacity of practitioners to engage with research by providing opportunities for practitioners to engage with research in ways that allow for trusting relationships to develop through ongoing and intense interactions (Amara et al., 2004; Kochanek & Clifford, 2014; Nelson et al., 2009; Tseng, 2012); work collaboratively with intermediaries to locate, sort, and prioritize research (Nelson et al., 2009); and translate research into practice (Penuel & Coburn, 2014). Putting these recommendations into action has proved challenging as the existing schooling structures are not well-equipped to handle such innovation (e.g., Honig, 2003).

In response to the recommendations described in the literature, I designed an intervention, the Mathematics District Leader Research (MDLR) Group, focused on building the

capacity of four MDLs to engage with research. The design was grounded in the DBR tradition (Cobb et al., 2003). It was meant to perturb the MDLs' existing conceptualizations of research as they engaged with one another in discussions about the content of research and the reasons as to why they found it to be credible. Initially, the intervention was meant to provide opportunities for the MDLs to make sense of using research; however, during the first meeting, it became apparent that before the MDLs could begin to think about using research, they had to clarify their definition of it and the accompanying factors that make engaging with research challenging. Hence, the use of research took a less prominent role in the design.

In this article, I address the following research question: *What are MDLs' revised understandings of educational research after engaging in intersubjective meaning making with a group of their like-role peers?*

Literature Review

Researchers, legislation, and practitioners have diverse understandings about what is meant by the word, *research*. These understandings are the product of individuals' and organizations' past experiences and beliefs that are steeped in their respective contexts. Here I present what is currently known about how these groups define research and then focus my attention on the influences that contribute to the ways in which practitioners' think about and define research.

Defining Research is Contingent Upon One's Context

Research means vastly different things depending on the context and the person or organization who is using it. In one's everyday language, phrases such as, "I did some research on…" or "I researched … and found..." are common. Often, such statements reference a Google search for information that involves using some sort of process to answer a question. This could

be as simple as reading user reviews for a product, or it could involve searching for facts through an internet search engine.

In contrast, researchers typically define research in terms of two purposes. One of which is expand the existing knowledge base and is inspired by an intellectual interest to develop new knowledge (Merriam & Tisdell, 2016). The other purpose is motivated by spurring the research audience to take action or enact change. Merriam and Tisdell (2016) refer to the former purpose as basic research and the latter as applied research. Others define research as "an activity in which people employ systematic, empirical methods to answer a specific question. Research bases its conclusions in investigations involving statistical data, interviews, observations, and case studies, or a combination of these" (National Center for Research in Policy and Practice [NCRPP]; 2016, p.3). I privileged the NCRPP definition of research that I privileged as I designed the MDLR Group because it is broad and encompasses research from both qualitative and quantitative paradigms.

In comparison, the definition of research from the perspective of federal policy like ESSA (2015) and governmental agencies (e.g., Institute of Education Sciences, What Works Clearinghouse) is much narrower. What "counts" as research is restricted to quantitative methodologies (e.g., randomized control trials, quasi-experimental studies) that are viewed as the gold standard. In contrast, research from non-postpositivist paradigms is considered to be inferior.

Although the definitions of research mentioned above appear to be straightforward within their respective domains, it is not always clear as to which definition someone is using, especially in education. To circumvent the potential confusion, researchers will sometimes provide a definition for their practitioner participants to reference (e.g., Penuel et al., 2017;

Vanderlinde & van Braak, 2010) and lessen any ambiguity around the meaning of the word. These approaches to understanding the ways in which practitioners use research have yielded much-needed knowledge in improving practitioners' access to and engagement with research; however, one limitation of these approaches is that they privilege researchers' definitions of research rather than those held by practitioners.

Other researchers have recognized this limitation and have tried to foreground the ways in which practitioners define and understand research (e.g., Coburn & Talbert, 2006; Gore & Gitlin, 2004) through the use of questionnaires and interviews to capture the perspectives of pre-service and in-service teachers by asking them to define *educational research* (Gore & Gitlin, 2004). Their findings match those of other studies done specifically with mathematics district-level practitioners who found that they define research in relation to their needs and context (Wonsavage, Ch. 5, 2021). Thus, practitioners often define research in ways that are incongruent with those held by the research community (e.g., student achievement data, practitioner knowledge, testimony from experts) (Coburn & Talbert, 2004; Honig & Coburn, 2008).

Practitioners' Definitions of Research Are Experiential

The discourse around practitioners' understandings and definitions of research are often framed in deficit ways. From the perspective of the research community, practitioners lack a clear understanding of what counts as research. This perspective has led to much literature identifying influences and factors that prevent practitioners from engaging with, understanding, and defining research. I call attention to this common perspective because it is helpful for thinking about how practitioners' definitions and conceptualizations are a product of their contexts, communities, experiences, and beliefs. Their experiences with research have largely had an eye towards practice and, as such, their definitions reflect that understanding.

One of the most common influences is a lack of access to research. Research is often locked behind paid subscriptions to databases or journals, thus making it cost-prohibitive (Behrstock et al., 2009). Research is also inaccessible due to the language in which it is written. When practitioners engage with research they often have to read lengthy and dense articles littered with academic jargon (Fusarelli, 2008; Gore & Gitlin, 2004; Hemsley-Brown & Sharp, 2003; Nelson et al., 2009; Nutley et al., 2007; Rickinson, 2005; Sin, 2008; Rickinson, 2005; Shkedi, 1998). Taken together, a lack of these various forms of access severely restricts the extent to which practitioners can even begin to engage with research.

Practitioners also look at the extent to which research is appropriate, worthwhile, and pertaining to issues relevant to them (Behrstock et al., 2009; Coburn et al., 2009; Gore & Gitlin, 2004; Shkedi, 1998; Zeuli, 1994). Common beliefs cited in the literature are that research is done in contexts that do not match reality (Shkedi, 1998), is unhelpful (Gore & Gitlin, 2004), and is undeserving of merit for lack of classroom applicability (Hemsley-Brown & Sharp, 2003). Such beliefs are understandable given the context in which practitioners work; they see their individual districts as unique. Unless the context of a piece of research matches their own, then the research recommendations may not apply (Cain, 2017; Gore & Gitlin, 2004). Collectively, this lack of perceived relevance may explain why practitioners turn to other sources for information (e.g., colleagues, peers) before looking to research (Behrstock et al., 2009; Honig & Coburn, 2008).

One's role and context also influence how practitioners think about and engage with research. Many practitioners report not having time to engage with research because of the way in which the school day is structured (Behrstock et al., 2009; Cain, 2017; Hemsley-Brown & Sharp, 2003; Nelson et al., 2009; Nutley et al., 2007). They often work in isolation from their

peers because of the highly compartmentalized nature of schools (Spillane, 1998) and districts, thus making collaboration challenging. There is also an epistemological component that places value on the specifics and uniqueness of individual classrooms (Labaree, 2003). Such beliefs tend to breed skepticism and devalue educational research in favor of other sources of knowledge (Behrstock et al., 2009; Cain, 2017; Coburn & Talbert, 2006; Fusarelli, 2008; Gore & Gitlin, 2004; Graves & Moore, 2018; Hemsley-Brown & Sharp, 2003; Honig & Coburn, 2008; Nelson et al., 2009; Nutley et al., 2007; Silver & Lunsford, 2017; Tseng, 2012; Vanderlinde & van Braak, 2010).

Finally, practitioners tend to have a set of criteria for evaluating research as credible that is very different from that of researchers. These criteria include aspects of the research itself (e.g., methods, citations) and extend beyond it to include the source from which one receives the piece of research or the extent to which it matches their personal experience (Behrstock et al., 2009; Gore & Gitlin, 2004; Honig & Coburn, 2008; Nutley et al., 2007; Silver & Lunsford, 2017; Zeuli, 1994). Using such criteria to measure the extent to which research is credible necessarily means that research that aligns with one's beliefs tends to be taken up more frequently (Honig & Coburn, 2008), while research that does not is discounted (Coburn, Honig, & Stein, 2009).

These various influences are heavily intertwined and make efforts to build practitioners' capacities to engage with research difficult as potential solutions need to address all facets of the issue. In the 1990's, federal agencies and members of the research community advocated for making research more accessible by publishing research in practitioner-friendly journals. This approach attempted to make research more accessible by changing the language and presentation so that practitioners could more easily engage with it (Silver & Lunsford, 2017). Unfortunately,

translation only accounts for access and assumes deficit views of practitioners. The implicit message is that practitioners are incapable of diagnosing and fixing their own problems of practice without the help of researchers. A more productive metaphor is *border crossing* which allows different communities to understand each other's practice, ways of knowing, and concerns as they develop new shared understandings. The connection between the two communities is mutually beneficial as it allows researchers to better understand practitioner perspectives about research and introduces practitioners to ways of thinking about research and what constitutes quality.

Theoretical Perspectives

In order to capitalize on the recommendations of the literature around building the capacity of practitioners to engage with research, I subscribed to a social constructionist approach to sensemaking that views sensemaking as a social interaction between individuals (Maitlis & Christianson, 2014; Weick, et al., 2005). Under this theoretical perspective, sensemaking is a cyclical process that begins with a discrepant event or cue that causes an individual to actively seek an explanation for how or why the event deviated from their expectation and then they act upon their new meaning (Maitlis & Christianson, 2014; Weick, 1995; Weick, et al., 2005). In what follows, I unpack each of these sensemaking features—cue, intersubjective meaning making, taking action—in more detail.

Cue

The first feature of sensemaking is a cue that is when an event, issue, or situation disrupts one's expectation and creates ambiguity and/or uncertainty about how to respond (Maitlis & Christianson, 2014). An example of a cue for an MDL might be if they made strong recommendations to the school board about adopting a certain curricular resource (Resource A), but when the school board made their decision, they went with a different resource, Resource B.

The school board choosing Resource B might have caused some confusion for the MDL around the rationale behind their choice that would spur the MDL to clarify their ambiguity. In this case, the school board's decision was a cue that triggered the sensemaking process for the MDL.

Cues are not universal. What triggers the sensemaking process for one individual might not trigger it for someone else. In the school board example above, imagine a teacher receiving the news that they would be using Resource B in the upcoming months. They might not be invested in the decision to the extent that the MDL was, so the decision might not cause the teacher to seek clarification for the rationale. Similarly, the teacher might have expected the school board to select Resource B, and in doing so, the outcome met their expectation. Thus, in order for an event, issue, or situation to trigger sensemaking, it has to deviate from one's expectation enough to catch one's attention and important enough for them to seek clarification about how they should respond (Maitlis & Christianson, 2014).

Intersubjective Meaning Making

Intersubjective meaning making follows the cue and is a social process that unfolds between individuals trying to make sense of the discrepant event. It's intersubjective in the sense that it requires the mutual co-construction of meaning (Maitlis & Christianson, 2014). The individuals involved are creating a shared understanding of the cue as they jointly engage with one another. One of the strengths of this part of the sensemaking process is that multiple ideas are surfaced as each individual has their own explanation or understanding of the cue. Thus, the individuals involved have the potential to be exposed to perspectives that they might not have thought of on their own.

Taking Action

Taking action is the fundamental last piece of the sensemaking process because it provides the potential for new cycles of sensemaking (Weick, 1988). As individuals take action on the sense they have made, they introduce new ideas and explanations into the environment which provide them with feedback about the extent to which their action was appropriate. Such feedback can serve as a future cue for further sensemaking or it might clarify the ambiguity surrounding the initial discrepant event (Maitlis & Christianson, 2014). In this sense, taking action is dual-purposed as it lets an individual know if they need to continue the sensemaking process (feedback), and it provides material for them to continue if needed (continued cycles of sensemaking). Additionally, taking action means altering the environment in response to the sense that was made, which can potentially alter future sensemaking. Thus, enactment is a reciprocal process in which the individual influences the environment, and the environment influences the sense made by individuals (Maitlis & Christianson, 2014; Weick, 1988, 1995).

Methodology

Design-based research is rooted in sociocultural perspectives that recognize that learning is situated in contexts (Brown, 1992; Collins et al., 2004). It aims to produce theory that is readily applicable to the work of practitioners by not studying what currently exists but rather what could be (Cobb et al., 2003). The current structures for MDLs to engage with research are not what they could be and because of that I subscribe to design-based perspectives with the goal of creating an intervention meant to support MDLs in building their capacity to engage with research. This process was iterative—guided by a set of theory and data-driven principles and key features.

Participants and Context

The MDLR Group was a consequence of a larger statewide partnership between researchers and practitioners that in recent years had worked to jointly improve access to research. Drawing from professional contacts from that partnership, I recruited four MDL participants from four diverse districts from across one southeastern U.S. state. These four MDLs were from different geographic regions within the state and their districts served students primarily from rural or suburban areas. Although I refer to all of the participants as MDLs for the purpose of this study, two of them are mathematics instructional coaches and the other two are mathematics district supervisors within their respective districts. I briefly describe each participant below. All participant names are pseudonyms.

Christine

Christine is from a school district that serves over 20,000 students from rural, suburban, and urban locations across 41 schools. The school district is in the top 20% for student population size and is located in Geographic Region 3. Christine is one of four mathematics instructional coaches in her district; she serves the high schools and her three counterparts work with the elementary and middle schools. Christine has worked in education for 11-15 years and has spent the past 6-10 years in her role as a mathematics instructional coach. She has an undergraduate degree in secondary mathematics education and described her research experiences during her schooling as limited to her practicum courses.

Meredith

Meredith also serves as a mathematics instructional coach for high school. She works in a suburban school district from Geographic Region 4 that serves over 25,000 students—top 20% for student population size in the state—at 45 schools. Meredith works with a team of six

mathematics instructional coaches (K-12) and one K-12 mathematics director. Meredith has worked in education for over 20 years with the last 6-10 years in her role as a mathematics instructional coach. Meredith has an undergraduate degree in secondary mathematics education; two graduate degrees, one in secondary mathematics education and the other in school administration, and is a National Board Certified Teacher. In addition to her duties as a mathematics instructional coach, Meredith consults for a private educational company and has held leadership roles in a state affiliate of NCTM for a number of years.

Leah

Leah is an MDL from a smaller rural district from Geographic Region 1. Leah's district which is in the top 50% of districts for student population size serves around 8000 students across 18 schools. Leah has a team of informal teacher leaders that she relies on regularly and has strong relationships with nearby higher education institutions. Leah's official title is the K-12 Director of Mathematics/Science and Data Analytics, and has been in the role for 20 years. She has an undergraduate degree in middle grades education with a focus on mathematics and science and a graduate degree in school administration.

Beth

Beth is a K-12 Mathematics Supervisor in Geographic Region 2. Her district is in the top 20% for student population size, serving over 22,000 students at 36 schools from rural areas. She is the sole person dedicated to K-12 mathematics in her district but does work with a team of other like-role individuals for other subjects (e.g., English supervisor). She has worked in education for over 20 years with about 10 of those being in the MDL role. She has an undergraduate degree in secondary mathematics education and a graduate degree in educational leadership.

The Mathematics District Leader Research (MDLR) Group

Design Principles of the MDLR Group

The MDLR Group was the culmination of a designed set of tasks and activities that included reading and analyzing research articles, engaging in discussion with peers, and disrupting the MDLs' existing conceptualizations of research. To guide this process, I drew upon five design principles, a) build a collaborative and supportive community of mathematics district leaders, b) value the expertise and practitioner knowledge of mathematics district leaders, c) provide access to educational research, d) build the capacity of mathematics district leaders to critically evaluate educational research, and e) collaboratively develop translational meanings of educational research, which I describe in more detail below.

Design principle 1: A supportive and collaborative community provides opportunities for learning to occur. Learning is an inherently social process (National Academies of Sciences, Engineering, and Medicine; 2018) in which individuals construct meaning of the world through their social interactions with others (Gephart, 1993; Maitlis & Christianson, 2014). This view of learning is typically in conflict with the existing structures of school districts because of their highly compartmentalized nature (Spillane, 1998). For example, MDLs are often the sole person in their role for an entire district which makes it challenging to interact with their like-role peers. This design principle recognizes the limitations of the existing structures and intentionally creates the conditions for MDLs to socially construct meaning of research within a group of their peers.

Design principle 2: The expertise and practitioner knowledge of mathematics district leaders is valuable. The second design principle aims to address the often-cited issue in the literature that practitioner knowledge is dismissed by researchers and not seen as valid

(Levin, 2013). This principle is in response to the epistemological tensions between researchers and practitioners (Labaree, 2003). More specifically, the purpose of this principle is to explicitly recognize that practitioners have extensive knowledge of the contexts in which they work, and such an emic perspective has value. Thus, this principle proactively addresses the epistemological tensions between the knowledge of practitioners and researchers (Korthagen, 2007; Cain, 2017; Gore & Gitlin, 2004).

Design principle 3: Access to educational research dictates the extent to which practitioners can engage with it. A lack of access to educational research is one of the most prevalent barriers cited in the literature and can be thought of in terms of physical access (Heid et al., 2006; Honig & Coburn, 2008; Shkedi, 1998) or in terms of the language of research being inaccessible (Hemsley-Brown & Sharp, 2003; Gore & Gitlin, 2004; Vanderlinde & van Braak, 2010). The third design principle is meant to address the issue by providing physical access to research and creating a space for MDLs to make sense of what they are reading through interacting with their like-role peers.

Design principle 4: Mathematics district leaders need support to be able to critically evaluate educational research. ESSA (2015) has put renewed pressure on MDLs to ensure that their decisions are informed by research. Such a responsibility necessarily requires MDLs to be well-versed in both research and practice; however, the support for MDLs to do so has been limited as their pedigrees are often oriented more towards practitioner perspectives rather than research (Gore & Gitlin, 2004; Korthagen et al., 2006). This design principle addresses this tension by creating structures to support MDLs as they work to build their capacity to engage with research.

Design principle 5: Translating educational research into practice is an active process that requires collaboration with others. The final design principle stems from the implementation literature and recognizes that local adaptation is necessary as individuals make sense of, interpret, and implement new policies (Berman, 1982; Greenhalgh et al., 2004; Spillane, 1998). To aid in this process, this design principle provides the space for the MDLs to socially construct their understanding of research with their like-role peers and discuss how it might be applied to their individual contexts.

Key Features of the Design

Using my five design principles, I designed an intervention with three key features that embodied the design principles and were grounded in the literature on the Research to Practice Gap, practitioners' conceptualizations, and their research use. I elaborate on each of the key features below.

Feature 1: Professional Learning Tasks that Perturb Existing Notions of Research and Promote the Seven Markers of Research Quality. The first key feature asks MDLs to participate in a variety of tasks that were designed to help them navigate the various factors and influences that complicate practitioners' engagement with research (e.g., barriers to access, the extent to which research is credible, role/context) by providing counterexamples to the MDLs' existing understandings of research. These counterexamples were meant to trigger sensemaking, promote intersubjective meaning making, and prompt the MDLs to revise their existing conceptualizations of research to align more closely with those held by the research community.

Feature 2: Research Talk Time and the Co-development of a Research Reflection Tool. The second key feature provided opportunities for *research talk time and the co-development of a research reflection tool*. During each MDLR Group meeting, there was

designated time for the MDLs to revise their definitions of research and discuss what makes it credible, trustworthy, and relevant. I designed question prompts based on the literature and the MDLs' existing conceptualizations. I hoped these prompts would serve as cues to introduce them to more canonical conceptualizations of research and provide opportunities for discussion. A resulting outcome was the need for a tool that the MDLs could use to help facilitate the process by which they engage with research. As Furtak and Heredia (2014) found in their study, the practitioner uptake of tools seems to be influenced by the extent to which practitioners were invested in the tool development. As such, this tool was informed by the MDLs' conversations over the course of the six MDLR Group meetings through a co-design process.

Feature 3: Research Translation Time. The third key feature, research translation time, designated time for examining the extent to which the research that MDLs read applied to their contexts. This key feature spanned a couple of the design principles and focused largely on research use or imagined use. This key feature allowed the MDLs to think about and discuss how the research articles we read could be or had been applied in their contexts. I designed question prompts that allowed MDLs to reflect on the past in terms of taken or missed opportunities for using research and prompts that looked towards use in the future. My purpose for doing so was to provide opportunities for them to make sense of research with respect to their contexts in concrete ways rather than operating on hypotheticals.

The MDLR Group Meetings

The MDLR Group had its first meeting in October 2020 and continued with meetings throughout the Fall 2020 and early Spring 2021 semesters. Each of the meetings was conducted on a video conference platform and lasted approximately 90 minutes. MDLs were provided with a focal article and were asked to read, annotate with a digital reference tool, and respond to

questions (see Appendix A for the annotation guide) about the article prior to the meeting in which it was discussed. The articles were selected based on the needs of the participants (e.g., a focus on online teaching and learning) and in response to the literature on practitioners' notions of research. A brief rationale for focal articles 1 and 2 can be seen in Table 5.1; however, a more detailed explanation of the rationales specific to each focal article (Meetings 1-6) appears in Appendix H.

Table 5.1. MDLR Group Meeting Dates and Times

Meeting	Focal Article	Article Choice Rationale
Meeting 1	Jung & Brady (2020)	• Short article (~8 pages) • Not peer reviewed • Published in a journal • Relevant to the MDLs' contexts
Meeting 2	Rehn, Maor, & McConney (2018)	• Had an explicit research question • Peer reviewed • More data shared in this article than the previous • Methods were explicitly mentioned • Bigger sample size, 8 teachers and their classes • Done in a K-12 context

Additionally, there were two resources that I drew from more broadly as I tried to expose the MDLs to notions of research that aligned more closely to those of the academic research community. I mention them here to claim my subjectivity and recognize that I purposefully drew on the markers of research quality (Shavelson & Towne, 2002), Penuel and colleagues' (NCRPP, 2016) definition in making my design choices, and Gutiérrez and Penuel's (2014) call for research needing to be relevant to practitioner audiences.

Prior to each meeting, participants were given a research article(s) to read and annotate using a digital reference tool. Participants were encouraged to use the tool's features to highlight and make comments using a color coding scheme of green (information that made the article more credible), pink (information that made the article less credible), and blue (information that

they wanted to discuss during the MDLR Group meeting). Additionally, the MDLs were asked to complete an annotation guide prior to each meeting and answer questions about defining research, research credibility, and potential use.

The MDLR Group meetings were loosely partitioned into sections that corresponded to the key features of the MDLR Group design. The partitions varied in quantity and length for each of the meetings, but in general, each meeting followed the same order.

The first 5-10 minutes of the meetings were spent asking the MDLs about their use or non-use of research in recent weeks. I asked them to share a time in which they a) were able to implement a research recommendation we had read previously, b) saw a research opportunity, or if c) something prevented them from using research (Feature 3). Although the exact wording changed from meeting to meeting, the main focus of this time was to get the MDLs talking about how they had translated research into their contexts.

Second, about 30-40 minutes was spent allowing the MDLs to revise their definition of research based on their individual engagement with the focal articles and their group discussions (Feature 2). As they made sense of and became clear about their definition of research, I would type what they said into our Google Slide presentation to keep a record that we could revisit as needed. This period of time also included the MDLs discussing the extent to which they found the article credible, trustworthy, and relevant (Feature 1).

Third, 20-30 minutes of each meeting was spent discussing how the MDLs might use (or not use) the research recommendations in their own contexts (Features 1 & 3). Question prompts were often embedded in fictional, but realistic, situations that MDLs might encounter daily. For instance, in Meeting 4, the MDLs were given a fictional scenario of a teacher coming to them after Thanksgiving and saying, “I just don’t know what to do about this online teaching thing.

The things that I normally do when I am face-to-face with my students just aren't working." I then asked the MDLs, what, if anything, from the article would they suggest to this teacher and why?

Fourth, about 10-20 minutes involved the MDLs co-designing the research reflection tool. In early meetings, this partitioned section was included within the discussion around research being credible, trustworthy, and/or relevant; however, as the MDLs became clearer about their criteria for each, a need for a designated time to co-design the tool became necessary. This time involved using the tool to reflect on the extent to which the article met their various criteria and they revised the tool as they made new meaning.

The final 5-10 minutes of the meeting focused on any outstanding questions, picking the next focal article to read, and scheduling the next MDLR Group meeting. See Appendix B for a sample meeting agenda.

After each meeting, I shared a new focal article to read and annotate before the next meeting. I would then review the meeting recording and design the forthcoming annotation guide in response to the conversation and negotiated meaning made by the MDLs. After creating the new annotation guide, I shared it with the MDLs via email along with a calendar invite for the next scheduled meeting.

Data Collection and Analysis

The data collection consisted of MDLs' annotated articles, their annotation guides, Google Slides presentations, nine hours and 23 minutes of video recordings of the MDLR Group meetings, and the accompanying six verbatim transcripts—one for each meeting. The transcripts were the primary source of data used in the analysis. The other data sources were used to inform the design of the meetings, guide the conversation within each meeting, and serve as secondary

data to clarify and contextualize the transcripts. The six transcripts were loaded into qualitative data analysis software and were coded in two cycles.

