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Author's Name:	Zachary Cohen
Submission Date:	05/31/2023

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Learning by Mistake: Constructing the Conceptual Framework of Mistake Literacy Through a Mixed Methods Case Study

A Dissertation

Submitted to the Faculty

of

Drexel University

By
Zachary Cohen

in partial fulfillment of the

requirements for the degree

of

Doctor of Education May 2023

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Dedication

To my beloved wife, Kenyon, who has been my unwavering support throughout my journey. Your love and encouragement have been instrumental in helping me pursue my dreams. Above all, thank you for tolerating all the mistakes I make on a daily basis. To my daughter, Sonja, your arrival during the writing of this dissertation reminded me that I still have much to learn about making and learning from mistakes. You have humbled me and enriched my perspective on life. To my parents and sister, you taught me the value of learning from my mistakes and have continued to guide me through every step of my life. You knew me during my teenage years, so you understand my mistakes intimately. To my teachers, each of whom has played a crucial role in shaping me and tolerated my mistakes while guiding me on this journey. I am eternally grateful for your patience, wisdom, and support. And finally, I dedicate this work to all of the mistakes that certainly littered the pages of this dissertation. Life and learning are an endless journey paved by mistakes. With this work, I hope to contribute to the literature that helps nurture a new understanding of how to develop Mistake Literacy in education.

Acknowledgements

I extend my heartfelt gratitude and appreciation to my esteemed committee members: Dr. Mary Jean Tecce DeCarlo, Dr. Salvatore Falletta, and Dr. James Rickabaugh.

MJ, your steady hand, unwavering support, and optimism have been instrumental in bringing me to this finish line. Your driving confidence instilled in me the self-belief I needed to navigate the vicissitudes inherent in this process. I am fortunate to have been paired with someone with your rare combination of talent and character. You are a force and an inspiration! I hope we will have the chance to meet in person one of these days. Ha!

Sal, your expertise, wisdom, and positivity have been invaluable in steering me through this mixed-methods study. You have an exceptional ability to convey complicated ideas in easily understandable terms, which made it possible for someone like me to grasp the quantitative elements of this study. I am grateful for your generosity, patience, and willingness to jump on a quick call to clarify concepts.

Jim, I recently shared with a friend how the greatest benefit of pursuing doctoral studies is the invaluable gift of connections. Perhaps it is because I have grown more confident in reaching out to individuals I admire, but the pursuit of a doctorate provided me with the courage to contact you. And I am grateful that I did. As the saying goes, one should never meet their idols, but in your case, that couldn't be further from the truth. Your graciousness, thoughtfulness, and generosity made me feel at ease and welcomed. You are among the wisest and brightest people I know, yet you have this ability to make others feel more intelligent just by talking with them. It is a rare and remarkable talent, and I am honored to now consider you a friend.

To my committee members, thank you for your contributions, guidance, and support throughout my dissertation. Without your unwavering support, valuable insights, and guidance, completing this undertaking would not have been possible.

Abstract

Learning by Mistake: Constructing the Conceptual Framework of Mistake Literacy Through a Mixed Methods Case Study

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In an age widely defined by change, one thing is for sure: People will make mistakes. What is uncertain is whether people will learn from them. As common as mistake-making is, learning from mistakes is not common at all. Students who possess the want-to and know-how to learn from their mistakes are best positioned to avail themselves of what is most natural and unavoidable to the learning process—the *process* itself; however, most educational institutions produce students who are ill-equipped to recognize, react to, and repair their mistakes. Without a blueprint to guide this process, students will continue to prioritize less-optimal but mistake-free learning strategies. This concurrent mixed methods case study constructed and tested a conceptual framework composed of the processes that mediate middle grades students' inclination and ability to learn from their mistakes in a progressive independent school. Using quantitative, qualitative, and data integration procedures, this conceptual framework—heretofore referred to as "Mistake Literacy"—articulated the proximal and distal conditions that exert a meaningful influence on mistake-learning, resulting in a proverbial playbook to guide educators in elevating and embracing the vital role that mistakes play in the learning process. This study found that in a classroom dedicated to fostering such conditions, the student-teacher relationship serves as the fulcrum. Once the student-teacher relationship is firmly established, students are then poised to operationalize the suite of dispositions identified in this study, which facilitate their ability to place themselves in the optimal position to learn from their mistakes. These

dispositions encompass cognitive engagement, intrinsic motivation, and metacognition, empowering students to maximize the benefits of the established conditions. Fundamentally, the conceptual framework of Mistake Literacy is characterized as a sequential and recursive process that becomes increasingly accessible for students as they gain experience.

Keywords: Mistake Literacy, mistake making, learning from mistakes, middle grades students, productive failure, learner efficacy.

Chapter 1: Introduction to the Research

> The central task of education is to implant a will and a facility for learning; it should produce not learned but learning people . . . In a time of drastic change, it is the learners who inherit the future. The learned find themselves equipped to live in a world that no longer exists.
>
> —Eric Hoffer, *Reflections on the Human Condition*

Mistake-making has a long, complex relationship with education in the United States (DeBrincat, 2015; Loibl & Leuders, 2019). Stemming from research conducted in the 1920s, mistakes have largely been seen as problems that should be eradicated. In 1922, the associationist theory of mathematics began to cultivate the belief that errors are the result of a lack of drill and mastery of number facts (Thorndike & Woodyard, 1922). These findings were further entrenched in the collective psyche of American educators in the 1960s when Terrace (1966) showed that "pigeons could be taught to discriminatively peck a red circle as opposed to a green circle by being reinforced in such a way that they never pecked the green circle, that is, the pigeons performed in an errorless manner" (Terrace, 2001, p. 9). This finding, whether correctly interpreted or not, pushed education towards an errorless model of teaching—the thinking being that if a bird can learn to eliminate mistakes, so too can a child. Later in the decade, Ausubel (1968) codified this now widely held interpretation by warning of the dangers mistakes present to the learning process, suggesting that "allowing [students] to make errors encourages them to practice incorrect and inefficient approaches that will cause trouble because they are difficult to overwrite later with correct approaches" (Ausubel, 1968, p. 25). To some extent, there is a logic to this idea that committing errors will strengthen and entrench the neural pathways responsible for this erroneous thinking; however, current research has concluded just the opposite.

The importance of learning from mistakes is echoed widely across the literature and across the globe. Studies from the Philippines, Germany, and Hong Kong conclude that there is a strong correlation between mistake-making and learning, with one study from the United States of America even arguing that "an unwarranted reluctance to engage with errors has held back American education" (DeBrincat, 2015; Metcalfe, 2017; Quieng et al., 2015; Song, 2018). Current research argues that ". . . making errors can greatly facilitate new learning . . . enhance the generation of correct responses, facilitate active learning, [and] stimulate the learner to direct attention appropriately . . ." (Metcalfe, 2017, p. 472). In fact, though it is perhaps not intuitive, Richland et al. (2009) found that error generation is positively correlated to enhanced memory. Errors occur at the edge of knowledge and experience; thus, errors must be accepted not just as a byproduct of learning, but as an instrument to illuminate the opaque innerworkings of the learning process. The trouble is that "human beings, who are almost unique in having the ability to learn from their mistakes . . . are also remarkable for their apparent disinclination to do so" (Whitman, 2016, p. 81).

In an age widely defined by change, one thing is for sure: People will make mistakes. What is uncertain is whether people will learn from them. As common as mistake-making is, learning from mistakes is not common at all. Mistake are the most undermined, undervalued way for learning to occur (Rickabaugh, 2012). And yet, to be prepared to navigate the uncharted future, students will need to possess the willingness to make mistakes and the ability to learn from them (Scharmer, 2016). A learning process steeped in mistake-making most nearly models "the messy, exciting, frustrating process in which discoveries are made and innovation occurs" (Eggleton & Moldavan, 2001, p. 43). Whether it is transitioning to a new career or acclimating to the breakneck pace of technological advances, students who possess the want-to and know-how

of learning from their mistakes are best positioned to avail themselves of what is most natural and unavoidable to the learning process—the *process* itself (Harari et al., 2018).

The Problem Statement

Most educational institutions produce students who are ill-equipped to recognize, react to, and repair their mistakes, thus denying students access to the sort of learning they will need to navigate the inevitable but uncertain challenges of the emerging future (*The Future of Jobs Report*, 2020).

Purpose and Significance of the Problem

Purpose Statement

The purpose of this mixed methods case study is to test the novel conceptual framework of Mistake Literacy, which articulates and individuates the proximal and distal variables that influence students' ability and inclination to reliably convert their mistakes into learning. Mistake Literacy demystifies and simplifies the opaque alchemy of how learning can become a promised byproduct of mistake-making. It lays the foundation for future learning to occur by counteracting students' documented tendency to ignore, deny, downplay, and outright disavow mistakes (Claxton, 2013).

Significance of the Problem

In 2009, then-President Obama spoke to a group of students at Wakefield High School in Arlington, Virginia (Obama, 2009). As someone who had readily and unabashedly admitted to his mistakes as a youth, and how these missteps informed the adult he had become, he humbly, but stridently impressed upon his audience the importance of learning from one's mistakes. "You

can't let your failures define you—you have to let them teach you" (Obama, 2009). Anyone listening to this speech would invariably nod along to President Obama's rhetoric. This is because learning from one's mistakes is an idea that is far from novel—it is both ancient and perennial—as exemplified by the scores of common and well known axioms transcending time, culture, and place. A Turkish proverb states, "He who knows much makes many mistakes;" a Romanian proverb serves as a reminder that "The man learns by making mistakes"; and a Chinese proverb roughly translates to "A fall into the pit, a gain in your wit" (Schulz, 2011, p. 30-31). The pervasive and shared nature of this wisdom is unsurprising considering that there is no barrier for entry: People living in any time period and at any socioeconomic level have all had equal access to mistakes. And yet, in spite of its universality, it is also one of the "most undermined, undervalued way for learning to occur" (Rickabaugh, personal communication, August 10, 2020).

Plenty of research has sought to account for maladaptive responses towards mistake-making by seeking ways to eradicate mistakes entirely (Tavris & Aronson, 2008). However, preventing future mistakes from occurring is not only unfeasible, it is undesirable. Mistakes are the atomic unit of learning (Claxton, 2021). Without mistakes, future learning would cease. Mistakes illuminate the horizons of one's knowledge and lend a meaningful sense of the discrepancy between what is known and what is left to be known (Rickabaugh, personal communication, August 10, 2020). Mistakes sharpen students' self-monitoring, judgements, and skills, and "stimulate questioning about why their performance was not correct, which then promotes rethinking learning strategies" (McMillan, 2017, p. 29). Mistakes are foundational and fundamental to the learning process. They aren't merely instructive; they are the keyhole, that

offers an honest glimpse into the unique nature of a protean mechanism like learning (Lewis, 2017). In fact, humans are already predisposed to learning from their mistakes.

When a person commits an error, subsequent action is delayed by a phenomenon known as post-error slowing (PES). PES refers to the tendency of individuals to slow down on a current trial after having committed an error on a previous trial (Rabbitt & Rodgers, 1977). Rabbitt and Rodgers (1977) found that when engaging in an activity that has been done erroneously before successive actions are delayed, permitting participants the time to employ a corrective action.

A 2018 study by researchers at the California Institute of Technology discovered that mistakes set off an almost instantaneous chain reaction of productive brain activity. Researchers found that before one is even cognizant of their error, one set of neurons—dubbed "error neurons"—begin to fire (Fu et al., 2019). In rapid succession, "the brain of a person making an error lights up with the kind of activity that encodes information more deeply," helping to ensure that the same mistake is not made on a subsequent attempt (Fu et al., 2019, p. 172).

Another interesting and related brain process triggered by mistake-making concerns the release of dopamine. Dopamine is released when students answer questions correctly—and are cognizant of their correctness, either through external and internal monitoring mechanisms. Conversely, when errors occur, dopamine levels decrease, but this decrease in dopamine triggers another response, which is that the brain seeks out corrective feedback and the accommodation of new information to prevent a dopamine drop in the future, "essentially altering incorrect neural networks and increasing the likelihood of making a correct response next time" (McMillan, 2017, p. 91).

And yet, in spite of the numerous ways that the human body and brain seeks to learn from mistakes, there is a socio-cultural dimension that interferes with these adaptive responses from

being embraced and operationalized. People have been socialized and, in turn, have internalized mistakes as being something to avoid (Fischer et al., 2006). It is also quite common to be afraid of making mistakes. “Teachers grade us down for errors on tests, bosses often chastise us (and worse) for taking risks, and religions may condemn us if we commit a sin or take the wrong path” (Tugend & London, 2011, p. 180). The aversion people have towards mistake-making is evidenced by the fact that people, on the whole, prefer less optimal learning outcomes so long as it allows them to avoid making a mistake.