First Cycle Coding

I started with a priori codes that were identified for each individual MDL based on their initial interviews and then open-coded the transcripts using a constant comparative method (Glaser, 1965; Corbin & Strauss, 2008). This process yielded four codebooks—one for each MDL. I coded the contributions of each individual MDL because they each brought a unique set of understandings about research that I wanted to capture in the coding process. My unit of analysis for the data was a thematic unit (Rourke et al., 2001) rather than a talk turn. As the MDLs engaged with one another, there was potential for multiple nested ideas to surface. The cumulative coding process was purposeful as it was meant to capture the MDLs' new meanings as they surfaced in conversation. Thus, the codebook for each MDL grew larger as new ideas surfaced over the six MDLR Group meetings. Over the course of the meetings, there were 18 codes for Beth, 20 codes for Christine, 24 codes for Leah, and 20 for Meredith. Each of these codes was specific to the individual MDL, but there were similarities across them. For example, each of the MDLs had a code [MDL name - Citations] that was assigned anytime an MDL talked about citations within the focal article or more generally.

Second Cycle Coding

After the first cycle of coding, I used a pattern coding process to group the 82 initial codes from the individual MDLs into 21 broader categories that spanned multiple MDLs (Miles et al., 2020). This was done for the purpose of looking for patterns across the four MDLs and as a data reduction technique (Miles et al., 2020). There were 10 of the 82 initial codes that did not

fit within the 21 pattern codes and only had a few occurrences within the data set. These codes were dropped from the data analysis for lack of sufficient data.

I queried each of the 21 pattern codes and downloaded the report for each. I then read through each of the reports and documented the number of code occurrences for each pattern code per meeting because I wanted to document the change in the number of codes over time. For example, the Methods pattern code was much more prevalent in Meetings 3 (n=14) and 4 (n=15) when compared with Meeting 1 (n=2), which can be explained by the lack of methods in the Meeting 3 focal article and the explicit detail given to the methods in the focal article for Meeting 4.

Using my theoretical framework, I looked for evidence of the MDLs' revised understandings of research for each pattern code across the six meetings and wrote analytic memos for each one (e.g., Methods for Meeting 1) (Corbin & Strauss, 2008). An example of the analytic memos for Meetings 1-3 for the Methods pattern code is shown below in Table 5.2.

Table 5.2. Analytic Memo for the Methods Pattern Code for Each Meeting

Meeting	Focal Article	Memo
Meeting 1	Jung & Brady (2020)	Meredith only; a process to collect data; what was the process to analyze data?
Meeting 2	Rehn et al. (2018)	Christine, Leah, Meredith; Methods in general, different ones; a process for collecting data; using data to answer a question; what was the method? Wanting specific info and details about what happened; ethical and moral issues about data collection (in response to the design)
Meeting 3	Morge et al. (2020)	Meredith, Beth, Leah; SYSTEMATIC shows up and seems to be a landmark event; can the research be DUPLICATED; what did the authors do? a way of collecting and analyzing data; The design was such that the methods were not present in the article

As shown in Table 5.2, the memos for each meeting attended to how the MDLs talked about the Methods pattern code and included my thoughts and questions about the data.

I then wrote one additional analytic memo for each pattern code that spanned the entire code across Meetings 1-6 (see Figure 5.1 for an example) because I wanted to longitudinally capture the ways in which the MDLs made sense of the pattern code.

Figure 5.1. Analytic Memo for the Methods Pattern Code Across All Meetings

Over the six meetings, we see methods get taken up by all of the participants in varying ways. Meredith started the conversation in Meeting 1 and the other MDLs took it up over the next five meetings. In Meeting 3 there is a shift in the way methods get talked about; the idea, "systematic" and "duplicated" show up to describe a need for methods to be present in an article in enough detail so that the reader knows what the authors did and could repeat the process. In Meeting 4, the article had a defined "methods" section which seemed to be much appreciated by the MDLs and became a part of their eval tool. Christine began to raise the issue of, does methods belong with definition or credibility? She is the only MDL to really take this idea up. In Meeting 5, Leah tried to impose the word organized rather than systematic just as a way to make sense of the methods, making sure that it was clear; however, this word switch did not get taken up. In Meeting 6, it seems that systematic methods paired with the descriptor, "authentic" are now a subset of the word, "methodology" which means to the MDLs that there was a thorough description of the methods that involve the collection and analysis of novel data.

This process was guided by my knowledge of the literature and theoretical perspective as I focused on the MDLs' revised understandings that resulted from their intersubjective meaning making (Maitlis & Christianson, 2014). As can be seen above, the Meeting 3 article triggered sensemaking for the MDLs about research needing a systematic process for collecting data that offers enough detail for the study to be duplicated and let the reader know what they did.

Assessing Research Quality

High-quality research needs to be valid and reliable. Different paradigms (e.g., quantitative, qualitative, design research) describe the extent to which a study is valid and reliable using a variety of terms. For example, quantitative researchers tend to use *internal* and

external validity, while terms like *credibility* and *transferability* are more common to qualitative work. Regardless of the terms used and/or the paradigm in which one operates, the kernel remains the same; to what extent can an individual trust the process by which someone conducts a study (internal validity) and to what extent are the study's findings applicable to contexts beyond the immediate study (external validity)? For this dissertation, I used the terms *replicability* and *trustworthiness* to address how I attended to maintaining research quality; these terms are commonly used in DBR studies. In what follows, I share how I attended to both of these criteria during the design and implementation of this dissertation study.

The design and implementation of this DBR study were guided and informed by five overarching design principles. These principles were the primary way in which I addressed replicability because they were specific enough to provide a frame for others to follow and allow for flexibility as others adapt the MDLR Group intervention to fit their contexts (Bakker, 2018). An example of an inconsequential adaptation of the MDLR Group intervention would be engaging with research specific to online learning. The principles are such that another researcher could easily change the content of the research focal articles to fit the needs of their context. Conversely, not attending to one of the principles (e.g., valuing the expertise of practitioners) could potentially result in a lethal mutation of the MDLR Group intervention. Thus, for other designers looking to replicate this study I would encourage them to adapt the intervention accordingly, but keep the five design principles central to their adaptations. The other way in which I attended to the replicability of the study was by keeping a conjecture log. Within the conjecture log, I kept a record of my decisions and rationales for those decisions. I looked for evidence to refute or support my conjectures.

To address trustworthiness issues, I employed member-checking strategies within the meetings to ensure that what I heard or understood the MDLs to say was actually what they meant. For example, it was common for me to ask, "Leah, I heard you say…., did I understand that correctly?" or "Meredith, when you said…, did you mean…?" Outside of the meetings, the member-checking process involved emailing the MDLs and asking for clarification about their annotation guide responses and/or their article annotations.

During the data analysis process, another mathematics education researcher and I would have regular conversations about my interpretations of the data. We would jointly look at excerpts from the transcripts and discuss how I analyzed and represented the data. Finally, all of the MDLR Group meetings were audio and video recorded to ensure that I accurately captured the MDLs' interactions during the meetings.

Findings

Analysis revealed that over the course of the six MDLR Group meetings, the MDLs became more discerning in how they defined research and made judgments about the extent to which they found a piece of research to be credible. At the beginning of the MDLR Group, the MDLs surfaced a variety of unsettled criteria that they used to define research and evaluate it as credible and/or relevant. Throughout the MDLR Group intervention, they began to parcel out their criteria into separate categories for defining an article as research, credible, and relevant. As this process unfolded, the MDLs' initial conceptualizations were subsumed, replaced by, or evolved into more nuanced ones as they engaged in intersubjective meaning making with one another. Through the data analysis process, three important themes emerged: (a) the MDLs came to have a clear, more sophisticated, shared definition of research; (b) when determining the extent to which they found a piece of research to be credible, the MDLs drew heavily on subjective, relational, and objective aspects of research; and (c) as MDLs judged an article to be

credible, the criteria they used was contingent upon their classification of the article as being research or research-based.

Developing a Shared Definition of Research

As was discussed in Chapter 4, the MDLs' research definitions were informed by their past experiences and defined in relation to their needs. Over the course of the six MDLR Group meetings, the MDLs developed a shared definition that more closely aligned with that of the research community (e.g., NCRPP definition of research). For the MDLs, educational research is,

> an authentic response to teaching, learning, and educational topics or for the purpose of finding a solution to a problem that includes the methodology in collecting and utilizing qualitative and/or quantitative data to provide actionable guidance for educators.
>
> - MDLs' Shared Definition of Research, Group Meeting 6

Data analysis indicated that the MDLs came to define research in terms of two criteria: the research process itself and the outcome of that process.

Educational Research has to go Through the Research Process

Much of the sensemaking that occurred around the MDLs' definition of research pertained to the research process. When determining if an article was research, the MDLs looked to see if the researcher(s) had gone through the process of investigating a research problem, designing a process to collect data (methods), and then actually collecting the data. In the initial meetings, each of the MDLs contributed to the group definition by drawing on their prior knowledge and past experiences with research. These initial conversations resulted in a list of characteristics that the MDLs wanted to include in their definition. However, the MDLs needed time to make sense of how to fit them together. Thus, there were many conversations in which

they made intersubjective meaning about their definition. An example of these conversations was during Meeting 2 as Leah and Christine talked about revising their provisional definition from Meeting 1,

> **Leah 07:30 -** it's [research] done in response to an issue or to find a solution to something, but then maybe we could just kind of add to that, to find a solution....utilizing data, both qualitative and quantitative.
>
> **Christine 07:54 -** Yeah, ..."on a variety of topics using a variety of different methods".....that kind of takes all the bullets into one."
>
> - Leah and Christine, Meeting 2 (2:40)

The ways that the MDLs talked about the definition of research in the early meetings resembled that of a checklist in which they were looking for a problem in need of solving, some sort of process for collecting data, and being able to see the collected data.

In Meeting 3, the MDLs read a book chapter (Morge et al., 2020) that shared examples of strategies that teachers could try in their online classrooms to promote discourse. Three of the four MDLs considered the book chapter to be a piece of research prior to the group discussion. Meredith was the exception as she raised concern with the book chapter not including sufficient data for her to be convinced of the book chapter being research. She shared,

> I was looking at this as you were talking about the interaction maps. And that's where I would have liked to have seen some data .... it would have been really nice, had they done a reflection on this strategy. And, and then just add, like a little table of, "here's some ways that teachers felt about that strategy and how it may have helped or hindered them from participating in the discussion." But it just said that "students may make statements

like", and I just, ...Well, did they make those statements? Or is that just sort of the "trying to remember what happened in the classroom thing?"

- Meredith, Meeting 3 (3:70; 56:51)

The absence of data within the book chapter was a cue for Meredith that triggered the MDLs to make intersubjective meaning around classifying the book chapter as research. The cue raised concern for the MDLs because they wondered if the authors had actually conducted a study or were merely reflecting on their experiences. The idea that the MDLs were grappling with was what the research community refers to when describing empirical research—drawing conclusions based on observations and data. Although the word, empirical, did not surface in the MDLs' intersubjective meaning making, they did take action on their new meaning by incorporating the word, *authentic* into their definition of research. They used authentic to describe a need for research to draw conclusions from observations and collected data. This book chapter served as a pivotal non-example from which the MDLs continued to draw upon in later meetings.

Another idea surfaced by the MDLs during Meetings 3 and 4 was the method for collecting and analyzing data. In Meeting 3, the MDLs discussed how the authors were unclear about their method. It was not until the book chapter was juxtaposed with the article in Meeting 4 that the MDLs were able to solidify their criteria for research needing to be explicit about the method for data collection. During an exchange between Meredith, Beth, and me in Meeting 4, the MDLs made sense of the word, *systematic* to describe the methods used. Meredith started the exchange by saying,

Meredith 20:18 - and I'll speak to the word systematic, ... this article, put in the "method", like, "here's our method." That's what I think I meant when I said there was a

systematic way, like they had a method, right? They had a reason and a process that they went through.

Paul 20:45 - I put Method in caps because it sounds like there's like an official section. Maybe that's like, "METHOD".

Meredith 20:51 - Yeah.

Beth 20:53 - I think there was some question last time, that they didn't tell us how they went about getting their data.

- Meredith, Beth, Paul, Meeting 4; (4:12)

As evidenced above, the article in Meeting 4 (Martin et al., 2018) offered clarity for Meredith as she looked for the researchers' process for collecting data. There was no systematic collection of data in the Meeting 3 focal article, but the one in Meeting 4 seemed to serve as a prototypical example of what she wanted to see when looking for the researchers' method. The word *systematic* ultimately did not make it into the MDLs' final definition of research, but it did serve as a waypoint in the MDLs' journey before being subsumed by the word *methodology* in Meeting 6.

In Meeting 6, Meredith surfaced the word *methodology* and felt that it would more succinctly capture what the MDLs meant when talking about the systematic process of collecting and analyzing data. The MDLs liked the word and quickly decided to incorporate it into their definition of research. Leah offered the revisions by saying,

Leah 21:18 - So just, you know, "educational research is an authentic response to a variety of different teaching", and then it would allow us to include the methodology at the end...

Paul 21:45 - and by "authentic" we mean, like, they actually collected some data of their own, not borrowing from others?

Leah 22:02 - Right... Like they're actually doing the research and conducting and doing the method, you know, following the methodology of collecting and analyzing and presenting their findings versus using someone else's work.

- Leah and Paul, Meeting 6, 6:44

The word *methodology* for the MDLs did not have a synonymous meaning with the research community's understanding of the word. For the MDLs *methodology* captured the idea that the authors were systematically going through a research process of collecting and analyzing data, but there was no evidence to suggest their use of the word included the use of theory to guide the process. The inclusion of *methodology* proved to be pivotal for the MDLs in distinguishing between classifying an article as a piece of research or based on research.

Educational Research has to Provide Guidance

The other part of the MDLs' definition of research was the extent to which the article provided guidance. From the start of the MDLR Group, Meredith was adamant that in order for an article to be research, it needed to offer guidance; however, the other MDLs were less convinced of it needing to be a part of their definition. In Meeting 4, there started to be a shift after Meredith said,

Meredith 17:28 - there's part of the definition that I sort of hold on to that hasn't been added to our collective definition. And that is the piece where it provides some guidance….It just doesn't collect the data. It actually uses the data to add some sort of

summary or guidance for educators. So.... that's a piece that I feel should be in the definition, but that is really just me.

- Meredith, Meeting 4, 4:9

There was some tension for Meredith as the group was reluctant to take up the idea of research needing to provide guidance. This tension was present throughout the data but really came to the surface in Meeting 5 after the focal article (Dorn et al., 2020) offered less than helpful recommendations. One of the pivotal conversations around the tension occurred between Meredith and Leah as they discussed the call to action:

Leah 1:15:43 - But do you think it's because of the call of action? Like, because what we talked about earlier, the Dorn article, the call of action was stupid...

Meredith 1:16:14 - Well it goes, it's that piece in that definition that I, I've said it before, that I feel strongly about is that it has to provide guidance.

Leah 1:16:22 - Yeah.

Meredith 1:16:23 - Right? And if it doesn't provide any guidance, why are you bothering to even write it? ... the Dorn article didn't help. You just told us what the problem was.

Leah 1:16:43 - Yeah.

- Leah and Meredith, Meeting 5, 5:43

Leah seemed to see Meredith's point about research needing to provide guidance. Throughout Meeting 5, the MDLs continued to make intersubjective meaning around the idea of providing guidance and ultimately took action by including it in the shared group definition.

The MDLs came to have a shared understanding about what counts as research, what is based on research, and what is merely advice. The meaning they made about what counts as research served as a pivotal moment in their journey to build their capacity to engage with

research. As a consequence of confidently classifying information as research, based on research, or advice, the MDLs also began to shift the ways they thought about and passed judgment on an article as credible.

The Criterion MDLs Use to Determine an Article to be Credible

When the MDLs made a judgment about an article being credible, they used the following definition, "the quality of being trusted and believed in" (Oxford Languages, 2021). To help them make a decision or pass judgment on the extent to which they believed what was being presented as they engaged with the focal articles, they drew upon subjective, relational, and objective aspects of research. Subjective aspects were those that were contingent upon the individual's personal thoughts, opinions, or feelings. An example of subjective criteria was when the MDLs trusted research that aligned with their beliefs or experiences. Similarly, the MDLs used relational criteria to deem an article credible based on their trust in the source from which they received the research. These relational criteria were independent of the research itself and included sources such as organizations (e.g., NCTM), trusted individuals the MDLs knew professionally (e.g., university researchers), and/or individuals who had gained recognition in the mathematics education field. Finally, there was a set of aspects that were not contingent upon the MDLs' beliefs and prior experiences, but were characteristics of the research itself (e.g., citations, peer review). This set of aspects was more objective in nature.

MDLs Use Subjective Criteria to Judge Research as Credible

When determining the extent to which research is credible, the MDLs consistently drew upon subjective criteria as they looked for alignment between the focal articles and their past experiences, beliefs, knowledge, and context. The frequencies of the MDLs talking about alignment with their beliefs and experiences can be seen in Table 5.3 below.

Table 5.3. Frequency of Quotations Coded as Alignment with Beliefs/Experiences

Code Name	Meetings					
	Meeting 1	Meeting 2	Meeting 3	Meeting 4	Meeting 5	Meeting 6
[Christine – Match my Experience]	2	0	1	1	N/A	0
[Leah – Aligns with her Beliefs]	N/A	3	3	N/A	5	2
[Beth – Aligns with her Beliefs]	0	2	3	1	3	1
[Meredith – Aligns with my Beliefs/Experiences]	1	4	6	3	4	4
Total	3	9	13	5	12	7

Note: N/A is used when a given MDL was absent from a particular meeting

In the early meetings, the MDLs talked about how they tended to believe an article's recommendations more so when they matched what they saw in their districts and the classrooms they observe. They mentioned how they could hear their teachers saying things similar to the participants in the focal articles, and it made them believe the research was being done with actual teachers in actual classrooms.

Although the MDLs consistently relied on the extent to which recommendations aligned with their beliefs and experiences, in Meeting 3 there was a lengthy conversation about the potential bias that could result from using such subjective criteria. The MDLs realized that they were using subjective criteria to judge an article as credible and decided to openly claim it. In explaining her rationale, Meredith said,

> if it's something that aligns with your beliefs, then you have to be cautious because the article we just read aligns to our belief….But if it goes against something that I believe,

I'm going to be a little bit more of a skeptic and you're really going to have to convince me otherwise.

- Meredith, Meeting 3, 1:29:16

Meredith seemed to speak for the group as she acknowledged the subjectivity of using alignment with one's beliefs as criteria to measure the extent to which an article is credible. The MDLs realized the potential bias that could result in using this criteria but felt that not including it would be disingenuous to their actual practice. This point was reiterated by Beth in Meeting 6 when she said, "I don't think any of us would use anything that we didn't feel was credible… If I didn't believe in it, I'm not going to go try to sell it to somebody else" (1:12:32).

Over the course of the six MDLR Group meetings, the MDLs used subjective criteria to determine the extent to which an article is credible and whether it was research or based on research. As they made intersubjective meaning of the extent to which the articles aligned with their beliefs and/or experiences, the MDLs realized moments in which they were being subjective and proceeded with caution.

MDLs Use Relational Criteria to Judge Research as Credible

Relational aspects of the research carried considerable weight with the MDLs and were dependent on their relationships within the MDLs' communities. These aspects encompassed endorsements from organizations, recommendations from people that the MDLs respected personally, or from people well-known in mathematics education. The frequencies of the MDLs talking about endorsements can be seen in Table 5.4 below.

Table 5.4. Frequency of Quotations Coded as Endorsement

Code Name	Meetings					
	Meeting 1	Meeting 2	Meeting 3	Meeting 4	Meeting 5	Meeting 6
[Christine – Endorsement]	1	3	0	1	N/A	0
[Christine – Trust]	0	0	0	1	N/A	0
[Leah – Endorsement]	N/A	1	3	N/A	5	0
[Beth – Endorsement]	1	1	1	0	0	0
[Meredith – Endorsement]	2	0	2	4	6	0
Total	4	5	6	6	11	0

Note: N/A is used when a given MDL was absent from a particular meeting

When the MDLs talked about endorsements improving the extent to which they viewed a piece of research as credible in the early meetings, they talked about the reputations of the universities from which the authors were affiliated and their sources of funding (e.g., National Science Foundation v. self-funded).

From the initial interviews, I knew that the MDLs tended to believe and trust research when it came from people they knew professionally. Using that information, in Meeting 3, I had the MDLs read a focal article (Morge et al., 2020) in which some of them knew the authors. This article started a chain of conversations that lasted multiple meetings as the MDLs continued to make sense of relational criteria for finding research to be trustworthy. In Meeting 3, Leah said, "we know what the authors stand for professionally...and knowing those people, I know that they actually did those things" (0:42:50). The other MDLs shared similar perspectives about knowing the authors. Knowing the authors was revisited in later meetings and was expanded beyond personal/professional relationships to include endorsements from authors who had gained

notoriety in mathematics education (e.g., Dylan Wiliam, Steve Leinwand) and/or organizations (e.g., NCTM).

As is shown in Table 6.4, there were more conversations about endorsements in Meeting 5 than the previous meetings. This seemed to stem from the article choices (TNTP, 2020; Dorn et al., 2020) that were published by private for-hire companies. One of the articles (TNTP, 2020) had been used previously by Leah as part of her districts' response to the COVID-19 pandemic. She found this article credible because of her past experiences with the organization that wrote it and because it was recommended to her by trusted colleagues at the State Education Agency. In our conversations about the extent to which the article was credible, Leah acknowledged that TNTP was a private organization that was a, "paid partnership to provide advice, to collect data to create a design and to execute a plan" (Meeting 5, 1:05:52). However, because of who recommended it, Leah put it into action. This article was an interesting example of the convergence of multiple forms of relational trust within a single artifact (e.g., trust in an organization, trust in a recommendation from colleagues) that resulted in a positive judgment of the TNTP (2020) article by the MDLs. Although there had been a discussion around the article having undergone peer review and the article being self-published by the organization, the MDLs ultimately found the article credible because of their relational criteria.

One of the outcomes of this study (discussed in detail in Chapter VII) was a tool that allowed the MDLs to reflect on the extent to which they found research or research-based articles credible and relevant. I mention the tool here because it seemed to give pause to the MDLs as they made sense of the focal article in Meeting 5. The tool was designed to help the MDLs reflect on the extent to which they consider an article to be credible/relevant. Towards the

end of Meeting 5, Meredith talked about how the tool had challenged her to revisit her assessment of the focal article being credible. She shared,

> ...you give me an article from TNTP, and … I'm gonna read it and, and really take it in and I'll probably be quick to share it too. Having the tool, however, helped me think about what others might question about the article and how could I respond? And should I be a little bit more critical in the things that I read and take on? And so that tool sort of gave me that perspective, that I normally, probably wouldn't have with a trusted source.
>
> - Meredith, Meeting 5, 1:12:14

Although the MDLs ultimately felt that the TNTP (2020) article was credible, the reflection tool provided an opportunity for them to be more critical of the article.

MDLs Use Objective Criteria to Judge Research as Credible

The last aspect of research that the MDLs took into account when evaluating the a piece of research as credible pertained to the qualities of the research that were independent of the user. One of those criteria was peer review—the process by which the piece of research underwent public scrutiny. The peer review process seemed to be new criteria for the MDLs for evaluating credibility because they did not mention it in the initial interviews. For the first MDLR Group meeting, I purposefully selected a focal article that did not undergo the peer review process in hopes of calling it to their attention, which it did.

The MDLs sensemaking process around peer review was brief, resulting in its inclusion as criteria for finding an article to be credible. Peer review was only discussed about a few times across the six MDLR Group meetings and typically was in response to checking to see if the article had or had not undergone the peer review process. There was one exception during Meeting 4 when Meredith raised the point that searching the internet for a journal's peer review

process was time-consuming and at some point "there comes this level of trust that what they say is what happened and, and that it was peer reviewed" (Meredith, Meeting 4, 29:16).

The other objective criteria that the MDLs looked for when finding an article to be credible was the presence of citations. The frequencies of occurrence are in Table 5.5 below.

Table 5.5. Frequency of Quotations Coded as Citations

Code Name	Meetings					
	Meeting 1	Meeting 2	Meeting 3	Meeting 4	Meeting 5	Meeting 6
[Christine – Citations]	0	2	1	1	N/A	6
[Leah – Multiple Sources]	N/A	1	0	N/A	1	0
[Leah – Citations]	N/A	0	2	N/A	6	0
[Beth – Citations]	1	0	1	1	1	0
[Beth – Lit Review]	1	0	1	1	0	0
[Meredith – Citations]	4	4	1	2	10	4
Total	6	7	6	5	18	10

Note: N/A is used when a given MDL was absent from a particular meeting

Over the course of the six MDLR Group meetings, the ways in which the MDLs engaged with citations in the articles became more sophisticated. The MDLs initially tended to look for citations to be present because it strengthened their belief in what the author(s) were saying and convinced them it was not just the opinion of the author.