Huelser (2014) sought to make study participants aware of the “utility of learning by making errors,” but found that even when participants ‘attention was drawn to the enhanced retention resulting from employing study techniques that required error generation, participants’ under-confidence in their ability to learn from their mistakes persisted (Huelser, 2014, p. 27). Relatedly, a 2017 study found that even when study participants’ attention was drawn to the benefits of errorful generation on information retrieval from memory, study participants continued to prioritize less effective study strategies that did not involve mistake-making (Yang et al., 2017). This adverse response to mistake-making would seem to suggest that people would prefer not to dip their toes in the murky waters of effortful learning, even if error generation actually improves learning outcomes.

A 2019 study sought to understand why by explicating medical students’ feelings about mistakes. The study found that medical students reported powerful emotional reactions when they were asked to just visualize committing errors. These medical students used such words as “scared,” “guilty,” “embarrassed,” “fearful, and “frightening” to describe the visualization exercise (Fischer et al., 2006, p. 420). The distress that these students verbalized is not unique to them. In fact, a fear of mistakes is prevalent enough to warrant its own diagnosis in the medical

nomenclature: atychiphobia. Even if this fear is a specter without a shape, it is still very real. The fear of failure is deep-seated. Researchers know that when students with math anxiety encounter numbers, for example, “a fear center in the brain is activated—the same fear center that lights up when people see snakes or spiders” (Boaler, 2019, p. 122). The trouble is that this fear is not just holding students back in the present; it is preventing students from actively realizing their future.

For students to be prepared for the vicissitudes of the emerging future, they need to possess the confidence and know-how to recognize, react to, and repair their mistakes. Mistakes are a feature of all aspects of life. They are present in equal measure and frequency across age, place, and context. A mistake is just as likely to occur in a social setting as it is in an academic setting; it is just as likely to occur in one’s home and when one is on vacation; it is just as likely to occur when one is young and excitable as it is when that child grows to be old and impatient. Given the ubiquity and unavoidable nature of mistakes, both big and small, the issue is not whether mistakes will be made, but whether mistakes can serve as instruments to enable learning. This study has sought to resolve this issue. To do so, there are a handful of problems this study addressed: 1) The current state of research on how individuals learn from mistakes lacks a comprehensive theoretical framework. According to Rhaiem and Amara (2021), this topic would benefit from devoting more attention to establishing a robust theoretical foundation to better understand and contextualize the phenomena; 2) Existing research into how students learn from mistakes is characterized by a compartmentalized approach, limiting cross-disciplinary insights and rarely building on or referencing other studies; 3) The prevailing and myopic perspective in existing research that treats mistake-learning as a phenomenon confined to the classroom, neglecting broader and informative contexts; 4) Current studies predominantly focus on instructional strategies, overlooking the importance of student-driven learning processes

in understanding how individuals learn from mistakes; 5) Extant studies' focus on individual couplings of mistake-making and mistake-learning, rather than approaching mistakes as a horizonless chain that requires a replicable, systematized process. This study addressed these problems by introducing and testing the conceptual framework of Mistake Literacy.

Research Questions

This study foregrounds students' experiences and educators' perceptions of the conditions and strategies that inform how students learn from their mistakes. Students and teachers each bring a unique and relevant perspective to the study. Students bring a lived experience that can elucidate the essence of the phenomenon. Relatedly, because educators are actively and proximally involved in their students' learning experiences, and possess an intimate knowledge of teaching and learning practices, their inclusion in this study can help to add depth and detail to students' lived experiences.

This study answered six research questions, four of which were answered using quantitative research methods and two of which were answered using qualitative research methods. In a concurrent mixed methods design, Creswell (2018) specifies that merging the two databases "works best if the researcher asks parallel questions in both the qualitative and the quantitative data collection efforts. By asking parallel questions, we mean that the same concepts are addressed in both the qualitative and quantitative data collection." The following research questions adhere to and have operationalized this wisdom.

Quantitative Research Questions:

1) Is there a significant relationship among the components of Mistake Literacy for middle grades students?

2) To what extent are statistical differences in Mistake Literacy components mediated by the contextual conditions of middle grades students (socio-cultural factors and parental involvement)?
3) Is there a significant relationship between Mistake Literacy components and mistake-repair efficacy for middle grades students?
4) What are the components of a classroom environment that have the greatest influence on middle grades students' willingness to make and learn from their mistakes?

Qualitative Research Questions:

5) How do students describe the socio-cultural conditions, classroom conditions, and strategies that influence their ability to learn from mistakes?
6) How do educators describe the socio-cultural conditions, classroom conditions, and strategies that influence their students' ability to learn from mistakes?

The Conceptual Framework

Researcher Stance

As far as we know, there is no such thing as purple to a rock, love to an ant, or boring board meetings to a bird. Similarly, I believe there are enumerable things imperceptible to a human and between humans—we can never truly walk in some else's shoes; thus, reality is, at least in part, bound by subjectivity. "The fact is, with the exception of our own minds, no power on earth has the consistent and absolute ability to convince us [of anything] . . . we are the ones who decide how to process and experience information" (Schulz, 2011, p. 45).

Our subjective perception and interpretation of the world is also not a constant. There is always an interplay between the individual and their circumstances. As a practicing Jew, I can understand and forgive those who participated in Hitler Youth by merit of the organization's activities being reflective of macro-level circumstances and not individual character. For this reason, it is vital to consider the researcher's reflexive stance to understand the "researcher as instrument" (Bloomberg, 2019, p. 171). Just as with any research instrument, there exists a bidirectional relationship between the study and the researcher. An individual's ontological and epistemological positions shape how questions are posited, and the researcher's questions shape an individual's epistemology and ontology (Chou, 2018, p. 171).

In my pedestrian life, I would most nearly identify as a constructivist—I do not believe in *being* so much as I believe in *becoming*; and yet, this study demands that I bracket my personal ontology, and approach this mixed methods case study as a pragmatist. Because much case study work is done across different philosophical approaches, the preponderance of philosophical assumptions means that I must foreground the problem, rather than my own ontological underpinnings (Stake, 1995). In this way, and for this reason, I have approached this study as a pragmatist. Instead of focusing on methods, pragmatism focuses on the research problem and permits the researcher to use all approaches available to understand the problem; thus affording me the freedom of choice to select the methods that best serve the needs and purposes of the study (Stuart, 2017). At the same time, pragmatism is not a significant deviation from my own personal beliefs: "Pragmatists do not see the world in absolute unity, and the truth is that which works at the time. Pragmatists agree with constructivists that research always occurs in social, historical and political contexts" (Creswell, 2008). Moreover, it is not some measure of methodological carte blanche; rather, it coheres to the design of my study. According to Creswell

and Clark (2018), case studies are most commonly rooted in pragmatism; moreover, because the concurrent mixed methods design involves "collecting, analyzing, and merging quantitative and qualitative data, it can raise issues regarding the philosophical assumptions behind the research . . . It is recommended that researchers who use this design work from a paradigm of pragmatism" (Creswell & Clark, 2018). Ultimately, researchers should be free to choose the methods and procedures that best meet their needs and purposes, which means the research questions should determine the methods used. Pragmatism ensures that both my own personal beliefs and the strictures of ontological, epistemological, or axiological purity do not interfere with the study's purpose.

Experiential Base

I have a personal connection to pragmatism by virtue of my background as a student, teacher, and administrator in progressive schools. After all, it was John Dewey, the father of progressive education, who spent his career applying pragmatic principles in developing his philosophy and in the practice of educating children (Johnson & Onwuegbuzie, 2004). Beyond my educational experience, the extensive time I have spent living abroad has also contributed to my lived experience and connection to pragmatism, with my time in China being both notable and formative.

When I arrived in China, I had no more than a novice grasp of the language. My day-to-day experience was hamstrung by the absence of my ability to communicate. The characters adorning store awnings meant nothing to me, and yet they served as a clear semaphore to everyone around me. Through a months' long process of immersion and deliberate practice, my fluency in Mandarin grew. As my grasp of the language evolved, my daily experience changed, as well. Increasingly, the world I had known for months was replaced by a richer, more vibrant

one, in which I could form connections and friendships, and develop a truer sense of belonging. This experience taught me that there is a fundamental interplay between knowledge and the knower—an increased knowledge-base will alter one's reality. In other words, because knowledge is not a constant, reality is not a constant. For this reason, there really can be no such thing as capital "T" truth.

Pragmatism similarly does not accept an objective reality, but rather preaches the presence of a lowercase "t" truth, which is a composite of the "provisional truths that we obtain and live by [and are] given through experience and experimenting" (Johnson & Onwuegbuzie, 2004). The pragmatic maxim states that truth is determined by experiences and the way that beliefs and expressions interact with the world (Murphy, 1990). Because this study has sought to understand students' experiences and relate them to the novel conceptual framework of Mistake Literacy, this study has no space for dogmatism, preferring instead to hold human experience in a higher regard.

Researcher Organization of the Literature Review

> What should we teach . . . that will help [a child] survive and flourish in the world of 2050 or of the twenty-second century? What kind of skills will he or she need to get a job, understand what is happening around him or her, and navigate the maze of life?
>
> —Yuval Noah Harari, *21 Lessons for the 21st Century*

In the twenty-first century, information has become ubiquitous. The "seamless" integration of information across platforms has allowed for individuals of any age and socio-economic standing to access information in previously unimaginable ways. This widespread access to information runs counter to the centuries' old model of schooling, which was premised on information dissemination; however, in a world where information is abundant, "the last thing a teacher needs to give her pupils is more information . . . instead, people need the ability to

make sense of information, to tell the difference between what is important and what is unimportant, and above all to combine many bits of information into a broad picture of the world" (Harari et al., 2018, p. 312). As the way people interact with information fundamentally changes, schools will need to change with it. This process, though, is not a simple one.

Schools are complex, human-centered organizations wherein learning is influenced by a dynamic constellation of environmental, personal, and behavioral factors (Bandura, 1997). Therefore, to construct a transferable, substantive theory on how students can more consistently embrace and learn from their mistakes, the multilayered and reciprocal nature of learning within schools must be accounted for. With this in mind, the literature review presented in Chapter 2 provides a comprehensive examination of four distinct, yet interrelated research streams: Contextual Conditions, Intervening Conditions, Strategies, and Outcomes.

Contextual Conditions, the first literature stream, accounts for the distal yet still present external variables that influence a students' willingness to acknowledge a mistake in the first place. The situational and socio-cultural factors that influence a students' willingness and capability to learn from their mistakes casually affect the efficacy and impact of what takes place inside a classroom. "The variables preceding and co-occurring with emotional adaptation in the classroom are the biological factors that students bring with them, as well as parent socialization practices and home learning" (McCaslin et al., 2016, p. 3). This stream surfaces and analyzes these contextual conditions that reinforce or undermine strategies. Though strategies can be implemented irrespective of these conditions, these conditions may help to explain the gap between implementation and change. Therefore, this foundational literature stream adds to the existing body of research by identifying the contextual conditions needed for students to recognize, react to, and repair their mistakes. Contextual Conditions leans on the work of

Bronfrenbrenner (1979), Guy-Evans (2020), Hofstede (1980), McCaslin et al. (2016), and Mih (2013).

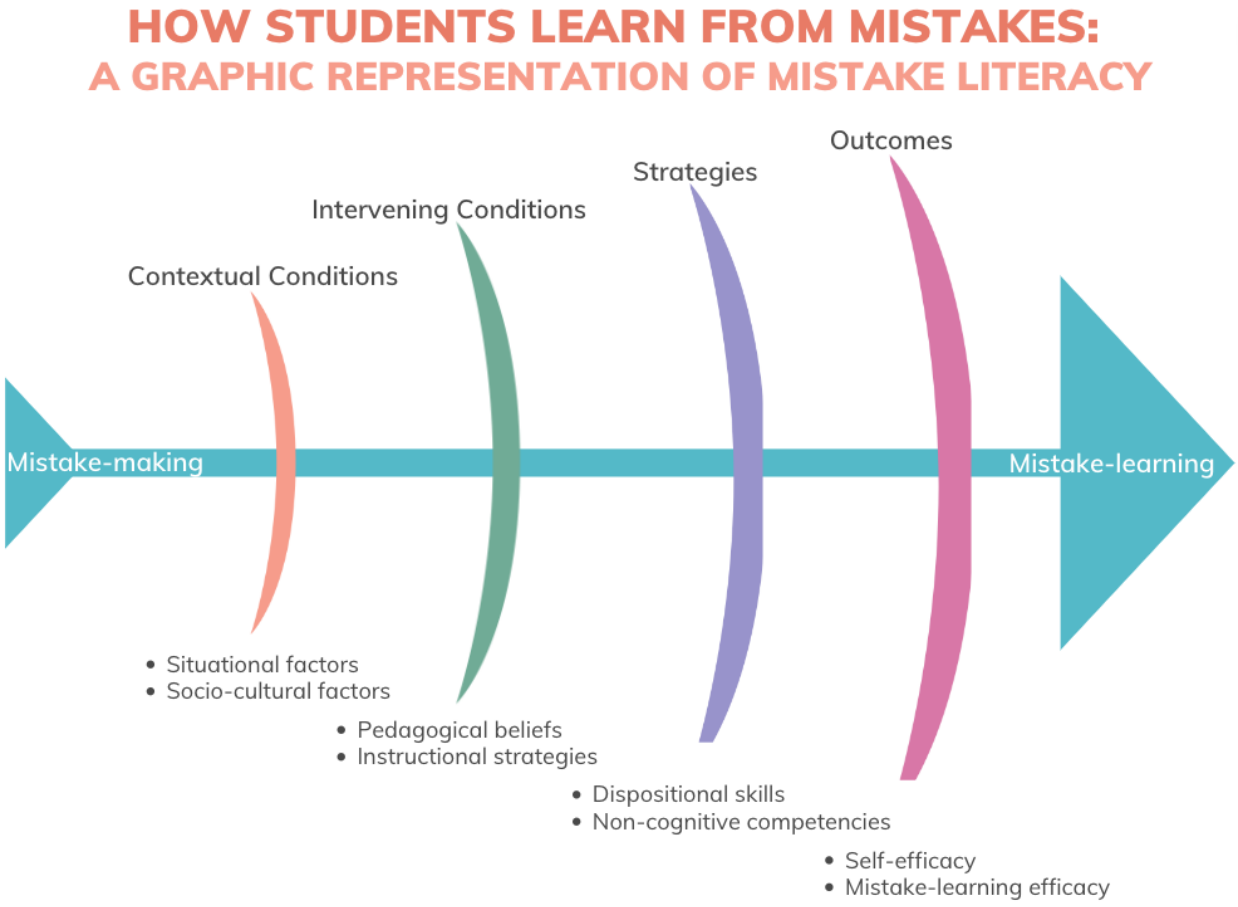
Intervening Conditions, the second literature stream, focuses on the intervening conditions that make it possible within a classroom context for students to experience the fun, frustration, and growth that is part and parcel to errorful learning. This literature stream—one that Degen (2019 refers to as "stage setting"—is intended to identify those variables that give "the new learning ecosystem the strength and stability necessary to scale beyond isolated pockets of innovation" (Rickabaugh, 2016, p. 60). This stream examines those proximal influences (e.g., instructional strategies, pedagogical beliefs) within an educator's control that cultivate a learning environment wherein students possess the know-how, know-why, and know-when to learn from their mistakes (Sturgis, 2018). The research base that supports Intervening Conditions includes DeBrincat (2015), Hattie (2010), Kapur (2012), Loibl and Leuders (2019), Rutledge (2017), and Tulis (2013).

Strategies, the third literature stream, revolves around the scarcity of existing research into how students learn from mistakes. Because there has been no notable synthesis of existing research, there is no extant theoretical or conceptual framework (Rhaiem & Amara, 2021). In fact, Rhaiem and Amara (2021) concluded that existing research into learning from mistakes currently "suffers from a lack of theoretical underpinning." As a result, there is little known about the invisible web of relationships that produce the probabilistic outcome of learning from a mistake. The purpose of this third stream is to create a constellation that connects the proverbial dots of the existing literature in order to devise, in a deductive sense, a provisional conceptual framework of *a priori* findings on the strategies that students can deploy regularly and freely to

learn from their mistakes. The sinuous strength of the constellation is derived from the research of Dweck (2007), Hattie (2010), Nayir (2017), and Wang et al. (2021).

The presence of a fourth and final literature stream is unconventional. In the case of this study, this deviation from common practice is warranted. Whereas the third literature stream articulates the suite of dispositional and non-cognitive skills that can be carried out from the students' perspective to optimize learning from mistakes. Outcomes, the fourth literature stream, explores and explains what is meant by "learning." Learning means so much to so many that leaving the term undefined or ill-defined would create a cloud of ambiguity around the specific and measurable outcomes sought by capitalizing on the opportunity that a mistake provides. As such, this fourth literature stream imbues the study with a needed outcome-orientation. Outcomes pulls from the work of Bandura (1997) and Song (2018) amongst others.

Graphic Representation



Definition of Terms

Contextual Conditions. Situational (e.g., parental involvement) and socio-cultural (e.g., cultural influence) factors that influence a students' willingness and capability to learn from their mistakes (Bloomberg, 2019).

Intervening Conditions. Proximal influences within an educator's control (e.g., instructional strategies, orientation and disposition) that cultivate a classroom learning environment most favorable to students' learning from their mistakes (Bloomberg, 2019).

Strategies. The suite of dispositional and non-cognitive skills that can be carried out from the students' perspective to optimize learning from mistakes (Bloomberg, 2019).

Outcomes. Learning can be measured in many ways. Outcomes articulates and individuates the "results produced by the implementation of a strategy" (Bloomberg, 2019, p. 120).

Mistake. The unsuccessful but legitimate attempt at a new task; an ongoing and iterative investment in the development of a new skill (Rickabaugh, 2016).

Mistake Literacy. A conceptual framework that functions as a roadmap to grow students' capacity and capability to recognize, react to, and repair their mistakes (Cohen, 2020).

Growth mindset. In a growth mindset, people believe that their most basic abilities can be developed through dedication and hard work—a view that instills in students the "ability to come back after a defeat or unsuccessful attempt" (Couros, 2016, p. 111).

Mistake-repair. The systematic planning to take action through the complementary processes of reflection and goal-setting in an effort to reconcile the divide between one's mental models and the correct model (Mason, 2016).

Learner empowerment cycle. A sequential and recursive set of synergetic dispositions consisting of choice, motivation, and engagement (Rickabaugh, 2012).

Mistake-learning efficacy. A learner's aptitude, motivation, and core belief about their ability to learn from mistakes in non-identical situations.

Socio-cultural factors. The gender, race, ethnicity, grade-level, and birth order of students participating in the survey and semi-structured focus group interview.

Dispositions. The attitudes and behaviors that inform the way that students engage in and relate to the learning process (Kallick, 2008).

Non-cognitive skills. Non-cognitive skills include those underlying transdisciplinary learning habits that include interpersonal skills such as communication and collaboration, as well as intrapersonal skills, like metacognition and self-regulation (Rutledge, 2017).

Assumptions, Limitations, and Delimitations

Assumptions

Assumptions are the bedrock of any study. As noted by Leedy and Omrod (2010), "Assumptions are so basic that without them, the research problem itself could not exist" (p. 62). In this study, there are an array of assumptions, each of which originates from those relevant ideas that I believe to be true (Bloomberg, 2019). The first such assumption is that participants hold a belief that mistakes provide students with opportunities for future learning to occur. The second assumption is that participants, either through experience or proximity, were able to explicate their beliefs about how students learn from mistakes. Third, this study is predicated on the assumption that participants possess the socio-cultural competency and macro-level perspective that allows them to understand and articulate the interplay between a student's demography and their willingness to make and learn from mistakes. Finally, it is assumed that participants were able to answer the interview and survey questions honestly and definitively, meaning every respondent has the reflective and linguistic capability to articulate their experience and observations.

Limitations

Limitations "are potential weaknesses that are out of [the researchers'] control" and are inherent and inescapable within the scope of the selected research design (Simon, 2011, p. 75). There are myriad limitations that are unavoidable in this research design, as it suffers from the limits associated with mixed methods, concurrent triangulation, and case study research. Rather than seek to circumvent the limitations listed, I have sought to embrace them and make overt note of these limitations in my analysis and discussion.

Common mixed methods limitations revolve around the complexity and sophistication of the method, especially for novice researchers, which, of course, I am (Creswell & Clark, 2018). Moreover, this study succumbs to the limitations of case study research, including "Lacking scientific rigor and providing little basis for generalization of results to the wider population, researcher bias, and difficulty in replication" (Miles et al., 2014). Moreover, this study is exposed to standard shortcomings in concurrent triangulation, which revolve around the discrepancies between quantitative and qualitative findings being potentially difficult to reconcile (Almeida, 2018).

Delimitations

Delimitations are similar to limitations in that they restrict and constrain the scope of a study, but they differ in that these parameters are intentionally set by the researcher (Simon, 2011). In all, there are three delimitations that warrant mention. First is the geo-demographic diversity of participants, which is natural to a bounded case study. However, for a topic that is so universal and timeless in nature, the monocultural participant pool potentially limits generalizability. Second, because this study examines middle grades students in specific, the study did not draw from the voices of established experts in the field. As such, this study made the determination to foreground educators' perceptions and students' experiences with the phenomenon of students' inclination and ability to convert mistake-making into mistake-learning. Third, one of the goals of this study was to explicate the extent to which socio-cultural conditions mediate students' willingness and ability to learn from their mistakes. The thing is, socio-cultural conditions is an entangled, multidimensional construct that could warrant a study unto itself. As such, I restricted the scope of socio-cultural factors to include gender, race, ethnicity, grade-level, and birth order.

Summary

Chapter 1 provided an overview of the study, including the problem statement, purpose, and significance of the study and conceptual framework. Chapter 2 contains a synthesis of salient, extant research on contextual conditions, intervening conditions, strategies, and outcomes pertaining to how students learn from their mistakes. Chapter 3 provides the research methodology and procedures used in the study. The results and findings of the study are contained in Chapter 4. Chapter 5 presents a summary of the study and findings, conclusions, and recommendations for future studies.

Chapter 2: Literature Review

The technological advances of the Fourth Industrial Revolution have begun to democratize and personalize learning in a way that has rendered the existing "grammar" of schooling obsolete. To adapt, schools need to begin to offer an education that is relevant to the way students live and work in the 21st century. Schools will need to provide students with the enduring and transferable skills necessary to navigate the uncertainty of the emerging future in order to develop confident, independent, life-long learners who possess the know-how to recognize, react to, and repair their mistakes—a skill that is evergreen and untapped (Rickabaugh, 2016). The importance of developing students who have the capacity and capability to monitor, evaluate, and act on their mistakes is echoed widely across the literature and across the globe (DeBrincat, 2015). The trouble is that there has been no single synthesis and summary of this literature. Therefore, Chapter 2 will not just review existing literature but will organize existing literature into a cohesive and coherent conceptual framework. By explicating what existing research says about how students learn from their mistakes, Chapter 2 advances the larger goal of this dissertation and affirms the position of mixed methods case study research by reviewing existing literature with a critical eye.

In accordance with established research practices in testing an emergent conceptual framework, the four literature streams presented in this chapter are organized to emphasize the process or action underlying the findings (Creswell & Clark, 2018). In this case, the underlying process that catalyzes student learning begins with a suite of macro-level and distal variables and then narrows to a host of ego-centric and proximal variables. As such, the literature review is presented as follows: 1) Contextual conditions: situational (e.g., parental involvement) and socio-cultural (e.g., ethnic background, socioeconomic status) factors that influence a students'

willingness and capability to learn from their mistakes (Bloomberg, 2019); 2) Intervening conditions: proximal influences within an educator's control (e.g., instructional strategies, orientation and disposition) that cultivate a classroom learning environment most favorable to students' learning from their mistakes (Bloomberg, 2019); 3) Strategies: the suite of dispositional and non-cognitive skills that can be carried out from the students' perspective to optimize learning from mistakes (Bloomberg, 2019); 4) Outcomes: learning can be measured in many ways. Outcomes articulates and individuates the result of the strategy (Bloomberg, 2019).

Literature Review

Stream 1: Contextual Conditions

> It's not a matter of if you're going to fail; it's a matter of when it's going to happen, and what you are going to do about it.
>
> —Andy Stumpf, *Fail More: Embrace, Learn, and Adapt to Failure as a Way to Success*

Learners differ in what they bring to given situations. Cultural and social opportunities and personal resources are not evenly distributed, and students differ in how they negotiate them (Blair & Raver, 2012). Sociocultural, situational, and historical perspectives can mediate how students respond to different contexts and opportunities, as well as accounting for differences in individual readiness in their willingness and ability to make mistakes in the classroom. McCaslin et al. (2016) found that cultural and social variables factored into the coregulation of students' responses to mistake-making. As such, contextual conditions is the logical jumping-off point and bedrock for the Mistake Literacy construct.

Contextual conditions are those situational and socio-cultural factors that influence a students' willingness and capability to learn from their mistakes (Bloomberg, 2019). These conditions exert a meaningful and often invisible influence on students, and exist beyond the

immediate and controllable environment of the classroom. This literature review opens with contextual conditions because **e**ven though classrooms might possess somewhat stable features, the research shows that the student experience is significantly informed by simultaneous and multidimensional extra-classroom variables that need to be taken into consideration, including political and historical legacies, familial values, and cultural norms (Kaufman, 2019).