In Meeting 3, there was a shift in the way that the MDLs talked about the citations. Specifically, the MDLs started looking more closely at what was being cited. They recognized familiar citations and began to notice when citations were absent. When citations were absent, the MDLs were more skeptical of what was being said, and it lessened the extent to which they found an article to be credible. Additionally, one of the MDLs, Christine, in Meeting 6 began talking about wanting to dig into the citations in more depth. She commented,

> I'd be interested to read that, that piece of work he's citing from though, so Davie (1989),... I wonder what the rest of that says?... Like he pulled out this one little thing, but then what did the rest of their stuff say?
>
> - Christine, Meeting 6, 00:42:38

It is unclear due to a lack of evidence as to whether digging more deeply into the citations was unique to Christine or if the other MDLs wondered similar things about the citations.

The Classification of the Article Dictated the MDLs' Criteria for Finding an Article to be Credible

One of the tensions experienced by the MDLs as they assessed an article as credible was that some of their criteria were not applicable when they classified an article as being research-based. For example, the MDLs realized that an article classified as research will provide the methods and data they used to make their claims, while an article based on research will, "probably lean heavily on the summary of what came out of the research" (Meredith, Meeting 4, 01:19:36). Realizing that a research-based article will have different criteria for deeming it credible was a cue for the MDLs that required making intersubjective meaning across multiple meetings. The tension surrounding this cue seemed to stem from the idea that the MDLs found "research-based books and articles to be very credible" (Meredith, Meeting 4, 01:19:36). Yet, they did not share the methods, data, and other criteria that the MDLs were looking for in a credible piece of research. The tentative result of this conversation was that when they classified an article as research-based, "You can still look for credibility, but I think it's under the assumption that you don't have to have all these…" (Christine, Meeting 4, 01:22:07).

The discussion reemerged in Meeting 6 as the MDLs made sense of the criteria for finding an article to be credible in the tool. The tension that the MDLs were grappling with was

the purpose of the tool because for the MDLs it felt like, “it’s asking two different things, is this research or is this credible?” (Meredith, Meeting 6, 01:06:14). During their sensemaking process around this tension, the MDLs realized that they each had different goals in mind. Some of them used the criteria to classify the articles as research. Others used the criteria to determine them as credible, but they were all engaging with one another under the assumption that they were all on the same page. The conversation during Meeting 6 lasted for about 22 minutes with a big realization coming after Meredith said,

> They're [definition and credible] not one in the same, right? There's some research out there that I could probably read that I'm like, uh ah,...I question your methodology, question, your data, your question, your conclusion, those sort of things. You have all the elements of what we say goes into the research, but I still don't find it credible.
>
> - Meredith, Meeting 6, 01:14:17

The MDLs went on to conclude that research and credible were not synonymous. An article could be research but not be credible—as Meredith mentioned above. Conversely, an article could be classified as not research (e.g., research based) and be highly credible to the MDLs (e.g., 5 Practices for Orchestrating Productive Mathematics Discussions). Coming to understand the relationship between research definition and what makes an article credible was a landmark moment for the MDLs in distinguishing between the various criteria they use when making a designation (e.g., research, research-based, credible).

Discussion

The literature on the Research to Practice Gap has largely investigated how practitioners have failed to understand research from researcher perspectives. Such perspectives have called attention to the disconnect between the two communities, rather than finding common ground in which researchers and practitioners can jointly make sense of what counts as research in ways

that acknowledge the expertise of both communities. In this study, I was able to see what was possible and gain insights into the process by which four MDLs made sense of research and what they draw upon as they pass judgment on an article being credible.

Much like recommendations from previous literature, providing opportunities for practitioners to engage in intense and sustained social interactions (Amara et al., 2004; Nelson et al., 2009; Tseng, 2012) was a productive avenue for the MDLs to build their capacity to engage with research. As evidenced by the revisions to the ways in which they defined research and determined an article to be credible, it was apparent that they became more discerning.

The findings from this study contribute to the literature surrounding the Research to Practice Gap by providing insights into MDLs' conceptualizations of research. In particular, this study provided an insider perspective on how MDLs define research and determine the extent to which research is credible. Much of the Research to Practice Gap literature focuses on practitioners in general (e.g., Hemsley-Brown & Sharp, 2003); the findings from this study about MDLs were consistent with those of practitioners more generally. As evidenced by the data, the challenges associated with research and its use ascribed to practitioners in the literature appear to hold true for MDLs as well. Such a finding is appropriate since both practitioners and MDLs operate within practitioner paradigms deeply rooted in relationships and context (Labaree, 2003).

Practitioners have few experiences engaging with research because many teacher prep and inservice programs have an eye towards practice rather than research (Borman et al., 2009). In this study, the MDLs' prior experiences with research were strictly limited to surveying the literature around a given topic to facilitate earning their degrees. I knew this going into the design of the study; however, my initial thoughts were that the MDLs would quickly be able to come to a consensus about what counts as research and what makes it credible so that we could

focus our attention on research use. In the initial interviews and first meeting, it became apparent that the MDLs' conceptualizations of research were unsettled, and before being able to make sense around use, we had to clear up the ambiguity around their definitions and what makes research credible. The MDLs' initial notions of research were oriented towards their experiences and beliefs. They were at times, unsure of the difference between a piece of research and an article that was research-based because up until this study, there had not been a need for them to make the distinction. Through participation in the MDLR Group intervention, the MDLs clarified their ambiguity by developing a clear definition of research and making their criteria explicit for passing judgment on a piece of research.

Finally, it's well-documented in the literature that organizational endorsements of research and the reputations of researchers carry considerable weight with practitioners (e.g., Coburn & Talbert, 2006; Honig & Coburn, 2008). Within this study, organizational support and endorsements were also important for MDLs. There were many instances throughout the study when the MDLs talked about trusting the National Council of Teachers of Mathematics (NCTM) or other well-known mathematics education researchers to provide high-quality research or research-based publications. This finding holds promise for organizations and publishing platforms that have a high standard for research and ensure that their publications reflect high-quality research.

This study also provides evidence that organizational endorsements extend beyond those who sponsor and/or conduct research and include the organizations and structures of public education. A prime example is when Leah talked about trusting the recommendations of her colleagues at the State Education Agency. Such a finding highlights the onus of those in positions of power to ensure that their recommendations are supported by high-quality research.

As was evident in Meeting 5, the MDLs' relational criteria (e.g., trust in the organization, trust in colleagues at the State Education Agency) played a prominent role as they made sense of the quality of the focal articles and ultimately found one of them to be credible despite skepticism around various aspects of the article itself (e.g., lack of peer review, who is cited). Going forward, it would be interesting to understand the sensemaking process in more detail in relation to the weights assigned to the various subjective, relational, and objective criteria because the evidence from this study suggest that the weights are not uniform as the MDLs consider the extent to which they find an article to be credible.

Limitations of the Study Design

The MDLR Group was purposefully designed to build the capacity of MDLs to engage with research. As the designer of this innovation, I implicitly, and at times explicitly, privileged my own notions of what counts as research and the criteria that make it credible. My goal was to align the MDLs' conceptions of research to a definition that more closely aligned to definitions and surface notions held by the research community in terms of what makes research credible.

The other limitation of this study was that it occurred during the COVID-19 pandemic. Schools operated remotely or on hybrid models of instruction (face-to-face and online). This meant that the MDLs were particularly interested in learning about research on teaching in online environments. It is unclear if the MDLs would have come to conceptualize research differently had they engaged with research focused on other topics.

Implications

This research has implications for researchers and those working with district-level leaders to bridge the gap between research and practice. In recent years, there has been a push to put research use at the forefront of bridging the gap between research and practice (Penuel et al., 2018; Tseng, 2012). While focusing on research use is a productive avenue to pursue because of

the roles and contexts in which district-level leaders work, I do so with a caveat. As I found with the MDLs in this study, jumping straight into building their capacity to use research was not possible because of the ambiguity surrounding their conceptualizations of research. Although my initial design was focused on promoting the informed use of research, the MDLs needed an opportunity to make sense of what research is, what makes it credible, and being able to make their criteria for each explicit. Thus, it seems that having a robust and clear understanding of what counts as research and what makes it credible is a consequential predecessor for promoting informed use which requires opportunities for MDLs to make intersubjective meaning with others.

CHAPTER VI: MAKING INFORMED DECISIONS IS HARD: A TOOL FOR DISTRICT LEVEL LEADERS TO ENGAGE WITH RESEARCH

Abstract: Since the passing of the Every Student Succeeds Act (ESSA, 2015) there has been a renewed emphasis on district-level leaders supporting their decisions with research and evidence. This requirement seems straightforward; however, making research-informed decisions is challenging because it requires district-level leaders to step outside of their practitioner expertise as they engage with and make sense of research. To aid in this process (as part of a larger dissertation study), four mathematics district leaders and I co-designed a tool to facilitate the negotiated meaning of research. I share this tool and illustrate its potential for providing an opportunity for district-level leaders to critically examine research.

Introduction

District-level leaders, who by formal or informal designation are uniquely positioned within schools and districts to develop and implement policy (Spillane, 2000). Sometimes referred to as mid-level decision-makers, such individuals have considerable influence when it comes to introducing and enacting ideas in their contexts (Wilson et al., 2018). Their position within districts comes with great responsibility as they must ensure that the decisions they make are supported by evidence or backed by research. This pressure has come to the forefront in the past two decades through the No Child Left Behind (2002) legislation and its descendant (ESSA, 2015), which tied funding to a requirement to use research and evidence to make "evidence-based" decisions. Although seemingly straightforward, such a requirement is complicated as there are multiple tiers of evidence for district-level leaders to navigate as they make decisions informed by evidence.

The top three tiers of evidence define research explicitly; whereas, interventions, activities, or programs must be supported by specific types of research studies: experimental,

quasi-experimental, or correlational studies. These types of research are particularly useful and informative when making district-level policy decisions (e.g. choosing curricular materials) but are less keen on offering practical advice for enactment in classrooms. The last tier, *Demonstrates a Rationale*, is much more broadly defined and simply says that interventions, activities, or programs must be based on "high quality research findings" (ESSA, 2015, p. 2091). It is this last tier that has provided some much needed breadth in expanding what counts as evidence to include research from qualitative paradigms, which tend to provide the details necessary to put evidence into action. It has also put a tremendous burden on practitioners and specifically district leaders as they are now tasked with making decisions about research quality with little direction or support.

The problem is further complicated by a number of barriers that prevent access to research, promote confusion, and make informed research use difficult. The literature is rife with complaints about research being inaccessible (e.g., lack of physical access, academic jargon, cost prohibitive), being irrelevant to the needs of practitioners, being only one of many resources from which practitioners draw upon to make decisions (Honig & Coburn, 2008), and practitioners' experiences are primarily oriented towards practice rather than research. Despite the many influences working against them, district-level leaders are still accountable for ensuring their decisions are supported by evidence and/or research.

In response, a growing body of research has come to recognize that practitioners (e.g., teachers, district-level leaders) need support in this endeavor (e.g., Kochanek & Clifford, 2014; Nelson et al., 2009) because they have had limited experiences with research in their professional training (Korthagen et al., 2006). Thinking about district-level leaders specifically, many of them have advanced degrees and many years of classroom experience, but they have had few

opportunities to engage with research (Wonsavage, Ch. IV, 2021). Thus, the tension between policy requirements and the capacity of district-level leaders has given rise to a problem with severe ramifications for districts, schools, and ultimately, students.

As part of a larger dissertation study (Wonsavage, Chapter V), I was able to design an intervention that helped support a group of district-level leaders to become more skilled at engaging with research. The intervention involved reading, annotating, and engaging with research within a group of mathematics district leaders (MDLs) for the purpose of building the their capacity to understand research, define it and surface criteria for what makes it credible. One outcome of the larger study was that the four MDLs and I were able to co-create a tool through an iterative process that helped them to make sense of a piece of research and reflect on the extent to which they should believe what is being presented. This tool, which I refer to as the Research Reflection Tool, is the result of much discussion between four MDLs and one researcher. An earlier version of the tool is in Appendix F and is an artifact of our group's understanding of research and what makes it credible.

In this paper, I share the most recent version of the tool (Appendix G) that was revised to be applicable to a broader audience than just the four MDLs in the larger dissertation study. I begin by sharing the context in which the four MDLs and I co-designed the Research Reflection Tool and highlight its potential for making sense of research. The tool shared is divided into five sections that take a closer look at 1) classifying an article as being research or based on research, 2) what use might look like in one's context, 3) examining one's bias, 4) reflecting on the credibility of the article, and then 5) making a decision about the extent to which the article meets ESSA's (2015) Tier 4 of Evidence. Within each of these sections, I highlight the rationale behind the inclusion of the various criteria from both a researcher and practitioner perspective. I

then provide direction for district-level leaders seeking to support their decisions with research and for teacher educators who are working to build the capacity of practitioners to engage with research.

The Mathematics District Leader Research Group

The Mathematics District Leader Research (MDLR) Group was an intervention meant to build the capacity of four MDLs to engage with research and promote a healthy skepticism of it. Using design-based perspectives (Cobb et al., 2003), I worked with four MDLs over the course of the 2020-2021 school year to help them make sense of articles focused on online learning. I purposely used the word *articles* and not *research articles* because it was the MDLs who designated the articles as either research, based on research, or merely advice. The discussion during the MDLR Group meetings had multiple foci. One of which was the identification of criteria for defining research and evaluating the extent to which it is credible and relevant. In what follows, I share one of the outcomes of our conversations, the *Research Reflection Tool*.

The Research Reflection Tool

Researchers and practitioners have different worldviews (Labaree, 2003) that allow them to operate within their respective domains. Practitioners have a wealth of knowledge that is deeply ingrained in contexts, relationships, and the specifics of individual classrooms and districts. In contrast, researchers tend to look for commonalities across many classrooms and contexts for the purpose of developing broad overarching theories about teaching and learning. Although each of these communities has different epistemological beliefs that have historically prevented the flow of information between them, the requirements put forth by ESSA (2015) have created a need to find common ground from which both communities can begin to build a shared understanding about research.

The Research Reflection Tool is an artifact of four MDLs' and one researcher's interactions as they came to understand research in ways that reflected their respective expertise in practice and research. The purpose of the tool was to help the MDLs critically and efficiently examine research or research based articles so that they could make informed decisions about its potential use under ESSA's (2015) Tier 4 of Evidence—*Demonstrate a Rationale*. The tool was in response to the goals of the MDL participants and was iteratively developed over the course of eight MDLR Group meetings. The tool privileges the perspectives of both practitioners and researchers about what counts as "high-quality research findings" (ESSA, 2015, p. 2091). In what follows, I share Version 2 of the Research Reflection Tool (Appendix G) and the rationale behind the included criteria from both a practitioner and researcher perspective.

Definitions Used in the Tool

Within the Research Reflection Tool, there are three words that I would be remiss if I did not define more clearly. The first word is *research*, which I defined as "an activity in which people employ systematic, empirical methods to answer a specific question" (NCRPP, 2016, p. 3). The second is *relevant*, which is the extent to which a user of the tool sees an article as pertaining to their context and/or relating to the work they do in their role. The third word requiring more clarity is *credible*, which is the extent to which a user of the tool trusts or believes what is being presented. Credible and relevant are both contingent upon a judgment made by the user of the tool which means that an article is not inherently credible or relevant because they are qualities assigned based on the judgment of an individual. These three words were topics of discussion throughout the larger study and were central to the Research Reflection Tool.

As the MDLs and I designed the tool, one of the tensions that surfaced was a desire to make a rubric-style tool in which the MDLs could evaluate an article using a 1-5 point scale or

assign a "Yes/No" designation to each criterion and then tally the responses so the tool could provide an "objective" score of *Use* or *Non-Use*. Despite this desire, we realized that making decisions about the extent to which research is credible and relevant were colored by our contexts, roles, current needs, and our personal histories of learning (e.g., beliefs, experiences). Such a realization meant that a rubric-style evaluation tool was not appropriate and seemed to diminish the agency needed to for the MDLs as they made decisions supported by evidence and research under the Tier 4 level of evidence (ESSA, 2015). Thus, this tool was created in service of reflection in support of or against using an article as evidence to support decisions.

Section 1 - Classifying the Article

The first section of the Research Reflection Tool focused on classifying an article as research, research-based, or merely advice. This section of the tool reflected the desires of the MDLs for a rubric by having a "Yes or No" option for each of the four criteria, but also provided a space for comments or concerns to give the MDLs agency in their decisions. An article needs to be classified as either research (i.e., "Yes" to all criteria) or based on research (i.e., "No" to 1a and 1b; "Yes" to 1c and 1d) in order to potentially satisfy the evidence threshold for Demonstrate a Rationale (ESSA, 2015). The four criteria in this section are based on the MDLs' perspectives of research (Wonsavage, 2021, Chapter 5) and those of the research community (e.g., NCRPP, 2016; NRC, 2002).

For each criterion, there are additional sub-questions listed that may or may not be applicable, but were purposefully included in the tool because of their potential for introducing new perspectives for district leaders to consider. For example, in 1c, the MDLs and I in the larger study had a conversation about the citations being from peer-reviewed sources in contrast to news articles and what that might mean for the strength of the evidence. The inclusion of the

sub-questions served as a reminder for the MDLs and proved helpful as they engaged with the articles.

We also considered the purpose of having a research question. As put forth by the National Research Council (2002), research questions should be significant and posed in a way that allows the question to be empirically investigated. This is no trivial matter as the research question dictates the choices made throughout a study (e.g., literature review, theoretical perspectives, data collection and analysis). Research questions are posed in response to a gap in the existing literature and employ rigorous and appropriate methods for the purpose of developing new knowledge backed by empirical support. Much like ligaments that connect the bones of the body, the research question connects the various parts of a research study (e.g., literature review, methodology, findings) and is an integral part of research.

Another criterion is the importance of peer review and publication. Peer review and disclosing one's research for others to read and critique is a hallmark of research (NRC, 2002). When research is peer reviewed it ensures that the claims being made are genuine and truthful. When research is published it becomes part of the existing literature from which future studies will build. Researchers have a duty to put forth accurate information not only for expanding the knowledge base but also so that others can trust the recommendations that they put into action. As is evident in Section 2 of the tool, the MDLs' put high value in an article offering guidance that was actionable. Inherent in MDLs putting guidance into action is that they trust it; peer review is one way to ensure that trust.

Section 2 - An Eye Towards Use

The second section of the tool asked about the extent to which an MDL could see themselves putting an article's recommendations into action and has two criteria, 2a) the extent

to which an article is relevant and 2b) the extent to which the guidance is actionable—both of which are in relation to the user. This section of the tool primarily reflects the contributions of the MDLs as these two criteria are focused on the practicality of an article rather than qualities of the research itself. Unlike Section 1, this section and the ones that follow do not use a "Yes or No" evaluation but rather ask the user of the tool to reflect on the strengths of the article and any concerns they may have with it. The rationale behind this choice was to provide MDLs with agency and autonomy by providing a space for them to think about the pros and cons of an article's relevance.

The National Research Council (2002) did not include research being relevant as a marker of research quality because of its subjectivity; it is highly temporal and contextual. More recently, researchers have come to recognize a need for research to be relevant as a criterion that practitioners readily use and have called for it to be, "an explicit criterion for judging the quality of research proposals" (Gutierrez & Penuel, 2014, p. 20). The criteria in this section align with the work of practitioners, which is steeped in district, school, and classroom contexts that require research to be relevant and actionable.

As users of this tool think about these criteria, I offer a word of caution when looking for alignment between the context under study and one's own context; mainly, there will always be discrepancies between the two. Researchers account for differences in contexts using a variety of techniques (e.g., purposive sampling, member checking, data triangulation) to increase the validity and generalizability of research (Merriam & Tisdell, 2016) so that research applies beyond the context in which it was conducted. Differences such as socioeconomic status (e.g., a 1-to-1 student/computer ratio v. 1 computer cart for an entire school) or class size (e.g., a class of 10 v. a class of 35) might be differences worth attending to; however, differences such as

geographic location (e.g., students in rural Georgia v. students in rural North Carolina) are less concerning.

Section 3 - Recognizing and Claiming Bias

Section 3 calls attention to the extent to which the article aligns with the user's beliefs, experiences, and the source from which they received the article. The MDLs drew upon these criteria throughout our discussions as they considered the extent to which they believed what was presented in an article. This section has three criteria that ask the user to think about the ways in which and to what extent 3a) the article aligns with their professional beliefs/experiences, 3b) the user is familiar with the authors or organization who wrote the article, and 3c) the source from which they received the article. Meeting these criteria increased the extent to which the MDLs judged an article to be credible as they frequently talked about trusting articles sponsored by organizations (e.g., NCTM), written by people they knew professionally (e.g., university faculty), and matched what they had seen in their own districts and classrooms.

The inclusion of these criteria on the tool is important in two respects. One being that it was evident that the MDLs drew on these criteria, and asking them to disregard them dismisses their expertise as professionals. The other is that the research community values claiming one's subjectivity and positionality. In keeping with that worldview, these three criteria allow a user to recognize their bias and claim it. Such was the case for one of the MDLs who mentioned that having the tool helped her to be a little more critical about the things she reads and takes on.

Section 4 - Reflecting on the Extent to Which the Article is Credible

The fourth section of the tool looked what was actually presented in the article and the extent to which a user finds it credible. The criteria put forth by the MDLs in this section was aligned with that of the research community and called attention to the extent that the article

matched the existing literature, the representativeness of the sample, the amount and type of data shared, and the level of detail shared about the methods. If an article was designated as research in Section 1, then there are four criteria (4a-d) to consider for the article to be judged as credible; if considered to be research-based, then only one of the four criteria (4a) may apply.

The MDLs were particularly attuned to the amount of data being shared. For the MDLs, their judgment of any given article as credible increased when they could see quotations, video clips, or artifacts from the actual participants. It allowed them to see the data for themselves rather than taking the authors' word for it that something happened. Additionally, seeing the data allowed them to overlay it on their own contexts and imagine their own teachers and students saying similar things.

Section 5 - Making a Decision About the Article

The final section of the tool provided a space for MDLs to reflect on the evidence presented throughout the article and make a decision about the extent to which the article meets the threshold for Tier 4 of Evidence - Demonstrate a Rationale (ESSA, 2015). This section of the tool was purposefully designed to be open-ended so that MDLs or other district leaders had a space to examine the evidence presented and create an argument either in support of or against the article under question. As has been noted in the literature, "evidence does not speak for itself" (Coburn et al., 2009, p.3), which necessarily means that the onus of making a decision rests with the user of the tool. The decision to use or disregard a piece of research as evidence for Tier 4 of Evidence is a nuanced process that requires MDLs to consider a variety of criteria that pertain to the article in question but also account for contextual, subjective, and relational influences. As such, this tool offers support for MDLs and other potential users as they make informed decisions about the use or non-use of an article within their local contexts.

Discussion

An anticipated question around the use of the research reflection tool is, "What is the threshold for saying that an article satisfies the Tier 4 of Evidence?" In designing the tool, the MDLs wanted a rubric-style tool in which they could follow a prescribed process for evaluating what was being presented; however, this was challenging because of the relational and subjective criteria they surfaced throughout the MDLR Group meetings. One of the positive outcomes around ESSA (2015) was that it provided autonomy and agency to practitioners as they made decisions for Tier 4 of Evidence. The policy provided a space that recognizes practitioners as professionals capable of making decisions informed by evidence. This recognition comes with serious responsibility as practitioners, and more specifically MDLs, have to rely on their own judgment as they make decisions about evidence. This tool is meant to support MDLs in that process but is unable to provide the resolute outcome that the MDLs wanted. It does, however, provide and raise a number of things to consider when presented with research or an article that is research-based. In reflecting on the power of the tool, two of the MDLs shared,

> I may read something. And I may agree with what they're saying. And, you know, I'm just reading… And so, having a tool such as that would make me think about things that I might not ordinarily consider.
>
> - Beth, Meeting 5

> [the tool] helped me think about what others might question about the article. And how could I respond? ...And so that tool sort of gave me that perspective, that I normally, probably wouldn't have with a trusted source.
>
> - Meredith, Meeting 5

Conclusion and Implications

The Research Reflection Tool is a product of the interactions of four MDLs who were hoping to build their capacity to engage with research. Through an iterative co-design process, four MDLs and I created a tool for use in their home districts anytime they were faced with making a decision. Version 2 of this tool was shared and discussed in detail.

In talking with the MDLs, they put forth a number of instances where this tool could be potentially useful. At a very localized level, the tool could be used when working with teachers within a professional learning community to make decisions about instruction. It could also be used at a district level to inform decisions about professional development offerings. The current ESSA (2015) legislation requires states, school districts, and practitioners to make instructional and programmatic decisions based on tiered levels of evidence that often come with high costs (e.g., materials, facilitators, time) in terms of financial and human capital. Thus, ensuring that these decisions are based on more than one's "gut feeling" or "best guess" is important for both accountability and capacity. This tool is meant to aid in that process by providing criteria for MDLs, or district-level leaders more generally, to critically and efficiently examine an article so that they can make informed decisions based on a blend of practitioner and researcher expertise.