Bronfenbrenner's (1979) ecological systems theory "views child development as a complex system of relationships that is affected by multiple levels of the surrounding environment, from immediate family settings . . . to broad cultural values" (Bronfenbrenner, 1979, p. 38; Guy-Evans, 2020). Ecological systems theory has implications for educational research, as it insists that we look beyond just the child and classroom to examine the larger learning environment at play across both a micro- and macro-level. At the micro-level are those proximal variables that remain outside of students' nexus of control, but still possess a direct and immediate influence on learning (Bronfenbrenner, 1979). An example of a micro-level influence that surfaces time and again in extant research is parental involvement. Macro-level influences consist of those distal variables that extend beyond a students' immediate environmental setting. An example of a macro-level influence that surfaces in the research is the learning values that are embedded in a student's culture (Guy-Evans, 2020). This literature stream will collect, collate, and communicate what existing research tells us about these micro- and macro-level influences by presenting findings across two interrelated but ultimately bifurcated categories: situational conditions and socio-cultural conditions.

Situational Conditions

The mission, vision, and values of a school standardize the expectations and norms of the learning culture; however, the efficacy and impact of a school culture is predicated on like values

being reinforced at home. Over a lifetime, students spend roughly 15,000 hours in school compared to the "29,000 hours they spend at home during their schooling years and 26,000 hours they spend in the care of parents *before* they start formal schooling" (Hattie, 2010, p. 52). While parents are not physically present during the school day, they wield an invisible influence that permeates the learning culture of a school. This stakeholder group is critical for schools to elevate and embrace the vital role that mistakes play in the learning process. Parental involvement should not be seen as a garnish, but rather as a central influence to cultivate a climate wherein students confidently confront mistakes with a learning orientation (*Staff of 2030: Future-Ready Teaching*, 2020).

When parents are involved in their child's schooling, it can result in positive learning outcomes for students of all ages. It is well established that parental involvement is positively correlated with learning in elementary, middle, and high school "across motivational constructs, including school engagement, intrinsic motivation, perceived competence, perceived control, self-regulation, student attitude, mastery goal orientation, and educational aspirations" (Gonzalez-DeHass, 2005, p. 112). According to Wang et al. (1994), the school-home partnership is the fourth most influential factor on student learning of the 28 factors studied. Hattie (2010) corroborates these findings, concluding that parental involvement has a relatively large 0.51 effect size. Of course, parental involvement can manifest in a variety of ways, some of which are more germane to students developing the underlying skills needed to learn from mistakes.

When it comes to mistakes, parents have to allow the child to find the learning (Tugend & London, 2011). When parents insist on inserting themselves in fixing a mistake, they are depriving their kid of the lesson that is learned when they allow the mistake to be the teacher (Tugend & London, 2011). Mih (2013) found that the degree to which parents support their

child's autonomy had a positive influence on school related outcomes. Parental support of their child's autonomy has been found to "encourage children's problem solving, choice, and participation in decisions . . . which in turn prompts autonomous motivation, engagement, effort, and persistence" (Mih, 2013, p. 42). Conversely, parents seeking to exert control over their child's autonomy can actually stunt the development of a secure sense of self (Mih, 2013). Results from a sample of 93 fifth-grade students showed that parental surveillance was related to a decrease in autonomous motivation. "The more parents were involved in monitoring schoolwork, the more students reported being dependent on external sources for guidance . . . teachers were also more likely to rate these children as being less motivated and demonstrating less persistence in their schoolwork" (Gonzalez-DeHass, 2005, p. 116). However, when parents reacted to schoolwork by providing encouragement, students were more likely to report "an intrinsic motivational orientation characterized by a preference for challenging tasks, curiosity, and interest in learning" (Gonzalez-DeHass, 2005, p. 117). Simply put, parental involvement can influence learning outcomes for better or worse. Thus, to optimize learning from mistakes, parental involvement should be thought of as the encouragement of children by empathizing with, connecting to, and supporting the growth of their autonomy.

Influential a variable as parental involvement can be, parental involvement is not devoid of context. In fact, parental involvement is in direct conversation with the conditions that define students' socio-cultural environment. A student's socio-cultural environment equally affects their choice to own and learn from their mistakes or disavow their own culpability and choose instead to apportion blame for their mistakes.

Socio-Cultural Conditions

A simple Google search on the topic of this dissertation will yield hundreds of proverbs, idioms, and aphorisms from around the world that detail the broad importance that cultures independently place on learning from mistakes. This seemingly bottomless collection of wisdom begets an important question: Why do we need a system to enable people to learn from their mistakes in the first place? Well, it is not only because learning from mistakes is rare, it is also because there are some people who are simply more or less predisposed towards it. While learning from mistakes might come naturally to some people, it does not come naturally at all to others. In fact, research has found that one's predilection for learning from mistakes is heavily influenced by those forces that are simultaneously the most atomic, immutable, and integral to who we are.

It turns out that some people are actually genetically more capable of learning from their mistakes. In 2007, a team of neuroscientists from Germany reported that "people with a particular gene variation have greater difficulty learning from negative reinforcement than those without the gene variation" (Tugend & London, 2011, p. 23). This means those with the gene variation are slower to learn from bad experiences and mistakes. Fascinatingly, one's proclivity towards mistake-making in the first place is something that also might not be within students' locus of control.

Birth order is not destiny, but it is a "human experience that is one of the most pervasive [determinants] of who we are" (Campbell et al., 2019, p. 130). A recent study sought to understand the relationship between birth order and strategic risk taking. This study found that there is an inverse relationship between birth order and strategic risk-taking, meaning one's propensity for risk-taking is positively correlated to their being a later-born sibling, and that this relative propensity "persists into adulthood influencing subsequent behaviors . . . with risk

preferences differing between siblings as much as between strangers" (Campbell et al., 2019, p. 130). In short, earlier-born siblings are socialized to be less willing to even put themselves in the sort of position where a mistake would be likely. It is hard to learn from mistakes when one seeks to avoid mistakes entirely. Of course, one's willingness to take risk is not just a matter of their genetics or socialization—is also the byproduct of their cultural upbringing.

Culture is defined as "the collective programming of the mind that distinguishes the members of one group of people from another" (Hofstede, 2005, p. 46). Cultural variance stems from the asymmetric value that one culture places on specific traits, qualities, and beliefs compared to other cultures. Hofstede (1980) found that one such differentiator is power distance, which is "the degree to which inequalities are accepted either as unavoidable or as functional by those with less power" (Hofstede, 1980, p. 17). In high power distance cultures, individuals with power are seen as superior and infallible, leading those with less power to accept their place in the hierarchy; conversely, in low power distance cultures, there are lower levels and less acceptance of inequality (Daniels & Greguras, 2014). Unsurprisingly, power distance is negatively correlated to the "creation of a classroom climate that encourages open interactions between teachers and students" in which ambiguity is embraced and feedback is sought-after and provided (Daniels & Greguras, 2014, p. 122). Needless to say, a learning environment devoid of feedback and ambiguity is not one that is going to be terribly tolerant of mistake-making nor conducive to mistake-learning. Research into power distance elucidates the role that cultural conditioning and entrenched norms play in students' willingness and ability to learn from their mistakes. Fortunately, power distance is not destiny. Acido et al. (2016) found that it is possible for low power-distance relationships between students and teachers to exist even if the students are raised in a high-power distance culture (Muega et al., 2016). In other words, under specific

conditions, it is possible for schools to not only insulate themselves from the effects of power distance, but to control for these effects. Of course, counteracting the effects of power distance does not necessarily mitigate the all the ways in which culture may influence students' willingness to learn from their mistakes.

As the age-old and unattributable saying goes, "If it is in the culture, it is in the schools." It should be no surprise then that study after study has found that school culture in the United States is heavily informed by white middle-class values (Lipsitz, 1995). Students who share these identity markers possess a sense of belonging in their learning environment that is not necessarily shared by their peers from marginalized groups, who may perceive their learning environment to be exclusionary (Healey, 2021). The absence of this ingrained sense of belonging may disrupt cognitive processing, reduce students' risk tolerance, and foreground a fear of stereotype threat (Healey, 2021). Conversely, bolstered by the comfort of familiar cultural signposts, mistake-making and mistake-learning becomes the domain of those who identify as part of the hegemonic culture. To make and learn from their mistakes, students need to be daring and bold, but students will only be as daring and bold as their privilege allows.

> There is a willingness on the part of our white male students to be able to just blurt out answers, and be kind of wrong. No fear whatsoever. And so that comfort comes from them feeling that sense of safety. There are no negative consequences beyond the moment. There's nothing that sparks structural wounds in them and so when they make mistakes, it's easier for them to recover. It doesn't leave them in a position of ill-repute, and this is a mindset that we don't teach to girls and to people of color (Cohen, 2020).

Equitable access to learning is predicated on equitable access to mistake-making. But, such access can be limited by the pernicious and pervasive presence of cultural stereotypes and

structural legacies in schools (Healey, 2021). The social power that students possess is a relative but fundamental reality, and it serves as an important explanatory condition to illuminate the extent to which students are willing to make and learn from their mistakes. Of course, demography is not destiny, and it does not define what students are capable of. And yet, demography does factor into students' relationship with mistakes. It is important that we acknowledge this and also articulate the ways that extant research tells us that classroom teachers can combat and counteract this. At the end of the day, the central concern of this dissertation is not mistake-making but mistake-learning. As such, we will now turn our attention to what extant research tells us about the classroom conditions that can neutralize these contextual conditions, and level the proverbial "playing field" for all students.

A student's ability to own their learning is predicated on the opportunities provided to them. Oftentimes, the presence, or lack thereof, of such opportunities is determined by their classroom teachers. McCaslin et al. (2016) concluded that irrespective of contextual conditions, students' responses to mistake-making in a classroom setting are malleable and open to intervention. Classroom opportunities can influence how students cope with and adapt to mistake-making, irrespective of readiness and preceding hindrances (McCaslin et al., 2016). As such, the second literature stream will identify those proximal variables that are within the teacher's control and can help set the stage for students to reliably convert mistake-making into mistake-learning**.**

Stream 2: Intervening Conditions

> This willingness to learn from mistakes is not a sign of self-doubt, but of faith: it tests and humbles you, allows newness into your life. Best of all, being open to one's errors, banishes the stifling effects of certainty. Certainty kills curiosity and change.
>
> —Jerry Saltz, *How to be an Artist*

Teaching is a deeply complex and delicate craft that is contingent on the bidirectional relationship between myriad distal and proximal influences (Claxton, 2021). In 1996, Charlotte Danielson conducted a study out of which the Framework for Professional Practice was born (Danielson, 1996). Part of the point of her study was to illuminate the complexity of the profession. Of her many findings, one in particular stands out: Teachers make more than 3,000 non-trivial decisions every day (Danielson, 2009). This means, a classroom teacher is making a nontrivial decision roughly every 6.25 seconds. Consider the extraordinary subtlety and stress involved in making instant decisions about which student to call on, how to frame an impromptu question, or how to respond to an interruption (Danielson, 2009). Given the immensity of the profession, the late Madeline Hunter analogizes teaching with surgery: "You must be very skilled, very knowledgeable, and exquisitely well trained, because neither the teacher nor the surgeon can say, 'Everybody sit still until I figure out what in the heck we're gonna [sic] do next'" (Hunter, 2004, p. 21). In part, the intractable complexity of the profession stems from the fact that there is no one-size-fits-all model to teaching—there is simply no panacea because the act of learning is as multifaceted as each individual learner; and yet, teaching is not guesswork. There are interventions that teachers can incorporate into their routine educational practices to positively influence learning outcomes. According to Hattie (2003), the choices that teachers make account for 30% of the variance in student learning—the single most influential source of variance other than the students themselves. The central role that teachers play in the classroom is lent additional depth and texture when the morass of mistakes is made a feature, rather than a bug, of the learning environment. When students make a mistake, their response can range from surprise and bewilderment to verbal expressions of frustration and anger. Which of these responses wins is the sum of multiple variables—one of which is the nature of the classroom

climate. “Teachers are the leader of their classroom, the one who has the most influence on the nature of the being-wrong climate that is established. [Their] actions and communication tells students what the expectations are for mistake-related behavior and thinking” (Schulz, 2011, p. 45). Though it may not be common in the United States, in places as culturally diverse as China and Japan, teachers have set the expectation that mistakes are integral to learning.

For American students, errors tend to be interpreted as an indication of failure, whereas for Chinese and Japanese students, they are an index of what remains to be learned (Stigler, 1992). In China and Japan, errors are seen as valuable sources of information that can be leveraged to make learning an increasingly personal and productive process. The research has found that in China and Japan teachers use errors as a springboard to prompt discussions of, and inquiry into, challenging concepts” (Schleppenbach, 2007, p. 135). These open discussions of errors exist in stark contrast to how they are handled in the United States where there exists an expectation of privacy. “Studies of Chinese and Japanese students reveal that their teachers . . . have much more open discussions about performance, marks, and mistakes. Scholars note that this seems to diminish the sense of shame that students feel when they err” (DeBrincat, 2015, p. 13). This approach normalizes mistake-making and decreases stigma, as students begin to develop a clearer understanding that failure can beget success (DeBrincat, 2015). On the other hand, students in the United States harbor feelings of stress and anxiety about school, in part because they harbor a belief that the primary success criterion to evaluate performance is perfection (Claxton, 2021). As Stephanie Cueva, a high-school student from King of Prussia, Pennsylvania, shares, these feelings of stress and anxiety can be alleviated if teachers embrace mistakes as part of the learning process:

> Perfectionism is one of the main causes as to why I do poorly on some things in school. I have been frustrated about a lot that I am expected to learn in school because they expect us to learn so much information in such little time that we end up forgetting about half of it anyway. The expectations that I wish that my teachers and school have of me is that I am only human and that I make mistakes ("What Students Are Saying About How to Improve American Education," 2019).

Interestingly, Stephanie Cueva's anecdotal experience is quantifiable. The degree to which mistakes are integrated and accepted as a natural part of the learning process appears to be correlated with student achievement.

Of the 77 countries that participated in the 2018 Performance for International Student Assessment (PISA), China placed first in all three categories: reading, mathematics, and science (*PISA Results in Focus*, 2019). Japan placed in the top five for mathematics and science, and in the top 10 for reading (*PISA Results in Focus*, 2019). The United States' performance was comparatively less stellar. The data showed that "performance in reading and math has been stagnant since 2000 . . . [with] about a fifth of American 15-year-olds scoring so low that it appeared they had not mastered reading skills expected of a 10-year-old (Goldstein, 2019; *PISA Results in Focus*, 2019). Instructional practices in China and Japan suggest there exist operational and optimal methods that can be deployed to not just maximize learning from mistakes, but, as evidenced by 2018 PISA results, actually *leverage* mistakes to maximize student achievement.

This literature stream will focus on how teachers in the United States can accomplish just this. To do so, this literature stream will examine and explicate those proximal variables that are within a teacher's control and can set the conditions for students to learn from their mistakes. As

based on extant research, this literature stream will be divided into two sections: 1) Adaptive mistake-orientation and dispositional attributes; 2) Instructional strategies.

Orientation and Disposition

The literature on establishing an error-tolerant learning environment suggests that there are a number of distinct yet interrelated qualities that emanate from, and concern themselves with, a teacher's outlook and attitude towards mistake-making (Tulis, 2013). Instructional strategies and programmatic changes can center errorful learning, but the efficacy of these shifts is mediated by how teachers respond to students when they make mistakes or are wrong: "While interacting with students, teachers display an attitude toward errors, and these attitudes in turn impact students' responses to mistakes" (Tulis, 2013, p. 59). Fischer et al. (2016) found that "individual [teacher] personality regulated students' responses to errors and was therefore important in setting the climate in their learning." This segment of the literature stream seeks to identify the distinguishable dispositional attributes and adaptive orientation towards mistakes that serve as a necessary precondition for mistake-learning to occur. According to Rutledge (2017), it could be argued that the basis for all classroom learning can be distilled to the presence and prevalence of these two variables.

How a student perceives the treatment of their mistakes in the classroom is called the error climate. Teachers set the conditions for an error climate that fosters the right kind of student response to mistakes that will prompt the sort of reflection and rethinking for students to reconcile their error and retrain their neural pathways to avoid the mistake in the future (Tulis, 2013). A high error climate is characterized by a teacher's "openness to different solutions to a problem, a willingness to share error knowledge, a comfort with facing misconceptions, and [continual] efforts to help students correct errors by themselves" (Schulz, 2010, p. 55). In

particular, four teacher-specific qualities can bring a high error climate to fruition: acknowledging students' mistakes, emphasizing the learning potential of mistakes, exhibiting patience when mistakes are made, and impeding negative reactions from classmates (Tulis, 2013). In a high error climate, students are motivated to correct their errors and pursue an understanding why they made a mistake (Steuer & Dresel, 2015). In short, a high error climate sets the stage for mistakes to be seen as an integral element of the learning process. Actually, a high error climate accomplishes more than just adjusting perception—it is positively correlated to student attitude and achievement. A 2018 study conducted by the Peruvian Ministry of Education found that a positive error climate is able to explain 18.5% of the variability of positive attitudes towards mathematics and 14.2% of the variability of achievement in mathematics (Christiansen, 2018). A high error climate is largely predicated on teachers' intentionally calibrating their efforts and attitude to mitigate the negative associations that students may carry with them in relation to mistake-making. The thing is, an aversion to mistakes is such an innate and automatic human response that leveraging mistakes as an instrument of learning cannot be wholly pathologized without consideration being given to offsetting the self-preserving brain patterns that hinder adaptive responses to mistake-making in the first place. Counterintuitive though it may be, this is where the role of humor comes into play.

One distinguishing feature between a low error and high error climate is whether a teacher responds to a student's mistake with acerbity or humor. According to the research, humor is a dispositional hinge point that can defuse the self-admonishment that may naturally arise following a mistake: "Humor has a much more disarming, leveling, humbling, and most importantly, comforting effect than many might admit. . . . [A] professional playfulness can relax

tensions, and create a more forgiving atmosphere for content exploration" (DeBrincat, 2015, p. 27). Moreover, responding to a mistake with a magnanimous chuckle or genial grin can elucidate the erroneous schematic that contributed to the mistake being made in the first place. As DeBrincat (2015) writes, "If handled properly, humorous moments can offer insight into students' thinking and serve as springboards for further inquiry." A bit of levity is a versatile tool to foster a culture of mistake-learning in a classroom. Perhaps, this is because mistake-making and humor share a parallel structure. "Incongruity theory posits that comedy [and errors] arise from a mismatch—specifically, a mismatch between expectation and actuality. These situations begin with an attachment to a belief . . . [which] is then violated, producing surprise, confusion, and replacement beliefs" (Schulz, 2010, p. 116). Ultimately, teachers set the tone for learning in their classrooms, so when teachers approach learning with a sense of humor, rather than exasperation, it can translate into students doing the same. Of course, wrongness is not something that students experience in the moment; if it was, students would likely choose to correct their mistake before making it. For this reason, teachers need to do a bit more than react with a well-meaning chuckle; rather, they need to cultivate the space and time for students to realize that a mistake has been made.

It takes time for a mistake to percolate. Nonetheless, teachers must exhibit self-restraint in drawing the learner's attention to their mistake too quickly. The distance between an erroneous response and the conscious recognition of one's wrongness must be traversed by the learner, not the teacher. Teachers simply cannot do students' pushups for them and expect their students to gain any muscle mass. Thus, a high error climate requires patience on the part of the teacher. The research shows that the development of the broad range of skills and competencies that undergird learning from mistakes cannot be developed merely by students being taught

about them (Claxton, 2013). There is simply no evidence to suggest that knowledge translates into action. As such, learning from mistakes can only be understood by being experienced cannot (Gorman et al., 1998). For teachers, this does not mean that they must passively stand by; rather, teachers have to exhibit practicality and patience as a matter of respect for their students' autonomy in the learning process. In classroom settings where students were "given more time to think about their errors and consider correct answers, [they] exclusively expressed positive affective reactions" (Tulis, 2013, p. 57). In this way, teachers hold space for learning to occur by creating an atmosphere wherein students feel safe to reflect and rethink without interjection (Senge et al., 2011). Such patience has a catalytic effect on learning by empowering students to take ownership for their mistakes and reorienting them to reconcile the dissonance between what they thought they knew, what they actually know, and what is left to be known. Such patience on the part of a teacher signifies a respect for their students, which, in turn, can strengthen the student-teacher relationship.

Findings across myriad studies show that the student-teacher relationship is positively correlated to significant increases in student achievement (Basham et al., 2016; Degen, 2019; Rutledge, 2017). Teachers who have close relationships with their students "respect them as learners and people and demonstrate care and commitment for them" (Hattie, 2003, p. 4). Hattie (2010) found that such respect for students is correlated to a 0.61 effect size, and that the student-teacher relationship has an effect size of 0.72—the 11th highest influence on learning of the 252 variables studied. Cornelius-White (2007) found the photo negative of this to also be true: Most students who do not wish to come to school harbor these feelings as a result of their relationship with a teacher. And so, while a strong student-teacher relationship positively influences learning,

a weak student-teacher relationship can turn students off school entirely. The importance of these findings is especially pronounced when filtered through the lens of high error climate.

The qualities that define a strong student-teacher relationship are the building blocks of student success in a high error climate. “Building relations with students encourages agency, efficacy, and allows the experiences of the child to be recognized in the classroom” (Hattie, 2010, p. 62). Teachers who invest in their relationship with students are better equipped to recognize possible barriers to learning and seek ways to support students to overcome them; such teachers are receptive to what the students need, rather than attempting to dominate the situation (Degen, 2019). The ability to forge these positive, powerful connections is the linchpin for students to see mistakes as learning opportunities rather than as negative indicators of performance.

Teachers may not be in control of the mistakes that students make, but they are in control of their response to these mistakes. As DeBrincat (2015) writes, “I can remind [students] that imperfection is a part of life, and that they should not paralyze themselves in pursuit of perfection. Instead, [students] should incorporate this reality in such a way that is beneficial to their learning experience.” A teacher’s adaptive orientation to mistakes and the dispositional attributes they bring to their teaching can be the difference in students seeing mistakes as a cudgel that dissuades learning or a carrot that incentivizes the pursuit of future learning. At the same time, a classroom culture is comprised of more than a teacher’s orientation and dispositions. Although teachers who possess these orientations and dispositions are ideal candidates to set the conditions for mistake-learning to occur, a like suite of complementary instructional strategies need to be operationalized, as well.

Instructional Strategies

Given the whenever, wherever possibilities for learning, students can now access content on their own terms, rather than relying on their classroom teachers. While on the surface this burgeoning reality may appear to be moving the profession towards a technology-driven obsolescence, the reality is that a teacher's role has never been more important (Hudson, 2019). Teaching is no longer a profession of information dissemination—as information is now ubiquitous—but of design. Pedagogical knowledge, rather than content knowledge, rules the day. "Expert [teachers] possess the skills to integrate learning by combining new subject matter with prior knowledge, relating current knowledge to other subjects in the curriculum, and changing, combining, and adding to lessons according to their students' needs and goals" (Hattie, 2003, p. 7). Teachers must be keenly attuned to the needs of their students, deploying optimal instructional strategies that match the learner with the learning. In a high error climate, this structure must account for, support, and seek to remedy the imperfections inherent to the learning process. So, what instructional strategies are best suited to turn mistakes into salutary lessons?

Error Management Training (EMT) is one instructional strategy that has been found to destigmatize mistake-making and reframe it as an unavoidable aspect of human behavior. It is a training method that involves the "active exploration as well as explicit encouragement for learners to make errors during training and to learn from them" (Keith & Frese, 2008, p. 63). EMT impels learners to make mistakes by creating an environment in which they are provided only minimal instruction and are encouraged to learn through a process of active trial and error. The idea being that encouraging mistakes in a low-stakes training setting can benefit learners by replacing "the neurotic mindset generated by the conventional fear of mistakes with a factual investigation [of their mistakes]" (Hagen, 2013, p. 23). This more clinical approach helps to foreground the positive consequences of mistake-making by repositioning mistakes as something

to be externalized and analyzed rather than internalized and experienced. The reflection and rethinking that this externalization enables is positively correlated to adaptive transfer, which is the ability to apply learning to novel environments and problems (Meritet et al., 2021). In other words, the learning that results from mistake-making in an EMT climate can be transferred across a diverse set of high-stakes circumstances. Classroom environments that employ EMT use formative learning exercises to encourage mistake-making and are characterized by an open and positive error climate (Tulis, 2013). Such an environment is cultivated by the teacher's frequent and proportional use of a rolodex of adaptive responses to mistakes, including "whole-class discussion, error correction being returned to the student who made the mistake, teacher wait time before reformulating the question or giving a hint, and an emphasis placed on the learning potential of a mistake" (Tulis, 2013, p. 62). In fact, the use of these technique has been found to be a viable method to deepen critical and creative problem solving. Robledo et al. (2012) found that EMT resulted in the production of "higher quality, more original, and more elegant solutions to creative problems" and that the "thoughtful analysis of errors was central to the eventual production of creative products" (Robledo et al., 2012, p. 226). In all, EMT permits students the space to safely make and learn from their mistakes. But, how can students learn from their mistakes outside of a training scenario?