CHAPTER VII: CONCLUSION

This dissertation was in response to the requirements put forth by federal legislation (e.g., ESSA, 2015) that in recent years has put a renewed emphasis on practitioners using research or evidence to support their decisions. In my own educational journey, I have noticed that much of the educational research from the past 30 years has not been taken up by practitioners in districts, schools, and classrooms. Through my review of the literature, I found that the disconnect is complicated and perpetuated by numerous factors and influences that prevent the bi-directional flow of information between the communities of research and practice. Much research has been done to understand the lack of research uptake by practitioners at multiple levels within the educational system (e.g., classrooms, schools, districts). One outcome of this work is that mid-level decision-makers (e.g., mathematics district leaders, instructional coaches) have been identified as important nodes within the educational system for enacting change (Cobb & Smith, 2008; Coburn et al., 2008; Wilson et al., 2018; Spillane, 2000). It is these mid-level decision-makers, who I refer to as mathematics district leaders (MDLs) and have been the focus of this dissertation study.

The existing structures for supporting practitioners to engage with research are insufficient for them to enact the requirements of ESSA (2015) to make research-informed decisions. In response, I subscribed to design-based perspectives (Cobb et al., 2003) in this dissertation to develop theories about learning in relation to the ways in which MDLs engage with research that are appropriate when it is unlikely for a phenomenon to naturally occur (Bakker, 2018). I designed and implemented an intervention meant to build the capacity of MDLs to engage with research by creating the conditions and supports for a group of MDLs to

make sense of research. Both of these characteristics, developing a theory of learning and designing supports for that learning, are hallmarks of DBR (Bakker, 2019).

Using an intervention guided by my five design principles, I investigated two learning conjectures that spanned the entire dissertation study and answered two research questions that looked at the phenomenon surrounding a subset of the larger dissertation study. The two research questions were, *What are MDLs' existing conceptualizations of educational research?* and *What are MDLs' revised understandings of educational research after engaging in intersubjective meaning making with a group of their like-role peers?*

My efforts to answer these research questions led to three manuscripts as well as revisions to my conjectures. The first manuscript focused on understanding the existing conceptualizations of research of four MDLs from four diverse school districts. The second looked at the ways in which the MDLs revised their conceptualizations through intersubjective meaning making over the course of the designed intervention. The final manuscript was written for a practitioner audience and offered a tool that an MDL could use to reflect on the quality of research being presented as they make decisions in service of ESSA (2015). In what follows, I offer my initial conjectures and a brief review of each manuscript. I then discuss how the findings relate to the extant literature and the implications for researchers, district-level leaders, mathematics teacher educators, and policy makers. I conclude by offering directions for future research.

Discussion of the Three Manuscripts

Initial Conjecture and Overview of Manuscript One

In response to my first research question, I conjectured that MDLs' conceptualizations of research would be similar to those described in the literature of practitioners more generally (e.g., teachers, district leaders, social workers, non-math practitioners). In the first manuscript

(Chapter IV), I explored four MDLs' existing conceptualizations of research by having them provide artifacts of research that they have used in their districts. These artifacts were classified as research by the MDLs and provided insights into their past experiences and beliefs about research and its use.

Analysis of the semi-structured, stimulated recall interviews—adapted from Vesterinen and colleagues (2010)—revealed that the MDLs' conceptualizations of research were influenced by their practitioner experiences with it. For example, the MDLs described how they operated on quick timelines, which made it challenging for them to engage with research. Thus, it seemed that the MDLs came to understand research to be a time-consuming endeavor.

The other interesting finding about the MDLs' existing conceptualizations was that there were parts of their conceptualizations that aligned with the research community's. Such was the case when the MDLs talked about wanting to hear similar messages about research from multiple sources. Looking to multiple sources within the literature to see where there is consensus or criticisms is a common practice within the research community. Although the MDLs' explanations did not go as far as reviewing the literature, there was enough evidence to say that their conceptualizations were primed and ready to emerge with a little support.

Discussion of Manuscript One and Revised Conjecture

In thinking about how the findings of the study in manuscript one align with the extant literature, there were similarities between the two. One of those is that many of the factors and influences on practitioners' conceptualizations of research appear to still hold true for a specific type of practitioner—mathematics district leaders. For example, during the initial interviews and the MDLR Group meetings the MDLs echoed many of the barriers to access mentioned in the literature when they talked about limited physical access (e.g., Shkedi, 1998), the length of the

articles being too long (e.g., Hemsley-Brown & Sharp, 2003), the academic jargon making research difficult to read (e.g., Gore & Gitlin, 2004), and their role and context seemed to dictate the extent to which they could engage with it (Coburn & Talbert, 2006).

The MDLs also talked about how they relied on social relationships when evaluating an article as being research and/or credible. For example, a national endorsement from the National Council of Teachers of Mathematics (NCTM) or a more local one from trusted individuals at the State Education Agency carried considerable weight for the MDLs in terms of the extent to which they found research to be credible and trustworthy. Although other researchers have found similar results with teachers in classrooms (e.g., Behrstock et al., 2009; Gore & Gitlin, 2004) and central office administrators (e.g., Honig & Coburn, 2008), I argue that endorsements from trusted individuals and organizations play a more central role for MDLs than previously thought.

MDLs have a considerable amount of practitioner expertise, but as I saw in this study, they are unsure of their ability to make sense of research as they have had few experiences with it. Like many novices who look to experts for guidance, MDLs turn to more knowledgeable others (e.g., organizations, university faculty) because they see them as experts steeped in research. In the teaching and learning strand of their strategic framework, NCTM clearly states that "NCTM provides guidance and resources for the implementation of research-informed and high-quality teaching" (nctm.org/About, 2021). The MDLs recognized NCTM's expertise, purpose, and long-standing history of excellence as trustworthy and credible. This same enthusiasm and trust were extended to include other private for-hire organizations by a few of the MDLs. This was a puzzling phenomenon because despite being presented with evidence that would raise concerns for researchers, the MDLs overwhelmingly found publications from private for-hire organizations to be credible. There seemed to be a number of factors that overpowered

any concerns, such as recommendations from the state education agency, past experiences with the organization, and the actionability of what was presented.

Based on the findings presented in Manuscript One (Chapter IV), I revised my initial conjecture to reflect the increased trust in a piece of research endorsed by an organization. My revised conjecture is, MDLs' conceptualizations of research are similar to those described in the literature of practitioners more generally (e.g., teachers, district leaders, social workers, non-math practitioners), but organizational endorsements are more important for MDLs than they are for other practitioners.

Initial Conjecture and Overview of Manuscript Two

In answering my second research question, I conjectured that the MDLs' conceptualizations would become more closely aligned with that of the National Center for Research in Policy and Practice (2016)[1] and reflect the markers of quality put forth by the National Research Council (Shavelson & Towne, 2002) and Gutiérrez and Penuel's (2014) notion of research needing to be relevant as they engaged with the intervention. The second manuscript (Chapter V) focused on attending to the MDLs' revised conceptualizations of research as they made intersubjective meaning with a group of their peers. The MDLs became more discerning in the ways they came to define research and determine the extent to which it is credible. Specifically, they developed a more sophisticated, shared definition of research which allowed them to distinguish between research, an article that was based on research, or merely

[1] Research is an activity in which people employ systematic, empirical methods to answer a specific question. Research bases its conclusions in investigations involving statistical data, interviews, observations, and case studies, or a combination of these. (NCRPP, 2016, p.3)

advice. Being able to classify an article proved helpful for the MDLs as they determined the extent to which they found an article credible because the criteria they used for research were different than that of an article that was based on research. They relied on subjective, relational, and objective criteria that reflected their expertise as practitioners (e.g., aligns with their beliefs) and the expertise of the research community (e.g., peer review). One of the products of the MDLR Group intervention was the Research Reflection Tool which embodied the intersubjective meaning making of the MDLs. The tool was the focus of the third and final manuscript.

Discussion of Manuscript Two and Revised Conjecture

In addition to the similarities between the findings of this study and the extant literature mentioned previously, there is one other similarity which is that research tends to be believed and taken up by practitioners more readily when it aligns with their beliefs and experiences (e.g., Zeuli, 1994, Honig & Coburn, 2008; Coburn et al., 2009). Similar to previous studies, the MDLs in this study also tended to give more credence to recommendations that aligned with their beliefs and experiences. While the MDLs did look for alignment between the research and their own beliefs when judging research to be credible, they also recognized that such a criterion was subjective. Rather than dismissing their phronesis, the MDLs embraced it as a reminder of their own personal stance and bias. Further, they decided to make it explicit in our Research Reflection Tool so that when they engaged with research that aligned with their beliefs, they had an opportunity to recognize their subjectivity. When the MDLs engaged with research, they did so through lens of their past experiences and beliefs. As the designer of the MDLR Group, I felt it would be disingenuous to dismiss their relational and subjective criteria because MDLs and practitioners use such criteria regardless of it being recognized by the research community. Thus,

it was not my intention to dismiss their previous understandings but rather to introduce them to new ideas that would hopefully trigger the sensemaking process, with the result being a revised understanding that aligns more closely with canonical perspectives of research.

There were also discrepancies between the findings of my study and the recommendations put forth in the literature. One discrepancy in particular was the push for studying practitioners' use of research (e.g., Tseng, 2012; Penuel et al., 2018). While I agree that working with practitioners on the ways in which they use research is productive, I offer a word of caution. In the original design of this dissertation study, I had intended to focus my efforts on how the MDLs used research in their contexts. I quickly found that before I could begin to work with them on use, we had to come to a common understanding about what counts as research and attend to the underlying influences surrounding their judgments about what makes research credible. This was no trivial feat as it took six MDLR Group meetings (~9 hours of discussion) and many cycles of sensemaking to clarify the ambiguity surrounding their definition of research, what makes it credible, and make their criteria for each explicit and cohesive. This finding raises a question about the existing literature which calls for focusing research efforts on practitioners' use of research. The findings of this study suggest that there are some precursors that need to be addressed prior to engaging with research use. As was the case with the MDLs in this study, they needed opportunities to make sense of what counts as research and clarify their understandings about what makes it credible before being able to think about informed use.

Finally, I want to address a common tension between practitioners and researchers with respect to the disconnect between research and practice. Much of the literature around practitioners' conceptualizations of research is framed deficitly from a researcher's perspective and focuses attention on where practitioners fall short of meeting the mark. Researchers criticize

practitioners for ignoring research recommendations, dismissing evidence, and if practitioners do take up research, they do so incorrectly (Cooper & Levin, 2010). The complaints are not one-sided; practitioners criticize researchers for putting forth research that is too theoretical and not relevant to the realities of classrooms, schools, and districts (Behrstock et al., 2009; Gore & Gitlin, 2004; Hemsley-Brown & Sharp, 2003). Despite these criticisms from both communities, the findings from this study suggest that there exists a middle ground. In working with the MDLs, they shifted their conceptualizations of research to reflect more canonical views of research held by the researcher community. For example, they incorporated peer review into their conceptualizations as a marker by which to assess research to be credible. The MDLs' willingness to incorporate researcher's perspectives into their revised understandings of research suggests that policies requiring evidence-based decisions like ESSA (2015) can potentially be a catalyst for forming new ways of working with practitioners. It also suggests that it might be worth considering what MDLs' conceptualizations might have to offer researchers.

Thus, my revised conjecture based on the findings from Manuscript Two is, As MDLs participate in the MDLR Group intervention, they will revise their understanding of research by adding more canonical notions of research to their existing conceptualizations.

Overview of Manuscript Three

Unlike the previous two manuscripts, the third manuscript was written for practitioners who work in roles that require them to make decisions at a district level that have the potential to impact schools, teachers, and ultimately students. The focus of the manuscript was sharing a tool, The Research Reflection Tool, co-designed by four MDLs and one researcher as a way to help MDLs make research-informed decisions and evaluate evidence within the scope of ESSA's (2015) fourth tier of evidence—Demonstrate a Rationale. This tool was not meant to serve as a

rubric that dictates an MDLs' course of action but rather meant to surface things to consider and reflect upon when engaging with and considering research.

Implications

My work with the MDLs during this dissertation study has implications for multiple stakeholders who may be interested in taking up this work. In what follows, I offer implications of my findings for researchers, district-level leaders, mathematics teacher educators, and policy makers who are interested in building the capacities of the communities they serve.

Researchers

This study has three implications for researchers who want practitioners to use their findings. The first of which is research needs to provide actionable guidance. The MDLs throughout the dissertation study repeatedly talked about how research needed to provide them with actionable guidance. When the MDLs were classifying the articles, the part they attended to most was the guidance. Given the contexts in which MDLs and practitioners more generally work, they need research to be actionable and the recommendations to be readily applicable.

The MDLs also wanted to see a considerable amount of detail with regard to the data, description of the participants, and contexts in which the study was conducted. Thus, my second recommendation is that researchers should make a point to provide as much detail as possible when sharing the contexts and participants under study. Further, I would add that researchers should provide as much of the data as they can in their writing. The MDLs in this study were vocal about their appreciation for studies that shared actual quotations from participants because it allowed them to see for themselves that what the authors were saying was true, and it allowed them to envision how the teachers in their own districts might respond.

Finally, I recommend that researchers find alternative open-access venues to publish their research and any corresponding data. During one of the MDLR Group meetings, we watched an

ancillary video that was not part of the publication, but it corresponded with one of the focal articles we read in preparation for Meeting 7. The response was overwhelmingly positive from the MDLs because they could see the actual participants for themselves doing and saying what the authors had portrayed in the written article. Watching a video was powerful for the MDLs and increased their trust in what was being presented in the article.

District Level Leaders

My second set of recommendations is for MDLs and District Level Leaders more generally. First, this dissertation study would not have been possible without capitalizing on professional relationships between researchers and individuals within school districts, and because of that, I would highly recommend that District Level Leaders extend a hand in partnership to local universities and researchers. Researchers and especially those that subscribe to design-based perspectives are willing to partner with and build relationships with local school districts. Such a recommendation is a long-term goal as establishing relationships with various stakeholders takes time and establishing a history of trust.

Second, there are a set of recommendations that require fewer resources (e.g., time, human capacity) and can be implemented on much shorter timelines. One such recommendation would be to create a culture of research use within one's school district. Putting this recommendation into action would require valuing research and making it known publicly. One way to do that would be to provide protected time for instructional coaches and/or lead teachers to read and engage with research. This could be incorporated into existing professional learning communities, or it could be structured more similarly to a book club in which the coaches and lead teachers would meet monthly to discuss a piece of research. Promoting a culture of research use also means making a point to privilege evidence-based decisions that go beyond using

standardized test scores. When Tier 4 of Evidence decisions need to be made, seek out research and/or experts in the field who could provide some direction or guidance. All of these recommendations would have low start-up and maintenance costs.

My other recommendation for District Level Leaders is that when faced with having to make decisions (e.g., picking a curriculum or professional development offerings) use a research evaluation tool (e.g., Applicability of Evidence-Based Interventions Tool, Accessing & Assessing Research and Evidence Tool, REL at WestEd, 2020) like the Research Reflection Tool to reflect from both a practitioner and researcher perspective on the evidence being presented. Take time to evaluate the claims or recommendations being made and think about where others might be critical. Under ESSA's (2015) fourth tier of evidence, practitioners are required to support their decisions with "high-quality research findings" (p. 2091), and such decisions typically have high costs (e.g. monetary, human capacity) of enactment. Thus, I recommend that District Level Leaders take a critical lens when examining recommendations and claims using the Research Reflection Tool prior to making decisions. I conclude this section by offering a word of caution; be critical of the recommendations put forth by organizations, especially private, for-hire organizations. Before putting the recommendations and claims of organizations into action, look at the evidence they use to support their claims. Why should you believe what they are saying? Go through the tool and reflect on the various criteria before making a final decision.

Mathematics Teacher Educators

For Mathematics Teacher Educators, I offer things to consider for when working in classrooms with pre-service and in-service teachers. My first recommendation is to think about opportunities within existing courses that could be improved by incorporating research into the

conversation. Undergraduate and Master's degrees are largely oriented towards practice which means that future and current teachers in these programs do not get a lot of exposure to research. Students need time to read, engage with, discuss with peers, and have opportunities to determine what makes research credible.

I also recommend making research explicit when working with teachers in professional development settings. Whether it's reading excerpts from research articles or merely calling attention to the citations during a presentation, it is important for practitioners to know the information being shared is research and where they can go to find more information.

Additionally, I encourage Mathematics Teacher Educators to establish and maintain relationships between districts and universities. University faculty are a resource that the MDLs valued and turned to when they needed support. The support offered could be done in a variety of ways such as providing professional development offerings or simply offering to be a research intermediary and provide research on an as-needed basis. From a programmatic perspective, support could look like a post-master's certificate that MDLs could earn that was focused on building their capacity to engage with research and make research-informed decisions.

Policy Makers

My final recommendation is for policy makers and pertains to the incentives and sanctions included in reform policies. ESSA (2015) established requirements that mandated that practitioners' decisions be supported by evidence and research and included severe financial penalties for districts that fall short of the expectation. Such policies should also include resources and support to build the capacity of practitioners to meet the policy goals. As I saw in my review of the literature and in this dissertation study, practitioners and my four MDL participants respectively had few experiences with research but by mandate of the federal policy

were still expected to use research. The goals of policies aimed at educational improvement would be better served in both the short and long term if they included resources to develop the human capacity of educators.

Direction for Future Research

In what follows, I present direction for future research in regard to two questions that spurred my interest going forward with understanding the MDLs' revised understandings of research. The first of my two questions is, "What did I not have an opportunity to learn but wish that I had?" The answer to this question stems from my original design that was focused on MDLs' use of research. Specifically, the MDLR Group intervention that I planned was not the intervention that I enacted. The intervention that I had hoped to enact was focused on the MDLs' use of research. Towards the end of the study, I caught glimpses of the MDLs using research as they talked about how they had used something we had talked about previously in their contexts. Sometimes this was actual use, and sometimes it was the MDL sharing something that prevented them from using research.

One of the challenges of having the MDLs think about use was that it often occurred in inauthentic situations. For example, in Meeting 4, I created a fictional scenario to get the MDLs thinking about use; however, such a scenario was missing the situatedness of the district contexts in which the MDLs work. This meant that it was difficult to get the MDLs to authentically engage with it as it lacked much of the needed contextual details that factor into the MDLs' decision-making process. I would have liked to be able to watch the decision process unfold for the MDLs as they had to make real decisions. For example, Meredith talked about a number of opportunities in her district to make research-informed decisions. Such decisions often seemed to be made by her superiors which meant that she was evaluating the decision after the fact to see if it was informed by research rather than the converse as ESSA (2015) requires. In future studies,

it would be interesting to follow the MDLs as they are presented with upcoming decisions or evaluating decisions in the past. Gathering this data would be helpful to see the weights that were given to various criteria in the moment. Although there were a number of conversations about assigning different weights to the criteria in the reflection tool, the MDLs and I did not come to a resolution. A possible conjecture going forward would be that the MDLs give more credence to their experiential knowledge more so than that of the research community. For example, does alignment with an MDL's beliefs outweigh poor quality research? Does misalignment with an MDL's beliefs devalue research that is of high quality?

The second of my questions of interest is thinking about what is next for the MDLR Group intervention and the Research Reflection Tool? I would like to use version two of the tool with another set of MDLs and get feedback so that I can iterate it again. Long-term, I think the reflection tool has potential for serving as a focal point of professional development for MDLs or district leaders more broadly. In order for that to happen, I want to iterate the tool again so that it has the utility that MDLs need, more accurately reflects their expertise, and raises criteria that they might want to consider.

One of the tensions that this long-term plan surfaces is one that I talked about previously in regard to researchers having to decide whether to provide a taken-as-shared definition of research or allow the MDLs to surface their own definitions. Within a professional development setting, the facilitator would have to provide a taken-as-shared meaning of research because it would be logistically impossible to do otherwise. Such a decision does raise an interesting point, because in my initial design, I purposefully provided the space for the MDLs to create their own definition of research. In doing so, they were afforded a number of opportunities for

sensemaking. Had I provided them a research definition, those opportunities might not have happened.

The other long-term goal that I would like to see come to fruition is to develop a university course for MDLs or district leaders more generally. Such a course would provide opportunities for MDLs to become more acquainted with research so that they can have more agency when making decisions that fall within the scope of ESSA (2015). The MDLs repeatedly talked about how they were unsure about what counts as research and, at times, struggled to have confidence in their decisions about making a designation. Their uncertainty signals to me that such a course is necessary because ESSA (2015) or policies like it will only become more prevalent.

In summary, future research needs to look at MDLs' use of research. Like other researchers have noted, practitioners' use of research is promising for addressing the gap between research and practice. The contributions of this study provided some much-needed insights into how this process could potentially unfold.

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APPENDIX A: MDLR GROUP ANNOTATION GUIDE – MEETING 6

MDLR Group Annotation Guide - Meeting 6

The following article was written by Zane Berge and was published in the journal, *Educational Technology* in 1995. At the time, Zane Berge worked as the Director for the Center for Teaching and Technology at Georgetown University in Washington DC. As we talked about during Meeting 3, 4, and 5, please think about the green sentences from our latest draft of the Evaluation/Credibility/Research Tool as you read the article. As you read, highlight or comment on instances of boosted credibility **(Green)**, decreased credibility **(Pink)**, and parts of the article that you want to discuss with the MDLR group **(Blue)**.

Educational Research is…
done in response to a variety of different teaching, learning, and educational issues/topics or for the purpose of finding a solution to a problem or more information in general, utilizing qualitative and/or quantitative data.
Additions to our definition:

- Need to include the word, "systematic" or something about METHODS
- What happened? What did the authors do? Where is the evidence?
- Provides guidance or a summary for educators; actionable!!!!
- Does "organized" meet the need for "systematic"?
- "Authentic" …distinguishing between research and research based.

Updated after Meeting 5 (12/14/20)

1. Based on our revised definition of educational research, is the Berge (1995) article, *Facilitating Computer Conferencing: Recommendations From the Field* a piece of educational research? Research-based? Good advice? Something else? Why or why not?

2. Are there any revisions you think we need to make to our definition?

3. Circle/Mark/Highlight YES or NO for the statements from the Evaluation/Credibility/Research Tool that the Dorn et al. (2020) article checked for you? Which ones did it miss (See Research Eval Tool V3)?

4. On a scale of 1 to 5, with 1 being low quality and 5 being high quality, how would you rate the overall quality of the Berge (1995) article? Why?

5. What (if anything) from this article would you want to share with your math teachers in an afterschool 90 minute PD session? How might you relay the information?

APPENDIX B: MEETING 2 – SAMPLE MEETING AGENDA

<table>
<tr><td colspan="3">Meeting 2 - Sample Meeting Agenda</td></tr>
<tr><td colspan="3">Prior to the Meeting:
- Read Rehn, Maor, & McConney (2018) “The specific skills required of teachers who deliver K–12 distance education courses by synchronous videoconference: implications for training and professional development”</td></tr>
<tr><td>Time</td><td>Activity</td><td>Prompts</td></tr>
<tr><td>5 minutes</td><td>Welcome</td><td>Welcome (Introductions w/ AL)

Revisit Group Commitments
- Respect each others’ contributions
- Okay to be uncertain; comfortable with uncertainty
- Open to new ideas, discussion, and recognizing that different perspectives have value
- Recognize that our learning is in progress

Paul’s Commitments
- Practitioner knowledge is valuable
- Access to research is important
- Making sense of and translating research is hard, hence the need for support and collaboration within our community</td></tr>
<tr><td>10 minutes</td><td>Revising our definition of research</td><td>List the revised definitions (from each MDL)

Educational research is…
- Done in response to an issue or to find a solution to something
- Has been done on a variety of topics (a lot of volume)
- Tries to answer a question and is supported by quantitative and/or qualitative data
- The data is used in support of answering a question</td></tr>
<tr><td></td><td></td><td>Questionnaire Responses:
- Research in education is about asking questions on teaching and learning, collecting and analyzing data, and summarizing the findings to provide guidance to educators. Meredith
- I feel that best practices have endured as major research topics through the years with technology changing how we present information to students and how researchers present information to us. Beth
- Research in education can be found to support any idea or belief that one has; therefore it can be confusing. Leah
- The sheer volume of "research" makes it difficult to identify and implement</td></tr>
</table>

		methods with fidelity for the targeted issue; education seems to move onto the next best thing rather than really let the method play out and have "quality research" Christine
30 minutes	Research Talk Time: Markers of quality, credibility, trustworthiness The purpose here is to see if anything else comes up about credibility, quality, etc. that I can add to the list of things.	I want to spend the next 30 minutes discussing the quality of what you read from Rehn, Maor, & McConney (2018). ~~What were your initial reactions?~~ - I noticed across your annotations that there were questions about context in terms of...content, grade band, blended F2F and remote, rural setting, etc. Let's talk about these points of tension. - Is the research credible? Do you believe what the authors were saying? Why or why not? - What were the specific aspects of the article that promoted credibility? - What were the specific aspects of the article that decreased credibility? - Is this piece of research high quality? Why or why not? - Rank on scale 1-5 - What convinced you to change your rating or keep it the same? Based on our conversation last week, I compiled a list of all the things that y'all mentioned that either promoted credibility or decreased it. [Show list] - Is there anything we want to add to or remove from the list based on our conversation about the Rehn et al. article?
20 minutes	Research Translation Time: Translating the article to one's context	This article puts forth some recommendations in terms of what teachers must be able to do in terms of 4 different roles: Pedagogical, Managerial, Social, Technical. - What were your thoughts about these 4 different roles? Do you agree with the findings of the article that teachers must have these to be successful online teachers? - Did anything presented in the article make you think differently about the skills teachers need to teach online? - Based on your responses on the Annotation Guide, ___ of you said that you would give your approval if your district wanted to implement the recommendations in the article. What did you take under consideration when making your decision? - How might the information presented in this article translate to your own district context? What might it look like? How would you take it up, if at all?
20 minutes	Professional Learning Task:	I'd like to now take a few minutes and dig a little bit more into the research questions in this study, *"What specific skills do K–12 videoconference teachers require to*

	I decided to dig into the RQs here b/c it is the first quality marker in the NRC's list and I am trying to get them to see that the research question is more than a check box of yes/no.	*create a successful learning environment for distance students?"* *"What are the implications for professional development and training?"* - Were the authors able to answer these questions in their study? Why or why not? - The authors used a collective case study approach (Stake, 1995) to conduct interviews, observations, and take field notes. Do you think these data collection methods were appropriate for answering the research questions? - Are the research questions worth asking? - What might the potential benefit from answering these questions? For whom? Imagine that rather than the research question the authors asked, they had asked the question, *"Should K-12 teachers be required to have specific videoconference skills when teaching in distance learning environments?"* - What data would they need to answer this question?
10 minutes	What questions about the topic do you still have?	Morge, Schwartz, & Hargrove (2019) "Strategies and Tools for Promoting Discourse During Mathematics Problem-Solving in Online Settings" Morge, S. P., Schwartz, C. S., & Hargrove, T. (2020). Strategies and Tools for Promoting Discourse During Mathematics Problem-Solving in Online Settings. In *Handbook of Research on Online Pedagogical Models for Mathematics Teacher Education* (pp. 216-233). IGI Global.