Productive Failure (PF) is an instructional strategy that combines open, student-guided inquiry with a subsequent instructional phase (Loibl & Leuders, 2019). In the initial inquiry phase, learners produce divergent and generative solutions that "result in failure due to the fact that learners are commonly unable to discover or generate correct solutions to novel problems by themselves" (Song, 2018, p. 99). The instructor then supports students to comprehend of and remedy their mistake-making through a period of direct instruction. A period of inquiry followed

by direct instruction has been found to "strengthen the semantic network associated with the task, enhancing retention of the correct response" (Tugend & London, 2011, p. 162). Findings show that PF results in students "significantly outperforming their counterparts . . . on procedural knowledge, conceptual understanding, and problem-solving competency" (Song, 2018, p. 100). In fact, the instructional design of PF provides "students the opportunity to think for themselves and activate their own understanding, which offsets the negative effects that direct instruction alone can have on student learning" (Kapur & Bielaczyc, 2012, p. 55). In addition to the instructional design of PF, the tenor of the instructional phase has also been shown to impact the strategy's efficacy. Students who worked with teachers who practiced high-press discourse achieved more than students who worked with low-press teachers (Schleppenbach, 2007). High-press is defined by a teacher's willingness to "invite discussion about student errors" and explicitly reference "good mistakes" (Schleppenbach, 2007, p. 132). This approach, in turn, has been shown to cultivate a climate of mutual respect free from judgement. The research has also found that PF is most effectively implemented when the teacher uses the instructional phase to "elaborate on erroneous solutions" as opposed to simply providing students with corrective feedback (Loibl & Leuders, 2019, p. 3). Effective as PF is, its efficacy is predicated on a premeditated instructional design. What happens when students make a mistake outside of the tight structure of this instructional model? This is where an embedded and recursive feedback model comes in—a model that accounts for the circuitous, non-linear process of mistake-learning.

Feedback—"information provided by a teacher about aspects of one's performance or understanding"—has been to found to have a 0.79 effect size, making it the 10th most influential variable on student learning (Hattie, 2010, p. 203). Of course, feedback comes in all shapes and

sizes, not all of which have the desired impact on learning. In a high error climate, the research has found that feedback is most effective when it is candid and detailed, which is only possible when said feedback is mastery-oriented, as opposed to student-oriented (Dweck, 2017). Feedback must go beyond praising hard work to encourage the use of strategies in a purposeful and apt way (Whitman, 2016). Such an approach to feedback can actually help to produce students who possess a growth mindset. In fact, similar research has found that student-oriented feedback results in "a helpless pattern of responses to setbacks" wherein students are less able to "correct errors on subsequent retests" (Franklin, 2016, p. 34). It is for this reason that praise-based feedback must be avoided, as it can result in a fear of failure (Franklin, 2016). However, when the right feedback is combined with the right instructional practices it can be a very powerful tool for learning (Hattie, 2010). Finding that balance between the right type of feedback and right instructional model is a delicate one, and also is one that exists within a teacher's control. When feedback is leveraged as a formative instructional tool, it can quell confusion and cue next steps. In such an environment, students see feedback as a means of "rethinking, reworking, and polishing. Students feel that they will be celebrated for going back to the drawing board, and it's our job to give them opportunities to do so" (Berger, 2003, p. 17). By providing students with recursive, formative opportunities to seek and apply feedback, they begin to understand that mistakes do not define their learning but are merely a signpost on a longer learning journey.

This suite of instructional strategies jointly forms a symbiotic ecosystem wherein teachers set the conditions for students to develop the skills and competencies to disentangle mistake-making from mistake-learning by cultivating a high error climate. When students make a mistake under "normal" conditions, it is their customary response to deflect responsibility by

playing the proverbial “blame game.” Under these maladaptive conditions, failure can “undermine learning, goal-orientation, and retention” because students will stay away from the heavy cognitive and emotional load that engaging with mistakes requires (Eskreis-Winkler & Fishbach, 2019, p. 173). However, a learning environment steeped in the abovementioned instructional strategies produces learners who not only acknowledge their mistakes but are accountable to them. In such an environment, learners view their mistakes with distance and benevolence, thus instilling a self-belief and inclination to “speak up, ask for help, express minority views, and feel valued in being different, even when they’re wrong” (Wooditch, 2019, p. 122). The thing is, the classroom conditions cultivated by a teacher’s adaptive orientation to mistakes, dispositional attributes, and instructional strategies can really only set the stage for students to learn from their mistakes.

From a strictly behavioral standpoint, mistakes will be resolved along various timelines. For example, my learning following touching a hot stove will be linear and immediate. On the other hand, the kinds of conceptually demanding tasks that students are engaged with in the classroom naturally require a higher number of deliberate, errorful passthroughs before learning may result. It is unlikely that this lengthy and non-linear process will be wrapped up neatly within a single class period (Wooditch, 2019). Because the mistake-learning process is not fully contained to a classroom, it is also not fully in the control of the teacher. In addition to this form of spillover, there is more and more learning taking place outside of the traditional classroom setting. The rapid evolution and accessibility of technology means that much learning now occurs away from the gaze and guidance of teachers. When we couple this burgeoning reality with the fact that students make upwards of 3,000 decisions each day, we are left with the conclusion that if even a small percentage of these 3,000 decisions are made on their own,

students should not wait around for classroom conditions to be perfect before pursuing learning from their mistakes (Sahakian, 2013). If they do, they are allowing many learning opportunities to pass them by. Rather, students need to possess the will and skill to cultivate the internal mechanisms to learn from their mistakes, irrespective—perhaps, even in spite of—external conditions (Sahakian, 2013). The overall success of errorful learning depends on the individual. It is for this reason that the next literature stream will focus on those proximal variables that can be controlled and operationalized by the learner.

Stream 3: Strategies

> [Daniel Kahneman] genuinely enjoys discovering that he is wrong, because it means he is now less wrong than before . . . being wrong is the only way that he's sure he's learned anything
>
> —Adam Grant, *Think Again: The Power of Knowing What You Don't Know*

At the end of the day, the amount of feedback and even guidance that teachers can provide to students is limited by unavoidable situational complications that can thwart the efforts of even the most committed educator. In the long term, the most productive strategy for students to learn from their mistakes is to equip them with the skills and competencies they need to do so (Wiliam, 2011). With this in mind, this literature stream will articulate and individuate what extant research has found to comprise the suite of dispositional and non-cognitive skills that can be carried out from the students' perspective to recognize, react to, and repair their mistakes (Bloomberg, 2019).

Growth Mindset

The idea of a growth mindset is based on the research around neuroplasticity, which has found that in spite of the "significant genetic component to the architecture of each individual's brain, the changes that happen are influenced by the environments and experiences to which

brains are exposed" (Whitman, 2016, p. 47). In other words, intelligence, skills, and abilities are not static, but are dynamic entities that can be strengthened through experience. This, of course, has serious implications for learners and learning. Learners who believe that "intelligence is malleable and can be developed through effort and practice" are said to have a growth mindset; whereas, learners who believe that intelligence is a predetermined and innate trait have a fixed mindset (Villanueva, 2016, p. 4). Students possessing a growth mindset are more likely to "learn more, learn it more quickly, and view challenges and failures as opportunities to improve their learning and skills" (Sturgis, 2018, p. 112). In this way, students who have a growth mindset are more likely to hold a positive perception of mistakes and mistake-making.

Dweck (2007) found that the skills and competencies that underlie a growth mindset produce learners who "embrace challenges . . . persist in the face of setbacks . . . [and] learn from criticism. While students with a fixed mindset gave up quickly and blamed their challenges on a lack of intelligence, the research has found that "students with more of a [growth] mindset kept working in spite of the difficulty . . . recognizing that setbacks were inevitable on the road to mastery and that they could even be guideposts for the journey" (Pink, 2018, p. 130). These students perceived failure as a cue to increase effort, planning, self-monitoring, and self-evaluation (Franklin, 2016). Moreover, these students have been found to possess a belief that they are in control of navigating these setbacks, rather than relying on others to help them do so. This sense of controllability is a dimension of the growth mindset that equips students with an internal locus of control that prompts a belief that being wrong can be moderated by internal and controllable mechanisms that can be changed and adjusted over time (Schulz, 2010). These students are reassured that "challenges arise for every student, and that challenges can be resolved with adequate effort, strategies, and time. When students understand that academic

ability can be improved, they are better positioned to read negative cues as changeable and respond adaptively" (Qin et al., 2021, p. 620). This growth mindset framing encourages students to seek out more challenges, putting themselves in a position where a mistake, and in turn, learning is a possible outcome. In fact, students with a growth mindset are more likely to possess a meaningful drive to pursue corrective action. "These students hold a positive emotional response to feedback that facilitates an internationalization about what the mistake means, how to correct it, and what strategies can be employed" (Schulz, 2010, p. 178). The implication here is clear: Students who do not feel a sense of controllability will not put themselves in position to make a mistake. And, students who do not experience mistakes, do not have the ability to learn from them. Simple as it sounds, a belief in the transformative power of mindset instills in learners the sort of adaptive cognitive, behavioral, and affective responses to their mistakes that facilitate learning and permits learners to be more tolerant of their own erroneous actions or thinking.

Mistake tolerance is a byproduct of a growth mindset, and has been found to hold a positive relationship with learning (Weinzimmer & Esken, 2017). Students can learn from both their successes and their failures. When they learn from success, it validates the rightness of their existing knowledge base. It is identity-affirming. On the flipside, mistakes call this same knowledge base into question. Mistakes are, therefore, ego-threatening. Coupled with a growth mindset, though, mistakes can serve as a driver to illuminate inadequacies and position individuals to "take risks and pursue innovative solutions to correct misunderstandings without fear of failure" (Weinzimmer & Esken, 2017, p. 326). In this way, the growth mindset sets the proverbial stage for learning. At the same time, one's mindset can only do just that—set the stage.

The growth mindset is foundational to growing mistake-literate learners, but it cannot do so as a standalone intervention. Wang et al. (2021) found that the learning benefits of a growth mindset are optimized in conjunction with the development of metacognitive skills: "Students need to develop their metacognitive skills (i.e., planning, monitoring, evaluating) to be aware of and regulate their learning and understanding while also subscribing to the belief that they are capable of improving their performance (i.e., growth mindset)" (Wang et al., 2021, p. 960). In fact, students with a high growth mindset but low metacognitive skills had lower engagement. In other words, a growth mindset decoupled from adequate metacognitive skills could actually be detrimental to learning (Wang et al., 2021). The growth mindset, like so many other learning interventions, is not a silver bullet, but rather a first step. The growth mindset opens the door for mistake-learning by fundamentally shifting a students' mindset around challenges, but this mindset shift is not, in and of itself, sufficient. So, how can students utilize and build upon a growth mindset to bring mistake-learning to life?

Mistake Repair

When students make a mistake in their learning, their first instinct should be to act on it—there is no sense in pretending the mistake did not occur. But, acting on a mistake is not, in and of itself, going to guarantee learning. In fact, action that is flippant or self-flagellating is no more effective than burying one's head in the sand. The action that one takes following a mistake needs to be purposeful and deliberate. But, when it comes to mistakes, action is predicated on more than just awareness. Even when students' attention was drawn to the fact that "error generation followed by corrective feedback leads to better subsequent memory," students continued to prioritize less optimal study strategies that did not involve mistake-making (Yang et al., 2017, p. 107). Before action can take place, students need to be able to disentangle

themselves from their mistake. “Across five studies, the results suggest that people will learn more if failure feedback can be separated from the ego. [These] results suggest that reducing the degree to which failure involves the ego is necessary to promote learning” (Eskreis-Winkler & Fishbach, 2019, p. 173). These findings are nothing new. Extracting the self from the mistake is, in large part, what has contributed to aviation becoming the safest transportation industry (Hagen, 2013).

In 1976, NASA set up the Aviation Safety Reporting System (ASRS). The ASRS reporting system was revolutionary, as it became the first government-initiated reporting system that guaranteed confidential, voluntary, non-punitive reporting on workplace mistakes (Hagen, 2013). Up until the 1970s, the widespread assumption had been that cockpit error played a secondary role to technical malfunction in plane crashes. However, upon the introduction and standardization of the black box on flights “the accident analyses the boxes produced revealed that technical issues actually played a secondary role” (Hagen, 2013, p. 122). Initial efforts to call crews’ attention to the data backfired, as pilots grew defensive and outright dismissed the findings. NASA was stuck with belligerent pilots and a mountain of data telling them that user-error was primarily responsible for plane crashes. This is where the idea of the ASRS was born (Hagen, 2013). Since this anonymized, confidential, non-disciplinary system was implemented, there have been hundreds of thousands of reports filed, with a correlated reduction in pilot error of 71% (Hagen, 2013). Students, like pilots, need a system in place that enables them to decouple themselves from their mistakes. This is not a novel sentiment. In fact, there is a $36 billion industry that has capitalized on just this (Wooditch, 2019).

Video games are popular for many reasons. In spite of what the most vocal anti-video games advocates might have you believe, their popularity is not attributable to themes or

content—no, it lies in the fact that video games are designed for failure (Suziedelyte, 2021). “No one wants to download a new game and play to the end on the first try. The fun lies in being challenged and figuring it out. You try something, you fail, you reboot, and you try again” (Wooditch, 2019, p. 96). Players do not perceive the mistakes of their in-game avatars as being a reflection of their own ineptitude. Rather, they see their missteps as a learning opportunity. When one plays a video game, there is no confrontational or personal consequence, so people do not take their mistakes personally. Players are focused on remembering what went wrong and building on it, not harping on the mistake itself. So, how can students better separate dissonant thoughts as clearly and cleanly as they do when they play video games? How can mistakes not be dismissed but properly examined without self-criticism? Mistake-repair is about doing just that.

Wrongness is not something we experience in the moment, but something we experience afterwards. It is not something we can experience contemporaneously to the mistake itself, thus the only way to learn from a mistake is to reflect upon it. “By definition, there can’t be any particular feeling associated with simply being wrong. Indeed the whole reason it’s possible to be wrong is that, while it is happening, you are oblivious to it” (Schulz, 2010, p. 17). Mistakes are invisible to us, until they are not. And, it is not until we realize that we are wrong that learning can begin. This is why mistake-repair is so important—it creates the necessary space and time for learners to acknowledge their mistake and recognize it for what it is: a gap in their knowledge.

Mistake-repair is comprised of the symbiotic and sequential steps of mistake-assessment and goal-setting—steps that work together to reconcile the divide between one’s mental model and the correct model (Mason, 2016). Mistake-assessment involves the learner reflecting on their

mistake to facilitate consideration of *what* to repair; goal-setting builds on this by challenging students to identify pathways and resources so they know *how* to repair it (Hattie, 2010). One can think of mistake-assessment as the diagnosis and goal-setting the prescribed remedy. In this way, mistake-repair serves as the intermediary between belief and action, helping to translate a growth mindset into learning.

The first step in the mistake-repair process is that of mistake-assessment. Mistake-assessment is, in its essence, an evaluation that is initiated and led by the learner. Within a clearly defined systematic approach, students do not require external feedback to learn from their mistakes, but are capable of monitoring their own comprehension, uncovering learning, and initiating behavioral adjustments on their own (Fu et al., 2019). Mistake-assessment asks learners to take stock of their perception of strengths and deficits relating to the learning, with the goal being to build an awareness of what they are ready for next. The importance of mistake-assessment within the scope of growing mistake-literate learners lies in the fact that it has a "large" effect size—that of a 0.75—but also because this effect size grows when mistake-assessment is coupled with mistake-making. It turns out that "reflecting on correct and incorrect examples has been shown to be effective for learning across domains . . . [with] the effects being strongest when students have previously generated erroneous solutions themselves" (Hattie, 2010, p. 322; Loibl & Leuders, 2019). Mason (2016) explains that this relationship stems from the fact that reflective questions help students "to gain a new perspective," thus clarifying what they did incorrectly and facilitating contemplation of strategies that can help to solve the problem (Mason, 2016). In other words, the influence of mistake-assessment on learning increases when it is rooted in mistake-making because this shift in perspective preempts a like shift in actions. When steeped in mistake-making, this period of reflection proves integral to the goal-setting

process, as “challenging goals involve some degree of risk of being wrong . . . and over time, students learn from setting and meeting increasingly difficult goals” (Tavris & Aronson, 2008, p. 267). In this way, mistake-assessment affords learners the opportunity to clarify their intention and set the stage for the goal-setting process to commence.

Goal-setting is the pivot point between mistake-making and learning—the benefits of which are well documented, with compelling evidence to suggest that goal-setting has a large and positive influence on learning and is directly correlated to growing mistake-literate learners. According to the research, the effect size of goal-setting ranges from 0.55 to 0.90, with the largest effect size reserved for mastery-goal orientation (Hattie, 2010). Students who have a mastery-goal orientation view the goal-setting process as an opportunity to “develop their skills and increase their competence”—an orientation that is colloquially thought of as “learning-oriented” (Svinicki, 2010, p. 27; Villanueva, 2016). This likely sounds familiar, as these traits are similar to those possessed by students who have a growth mindset. As it happens, mastery-goal orientation and growth mindset are cognitive cousins. “Typically, individuals who hold a growth mindset have been linked to be more mastery-goal oriented,” with research finding that their association “is significant, meaning that there is a [positive correlation] between growth mindset and high mastery-goal orientation” (Villanueva, 2016, p. 70). Unsurprisingly, these same students are also more likely to view mistakes as learning opportunities. “When we examine the characteristics of mastery-oriented learners, one quality that seems to stand out is their willingness to take risks and learn from their mistakes. They appear confident that nothing bad will happen to them when they fail” (Svinicki, 2010, p. 26). To some extent, this confidence stems from the fact that a mastery-goal orientation actually fosters a greater sense of perseverance when students come face-to-face with challenging situations (Bailey, 2005 as cited

by Scruggs, 2018). Ultimately, the goal-setting process, and specifically a mastery-goal orientation, leverages the growth mindset and builds on mistake-assessment to put students in a position where learning from mistakes is not only possible but purposeful.

In all, the mistake-repair process operationalizes the growth mindset. Students who possess a growth mindset, and, in turn, the confidence and inclination to learn from their mistakes, are provided with the time to reflect on information, make sense of it, and develop a plan, which prepares them to pursue alternative approaches. These students already understand one approach that does not work—that being what led to the mistake in the first place—so they now have the chance to consider what that teaches them and what other options are available. In this way, the mistake-repair process brings students to the edges of their knowledge, which is where learning occurs (Rickabaugh, personal communication, August 10, 2020). However, for learning the occur, a choice needs to be made—when a learner reaches that precipice of their knowledge and experience will they choose to journey into the unknown or do they turn back? Mistake-repair positions students to take action that is planned and purposeful, but to learn from their mistakes, students must make the choice to act. "To err is human, but humans have to make a choice. That choice is critical to what we do next. We are forever being told to learn from our mistakes, but how can we learn unless we take action" (Tavris & Aronson, 2008, p. 271). This is where the Learner empowerment cycle comes into play.

Learner empowerment cycle

The Learner empowerment cycle consists of choice, motivation, and engagement—three synergetic dispositions that work sequentially and recursively to develop confident, self-directed learners who are increasingly likely to see mistakes as learning opportunities. "We too often think about how to motivate learners, engage them, [and] build self-efficacy . . . as separate

efforts. Consequently, we focus on each characteristic in isolation . . . yet, there exists a [shared] power that can make a determinative difference in learners' long-term success" (Rickabaugh, 2012, p. 3). As stated, there exists a cumulative, symbiotic relationship between choice, motivation, and engagement: When learners have choice, they develop feelings of autonomy; when learners feel autonomous, they are more motivated; and, when motivation is acted upon, it becomes engagement (Rickabaugh, 2012; Svinicki, 2010). Mistake-literate learners must be engaged, but the goal of Mistake Literacy is not to engage them; rather, the goal is to create the conditions wherein engagement becomes possible. When learning is connected to choice, learning becomes more purposeful and relevant. And, according to the research, when choice is integrated into the learning, it can increase levels of motivation, which, in turn, can increase student engagement (Svinicki, 2010).

Choice is the natural next step after the mistake-repair process, and is thus the entry point to the Learner empowerment cycle. When choice is present, student motivation increases; and, when motivation increases, so does engagement. Of course, choice, motivation, and engagement are not monoliths—they each contain multitudes, some of which are more relevant to building mistake-literate learners than others.

Choice is omnipresent, residing in every situation regardless of one's awareness of it. For many students, however, choice is hidden. Students do not see deadlines, for instance, as a choice. The reality, though, is that the mere act of abiding or failing to abide by a deadline is, in and of itself, a choice that students are making. Inaction is as much a choice as action is. Whether students realize it or not, choice is always operating in the background at the subconscious level (Wooditch, 2019). The purpose of the Learner empowerment cycle is to bring choice to the conscious level. In doing so, students become aware of the broad array of choices at

their disposal, which allows them to acknowledge the power and control they actually have over their learning. By bringing choice to the forefront of one's consciousness, it increases feelings of autonomy. Specifically, there are three kinds of choice that promote autonomy: organizational, procedural, and cognitive. Organizational choice refers to the "ability to choose group members or participate in establishing classroom rules;" procedural choice is choice in "demonstrating competence or mastery;" and cognitive choice is about "empowering students to find multiple solutions to problems and align tasks according to interests" (*Impact of Student Choice and Personalized Learning*, 2014, p. 33). According to Ely (2013), the feelings of autonomy that students develop through these forms of choice are closely associated with "a complex combination of affects . . . positive feelings, happy, excited, and proud." Rooted in these positive feelings, students are increasingly likely to become active participants in their education, thereby increasing levels of motivation (*Impact of Student Choice and Personalized Learning*, 2014). In this way, choice, as a necessary precondition for motivation, lays the foundation for the rest of the Learner empowerment cycle.

Motivation is the presence of an emotional or psychological attraction to a task. Within the context of education, learner motivation "refers to a student's willingness, need, desire, and compulsion to participate in, and be successful in, the learning process" (Bomia et al., 1997, p. 6). The reason why mistakes can be such an effective catalyst for learning is that students have an initial motivational advantage to correct their mistake to avoid making the same mistake again in the future (Rickabaugh, 2016). Of course, there are multiple forms of motivation, some of which are better suited to empowering learners. According to the research, there are three types of motivation: lacking, extrinsic, and intrinsic (Nayir, 2017). To empower learners, it is imperative that students are put in positions to be intrinsically motivated. Learners who are

intrinsically motivated do not wait for someone else to motivate them, because they have access to skills, tools, and stimuli to keep themselves going without depending on someone else to tweak their pursuit or manipulate their circumstance. Such learners operate with a "mastery goal orientation," meaning they are focused on "self-development and the attainment of new knowledge and skills" (Nayir, 2017, p. 62). Furthermore, these learners do not seek to hide their failures and are more likely to see mistake-making as a learning opportunity (Nayir, 2017). These dispositional qualities possessed by intrinsically motivated students hold a tight, progressive relationship to the development of engaged learners. "Motivation is about energy and direction . . . Engagement describes [that] energy in action, developing a connection between person and activity" (Rickabaugh, 2012, p. 6). By stimulating intrinsic motivation, students can begin to find that spark of engagement and ignite their own fire (Ferlazzo, 2017).

Student engagement is a critical and multifaceted factor comprised of three interrelated and mutually reinforcing dimensions: emotional, behavioral, and cognitive engagement (Fredricks et al., 2004). Emotional engagement involves students' attitudes and feelings toward their learning environment and academic progress. Behavioral engagement is reflected in observable actions and behaviors such as attendance, participation, and attentiveness (Freeman et al., 2014). Cognitive engagement is the intellectual commitment students make to their learning and is the most fundamental aspect of student engagement in the context of building on motivation and reliably converting mistake-making and mistake-learning.

Cognitive engagement involves students pursuing the cultivation of critical thinking skills, problem-solving skills, and metacognition (Kahu, 2013). Students who are cognitively engaged in a learning task see learning as its own reward, focusing on the process rather than seeking external validation (Rickabaugh, 2012). They are motivated by personal value and the

meaning they construct from their learning, continuing to study even when faced with challenges and setbacks in their initial comprehension (Schlechty, 2011).

In the context of mistake-making, cognitive engagement plays a key role in helping students take ownership of their mistakes and turn them into learning opportunities. Students who are cognitively engaged possess the meta-skill of being able to transfer knowledge and solve problems creatively, empowering them to take greater ownership of their learning process (Saeed, 2012). Recent studies have highlighted the importance of cognitive engagement in helping students transform their mistakes into learning opportunities (Nayir, 2017; Saeed, 2012).

Saeed (2012) found that when students are cognitively engaged, they are more likely to approach mistakes with a growth mindset, viewing them as opportunities for improvement rather than indicators of failure. This mindset allows students to analyze their mistakes, identify areas for improvement, and take the necessary steps to refine their understanding of the subject matter. As a result, cognitively engaged students are better equipped to learn from their mistakes and apply the acquired knowledge in future situations, leading to deeper understanding and long-term retention of material. Nayir (2017) also highlighted the importance of cognitive engagement in facilitating mistake-learning. According to Nayir, students who are cognitively engaged are more likely to actively seek feedback, both from teachers and peers, as a means of identifying areas where they may have made mistakes. This proactive approach enables students to recognize and acknowledge their errors, fostering a willingness to learn from them and apply the lessons learned in future situations. In short, engagement inspires the qualities and habits for students to learn confidently, intentionally, and independently—or, phrased more succinctly, for learners to feel empowered.

When it comes to developing mistake-literate learners, "choice, motivation, and engagement do not constitute 'warm and fuzzy' extra components of efforts to improve [learning]" (Nayir, 2017, p. 72). In fact, they are primary drivers in developing learners who possess the feelings of competence and confidence to learn from their mistakes. The cumulative impact of the Learner empowerment cycle equips students to become increasingly autonomous in their learning and, in turn, nurture a belief that they are in control of their learning. The Learner empowerment cycle is an ongoing, recursive process—a virtuous cycle that produces better and better results each time through. As students engage in the Learner empowerment cycle, they become fuller agents in their own learning, and begin to develop a stronger sense that learning is within their locus of control. However, learners who leverage choice to maximize motivation and find their spark of engagement are not yet fully equipped to be mistake-literate—they are on the right path, sure, but they have not yet reached the final destination.