APPENDIX C: INITIAL QUESTIONNAIRE

To better understand the ways mathematics district leaders interact with mathematics education research, please respond to the following questions about how you define, evaluate, and use mathematics education research in your current role.

Demographic Information:

1. Name
2. Years of experience in education
    a. 0 - 5
    b. 6 - 10
    c. 11 - 15
    d. 16 - 20
    e. 20+
3. How many of those years have you been in a mathematics district leader role at the school or district level? _____
4. What is your job title? _____
    a. Briefly describe what your job duties entail. _____
5. Are you the sole person in your role in your district?
    a. Briefly explain_____
6. Do you have a website by which you communicate with your mathematics teachers?
    a. Yes
    b. No
    c. If yes, please list: _____
7. Where did you receive your undergraduate degree? _____
    a. Title of degree _____
    b. Did you have any research experiences? Yes/No
        i. If yes, please describe._____
8. Graduate degree:
    a. Yes
    b. No
9. If yes, where did you receive your graduate degree?_____
    a. Title of degree _____
    b. Did you have any research experiences? Yes/No
        i. If yes, please describe._____
10. **In no more than one sentence, how would you define research in education?**- (short answer)
11. **Provide an example of a piece of research that you have encountered recently.** (short answer)

[Definition of Research]

For the purpose of this questionnaire I would like to use the following definition of educational research:

Research is an activity in which people employ systematic, empirical methods to answer a specific question. Research conclusions are based in investigations involving interviews, observations, case studies, statistical data, or a combination of these. Research can appear in books, academic journal articles, practitioner-oriented journals, and analyses of program implementation. It can also appear in policy and evaluation reports or presentations.

For this study, we differentiate between research that involves systematic inquiry to answer a specific question from the practice of looking at data from the district, school, or classroom, which is more open-ended and seldom addresses specific research questions. For example, looking at state standardized test results to identify concepts in need of more attention would be formative assessment but not research necessarily. However, asking the question "what is the relationship between fourth grade state standardized test results and high school graduation?" would be research.

12. **Which of the following features of a specific piece of research do you take into consideration when assessing its credibility?** (Pick top 3 choices):
    a. Methods in which the research was conducted
    b. The presence of citations
    c. The context in which the research occurred
    d. The amount of data presented (tables, quotes, graphs, transcripts, figures, etc.)
    e. The length of time in which the research was conducted
    f. The sample size
    g. The evidence to support the claims being made
    h. The ease in which I can read the research
    i. The ease in which the research is actionable
    j. How long the research as been around
    k. Whether or not it aligns with my teaching philosophy
    l. Whether or not other people in my school, district, or state are using it
    m. Whether or not it is supported by an organization (NCTM, NCCTM, NC DPI, NC2ML, NCSM)
    n. The person who shared the research with me
    o. The format in which the research is presented (article, book, presentation, blog, etc.)
    p. Where the research was published
    q. Other _____
    r. None of these

13. **I typically consider a piece of research to be trustworthy when it comes from…** (Pick top 3 choices)
    a. An author that I know personally/professionally
    b. An author that is sponsored by a university
    c. A researcher(s) that is/are passionate about their research
    d. A trusted colleague
    e. My principal or assistant principal
    f. A district level math leader or math coach

g. the North Carolina Department of Public Instruction (NC DPI)
h. A curriculum/textbook company
i. A tweet that has been hashtagged with #MTBoS (Math-Twitter-Blog-o-sphere)
j. The North Carolina Collaborative for Mathematics Learning (NC2ML)
k. Someone I know personally/professionally
l. Someone I follow on social media (e.g. Facebook, Instagram, Twitter)
m. A presentation at a professional conference
n. A school, district, or state sponsored professional development
o. A professional organization (e.g. NCTM, NCCTM, AMTE, NCSM, or their websites)
p. An author/teacher/leader who has acquired fame in the math ed community at large
q. None of these
r. Other _____

14. **When I seek out research, the top 3 places I look for it are from…** (rank-order 1, 2, 3)
a. Someone that I know personally/professionally
b. Someone that I do not know personally/professionally
c. A district or school level math leader or math coach
d. A professor at a university whom I have not met
e. A professor at a university whom I have met
f. NC DPI
g. Math Educators who have published books
h. A professional organization (NCTM, NCCTM, AMTE, NCSM, or their websites)
i. Someone I follow on Twitter
j. The Math Teacher Blog-o-Sphere (#MTBOS)
k. A presentation at a professional conference
l. A curriculum/textbook company
m. A principal or assistant principal
n. The North Carolina Collaborative for Mathematics Learning (NC2ML)
o. A school, district, or state sponsored professional development

15. **In the last year, I used mathematics education research to...** (Likert Scale 1-4; Never (1), rarely (2), sometimes(3), often(4))
a. Convince others of my view(s)
b. Support a previous decision I made
c. Support math curricula, policies, or program decisions
d. Discredit math curricula, policies, or program decisions
e. Explain something to a parent or community member
f. Mobilize support for important mathematics education issues
g. Think about a problem, issue, or solution in a different way
h. Inform a decision based on the research evidence
i. Fulfill requirements put forth by a grant or funding source
j. Fulfill requirements put forth by my school or district

k. Improve my teaching practice in relation to content and/or pedagogy
l. Have an informed conversation with my colleagues (face to face or online) about best teaching practices

16. One of the outcomes of this study is to help build the practice of using research in one's professional context. Recognizing that there are a lot of potential topics and research areas that we can explore, **what is the most pressing/important topic for you in your role as a mathematics district leader over the next year that you would like to see us work on together (e.g. cognitive demand of mathematical tasks, supporting teachers to teach online)?** (short-answer)

APPENDIX D: THREE ARTIFACTS OF RESEARCH USE

MDLs use research in a variety of different ways within school contexts as they interact with teachers, schools, parents, communities, and district level administrators. In an effort to understand how MDLs use research within these interactions, I am asking that you provide three artifacts from your practice that are supported by research. More specifically, please provide one artifact from each of the categories listed below:

Provide an artifact supported by research (pick 3 from 4 options) that represents an instance in which…

- You were interacting with teachers
- You were making decisions at the school or district level
- You were interacting with a parent, community member, or school board
- You interacted with research for your own learning

**Artifacts might include, but are not limited to a PowerPoint presentation that you used during a PD, an email to a colleague, a video you created, evaluation rubrics, curricular resources, etc.*
***If the artifacts have any identifiers on them (e.g. email addresses, names) please remove them prior to sharing them with me.*

Artifact #1 - _____ (File name)	
This artifact is an example of an instance where I was… *Highlight 1	● You were interacting with teachers ● You were making decisions at the school or district level ● You were interacting with a parent, community member, or school board ● You interacted with research for your own learning
Please provide a brief description of how you see the artifact being supported by research	

Artifact #2 - _____ (File name)	
This artifact is an example of an instance where I was… *Highlight 1	● You were interacting with teachers ● You were making decisions at the school or district level ● You were interacting with a parent, community member, or school board ● You interacted with research for your own learning
Please provide a brief description of how you see the artifact being supported by research	

Artifact #3 - _____ (File name)	
This artifact is an example of an instance where I was… *Highlight 1	● You were interacting with teachers ● You were making decisions at the school or district level ● You were interacting with a parent, community member, or school board ● You interacted with research for your own learning
Please provide a brief description of how you see the artifact being supported by research	

APPENDIX E: INITIAL INTERVIEW PROTOCOL - LEAH

Initial Interview Protocol - Leah

1. First, I wanted to say thank you for taking time to talk with me and find these 3 different artifacts. I know you are super busy, so please know that I really appreciate you. During this interview, I am going to be asking you some questions about the 3 artifacts you submitted **in terms of the research that these artifacts embody.** I am also going to be asking some questions to try to more fully understand your questionnaire responses. Is it okay with you that I video record our conversation?
2. (Have Leah share her screen showing the first artifact) The first artifact you shared with me was a PPT slide deck about a Foundations of Math Training. You said that this artifact was an instance of you interacting with research for your own learning. Can you give me some more information about this artifact to help me understand how the research it embodies increased your own learning?
    a. In your description of the artifact, I know you mentioned John Hattie's work as being an example of research embodied in this artifact. Was there other research embodied in this artifact?
    b. It sounds like this presentation might have inspired you to dig deeper into the work of John Hattie. Can you talk about what convinced you it was worth the deep dive?
    c. Do you consider the research presented in this artifact to be high quality? What convinced you?
3. Thank you for helping me understand artifact 1 in more detail, now I'd like to shift our attention to your second artifact, if that is okay? (Have Leah share her screen showing the 2nd artifact) Your second artifact was a K-8 Math Curriculum Mapping Agenda and was an example of you making decisions at the school or district level. Can you give me some more information about this artifact to help me understand it?
    a. From your description, it sounds like this artifact was in response to learning loss due to COVID-19. You mentioned the TNTP: Learning Acceleration Guide as putting forth recommendations based on research as a way to address accelerating students to grade level. Can you talk about the decision to use the TNTP recommendations?
    b. What made these research based recommendations credible for you?
    c. In this artifact, there was a lot of information and links to documents. I'll admit, I was only able to look at some of them. With that said, were there other instances of research in the artifact besides what was put forth by TNTP?

4. (Have Leah share her screen showing the 3rd artifact) Now I would like to shift focus to the 3rd artifact in which you were interacting with teachers. You provided an email that seemed to recap some in-person PD that occurred and provide resources and links to information.

a. You mentioned sharing data from the NAEP and PISA assessments as being examples of research studies that were discussed with teachers. Can you talk about where you were introduced to these studies?
b. Do you think that these studies are credible? How do you know?
c. In the artifact, you also shared a number of different readings from Dr. Faulkner, Dr. Clements, Carol Dweck, and some book chapters from Liping Ma. Where did you find these readings?
d. What was your rationale for sharing these specific readings?
e. Do you consider these readings to be research? Why or why not?
f. At the end of your email, I noticed you said, "Never say anything a student can say!" Being an outsider of your context, it felt like there might have been some backstory to this, can you talk about what that sentence means?

5. (Share Leah's survey responses) At this point, I'd like to shift focus to some of your responses on the questionnaire. First, I saw that you described educational research as being confusing because it can be found to support any idea or belief that one has. Can you talk more about what you meant?
6. In the question that asked to provide an example of piece of research that you encountered recently, you offered Carol Dweck's Growth Mindset and her Mindset Scholars Network. Can you talk about why you consider this example to be research?
7. In the question that talked about credibility, for your top 3 choices you picked:
    - Methods in which the research was conducted
    - The evidence to support the claims being made
    - Whether or not it is supported by an organization

    a. In terms of methods, can you elaborate on what you look for in a study's methods to determine credibility? Are there specific things?
    b. When evidence is presented in research, what convinces you of what is being said?
    c. Can you tell me more about why you picked, whether or not research is supported by an organization, when assessing the credibility of research?
        a. I apologize for jumping back and forth here, but I noticed that in Artifact #2, there were some organizations listed:
            i. Achievement Network
            ii. TNTP
            iii. Achieve the Core

    What about these organizations makes them credible to you?

APPENDIX F: RESEARCH REFLECTION TOOL (VERSION 1)

<table>
<tr><td colspan="4">The Research Reflection Tool (Version 1)</td></tr>
<tr><td colspan="4">The following tool is to be used any time decisions are being made in which research is being used to substantiate decisions. This tool has two parts, 1) to determine if an article is educational research, research-based, or simply advice, and 2) to determine the credibility of the information being presented.</td></tr>
<tr><td colspan="4">Definition of Educational Research: Educational research is either an authentic response to teaching, learning, and academic topics or for the purpose of finding a solution to a problem; each includes the methodology in collecting and utilizing qualitative and/or quantitative data to provide actionable guidance for educators.
*An article that falls short of being considered educational research might be research-based in which the article pulls from past research to make recommendations or provide advice. Such recommendations may have not been implemented.</td></tr>
<tr><td colspan="3">Classifying the Article</td><td>Notes/Comments:</td></tr>
<tr><td colspan="3">1a) The article is an authentic response to teaching, learning, and educational topics or for the purpose of finding a solution to a problem. This is evidenced by:</td><td></td></tr>
<tr><td colspan="3">[Authentic]
- The authors collected data of their own
- The authors are following the methodological process and presenting their findings rather than presenting the findings of someone else’s work</td><td>YES or NO</td></tr>
<tr><td colspan="3">[Response]
- The authors have read the literature to see what is currently known about the topic, and the new study asks a question that is in response to what is currently known.</td><td>YES or NO</td></tr>
<tr><td colspan="3">1b) The article includes the methodology. This may be evidenced by:
- There was a systematic process for the way in which the study was carried out (e.g. study design, participants, methods, length of study)
- A description of the types of data collected and the way it was collected
- A description of how the data was analyzed</td><td>YES or NO</td></tr>
<tr><td colspan="3">1c) The article provides qualitative and/or quantitative data. Evidence of this criteria might include:
- Seeing excerpts, vignettes, quotations, data tables, graphs, etc. that qualify and/or quantify the person, place, or object under study.</td><td>YES or NO</td></tr>
<tr><td colspan="3">1d) The article uses the data to provide actionable guidance for educators. This may be evidenced by:
- A section of the article titled conclusion, implications, findings
- The author(s) providing advice, suggestions, recommendations, etc. that can be taken up and used by the reader</td><td>YES or NO</td></tr>
<tr><td>This article is…
(Circle/Highlight one)</td><td>Educational Research

Comments/Justification:</td><td>Research-Based

Comments/Justification:</td><td>Advice

Comments/Justification:</td></tr>
</table>

Before Evaluating Credibility	Educational Research	Research-Based
2a) The article is relevant to my context. This could be evidenced by: - *The extent to which the article offers guidance to educators* - *The extent to which the guidance pertains to my current job or what I am currently working on* - *The extent to which I can apply the article recommendations to my context* **Relevance is subjective, temporal, and highly contextual to the individual*	**YES or NO** **Notes/Comments:**	**YES or NO** **Notes/Comments:**
Credibility Checklist **Credibility is –** " the quality of being trusted or believed in, the quality of being convincing or believable"		
3a) The article aligns with the findings of or is supported by previous research and calls attention to underdeveloped areas in the literature. This could be evidenced by: - *In-text citations* - *Reference Lists* - *University support or author pedigree* - *Reputable funding sources (e.g. NSF)* - *Gaps in the literature* - *The extent to which the findings have been replicated in other studies*	**YES or NO** **Notes/Comments:**	**YES or NO** **Notes/Comments:**
3b) The article aligns with my professional beliefs and/or my professional experiences in educational settings. Evidence of this might look like: - *I could hear my teachers/students saying the things presented in the article* - *I have seen the same events occur in my setting or context*	**YES or NO** **Notes/Comments:**	**YES or NO** **Notes/Comments:**
3c) The study is conducted with a sample of individuals that accurately represents the population for which the implications are intended. This could be determined by looking at: - *The sample size of the study* - *The extent to which the sample is representative of the population*	**YES or NO** **Notes/Comments:**	**N/A**

- *The extent to which the context of the study matches the K-12 educational setting* - *The amount of information shared about who the participants and the context in which they operate (e.g. grade level, content)* - *The ways in which the participants were recruited to participate*		
3d) The article presents authentic actual data from participants. Evidence of this criteria can be might include: - *More than a single interaction, vignette, excerpt* - *Multiple examples, quotations, etc.* - *Video evidence* - *Providing examples of raw data; actual quotations* - *Providing both confirming and disconfirming examples* - *Claims/Conclusion/Implications are supported by the evidence present in the article* and don't overreach	**YES or NO** **Notes/Comments:**	**N/A**
3e) The article presents a thorough description of the methods, data collection process, and data analysis. This could be evidenced by: - *A description of how the study was carried out (e.g. length of study, case study, study design)* - *A description of the types of data collected and the way it was collected* - *A description of how the data was analyzed*	**YES or NO** **Notes/Comments:**	**N/A**
3f) The article has undergone the peer review and publication process and was published in a research journal. This may be evidenced by: - *Requirements for publication* - *A statement of peer review* - *Length of time between article submission and publication* - *Journal Title*	**YES or NO** **Notes/Comments:**	**YES or NO** **Notes/Comments:**

3g) I know the authors/organization that wrote the article and I know where they stand in terms of their professional beliefs. Examples of this might be: - *I know them personally* - *I recognize them as experts in the field*	**YES or NO** **Notes/Comments:**	**YES or NO** **Notes/Comments:**
After Evaluating Credibility		
4a) The article is relevant to my context. This could be evidenced by: - *The extent to which the article offers guidance to educators* - *The extent to which the guidance pertains to my current job or what I am currently working on* - *The extent to which I can apply the article recommendations to my context* **Relevance is subjective, temporal, and highly contextual to the individual*	**YES or NO** **Notes/Comments:**	**YES or NO** **Notes/Comments:**

APPENDIX G: RESEARCH REFLECTION TOOL (VERSION 2)

The Research Reflection Tool (Version 2)	
This tool is to be used any time a district level leader needs to make evidence-based or research-informed decisions as put forth by Tier 4 – Demonstrate a Rationale (ESSA, 2015). This tool has 5 sections, 1) Classifying the Article, 2) An Eye Towards Use, 3) Recognizing and Claiming my Bias, 4) Reflecting on the Credibility of the Article, 5) Making a Decision About the Article	
1) Classifying the Article: - Answering "YES" to all four criteria (1a-d) is evidence to classify the article as a piece of **Educational Research**. - Answering "NO" to 1a and 1b is evidence to classify the article as **Research-Based**. - Answering "NO" to three or more criteria is evidence to classify the article as **Advice**.	
1a) Does the article pose a research question that can be answered empirically? Things to consider might include: - *Is the research question explicitly stated?* - *Can the necessary data be collected answer the research question?* - *What data would you expect the authors to collect to answer the question?*	**Circle one: YES** or **NO** Comments/Concerns:
1b) Does the article employ systematic, empirical methods in service of answering the research question? Things to consider might include: - *What was the process for the way in which the study was carried out (e.g. study design, participants, methods, length of study)?* - *What types of data were collected? Does the data help answer the research question?* - *How the data was analyzed?* - *To what extent do the authors share excerpts, vignettes, quotations, data tables, graphs, etc. that qualify and/or quantify the person, place, or object under study?*	**Circle one: YES** or **NO** Comments/Concerns:
1c) Are there citations and/or a review of the existing literature on the topic? Things to consider might include: - *To what extent have the authors shared what is currently known about the topic?* - *Have the authors identified a gap in the literature that their study hopes to fill? What is it?* - *Are the citations from peer reviewed sources? Blog posts? News articles? Websites?* - *To what extent are the citations appropriate and relevant to the content being shared?*	**Circle one: YES** or **NO** Comments/Concerns:
1d) Was the article submitted for peer review? Things to consider might include:	**Circle one: YES** or **NO**

- *Where was the article published (e.g. a journal, website, blog, magazine)?* - *What was the process for peer review (e.g. double blind, one or more reviewers, no process)?*			Comments/Concerns:
This article is… (Circle/Highlight one)	**Educational Research** Evidence/Justification/Comments:	**Research-Based** Evidence/Justification/Comments:	**Advice** Evidence/Justification/ Comments:

<table>
<tr><td colspan="3">2) An Eye Towards Use – To what extent can you see using this article in your own context?</td></tr>
<tr><td rowspan="2">2a) In what ways and to what extent is the article relevant to my context? Things to consider might include:
- Does the content of the article pertain to the work I’m currently doing or my current job?
- To what extent does my context match the study’s context? The participants match my teachers/students? (e.g. SES, geographic location, public v. private school, class size)
*It is rare for the sample to be equal to your own; however, it’s very possible to have samples that are roughly equivalent.</td><td>Strengths:</td><td>Concerns:</td></tr>
<tr><td colspan="2">Comments:</td></tr>
<tr><td rowspan="2">2b) In what ways and to what extent does the article provide actionable guidance? Things to consider might include:
- What might the recommendations look like in my own context?
- What can I use immediately and what needs to be modified to fit my context?
- What resources will I need to put the recommendations into action?
- How much time will putting the guidance into action require of me? My instructional coaches? My teachers?
- What are the potential challenges of putting this into action?
- What parts of the guidance align with what I am currently doing?
- What parts of the article do more harm than good?
- How will I get people on board with implementing the recommendations?
*Guidance might be within sections of the article with official titles like, Findings, Implications, and/or Conclusion. They also might be mentioned more informally.</td><td>Strengths:</td><td>Concerns:</td></tr>
<tr><td colspan="2">Comments:</td></tr>
<tr><td colspan="3">3) Recognizing and Claiming Bias – To what extent do my personal beliefs and experiences influence my perception about the article and/or authors who wrote it?</td></tr>
<tr><td>3a) In what ways and to what extent does the article align with my professional beliefs and/or my professional experiences in educational settings. Things to consider might include:
- Could I hear my teachers/students saying the things presented in the article?
- Have I seen the same or similar things in my own setting or context?</td><td>Strengths:</td><td>Concerns:</td></tr>
</table>

<table>
<tr><td>- Is the author affiliated with a university or trusted organization?
- Are the authors qualified to make the claims being put forth in the article (e.g. experience in education)?</td><td colspan="2">Comments:</td></tr>
<tr><td rowspan="2">3b) To what extent am I familiar with the authors or organization that wrote the article? Things to consider might include:
- What are the professional beliefs of the author?
- What is the professional stance of the organization (e.g. mission statement)?
- Are the authors/organization experts in the field?
- What are their other published works?
- To what extent does my bias (positive or negative) about the author or organization influence my judgment of this article?</td><td>Strengths:</td><td>Concerns:</td></tr>
<tr><td colspan="2">Comments:</td></tr>
<tr><td rowspan="2">3c) To what extent does the source from which I received the article influence my judgment of the article? Things to consider might include:
- Did I receive the article from a trusted source (e.g. colleague, higher ed faculty, state/district level admin) who has used the recommendations?
- Why do I trust the person who gave me the article?
- Did I receive the article from a research journal? Research database? An internet search? Social media? An organization? Blog? Private company?
- Am I hearing the same message from multiple sources about the article?</td><td>Strengths:</td><td>Concerns:</td></tr>
<tr><td colspan="2">Comments:</td></tr>
<tr><td colspan="3">4) Reflecting on the Extent to Which the Article is Credible – To what extent do you believe what is being presented?</td></tr>
<tr><td rowspan="2">4a) In what ways and to what extent does the article align with previous research? Things to consider might include:
- Does the author call attention to underdeveloped areas in the literature and/or identify a gap that this article fills?
- Who does the author cite in the in-text citations?
- What other research is cited in the reference section?
- Where did the funding for the study come from (e.g. NSF)?
- Have other research studies found similar things as this article?</td><td>Strengths:</td><td>Concerns:</td></tr>
<tr><td colspan="2">Comments:</td></tr>
</table>

<table>
<tr><td colspan="3">*If the article is research-based, then the following three criteria (4b, c, d) may not apply.</td></tr>
<tr><td rowspan="2">4b) In what ways and to what extent is the sample of the study representative of the larger population. Things to consider might include:
- What was the sample size of the study?
- To what extent is the sample representative of the larger population?
- What information was shared about the participants and the context in which they operate (e.g. grade level, content)?
- How were the participants recruited to participate?
- Are the claims of the study sample appropriate to the larger population?</td><td>Strengths:</td><td>Concerns:</td></tr>
<tr><td colspan="2">Comments:</td></tr>
<tr><td rowspan="2">4c) In what ways and to what extent does the article present actual data. Things to consider might include:
- How much and what types of data were collected (e.g. multiple interview(s), a single interaction, observations over months, survey)?
- Does the article provide multiple examples and actual quotations?
- Does the article provide video or audio evidence?
- Does the article provide tables, graphs, and/or figures?
- Are they both confirming and disconfirming examples shared?
- Are the claims/conclusion/implications supported by the evidence present in the article and don’t overreach?</td><td>Strengths:</td><td>Concerns</td></tr>
<tr><td colspan="2">Comments:</td></tr>
<tr><td rowspan="2">4d) To what extent does the article present a thorough description of the methods, data collection process, and data analysis. Things to consider might include:
- Did the authors provide description of how the study was carried out (e.g. length of study, case study, study design)?
- Did the authors have a systematic process for collected and analyzing the data?</td><td>Strengths:</td><td>Concerns:</td></tr>
<tr><td colspan="2">Comments:</td></tr>
</table>

5) Making a Decision About the Article – Does the article provide evidence that meets the criteria for "high quality research findings" as put forth by ESSA's (2015) fourth tier of evidence, Demonstrate a Rationale?		
5a) Why do you believe what is being said to be of higher or lesser quality?	5b) What do you consider to be the strengths of this article?	5c) What are your concerns or hesitations?
5d) My decision about this article is…	5e) My justification with evidence for my decision is….	

APPENDIX H: THE DESIGN OF THE MDLR GROUP

My overarching goal for the MDLR Group intervention was to build the capacity of four MDLs to engage with research so that they could make informed decisions in service of ESSA's (2015) Tier IV of Evidence. To accomplish my goal, I designed the MDLR Group intervention as a set of meetings in which four MDLs were provided the space to read research and research-based articles and then discuss with a group of their peers. These discussions were multi-purposed, allowing the MDLs to learn about the content of the articles, make sense of what educational research is, and determine what makes it high-quality. I begin this chapter by highlighting my assumptions of learning and learners before delving into the details of my design choices and rationales for the focal articles and agendas for Meetings 1 through 6.

Design-Based Research

Design-based research (DBR) is rooted in sociocultural perspectives which recognize that learning is situated in contexts (Brown, 1992; Collins et al., 2004). It aims to produce theory that is readily applicable to the work of practitioners by not studying what currently exists, but rather what could be by creating the conditions by which to test an innovation (Cobb et al., 2003). DBR has drawn criticism from traditional laboratory researchers who argue issues of generalizability or validity due to uncontrolled variation (Collins et al., 2004); however, it is the uncontrolled nature of working in real contexts that gives it strength. Research that accounts for the variability of real classrooms can yield more robust interventions that are usable in practice (Cobb et al., 2003). Through an iterative design process guided by theory and principles derived from the literature, conjectures are made, tested, and revised with the ultimate goal of designing features of an intervention and investigating how they work to produce learning (Cobb et al., 2003; Collins et al., 2004).

DBR is an appropriate methodological choice for this study because I am trying to better understand the ways MDLs engage with research. ESSA (2015) has put requirements on MDLs to use research to support and inform their decisions; however, the current structures are such that they have few opportunities to do so. Thus, I am testing an intervention to imagine what the structures to support MDLs in this process could potentially look like. My hope is to generate theories of learning about MDLs' conceptualizations of research and to design a set of supports to build their capacity to engage with research.

In what follows, I share the design of the Mathematics District Leader Research (MDLR) Group and the rationale behind my design decisions. I begin by sharing my initial learning conjectures and assumptions about the MDLs as learners, the knowledge I wanted them to learn, and the process by which I engineered learning. I then visit the structure of the MDLR Group design to provide context for my five design principles and the accompanying key features that embodied the principles. I then detail my iterative process for designing the MDLR Group Meetings 1 through 6 as I looked for evidence to confirm or refute the initial learning conjectures.

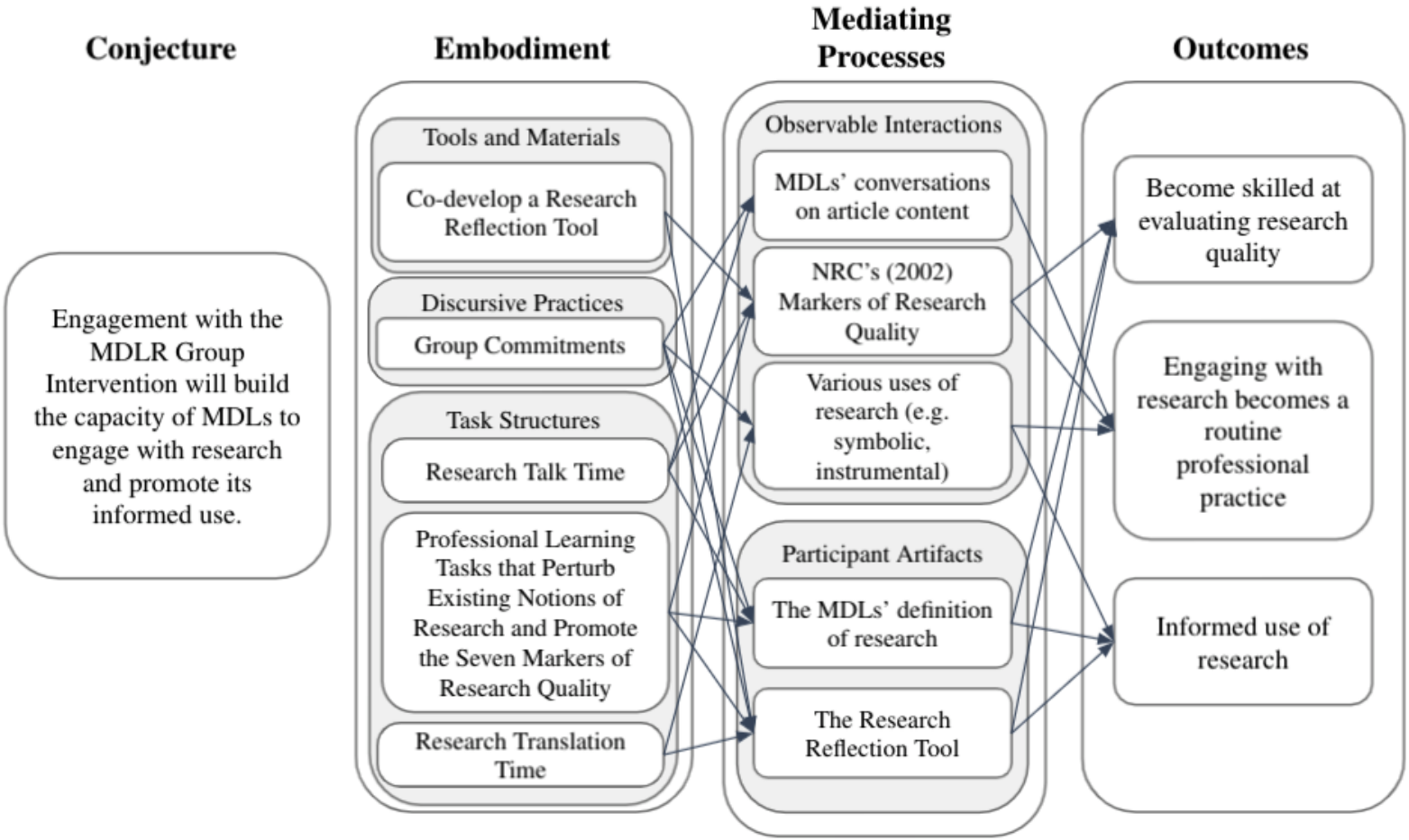
Design of the MDLR Group

Initial Conjecture Map for the MDLR Group

In recent years, conjecture mapping (Sandoval, 2014) has become popular among design researchers as productive technique for tracing the evolution of a conjecture over the course of the design of a DBR study (e.g., Bakker, 2018; Lee et al., 2018; Wonsavage et al., 2018). According to Sandoval (2014), a conjecture map has six major related elements: *a high-level conjecture, embodiments* of that conjecture, *design conjectures* that lead to the identification of *mediating processes, theoretical conjectures,* and *outcomes*. Collectively, these elements reduce

and organize the complexity of a design into concrete, salient pieces. My initial conjecture map for the MDLR Group is in Figure H.1 below.

Figure H.1. Initial Conjecture Map of the MDLR Group



A *high-level conjecture* is one's best educated guess for how to create and support learning (Sandoval, 2014). As was the case for the conjecture map for the MDLR Group intervention, my high-level conjecture was "Engagement with the MDLR Group intervention will build the capacity of MDLs to engage with research and promote its informed use." The second element of the conjecture map is the embodiment which is when the high-level conjecture is given tangible form within various elements within the learning environment (e.g., *tools and materials, task and participant structures, discursive practices*) (Sandoval, 2014). As shown in Figure H.1, the embodiments of my high-level conjecture were key features of the MDLR Group Design which I categorized in terms of tools and materials, discursive practices, and task structures. The arrows leading from the embodiments to the mediating processes are my design conjectures which are too large in quantity to include within the conjecture map; however, they are detailed throughout the chapter. Fourth, the mediating processes of a design connect the design of the learning environment to the anticipated outcomes by identifying observable evidence of learning. Such evidence can be categorized in terms of *observable interactions* and/or *artifacts from participants* (Sandoval, 2014). In Figure H.1, I identified three observable interactions that I expected to unfold as the MDLs discussed during the meetings. I also believed that I would see evidence of the MDLs' learning as I looked at artifacts: *their definition of research* and *the criteria they included in their Research Reflection Tool*. As can be seen below, there are arrows connecting the mediating processes to the outcomes. These arrows are theoretical conjectures that hypothesize that if/when the mediating processes occur, then they will lead to the given outcomes (Sandoval, 2014). Like the design conjectures, the theoretical conjectures are too abundant to explicitly include in the conjecture map; however, they are described throughout the chapter. The final element of the conjecture map is outcomes—the

anticipated and hoped for result of the design. In the case of the MDLR Group intervention, I hoped to see the MDLs become *more skilled at evaluating research quality* and *incorporate research into their professional practice* with the goal being *informed research use*.

The conjecture map shown in Figure H.1 is my initial version of how I mapped the MDLR Group intervention and was informed by my pilot work and knowledge of the literature. I revisited this conjecture map at the end of Meeting 1 and again at the end of Meeting 6 to revise it in response to the MDLs' responses during the initial interviews and their interactions over the course of the study.

Learning Conjectures

This dissertation study was guided by two broad conjectures of learning focused on the MDLs' engagement with research. These conjectures were informed by my knowledge of the literature surrounding the Research to Practice Gap, my pilot work with mathematics practitioners' existing understandings of educational research, and my experiences with educational research during my graduate studies. My two conjectures are:

> *Conjecture One:* MDLs will have similar conceptualizations of research to those ascribed to practitioners more generally in the literature (e.g., teachers, district leaders, social workers, non-math practitioners).
>
> *Conjecture Two:* Engagement with the MDLR Group intervention will build the capacity of MDLs to engage with research and promote its informed use.

Conjecture One is addressed in Chapter IV and revised in Chapter VII as all of the evidence to confirm or refute this conjecture was collected during the initial interviews. Thus, this conjecture was not included in the conjecture mapping and not a focus of this design chapter. In what follows, I share my chronological design journey in looking for evidence to support or refute my

second conjecture which was revised after Meeting 1 and again after Meeting 6. Both of the revised conjecture maps are shared and discussed as they occur chronologically within the design of the MDLR Group intervention. In what follows, I offer my assumptions, a brief overview of the MDLR Group intervention, design principles, key features, and how the design unfolded chronologically over the course of the dissertation study.

Assumptions of the MDLs as Learners and of the Design

As the designer of the MDLR Group Intervention, there was a set of assumptions that I had about the MDLs, the knowledge that I hoped for them to learn, and the process by which I engineered learning. My assumptions were based on my knowledge of the literature, my previous pilot work, and my theory of learning. They played a fundamental role in the design of the MDLR Group Intervention and are as follows:

Assumption 1. The MDLs will be willing and open to becoming more skilled at evaluating research.

Assumption 2. The MDLs' conceptualizations of research are primarily based on their practitioner experiences and expertise.

Assumption 3. The MDLs will benefit from having opportunities to interact and discuss with their like-role peers.

Assumption 4. Using examples and non-examples of research will perturb the MDLs' existing understandings of research and trigger the sensemaking process.

Assumption 5. It is important for the MDLs to clarify their criteria for defining research and determining what makes it credible.

Overview of the Design of the MDLR Group Meetings

The purpose of the MDLR Group was to build the capacity of four MDLs to engage with research so that they could make informed decisions that meet the threshold of evidence for Tier IV of Evidence (ESSA, 2015). I designed the MDLR Group intervention and its activities to trigger sensemaking for the four MDLs as they engaged with one another to make intersubjective meaning. The design process for the intervention was iterative and informed by the literature on the Research to Practice Gap and the intersubjective meaning made by the MDLs. In what follows, I share a brief overview of the MDLR Group intervention to provide context for my set of design principles and key features before sharing a detailed chronological account of the design decisions and rationales for each of the six MDLR Group meetings.

The MDLR Group intervention consisted of four MDL participants and one researcher who met eight times over the Fall 2020 and early Spring 2021 semesters. This dissertation study looks at a six meeting subset of the eight meetings (Meetings 1 – 6). The meetings were conducted on a video conference platform and lasted approximately 90 minutes. A schedule of the meetings with the focal articles is shown in Table H.1 below.

Table H.1. MDLR Group Meetings and Focal Article

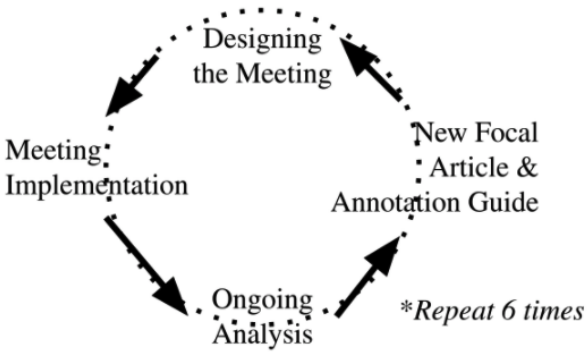
Meeting	Month	Focal Article	Article Title
Meeting 1	October 2020	Jung & Brady (2020)	Maintaining rich dialogic interactions in the transition to synchronous online learning
Meeting 2	October 2020	Rehn, Maor, & McConney (2018)	The specific skills required of teachers who deliver K-12 distance education courses by synchronous videoconference: Implications for training and professional development
Meeting 3	November 2020	Morge, Schwartz, & Hargrove (2020)	Strategies and tools for promoting discourse during mathematics problem-solving in online settings

Meeting 4	December 2020	Martin, Wang, & Sadaf (2020)	Facilitation matters: Instructor perception of helpfulness of facilitation strategies in online courses
Meeting 5	December 2020	TNTP: Learning Acceleration Guide (2020)	Learning Acceleration Guide
		Dorn, Hancock, Sarakatsannis, & Viruleg (2020)	COVID-19 and student learning in the United States: The hurt could last a lifetime
Meeting 6	February 2021	Berge (1995)	Facilitating computer conferencing: Recommendations from the Field

Prior to each meeting, the MDLs were provided with a focal article and were asked to read, annotate with a digital reference tool, and respond to questions (see Appendix A for an example annotation guide) about the article prior to the meeting in which it was discussed. Participants were encouraged to use the digital reference tool's features to highlight and make comments throughout the articles. The articles were selected based on the needs of the participants (e.g., a focus on online teaching and learning) and in response to the literature on practitioners' notions of research.

The design and enactment of the meetings followed a cyclical process (see Figure H.2 below) of designing the meeting, implementing the design, conducting ongoing analysis, selecting the new focal article, and revising the annotation guide.

Figure H.2. Design and Enactment Cycle



Using Meeting 1 as an example, the design process began by using my knowledge of the literature and the MDLs' initial interviews to design Meeting 1. I then implemented the design with the MDLs in mid-October 2020. Following the meeting, I watched the recording of Meeting 1 and recorded evidence to support or refute my conjectures in my conjecture log. From that ongoing analysis, I selected a new article for the MDLs to read, revised the annotation guide for the upcoming meeting, and then designed Meeting 2. I repeated the process for each of the six MDLR Group meetings used in this dissertation.

I also drew upon three resources more broadly as I tried to expose the MDLs to notions of research that aligned more closely to those of the academic research community. I mention them here to claim my subjectivity and recognize that I purposefully drew on the markers of research quality (Shavelson & Towne, 2002), Penuel and colleagues' (NCRPP, 2016) definition of research, and Gutiérrez and Penuel's (2014) call for research needing to be relevant to practitioner audiences as I made my design choices.

Design Principles of the MDLR Group

Participation within the MDLR Group involved engagement with a set of tasks and activities that included reading and analyzing research articles, engaging in discussion with peers, and thinking about how the research might be applied to one's context. This process was guided by five design principles that specify qualities/characteristics that I embodied in the design. The five design principles are as follows: (a) build a collaborative and supportive community of mathematics district leaders; (b) value the expertise and practitioner knowledge of mathematics district leaders; (c) provide access to educational research; (d) build the capacity of mathematics district leaders to critically evaluate educational research; and (e) collaboratively develop translational meanings of educational research, which I describe in detail below.

Design principle 1: A supportive and collaborative community provides opportunities for learning to occur

Funding and accountability models have historically created and perpetuated a culture of competition among school districts in which educators work in silos rather than in collaboration (e.g., Daly & Finnigan, 2011). Such structures make it challenging for MDLs to interact with their like-role peers because they are often the only person in their role within their district and run counter to the fact that learning is an inherently social process (National Academies of Sciences, Engineering, and Medicine; 2018). This design principle was in response to these existing structures and was meant to promote collaboration and positive interactions between MDLs.

Design principle 2: The expertise and practitioner knowledge of mathematics district leaders is valuable

There is an epistemological tension between researchers and practitioners (Labaree, 2003) that often results in researchers dismissing practitioner knowledge (Levin, 2013). This principle challenges this perspective and recognizes that practitioners have extensive knowledge of the contexts in which they work. This principle proactively addresses the epistemological tensions between practitioners' and researchers' knowledge (Korthagen, 2007; Cain, 2017; Gore & Gitlin, 2004).

Design principle 3: Access to educational research dictates the extent to which practitioners can engage with it

Practitioners find educational research to be inaccessible because they do not have physical access to it (Heid et al., 2006; Honig & Coburn, 2008; Shkedi, 1998) and researchers use academic jargon in their writing (Hemsley-Brown & Sharp, 2003; Gore & Gitlin, 2004;

Vanderlinde & van Braak, 2010). The third design principle is meant to address practitioners' lack of access to educational research with respect to both of these roadblocks by providing physical access to and creating a space for MDLs to interact with their like-role peers around a common research or research-based article.

Design principle 4: Mathematics district leaders need support to be able to critically evaluate educational research

ESSA (2015) has put renewed pressure on MDLs to ensure that their decisions are informed by research; however, the support for MDLs to do so has been limited. The ways in which policy defines research is misaligned with the definitions of MDLs. MDLs define research broadly to include student achievement data, practitioner knowledge, testimony from experts (Honig & Coburn, 2008); whereas, policy subscribes to a much more narrow definition of what counts (e.g., randomized control trials, quasi experimental studies). The misalignment between the two is problematic for MDLs as they try to meet the ESSA (2015) policy requirements. As such, the fourth design principle is meant to help MDLs navigate this tension.

Design principle 5: Translating educational research into practice is an active process that requires collaboration with others

The final design principle stems from the implementation literature and recognizes that local adaptation is necessary as individuals make sense of, interpret, and implement new policies (Berman, 1982; Greenhalgh et al., 2004; Spillane, 1998). As MDLs engage with research, they do so by drawing on their past experiences and beliefs which are typically oriented towards practitioner perspectives and less so towards research (Gore & Gitlin, 2004; Korthagen et al., 2006). It is within this realm that I situate this design principle and call attention to the need to support MDLs as they take on the work of translating research to practice.

Key Features of the Design

Using my five design principles, I designed an intervention with three key features that embodied the design principles and were grounded in the literature on the Research to Practice Gap, practitioners' conceptualizations, and their use of research. I elaborate on each of the key features below.

Feature 1: Professional Learning Tasks that Perturb Existing Notions of Research and Promote the Seven Markers of Research Quality

Throughout the MDLR Group meetings, there were a variety of tasks meant to help the MDLs navigate the various factors (e.g., barriers to access, the extent to which research is credible, role/context) that make engaging with research challenging (Design Principles 3, 4). These tasks were designed to provide counterexamples that triggered the sensemaking process for the MDLs as they made intersubjective meaning of the cue. Using counterexamples as cues to disrupt the MDLs' existing conceptualizations, I meant to prompt them to take action and revise their current understandings to more closely align with notions of research held by the research community.

Feature 2: Research Talk Time and the Co-development of a Research Reflection Tool

During each MDLR Group meeting, there was time reserved for the MDLs to make sense of their definitions of research and discuss what makes research credible, trustworthy, and relevant (Design Principles 1, 2, 4). To help facilitate the intersubjective meaning making process, I designed questions and prompts based on my knowledge of the literature and the MDLs' existing understandings to introduce them to more canonical conceptualizations of research. A consequence of the MDLs making intersubjective meaning was that they surfaced a need for a tool to help them reflect on the quality of research when making decisions in service

of ESSA (2015). This tool was co-developed by the four MDLs and me using an iterative co-design process and was informed by the conversations during the MDLR Group meetings.

Feature 3: Research Translation Time

The third key feature designated time for the MDLs to think about how they might apply what they read in the focal articles to their local contexts (Design Principles 1, 2, 4, 5). To aid in their sensemaking process, I created fictional, real-life situations in which they might need to use research and posed questions meant to have them reflect on taken and/or missed opportunities for research in their contexts.

The MDLR Group Meetings

The MDLR Group meetings were loosely partitioned into sections that corresponded to the key features of the MDLR Group design. The partitions varied in quantity and length for each of the meetings, but in general, each meeting generally followed the same order.

The first 5-10 minutes of the meetings (Feature 3) served as a welcome and check-in time. During the check-in, I would ask the MDLs to share a time in which they were able to implement a research recommendation we had read previously, a time in which they saw an opportunity for research, a time in which something prevented them from using research, or something of the like in the past few weeks.

Second, the MDLs spent roughly 30-40 minutes of time revising their definition of research based on their new understandings from the focal articles and making intersubjective meaning (Feature 2). As they engaged in sensemaking, I would type what they said into our Google Slide presentation for each meeting. The MDLs also discussed the extent to which they found the article credible, trustworthy, and relevant during this time (Feature 1).

Third, the MDLs spent 20-30 minutes of each meeting discussing how they might use (or not use) the research recommendations in their own contexts (Features 1 & 3). To aid in this

process, I designed fictional, but realistic question prompts that MDLs might encounter on a daily basis. For instance, in Meeting 4, the MDLs were given a fictional scenario of a teacher coming to them after Thanksgiving and saying "I just don't know what to do about this online teaching thing. The things that I normally do when I am face-to-face with my students just aren't working." I then asked the MDLs, what, if anything, from the article would they suggest to this teacher and why?

Fourth, about 10-20 minutes involved the MDLs co-designing a tool (Feature 2) that allowed them to reflect on their understanding of research in terms of whether or not they considered an article to be research, to what extent they found the article to be credible, and pertaining to their contexts (Feature 1).

The final 5-10 minutes of the meeting focused on any outstanding questions, picking a direction for the next focal article, and scheduling the next MDLR Group meeting (see Appendix B for a sample meeting agenda). After each meeting, I shared a new focal article for the MDLs to read and annotate before the next meeting. I also would review the recording of the meeting and design the forthcoming annotation guide in response to the conversation and sense made by the MDLs. I would then share it with the MDLs via email along with a calendar invite for the next scheduled meeting.

My role during the meetings was that of an Observer as Participant (Merriam & Tisdell, 2016; Adler & Adler, 1998) in which I participated in the MDLR Group as a peripheral member whereas the MDLs were full members of the group. As such, my participation in the group was limited to asking probing and clarifying questions of the MDLs. For example, it was typical for me to re-voice a MDL's idea and say "Did I understand that correctly?" or for me to ask "MDL,

can you explain a little bit more about what you meant when you said…?" whereas the MDLs were full participants.

Design Choices and Rationales for MDLR Group Meetings 1 – 6

In the following section, I provide a chronological walkthrough of my design decisions throughout the MDLR Group intervention. I begin by sharing my design decisions and rationales for Meeting 1. After Meeting 1, I realized that I needed to revise my initial conjecture map based on the initial interviews and the ongoing analysis of Meeting 1. Thus, I share my revised conjecture map before continuing to elaborate on my rationale for the focal articles, provide a commentary on my design choices with attention to the design principles and key features, and share the evidence to support and/or contradict my conjectures from my ongoing analysis for the remaining five meetings (Meetings 2-6). I conclude this chapter with my final conjecture map which presents a retrospective view of the high-level conjecture across Meeting 1-6.

Meeting 1

In preparation for the first MDLR Group meeting in mid-October 2020, I selected a focal article, created an annotation guide, and designed the activities of the meeting. In what follows, I share the design decisions and summarize how the design of the first MDLR Group meeting unfolded. I then provide my action steps for the upcoming meeting.

Article Rationale

Prior to Meeting 1, I had the MDLs read Jung and Brady (2020) which was a case study of one mathematical content course for pre-service K-8 teachers that discussed the authors' process for maintaining dialogic interactions as they transitioned their face-to-face mathematics content course to an online environment during the onset of the COVID-19 pandemic. My

rationale for selecting the Jung and Brady (2020) article was based on the MDLs' initial interviews, my design principles, the extant literature, and my theory of learning.

In the initial interviews, the MDLs described a need to learn more about online teaching and learning within the COVID-19 context, thus I chose this article because of the similarities between the context and because of the focus on online learning within the mathematics domain. Second, I knew from the literature that lengthy research articles were a barrier for access for practitioners in general and that finding time to engage with research is challenging (Behrstock et al., 2009; Cain, 2017; Gore & Gitlin, 2004; Hemsley-Brown & Sharp, 2003; Nelson et al., 2009; Nutley et al., 2007; Rickinson, 2005; Sin, 2008). Thus, for Meeting 1 I picked a short article (~8 pages) for the MDLs to engage with because I wanted to acknowledge that their time is valuable (Design Principle (DP) 3) and wanted to proactively address barriers to access. Third, I realized that peer review had not been mentioned in the MDLs' initial interviews and I wanted to surface it in hopes of having them add it to their criteria for determining if an article is credible. Finally, I wanted to provide them with a journal article rather than proceedings or a book chapter because I wanted to privilege journals as sources for research.

Design of Meeting 1

During the first MDLR Group meeting, I attended heavily to creating a trusting community of learners (DP 1) because I wanted the MDLs to feel comfortable interacting with one another. I provided opportunities for the MDLs and me to share about ourselves and develop a set of commitments that we all agreed to follow. After the initial introductions, we began co-developing a shared definition of research (DP 4) by looking at the four MDLs' definitions of research in a word-cloud format and doing a "Notice and Wonder" protocol (Rumack & Huinker, 2019) to make sense of the existing understandings of the group. One outcome of this

activity was that the MDLs realized that they had varied definitions of research and that they needed to come to a shared understanding so they could engage with one another. This was the first of many conversations across the meetings in which the MDLs got clearer about their definitions of research through discussion, reading articles, and interacting with one another. During each meeting, there was time set aside for them to clarify their understandings of research and revise their group definition as new ideas were surfaced in conversation (DP 1).

Following the discussion around their shared definition of research, I used question prompts to have them discuss the content of the article, the extent to which they believed what was presented, if the article was relevant or useful, the quality of the article, and determine if the article was a piece of research (DP 2). My purpose for posing question prompts related to these ideas was that I wanted the MDLs to start thinking about evaluating the quality of research and the various aspects that they may want to consider when doing so (DP 2). For example, topics of discussion they surfaced during this time were the small sample size and the participants being pre-service teachers. By providing the space for these discussions, the MDLs began to interrogate their notions of what makes research credible and relevant as they shared their expertise (DP 2) and supported one another in making sense of what they read (DP 4).

One of my goals for the study was to co-develop a reflection tool that the MDLs could use in their districts to help them critically evaluate educational research (DP 4). I knew from the literature (Furtak & Heredia, 2014) that MDLs needed to be invested in the tool if I wanted them to use it, which meant that I needed to purposefully design for their investment. In their annotations for Meeting 1, I noticed that the MDLs found it challenging to pass judgement on the article. In response, I decided to capitalize on this tension as I designed the slide deck for Meeting 1 by explicitly asking them “What was challenging about making a judgement call on

quality?" During the ensuing conversation, the MDLs came to the realization that a tool could be helpful for them to make sense of research and reflect on what makes it credible, useful, and relevant (DP 4). Examples like this, where I asked questions in response to the ideas they surfaced in their annotations, were common within the design of the meetings and were productive avenues for helping the MDLs build their capacity to engage with research.

Ongoing Analysis

After Meeting 1, I watched the recording of the meeting and used my conjecture log to reflect on the MDLs' sensemaking about their definitions of research, what makes it credible, relevant, and plan my next steps for Meeting 2 and the co-development of the research reflection tool. My initial conjecture was that as the MDLs engaged with the MDLR Group intervention, their conceptualizations of research would shift to more closely align with the conceptualizations of the research community (e.g., NCRPP (2016) definition of research, NRC's (2002) markers of research quality). From the recording, I found the following evidence to support and contradict my initial conjecture (See Figure H.3 below).

Figure H.3. Meeting 1 Conjecture Log

Evidence to support of the initial conjecture:

- The MDLs called attention to the fact that the article did not undergo peer review
- The literature review was distracting at first for the MDLs, but it provided helpful information for making sense of the findings
- Statements within the article were supported by in-text citations and other research
- The study provided a limited amount of data from which they drew their conclusions; only 2 months of data collection; representativeness of the sample is questionable
- In the MDLs' bulleted list for research definition, they mentioned that research tries to answer a question

Evidence to contradict the initial conjecture:

- The research may not be applicable because it was not done in K-12 classrooms
- Quality research is done on a larger scale than a single case (e.g. one classroom)
- The reputation of the university in which the authors work and the source of funding influences the extent to which they found the article credible

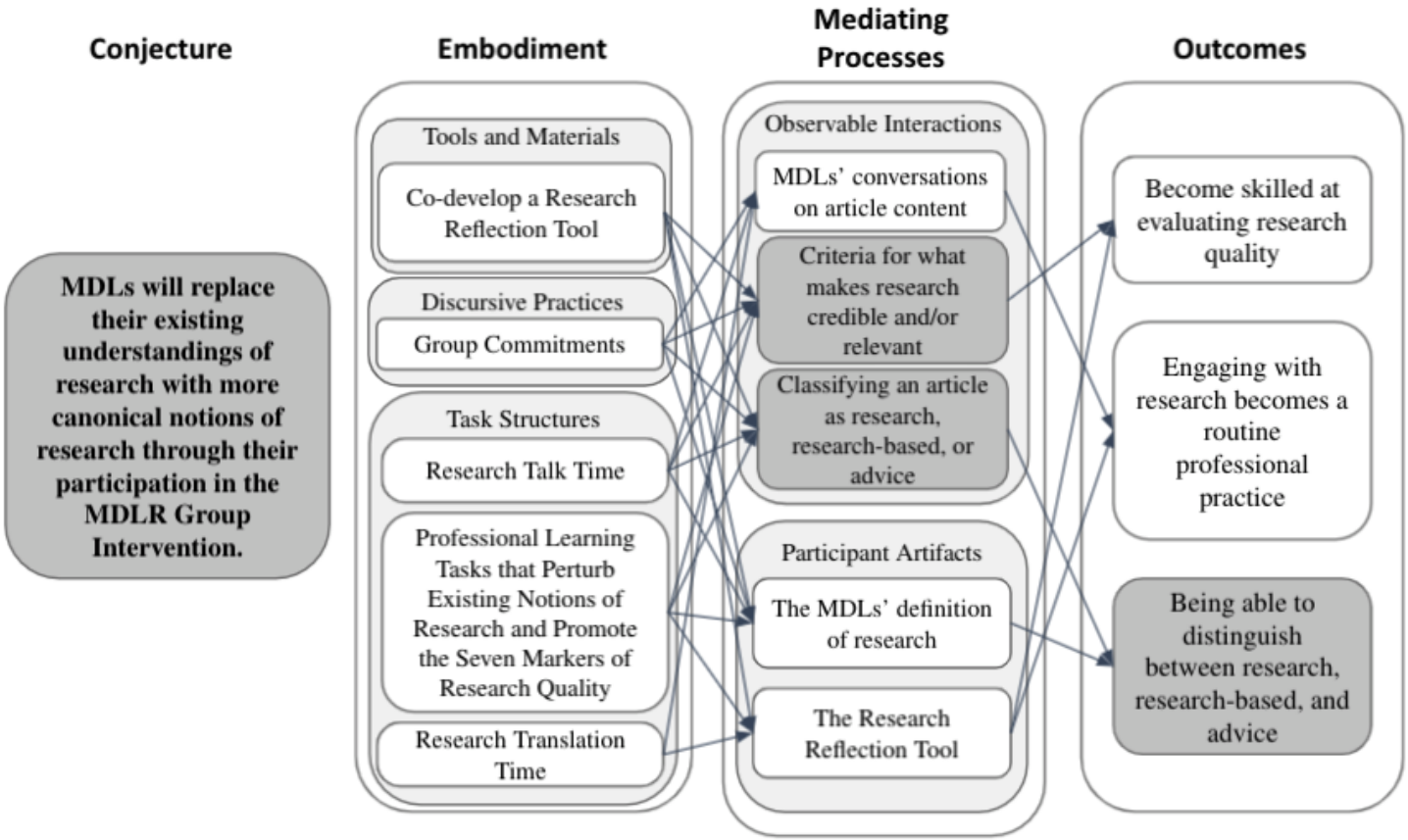
As can be seen in Figure H.3, the MDLs attended to the lack of peer review, the in-text citations, and the limited amount of data shared within the article. These three things I considered to support my initial conjecture. In contradiction, the MDLs were weary of the extent to which the findings would apply to their setting, took issue with the small sample, and saw the endorsements of universities and funding agencies as contributing to the extent to which they found the article to be credible.

Revised Conjecture Map Based on Initial Interviews and Meeting 1

After Meeting 1, I decided to revise my initial conjecture to get more specific about the learning that I was trying to engineer and respond to the needs of the MDLs. When I formulated my initial conjecture, I was unsure of the specific needs of the MDLs and because of that I decided to phrase the conjecture broadly. After the initial interviews and Meeting 1, I realized that *building the MDLs' capacity to engage with research* meant that they needed opportunities to get clearer about what counts as research and what makes it credible. I also realized that *promoting informed use* was going to require some pre-requisite knowledge. Thus, I decided to revise my high-level conjecture to say "MDLs will replace their existing understandings of research with more canonical notions of research through their participation in the MDLR Group Intervention." Although I had intended to make informed research use a primary part of the intervention, I realized that the MDLs would be better served if they were afforded opportunities to clarify their unsettled notions of research. Thus, informed research use took a secondary, more implicit role in the revised conjecture map.

The new high-level conjecture meant a few changes to the mediating processes and the outcomes of the MDLR Group intervention. As shown in Figure H.4 in dark gray, I shifted my primary focus away from research use and towards criteria for evaluating research quality and classifying research.

Figure H.4. Revised Conjecture Map Based on Initial Interviews



Note: Changes from the previous iteration are highlighted in dark gray.

Meeting 2

The second MDLR meeting occurred in late October 2020; about two weeks after the initial meeting. At the end of Meeting 1, the MDLs agreed to a common annotation structure in which they would use green to highlight parts of the article they found credible, pink to highlight parts of the article that they were skeptical, and blue to highlight parts that they wanted to talk about in more detail during the upcoming meeting. Prior to Meeting 2, the MDLs read an article (Rehn et al., 2018) that provided a set of specific skills that teachers need to be successful in navigating synchronous online environments. As the MDLs read the article, they used the agreed-upon color scheme for their annotations using an online reference tool and responded to the annotation guide questions.

Article rationale

In picking the focal article for Meeting 2, I attended to the needs of the MDLs and tried to address a variety of factors associated with barriers to access, the MDLs' definition of research, context, and criteria for deeming an article to be credible. First, the Rehn et al. (2018) article was meant to address the MDLs' concerns in Meeting 1 about the study not being conducted in a K-12 context and done only with a single class. Rehn and colleagues' (2018) study was conducted with eight classrooms of teachers who taught in K-12 contexts. Second, the literature on practitioners' conceptualizations of research is clear that research needs to be relevant and useful (Behrstock et al., 2009; Coburn et al., 2009; Gore & Gitlin, 2004; Honig & Coburn, 2008; Shkedi, 1998; Zeuli, 1994). This article met that need by offering a list of actionable skills that I thought the MDLs could take and use immediately in their local contexts. Third, I wanted to surface the idea that research is guided by a research question (Shavelson & Towne, 2002). The article in Meeting 1 did not explicitly state the research question, so in

Meeting 2, I wanted to call attention to its importance by having the MDLs engage with an article that had one clearly stated. Fourth, I wanted to revisit the importance of peer review (Shavelson & Towne, 2002) by picking an article that had undergone the peer review process. Unlike the previous article that called attention to the lack of peer review, the Rehn et al. (2018) article did not explicitly say that it had undergone peer review. It was my hope that the MDLs would seek out this information. Finally, I selected this article because it offered a considerable amount of detail in regard to the methods and actual data which the MDLs had been critical of in the previous meeting as they talked about wanting to see more of the data and details of the research process.

Design of Meeting 2

At the start of Meeting 2, I began by revisiting our group commitments and asking one of the MDLs, Leah, to share about herself since she missed Meeting 1. We then began trying to get clearer about our definition of research. In the previous meeting the MDLs had requested some time to come up with their own definitions, so during this meeting I provided the space for them to share. The result of this discussion was a more cohesive statement about research rather than a bulleted list like it had been in Meeting 1. The MDLs also agreed that this revised definition of research was "in-progress" and that they wanted to continue to revise it as they engaged with more articles.

After revising their definition, I shifted the conversation to focus on talking about the content of the research (Feature 2) by prompting the MDLs with questions related to their annotations, determining the extent to which they found the article to be credible, and if they believed what the authors were saying. One of the topics of conversation within this section of the meeting was an organization that had put forth standards and guidelines for teachers in online

learning environments. The MDLs highlighted it in their annotations and I wanted to discuss it because it was an example of an organization putting forth standards that lacked empirical support, which the article explicitly called attention to. My rationale for making it a topic of discussion was that I wanted to problematize the notion that organizational support is tied to research quality. In the initial interviews, the MDLs talked about an organizational endorsement as being one criteria by which they found an article or piece of research to be credible. This conversation was the first of many where I pushed on endorsements from organizations as a criteria for deeming something credible.

During the next section of the meeting, I provided the MDLs with a list of all the criteria they surfaced in Meeting 1 in relation to finding research to be credible or not credible and asked them if there were any additions that needed to be included or criteria that needed to be removed. One of the criteria on the list that was of particular interest was *the extent to which the research was relevant* because it led to a conversation about the relationship between a piece of research being relevant and/or credible. The resulting realization being that finding a piece of research to be relevant was separate from finding a piece of research to be credible.

Following the conversation about the criteria for finding a piece of research to be credible, I asked the MDLs about the recommendations put forth in the article and how they might put those recommendations into action in their local contexts (Feature 3). My purpose for doing so was to prompt the MDLs to think about research use and try to understand the different ways in which they might use it (e.g., symbolic, instrumental, conceptual).

In the last section of the meeting, I tried to perturb their existing understandings of research needing a research question (Feature 1). In particular, I designed question prompts that asked the MDLs to reflect on the appropriateness of the research questions. For example, I asked

"Were the authors able to answer the research questions?", "Were the data collection methods appropriate for answering the research questions?", and "Are the research questions worth asking?" My decision to elevate research needing to have a research question was twofold. First, research questions are a prominent part of my definition of research and they are the first marker of research quality put forth by the National Research Council (Shavelson & Towne, 2002). Second, research questions were not a prominent aspect of the MDLs' initial interviews. Thus, incorporating research questions into the MDLs' conceptualizations was a goal of my initial/revised conjecture.

I concluded the meeting by posing a hypothetical research question and asking the MDLs to imagine the types of data that would be needed to answer it. The original question in the article had asked "What are the specific skills that K-12 teachers need for teaching online and what the implications would be for professional development?" In the activity, I modified the questions to say "Should K-12 teachers be required to have specific videoconference skills when teaching in distance learning environments?" My rationale for revising the question was that I wanted the MDLs to come to the realization that this was a question that could not be empirically answered because of the word, *should*. Moreover, I wanted them to understand that research questions can vary in quality and that they need to be critical and ask themselves "Can this research question be answered empirically?"

Ongoing Analysis

Similar to the process described in Meeting 1, I watched the recording of Meeting 2 and looked for evidence to support or contradict my initial learning conjecture. I recorded the evidence in my conjecture log (shown below in Figure H.5).

Figure H.5. Meeting 2 Conjecture Log

Evidence to support the initial conjecture:

- The MDLs all agreed that their definition of research was in-progress
- The MDLs took note that the authors drew on the previous literature as they made their arguments
- An article being perceived as relevant is important for MDLs as they engage with research; Is the research relevant? Then decide if it's credible. Determining the extent to which something is relevant is dependent on the person doing the assessment
- The MDLs recognized that the hypothetical research question that asked, "Should…" was a moral question that could not be answered empirically, but rather was one's opinion. The data collection required of this hypothetical research question would be unethical.

Evidence to contradict the initial conjecture:

- In the conversation around definition of research, "research question" was removed from the written definition of educational research
- The small sample size and method of participant recruitment was troublesome for some of the MDLs; they wanted the study to be done with more than eight teachers and not just ones that volunteered
- The MDLs saw the findings aligning with their own experiences and that made it credible
- No mention of peer review

As shown in Figure H.5 above, there was evidence to both support and refute my conjecture. In relation to the evidence that supports my conjecture, the MDLs recognized that they were in the process of learning about research and wanted to ensure that their definition of research reflected their in-progress understanding. They also continued to attend to the citations and the presence of the literature review. Specifically, these two things increased the MDLs' confidence in what was being presented in the article. Additionally, the MDLs discussed the extent to which they found the article to be relevant, which was argued by Gutiérrez and Penuel (2014) as a necessary marker of research quality.

The ways in which the MDLs talked about research needing a research question were somewhat contradictory. On one hand, they talked about research being done in service of answering a research question, but on the other hand it was omitted from their definition of

research. Other contradictory evidence of importance included the conversations around the sample, the extent to which the research findings aligned with the MDLs' experiences, and the absence of conversation around peer review.

Meeting 3

The third MDLR Group meeting was held in mid-November, about three weeks after Meeting 2. I gave the MDLs a book chapter written by three university faculty whom the MDLs knew professionally and/or had interacted with in professional development offerings in recent years. The book chapter (Morge et al., 2020) provided strategies and tools to help practitioners promote discourse as they engaged their students in problem-solving in an online environment. Prior to Meeting 3, I had the MDLs annotate the book chapter using our agreed upon protocol and asked them to complete the questions on the annotation guide.

Article Rationale

I had a few reasons for selecting this book chapter for our third meeting. First, during the initial interviews, the MDLs frequently talked about the source of research contributing to the extent to which they considered an article to be research and find it credible. For example, the MDLs talked about considering an article or resource to be research when it came from a trusted university faculty member or well-known author. My rationale for choosing this book chapter for Meeting 3 was that I wanted to problematize their conceptualization and provide a counterexample to what I heard in the initial interviews. Second, I wanted to create an additional bin or categorization for the MDLs that allowed them to make a distinction between a piece of research and something that is research-based. I considered this article to be based on research because it was missing a research question and I wanted to help the MDLs incorporate this distinction into their existing conceptualizations. Third, I felt that it was unclear for the MDLs

about the criteria they were using to classify an article as research because their criteria for research seemed to be blended with their criteria for finding something to be credible. This book chapter was meant to surface this tension because I thought the MDLs would find it credible, but have reservations about it being research. Fourth, I continued to want to provide the MDLs with information that was useful, relevant, and actionable because of my knowledge of the literature. This book chapter provided actionable recommendations or activities that could be applied to their contexts.

Design of Meeting 3

I began Meeting 3 by having the MDLs reflect on the past three weeks since Meeting 2 and asked them to think about how they had used research, saw an opportunity for it, or identify an instance in which something prevented them from using research. My intent was to have them begin to think about and share the ways in which they had translated research from our group discussions into their local contexts (DP 5).

I then revisited our group commitments and suggested we add "Respectfully push back on one another's ideas when we disagree." During Meeting 2, there was hesitation among the MDLs when we talked about the hypothetical research question due to the power differential between me as the facilitator and them as participants. In an attempt to lessen the differential between the MDLs and me, I added this commitment in hopes of encouraging different viewpoints.

Following the addition to our group commitments, I had them respond to the question "Is this book chapter a piece of educational research? Why or why not?" I decided to have them answer this question prior to revising the group's definition of research because I thought a tangible example would be a productive way to surface new additions or revisions to our

definition. From their annotation guides, I knew that three of the MDLs considered the chapter to be a piece of research and one thought it was not. Knowing that information, I thought it would be productive to surface multiple perspectives and have the MDLs navigate the tension. In particular, I knew that the book chapter had many of the MDLs' criteria for considering an article to be research, but I knew that it fell short in a few places (e.g., no explicit research question). Based on that discussion, I hoped to then have the MDLs engage with one another on a JamBoard and revise their definition.

During the Research Talk Time (Feature 2) section of the meeting, I pulled the annotations from three parts of the chapter that received a number of annotations and highlights and shared them on three slides in the presentation. After some discussion around these three parts of the chapter, I asked the MDLs "Is the information relevant? Credible? High-Quality?" I chose to use the word, information, rather than research or research-based because I wanted the MDLs to come to their own decision about how the chapter should be classified. I decided to ask all three of these questions because I wanted to work on teasing these constructs apart because it was not clear to me if these constructs were separate or intertwined for the MDLs.

Finally, I spent the last section of the meeting sharing what I had noticed about the four MDLs' goals for our time together; mainly that, they all talked about needing support as they engage with research (DP 4). My interpretation of their needs was to present them with the skeleton of a tool from which we could revise and co-design so that it helped them meet their goals for our time together and provide them with a tangible object they could take and use in their districts (Feature 2). I shared my initial draft of the tool with the MDLs which was based on the criteria they surfaced during Meetings 1 and 2 in relation to defining research and determining what makes it credible and relevant. Together we looked at the tool and they

responded to five questions about the content and design of the tool (e.g., What's missing? Where does definition belong within the tool?).

I concluded the meeting by providing them with abstracts from articles and asked them to pick one of them to read for Meeting 4. One was focused on students' perceptions of online teacher support and the other discussed instructors' perceptions of various online facilitation practices. The MDLs decided to read the latter article (Martin et al., 2020).

Ongoing Analysis

Following Meeting 3, I watched the recording and kept track of the evidence to support or refute my initial conjecture in my conjecture log (see Figure H.6 below).

Figure H.6. Meeting 3 Conjecture Log

Evidence to support the initial conjecture:

- One of the MDLs mentioned that there was a research question, it wasn't explicit, but was understood to be, "how do you encourage discourse in online settings?"
- This article lacked a systematic collection of data and because of that, it's not a piece of research; they used a lot of hedging words like, "may" or "can"; there wasn't enough data shared; Systematic collection of data needs to be included
- The authors were citing other research, but the MDLs were left wondering, what was their research? How many people and who participated? Where was the data?
- The MDLs are beginning to formalize the idea that research is different from being credible and that there is another category that accounts for "research-based" articles…although the word, "research-based" is not mentioned
- The extent to which something is relevant is different from being credible or being classified as research; One MDL mentioned that this article is potentially more relevant than research that collects the data because it's actionable
- Peer Review was accepted by the MDLs as a criteria for finding an article to be credible
- Reference other literature that supports the ideas presented in the book chapter

Evidence to contradict the initial conjecture:

- Name recognition contributes to the article being perceived as credible; the MDLs know the authors and know where they stand professionally
- The article was credible because it aligned with the MDLs' beliefs and matched their experiences

In Meeting 3, there was a good amount of evidence in support of the initial learning conjecture. One of the main points of discussion was the need for research to have a systematic process for collecting data and when that process is absent, the article seems to fall short of being considered a piece of research. The MDLs also got clearer about extricating their criteria for defining research, determining it to be credible, and relevant. Although the MDLs did not surface an official name for describing this article (e.g., research-based), they seemed to talk about it as such. They found it credible because it cited other research, it aligned with their beliefs and experiences, and the MDLs knew the authors. These last three criteria (alignment with beliefs, experiences, and knowing the authors) were evidence to contradict my initial learning conjecture.

Meeting 4

The MDLs and I met for the fourth time at the beginning of December to talk about instructors' perceptions of various facilitation strategies in online environments (Martin et al., 2020). This article was the first and only purely quantitative article the MDLs engaged with during the MDLR Group intervention. This was partially due to my judgement of it being relevant to the MDLs' needs as I searched for articles, but also because of my belief that qualitative research would provide more valuable recommendations for the MDLs than quantitative ones. Despite this belief, I selected a quantitative and a mixed-methods article for the MDLs to choose from because one of the MDLs had mentioned wanting to see "numbers" a few different times as we engaged with qualitative articles in the previous meetings. As was mentioned at the end of Meeting 3, the MDLs picked this article from a two article line-up because of the content being focused on teachers.

Article Rationale

I had four big reasons for selecting this article for the MDLs to read. The first being that this was a quantitative study that shared a considerable amount of data within the article. In Meetings 1 and 2, one of the MDLs had reiterated that having a larger sample size, bigger than a few cases (e.g., one classroom, eight teachers) was important for her when trusting research. Unlike the previous articles we read, Martin and colleagues (2020) provided survey data that used means, standard deviations, and ANOVAs. For one of the MDLs, it seemed that quantitative data was a criteria that she wanted to see in order to find research credible. Second, the authors of this article explicitly stated their research questions which I was trying to privilege in hopes of the MDLs making it a prominent part of their definition of research. Third, the format of this article was such that it had explicit headings throughout that seemed to align with the MDLs' prototypical images of research. In the previous meetings, the MDLs discussed wanting to see the methods, so this article provided them with a study that explicitly stated them. Fourth, this article used academic jargon and was longer than the previous article (~22 pages). My rationale being that the way in which this quantitative article was written was such that I thought the MDLs would find it dry, hard to read, and dense because of the statistical language used to describe the data analysis. I thought that given the opportunity to engage with quantitative research, the MDLs might not find it as applicable to their contexts as qualitative research might be.

Design of Meeting 4

Similar to the start of Meeting 3, in the fourth meeting I began by asking the MDLs to think about the recommendations of the book chapter (Morge et al., 2020) and respond on a JamBoard to sentence prompts (e.g., I used the book chapter or pieces of it to…). This opening

activity was meant to get the MDLs thinking about translating research or research-based information into their local contexts (Feature 3).

After the initial activity, I asked the MDLs to classify the article as either *research*, *good advice*, or something else. Good advice was a term surfaced in Meeting 3 to describe the book chapter (Morge et al., 2020). My purpose for asking the MDLs to classify the Meeting 4 focal article was that I wanted them to continue to get clearer about their classification categories. A result of this discussion was that the good advice category was re-named to be *research-based*, which was the designation assigned when an article fell short of being actual research (e.g., including the methods for collecting data, analyzing the data, done in response to an issue). During the second part of this discussion, I asked the MDLs to revisit their definition of research. The big additions/revisions to their definition during this meeting were a need to see the method by which the data was collected and that research needs to provide guidance for the reader. Adding *Methods* to the definition was in response to the Martin and colleagues (2018) article providing an explicit Methods section in their article. Thus, this article served as a prototypical image for research as the MDLs discussed how the explicit attention to methods was missing in the book chapter (Morge et al., 2020).

In the next section of the meeting, my hope was to get the MDLs to include having a research question in their definition of research by juxtaposing two articles that we had read and designing question prompts meant to call attention to the link between the research questions and the process for data collection. The two articles I picked were from Meeting 2 (Rehn et al., 2018) and Meeting 4 (Martin et al., 2020) because they both used a common framework (Berge, 1995) that highlighted the four roles of an online teacher—*social*, *technical*, *pedagogical*, and *managerial*—however, one used qualitative methods and the other used quantitative ones. My

intent being that I wanted to call attention to how the research questions dictated the data collection process in the hopes of the MDLs incorporating having a research question into their definition. During this section of the meeting, there was also discussion around the extent to which either article was seen as credible and/or useful because I wanted to see if there was a difference in the MDLs' judgement depending on the type of data.

The final section of the meeting involved the MDLs and I looking at the Research Reflection Tool and making adjustments accordingly (Feature 2). The MDLs overwhelmingly agreed that the article met all of their criteria for classifying it as research, credible, and relevant with the exception of the representativeness of the sample. There was some skepticism because the sample was only 100 people who volunteered from a small population of higher education instructors and the survey had a low response rate.

I concluded the meeting by giving them two articles to read for Meeting 5. The first of which was a publication from a private organization that had been put forth during the initial interviews as being a piece of research. The second was an article that was cited in the first publication. My intent was to see if the MDLs' judgement on this publication had shifted since the start of the study and I wanted to add a practice to their repertoire of looking critically at what is being cited when they engage with research.

Ongoing Analysis

After Meeting 4, I once again watched the recording of the meeting and kept track of evidence to support or refute the learning conjecture. The evidence shown in Figure H.7 below.

Figure H.7. Meeting 4 Conjecture Log

Evidence to support the initial conjecture:

- The Martin et al. (2020) article fit the MDLs' prototypical image of research: pose a question, design data collection method, analyze the data, provide advice or summary

based on the data, but not necessarily what the MDLs turn to when looking for when they use research
- There was an abundance of literature cited (e.g. books, articles)
- A systematic collection of data (e.g. methods)
- Research articles are different from articles that are research-based
- Peer review process…trust that when it's published in journals that it has undergone this process…not going to actively search for the process by which peer review is done because time is not available
- There is a common framework that multiple authors are drawing from
- Being able to see the data
- "I'm still in that learning stage, very flexible and thinking about it in other ways…"

Evidence to contradict the initial conjecture:
- Providing actionable guidance
- Research is synonymous with medical research; randomized control trials with a large sample
- Alignment with my beliefs
- How prevalent is the information? Am I hearing about it from multiple sources? At conferences? In other articles? This may highlight my own bias.

In Meeting 4, a big topic of conversation was the level of detail offered around the methods. This article and ensuing discussion seemed to solidify the need for research to provide a high level of detail around the process for collecting data; there needs to be a systematic process. The MDLs also surfaced the idea that an article that is research is different from that of one that is research-based. They began to make a distinction in their categorization that went from two categories, being research or not, to a three-bin categorization that included research, research-based, and other. The MDLs seemed to have fully adopted research needing to undergo peer review as a marker of credibility and publication in an academic journal satisfies their trust that the article was indeed peer reviewed. They also realized that their learning and understanding of research was in progress which was evidence to suggest that they are adopting new ways of conceptualizing research. Finally, the MDLs wanted to see the presence of actual data within the article because it offers a degree of transparency.

As can be seen in Figure H.7, there was also evidence to contradict the initial conjecture. Such was the case as the MDLs reiterated criteria such as alignment with their beliefs, hearing information from multiple sources, having a need for research to provide actionable guidance, or privileging research that uses quantitative data. All of which were mentioned in the MDLs' initial interviews.

Meeting 5

The fifth meeting of the MDLR group was the last meeting of the 2020 calendar year and occurred in mid-December. In preparation for this meeting, I had the MDLs read a publication (Article 5A) from a private organization that had been mentioned by two of the four MDLs during the initial interviews. I also had them read an article (Article 5B) cited within Article 5A for the purpose of digging into the citations of an article to see what and who is being cited. Article 5A (TNTP, 2020) was written in response to COVID-19 and the hurried shift to online learning during the spring of 2020 and provided action steps for practitioners trying to counteract the lost instructional time. A revised version was published in November 2020 and was the version I had the MDLs engage with. Article 5B (Dorn et al., 2020), which was also written by a private organization, quantified the amount of lost instructional time using dollar amounts and the effect on the United States' GDP. The MDLs were asked to skim Article 5A, read Article 5B, annotate, and respond to the annotation guide questions in preparation for Meeting 5.

Article Rationale

I was first introduced to Article 5A (TNTP, 2020) during the initial interviews. Two of the MDLs mentioned being familiar with the organization who wrote the article and one had used it to make a plan of action in her district. In talking with the latter MDL, she said she had been introduced to Article 5A during a professional development sponsored by the State

Education Agency and she considered it to be a piece of research. It was for these reasons that I was initially drawn to Article 5A and I wanted to see how the MDLs would classify it now given the discussion from the previous four meetings.

My rationale behind selecting Article 5B (Dorn et al., 2020) for the MDLs to engage with was multipronged. First, Article 5B was written and published by a private company who self-published the article and it did not undergo peer review. It was my hope to call attention to the avenue in which an article is published and reinforce the need for peer review that we had already established in earlier meetings. Second, Article 5B had few citations throughout and the sources that it cited were typically from non-academic sources (e.g., Education Week, governmental data websites, for-profit companies, the organization's own publications). My intent was to surface a need to look at the citations to ensure other peer-reviewed articles are being cited. Third, I hoped to address barriers that had been present in the last article such as length and academic jargon. Article 5B was short—only nine pages in length with graphs and figures—and was written for a practitioner audience. Finally, I hoped the MDLs would attend to Article 5B not presenting the authors' own data and lack of a research question.

Design of Meeting 5

I opened Meeting 5 in a similar fashion to the previous two meetings by asking the MDLs to reflect on the two weeks since our last meeting and think about how they took up the ideas we talked about in Meeting 4, saw an opportunity for them, or share something from the readings that had been on their minds. My rationale for this opening activity was to get the MDLs thinking about translating research into practice (Feature 3). In the past meetings, I had the MDLs put their answers on a JamBoard before sharing verbally, but for this meeting I just asked

them to share verbally and did not use the JamBoard because the MDLs seemed more comfortable speaking to the group.

Following this opening activity, I asked the MDLs to classify Article 5A and 5B as research, research-based, or something else and offer a justification. There were mixed responses on the annotation guides with some MDLs saying the articles were *advice*, while others were saying they were research-based. None of the MDLs considered the two articles to be research. This initial discussion led to us revising our definition of research. My hope was the two focal articles would be clear non-examples of research so that in addition to getting clearer about our definition, we could make a clear distinction between an article that is research and research-based. Being able to categorize an article was important for the MDLs because it dictated the criteria they used to determine if it was credible or not (e.g., methods not being applicable for an article that is research-based).

In the next section of the meeting, I asked the MDLs if they found the articles to be credible and if there were places where they were skeptical of what was being presented. As the designer of this opportunity for discussion, there were many places that I was skeptical of what was being presented. In particular, I was skeptical of the lack of citations to support the authors' claims and when there were citations, they were sources that had not been peer reviewed. I also knew that the MDLs had received Article 5A from a source that they trusted, the State Education Agency. The endorsement of Article 5A from the State Education Agency carried significant weight with the MDLs, so I knew that as I designed my questions and prompts there would be tension as I tried to perturb their trust in the articles.

After asking about the articles broadly, I decided to go through the Research Reflection Tool on a criteria by criteria basis to try to surface instances in which the MDLs might take

issue. For example, for the criteria that says, “The article aligns with the findings of or is supported by previous research and calls attention to underdeveloped areas in the literature,” the MDLs were unsure. By asking the MDLs to attend to the specifics mentioned in the Research Reflection Tool, I hoped to problematize their beliefs about the articles being credible because the State Education Agency endorsed it. The MDLs and I continued this process for each criteria in the Research Reflection Tool.

Following our unpacking of the articles in relation to the Research Reflection Tool, I revisited my original question about the articles being credible and asked if the tool and ensuing conversation had influenced the MDLs’ take on the articles and specifically, Article 5A (TNTP, 2020). My rationale being that I thought the MDLs’ would shift their position about the articles being credible.

I concluded the meeting by sharing the next article (Berge, 1995). My rationale being that Berge (1995) seemed to be a seminal article for talking about online learning and teaching. Two of the articles we read previously cited it and I wanted the MDLs to engage with the article that seemed to be foundational for the research that had been done since.

Ongoing Analysis

After the fifth meeting, I watched the recording of the meeting and kept a record of the evidence to support or contradict the initial learning conjecture. The evidence in support of and to refute is shown in Figure H.8 below.

Figure H.8. Meeting 5 Conjecture Log

Evidence to support the initial conjecture:

- The articles were classified as being based on research or advice, rather than research themselves; marks a shift for Leah who deemed Article 1 as research in the initial interview
- The sources being cited were private, paid organizations in Article 2 in some instances; the MDLs attended to what was being cited;

- Beth compared Article 2 to a white paper where a company self-publishes an article rather than it going through a peer review process; the MDLs recognized the source of the information maybe had a bent to it; the authors of Article 2 are not in the field of education
- Research needs to go through the research process of collecting and analyzing data; research-based is where the authors are giving advice based on other people's research; the designation dictates the criteria used to evaluate it.
- The MDLs were skeptical of undocumented statements and unwarranted claims in Article 2
- The MDLs look at the extent to which the articles were relevant
- The tool gave the MDLs pause to more critically evaluate what they are reading

Evidence to contradict the initial conjecture:

- The actionable guidance of Article 2 was valuable, relevant, it fit an urgent need of the MDLs; the call to action made the judgement of Article 1 positive and the judgement of Article 2 not so much; The MDLs need something they can use
- Endorsed by people the MDLs trust at the State Education Agency
- The call to action and recommendations of Article 2 were not helpful whereas Article 1 provided action steps that were useful
- The MDLs looked for alignment between the article and their experiences
- Trust in the organization, their endorsement, and trust the source who made the recommendation for it

In Meeting 5, the MDLs solidified their distinction between research, research-based articles, and articles that they referred to as advice. In doing so, the MDLs realized that the criteria they used to judge an article as credible would be different depending on their classification. The other main topic of discussion was the presence or absence of citations. The MDLs were critical of Articles 5A and 5B because there were many statements that they felt were either undocumented or unwarranted. For example, in Article 5B the authors compared the COVID-19 pandemic to other natural disasters (e.g., hurricanes) which the MDLs felt was an overextension. Thus, these two articles were good examples of the importance of having appropriate citations to support one's claims.

These two articles also provided disconfirming evidence of the initial learning conjecture. Mainly, the extent to which an article provides actionable guidance seemed to dictate the MDLs' judgement of it. More so than other criteria, the lack of actionable guidance for Article 5B

seemed to take precedence for the MDLs as they discounted the article. The other tension that surfaced was the fact that trusted individuals at the State Education Agency had recommended Article 5A for use. The MDLs recognized the potential bias of Article 5A being self-published by a private company, but that skepticism seemed to be outweighed by the SEA endorsement and the extent to which the MDLs found the recommendations to be useful and actionable.

Meeting 6

The sixth meeting of the MDLR Group was held in early February after numerous schedule conflicts in January. The focal article (Berge, 1995) was one that had been cited by other articles the MDLs read in earlier meetings and because of that I chose it for the sixth meeting. Berge (1995) provides a framework for online teaching that specifies four roles of an online instructor—*social*, *managerial*, *pedagogical*, and *technical*.

Article Rationale

I had a few different reasons for selecting this article for the MDLs to read and engage with. The first of which was that Berge (1995) was not an empirical research article, but rather a theoretical one in which the author built his framework for online teaching by drawing from the existing literature. I anticipated the MDLs would consider this article to be research-based and not a piece of research, but I was unsure of how this article would compare with some of the other articles that had been characterized by the MDLs as advice or research-based. My goal was to surface a need for an additional category, *theoretical research*, that was different from articles classified as research-based. Second, Berge (1995) used a considerable amount of citations and supporting research which I wanted the MDLs to notice. Third, this article had been cited by other authors we read and I wanted to have the MDLs think about the ways in which research builds from and connects to previous work. Fourth, this article is about 25 years old and I wanted

to see if the MDLs thought the recommendations had an expiration date. Finally, this article was missing many of the pieces of the research process (e.g., research question, methods, data, etc.), but from my perspective it offered a lot of actionable guidance. My rationale was to provide another example of an article that could help them get clearer about their definition of research.

Design of Meeting 6

At this point in the MDLR Group, the MDLs had a fairly clear understanding of research. There was less discussion around if an article was *research* and more conversation around the extent to which they found it credible and relevant to their local contexts. In response to that perceived shift, I opened Meeting 6 by asking the MDLs to provide an instance in which they had used research or saw an opportunity for it. My goal in doing so was to get the MDLs thinking about using research and how it might translate to their contexts (Feature 3).

Following the opening conversation, I asked the MDLs to classify the article as research, research-based, advice, or something else. I knew from their annotation guides that they considered the article to be research-based, but I had hoped that they would say that it felt different than some of the other research-based articles we had read. To try to make that conversation happen, I asked the MDLs specifically if they considered this article to be research-based in the same way that the focal article from Meeting 3 (Morge et al., 2020) was. My hope was to surface an additional category, theoretical research to capture articles like Berge (1995) that built their argument theoretically that was separate from articles like Morge et al. (2020) that put forth recommendations for practitioners based on a blend of the authors' experiences and knowledge of the literature.

Next, I asked the MDLs to revise their definition of research. Specifically, we had a lot of additions, bullets, comments, and questions that had accumulated over the previous five

meetings which made it difficult for the MDLs to clearly designate an article as research, research-based, or advice. During this section of the meeting, we crossed off the additions and incorporated them into our definition which was,

> Educational research is an authentic response to teaching, learning, and educational topics or for the purpose of finding a solution to a problem that includes the methodology in collecting and utilizing qualitative and/or quantitative data to provide actionable guidance for educators.

After formalizing our definition, Leah offered to run it through a grammar software to make it grammatically correct.

In the next section of the meeting, I identified three criteria in the Research Reflection Tool that the MDLs marked as not met because Berge (1995) did not go through the research process of collecting and analyzing data. I then asked the MDLs if they believed what was being presented and if they found it credible since Berge (1995) did not collect his own empirical data to inform the article. My reason for doing so was to push on the idea that articles do not have to be empirical research in order to be credible. I followed this conversation with a discussion about how they might translate this article into their local contexts and asked "To what extent is it applicable given that it is 25 years old?"

For the last section of the meeting, I asked the MDLs to have a conversation about the usefulness of the Research Reflection Tool "Were there places that needed to be revised or modified?", "Do we want to include our definitions for research, research-based, advice?", and "What is the threshold for finding an article to be credible?"

Ongoing Analysis

Following Meeting 6, I watched the recording and looked for evidence to support or refute my initial conjecture. My conjecture log evidence is below in Figure H.9.

Figure H.9. Meeting 6 Conjecture Log

Evidence to support the initial conjecture:

- Research has to go through a research process, systematically collecting data
- Methodology… the systematic process for collecting and analyzing the data
- The MDLs used the word "authentic" to mean that the researcher asks a question, read the literature, designs the study, provide the details about the research process of collecting and analyzing data
- The amount of citations let the MDLs know that the author had done his reading and knew the literature…made it credible
- Credible is not synonymous with research; research can be not credible or not research can be credible
- Other research has tied itself to this article
- Wanting to dig into some of the citations to see what they say
- Undergone peer review and published in a research journal
- Research needs to be both credible and relevant for use
- Definition of research includes going through the research process
- Criteria for finding research credible is different from finding research-based articles credible (e.g., methods, data)

Evidence to contradict the initial conjecture:

- This article was considered good advice and the article from Meeting 3 was more research-based; Advice and research-based might not be mutually exclusive
- Aligns with my professional beliefs
- Definition of research includes providing actionable guidance

There were three big ideas that surfaced in relation to the learning conjecture during Meeting 6. The first of which was that *research needs to go through a research process of asking a question, reading the literature, designing a study, providing the details about collecting and analyzing the data, and putting forth recommendations based on the data*. The MDLs captured this understanding of the research process by using the words *authentic* and *methodology*. It is worth noting that the MDLs' definition of the word methodology is different than that of the research community and does not attend to the theoretical perspectives guiding the design of the

study. The MDLs' use of methodology more closely resembles what researchers mean when they say, *methods*.

Second, the MDLs realized that their list of criteria up until this meeting had blended the criteria they were using for classifying an article as research and their criteria for finding an article to be credible. During this meaning, they separated the criteria after having a discussion about the potential for a piece of research to be not credible or a piece of not-research to be credible. Many of their criteria supported the learning conjecture (e.g., peer review, citations, methods, systematic data collection process) and others contradicted it (e.g., providing actionable guidance, alignment with their beliefs).

Third, instead of creating a new category to classify Berge (1995) as a piece of theoretical research, the MDLs found it to reside on the border between research-based and advice whereas I was hoping they would see it situated on the border between research and being research-based. The MDLs recognized that this article was different than that discussed in Meeting 3; however, their interpretation of the difference tended to privilege the book chapter in Meeting 3 because of the actionable guidance it provided.

Final Conjecture Map for the MDLR Group

After Meeting 6, I revised my conjecture map again to reflect the evidence surfaced throughout the study. The evolution of the high-level conjecture over the six meetings can be seen below.

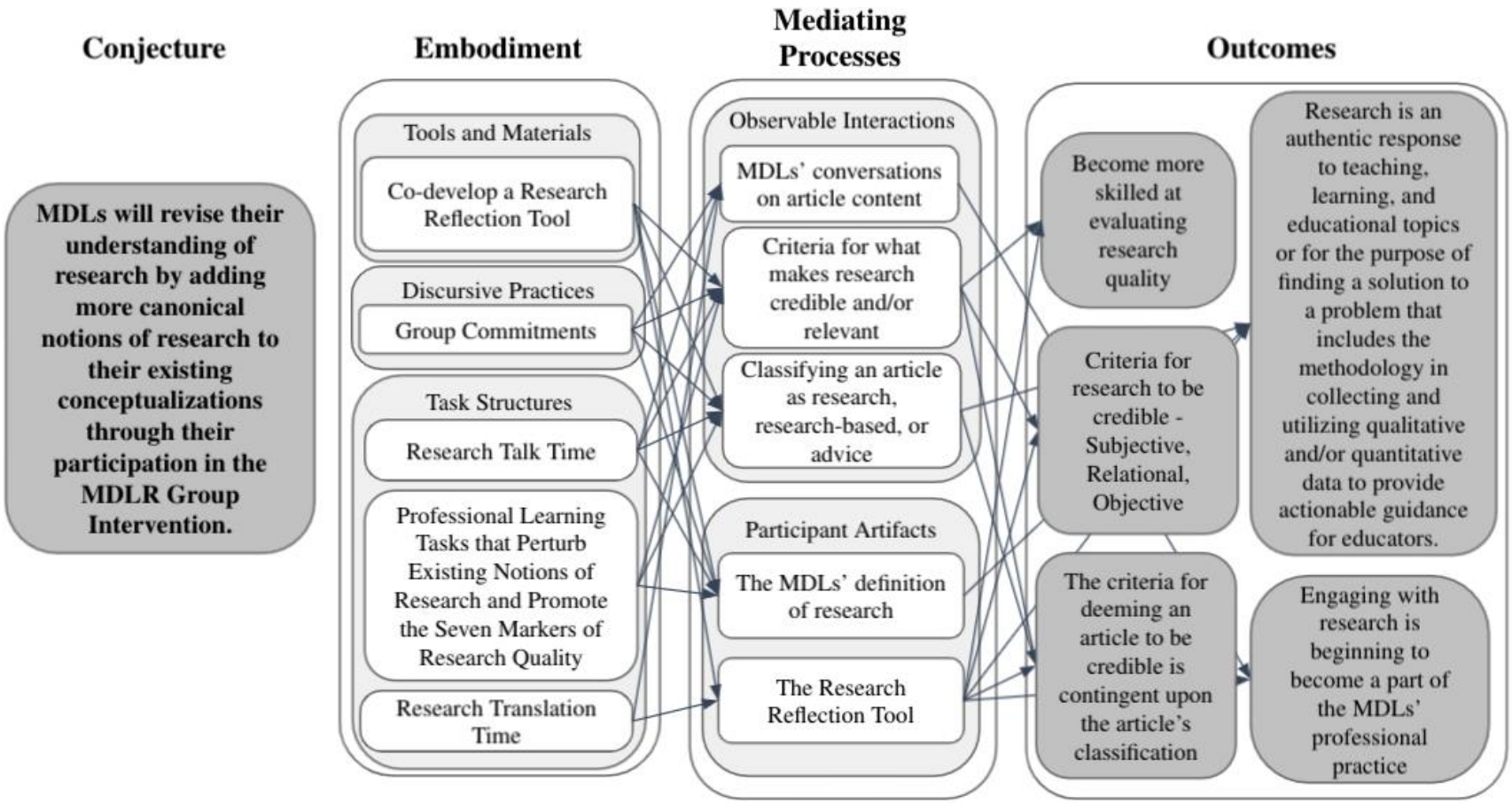
Conjecture Two (Initial): Engagement with the MDLR Group intervention will build the capacity of MDLs to engage with research and promote its informed use.

Conjecture Two (Revised): MDLs will replace their existing understandings of research with more canonical notions of research through their participation in the MDLR Group Intervention.

Conjecture Two (Final): MDLs will revise their understanding of research by adding more canonical notions of research to their existing conceptualizations through their participation in the MDLR Group Intervention.

The final version of the high-level conjecture recognizes that the MDLs held on to many of their initial conceptualizations of educational research, but were open to adding conceptualizations to it that aligned with those help by the research community (e.g., peer review). Changes to the previous iteration are highlighted in dark gray and included the high-level conjecture and the outcomes (see Figure H.10 below). The outcomes are discussed in detail in the Findings section of Chapter V.

Figure H.10. Final Conjecture Map of the MDLR Group Intervention



Note: Changes from the previous iteration are highlighted in dark gray.