All learners make mistakes. Mistakes are a natural and unavoidable feature of learning. But, without a directed effort, mistakes will remain missed learning opportunities. The suite of strategies outlined and detailed in this literature stream empower students to leverage mistakes for the sake of learning. At the same time, these strategies do not constitute an endpoint. The goal of Mistake Literacy is not to produce learners who can only learn from mistakes under favorable and familiar conditions; rather, the goal is to produce learners who possess the aptitude, motivation, and core belief about their ability to learn from mistakes in non-identical situations.

Stream 4: Outcomes

> Failure is a gift. Successful risk-takers are often motivated by failure—it's what tells them that they aren't done preparing yet. It's inspiration to work harder, to train better, and to learn more. They understand that mistakes have the potential to offer them as

> much, if not more, than success in the way of both data and experience. They don't take failure as a sign to stop.
>
> —Kayt Sukel, *The Art of Risk*

When distal and proximal variables, contextual and intervening conditions, and student-initiated strategies collide, the force of their sudden synchronicity produces students who possess the capability and capacity to learn from their mistakes. But, what does it mean to *learn* from a mistake? Learning can be understood and defined in many different ways. There are a multiplicity of definitions for learning (M. C. Wang, 1994). Especially as the goals of learning continue to evolve beyond the assembly line model of education, definitions of learning have begun to focus less on cognitive achievement and have become less and less compatible with measures of "right" and "wrong" (Ball, 1991). Thus, this literature stream seeks to articulate and individuate what extant research has found to be the sought-after byproduct of learning from mistakes.

Mistake-Learning Efficacy

According to the research, students who feel empowered in recognizing, reacting to, and repairing their mistakes also report increased feelings of self-efficacy (Bandura & Schunk, 1981; Conner, 2021). Self-efficacy can be thought of as a catch-all term for students' confidence in exerting control over their learning and "persisting to overcome challenges" (Bandura, 1997, p. 4). Said another way, self-efficacy is the belief that students can control their learning by the "strategies they employ, effort they exert, and resources they engage" (Wigfield & Wagner, 2005, p. 235). The presence or absence of strong self-efficacy often determines whether learners will engage in challenging tasks where the outcome of the work is not certain. "Self-efficacy leads learners to persist in the face of challenges [and] continually try different strategies to overcome obstacles . . . the presence of self-efficacy is important for learners to stretch and grow

and to move beyond present levels of skill and knowledge" (Rickabaugh, 2012, p. 10). According to Gunn (2019), students with high self-efficacy "work harder, persist longer, and have fewer adverse emotional reactions when encountering difficulties. Students who hold the adaptive attitudes, dispositions, and beliefs towards learning that help them to see themselves as playing a key role in their own success possess the want-to and know-how to independently navigate and learn from their mistakes. Self-efficacy actually regulates and reinforces the operationalization of the Mistake Literacy construct.

The effect size of the mistake-repair process, for example, increases when high levels of efficacy are present. The effect of mistake repair and goal setting "positively affects the choice of difficulty of goals . . . [and] has an effect size of .92" (Hattie, 2010, p. 366). Moreover, self-efficacy further supports the solidification of a mistake-literate mindset by curbing the negative emotional effects associated with mistake-making. "Self-efficacy influences thought patterns and emotional reactions and these influences relate to stress, depression, and tunnel vision-like thinking in individuals with low self-efficacy and clarity, confidence, and convergent thinking in individuals with high self-efficacy" (Degen, 2019, p. 41). Furthermore, "when success is daunting, and failure is prevalent in a situation or context, high efficacy students persist, and low efficacy students quit" (Bandura & Schunk, 1981, p. 590). In part, this is because high efficacious learners understand that mistake-learning requires more than just will and want—it requires hard work coupled with strategies (Whitman, 2016). High efficacious learners have the tools to "deal with failure and build resiliency to setbacks" (Marschalko et al., 2019, p. 322). These high-efficacious learners possess the aptitude, motivation, and core beliefs to apply a broad constellation of mistake-making experiences to novel and non-identical situations, thus exhibiting a demonstrable and repeatable learning efficacy when they encounter mistakes. This

specific form of efficacy, which I will dub "mistake-learning efficacy" is about learners possessing the know-how and know-when to apply the Mistake Literacy construct across time and place, emotional experiences, content, and context—a transferability that enables students to experience and cope with mistakes in an adaptive and productive manner (McCaslin et al., 2016).

Students who possess mistake-learning efficacy build on the generalized themes and findings of self-efficacy by advancing learning and promoting positive beliefs about self when making mistakes. Mistakes become a normalized component of the learning process, rather than threatening their conceptualization of what it means to learn and to be that learner. These students do not only solve their current difficulty, but demonstrate a sense of controllability that reinforces their approach and improves achievement in the long term (McCaslin et al., 2016). When students make mistakes in the pursuit of classroom learning, those with high levels of mistake-learning efficacy dismiss feelings of inadequacy, report heightened feelings of pride, and express increased motivation to repair their mistake (McCaslin et al., 2016).

These learners are now better positioned to recognize, react to, and repair their mistakes irrespective of context and detethered to content. Song (2018) found that when such students encountered instruction that they deemed to handicap their learning, they simply circumvented existing systems by replacing them with systems that better suited their individual learner profile (Song, 2018). These students embraced the responsibility of taking appropriate, autonomous action to bridge the gap between what is known and what is yet to be known. Each passthrough of Mistake Literacy strengthens the user's ability to learn from mistakes. Even when circumstances change, these same systematic steps can still be followed. Mistake-learning efficacy is characterized by the learner utilizing all possible resources at their disposal, rather

than relying on schematics. Through the application of this systematic and recursive approach, these learners develop an understanding of the learning, the context in which the learning occurs, and their control over future learning.

Students with high mistake-learning efficacy possess the daring and self-certainty to ignore barriers and learn from their errors (Webb & Mastergeorge, 2003). These students see mistake-making as an opportunity, as opposed to an obstacle. Of course, achieving high mistake-learning efficacy is not an endpoint, nor is it something that can even really be achieved so to speak. The amalgam of conditions and strategies laid out in this literature review must be revisited, examined, and heeded whenever an error occurs, as this constant application is a recursive cycle that grows stronger with each passthrough. When a student with high mistake-learning efficacy finds success—having learned from a mistake—it, in turn, strengthens their growth mindset—"With effort, I can learn from my mistakes"—and thus strengthens the student's commitment to the process at-large. In this way, mistake-learning efficacy should not be thought of as a goal, but rather as a linchpin that links one mistake to the next.

Summary

According to Hattie & Yates (2013), "students go to lessons because they 'do not know' and thus errors, mistakes and not knowing are the key to all subsequent learning." Errors occur at the edge of a student's knowledge and experience. Such mistakes, which are the unavoidable byproduct of learning, expose gaps and raise questions, and open the possibility for reflection and analysis. The particular value in mistake-making lies in the ability to indicate where inadequacies in knowledge are present. Through this form of mistake-making, learners develop a theory of what's correct, apply it, and revisit as necessary, which is the very basis of the learning

process. “The growth of knowledge occurs through a process of reasoning that requires conjectures and unjustified guesses that are refined and revised over time” (Metcalfe, 2017, p. 470). Thus, errors must be accepted not just as integral to learning, but as a byproduct of the learning process that draws attention to a student’s zone of proximal development. The thing is, students who are inadequately equipped to learn from their mistakes will prioritize an errorless model of learning (Yang et al., 2017). In large part, this is because wrongness’ vastness can feel overwhelming. “There is a dizzying array of mistakes that exist: errors of planning, errors of execution, errors of commission, errors of omission, design errors, operator errors, endogenous errors, and exogenous errors . . . to name just a few” (Schulz, 2010, p. 371). But, the auspicious corollary to this endless diversity of mistakes is the endless possibilities for learning. It is only logical that every mistake has a learning counterpart. Chapter 2 sought to synthesize and summarize what extant research has found about how to bring these learning counterparts to life by presenting the conceptual framework of Mistake Literacy. With an extant framework now carefully considered and categorized, Chapter 3 will articulate the research design I will use to test it.

Chapter 3: Research Methodology

This study tested the conceptual framework that explains the processes that mediate students' inclination and ability to reliably convert mistake-making into mistake-learning. The symbiotic and recursive relationship between error generation and subsequent learning is foundational to the development of 21st century skills. In a world where Artificial Intelligence (AI) and generative AI is increasingly responsible for algorithmic tasks, a learning process that deemphasizes perfect performance as a reliable criterion of learning is more suitable to support students in developing future-ready skills such as problem-solving and frustration tolerance (Martinez, 1998). But, destigmatizing mistakes and creating conditions for students to embrace them as learning opportunities cannot be willed into existence. In fact, without a blueprint to guide this process, students will continue to prioritize less-optimal but mistake-free learning strategies (Yang et al., 2017). This mixed methods case study employed a systematic analysis of participants' experiences and insights in order to test this aforementioned blueprint. To do so, this study was guided by the following research questions:

Quantitative Research Questions:

1) Is there a significant relationship between the components of Mistake Literacy for middle grades students?
2) To what extent are statistical differences in Mistake Literacy components mediated by the contextual conditions of middle grades students (socio-cultural factors and parental involvement)?
3) Is there a significant relationship between Mistake Literacy components and mistake-repair efficacy for middle grades students?

4) What are the components of a classroom environment that have the greatest influence on middle grades students' willingness to make and learn from their mistakes?

Qualitative Research Questions:

5) How do students describe the socio-cultural conditions, classroom conditions, and strategies that influence their ability to learn from mistakes?
6) How do educators describe the socio-cultural conditions, classroom conditions, and strategies that influence their students' ability to learn from mistakes?

The remainder of this chapter outlines the design and methodology of this fixed mixed methods study. Primary components include research design and rationale, site and population, methodology, procedures, and ethical considerations, with the goal being to elucidate the proverbial recipe that was used to answer my research questions.

Research Design and Rationale

Fixed mixed methods designs are mixed methods studies where the use of quantitative and qualitative methods is predetermined and planned at the start of the research process, and procedures are implemented as planned (Creswell & Clark, 2018). This research design is the optimal approach to test the conceptual framework of Mistake Literacy, because four of the study's research questions are quantitative and the other two are qualitative. Though there are paradigmatic differences between quantitative and qualitative research "the collection of both quantitative and qualitative data in combination" provides rich and robust results, which ensure a more accurate and robust understanding of the research problem than either method by itself

(Creswell & Guetterman, 2019, p. 362). To use a basketball metaphor, in a mixed methods study, quantitative data "alleys" and qualitative data "oops."

The advantages of a mixed methods study—its inclusion of multiple, diverse, and complementary methods, epistemologies, and approaches—account for its widely perceived strength for use in educational research (Johnson & Christensen, 2020). It can prove especially useful in researching little understood phenomena within education because of the knotted, multifaceted nature of learning. Education is a protean and dynamic field of study, which is best served by a research design that can illuminate and uncover its nuance and subtly (Johnson & Onwuegbuzie, 2004). A mixed methods design accomplishes this by enabling researchers to collect in-depth and comprehensive data on their research problem that offset weaknesses of both quantitative and qualitative research.

> The argument goes that quantitative research is weak in understanding the context or setting in which people talk. Also, the voices of participants are not directly heard in quantitative research . . . On the other hand, qualitative research is seen as deficient because of the personal interpretation made by the researcher, the ensuing bias created by this, and the difficulty in generalizing findings . . . the combination of both approaches can offset the weaknesses of either approach used by itself (Ivankova et al., 2006, p. 14)

Lincoln and Guba (1985) explain this idea using the metaphor of fishing nets. A fisherman layers fishing nets, each of which has many holes. By layering these nets, the fisherman is able to create one large net of differing strengths and non-overlapping weaknesses. In a mixed methods study, the "holes" of a quantitative method are covered by the qualitative design, and vice versa. Given this study's aim to test the conceptual framework of Mistake Literacy, the depth, detail, and symbiosis inherent to a mixed methods study will prove ideal. At the same time, there are

multiple fixed mixed methods research designs to choose from, so I had to choose which design would be best suited to answer my research questions.

Concurrent triangulation is a type of mixed methods design. In concurrent triangulation designs, “quantitative and qualitative data are collected and analyzed at the same time, with equal weight being given to both forms of data” (Hanson et al., 2005, p. 231). Such a design offers a position that most nearly factors in the diverse cross-section of proximal and distal variables that inform a student’s inclination and ability to recognize, react to, and repair their mistakes, because it embraces methodological balance in which neither quantitative or qualitative data will dominate, thus allowing complementary, contradictory, and confirming data to emerge without threat or priority. Moreover, concurrent designs are noted as being advantageous for novice researchers because such a design creates a unified “umbrella” under which data collection, analysis, and interpretation occurs (Creswell & Clark, 2018). In addition to matching the design of the study’s purpose, concurrent triangulation is fitting to serve the population of this study.

Population and Sample Description

In both quantitative and qualitative studies, sampling strategies are unavoidably complex. This complexity is exacerbated in mixed methods research because “sampling schemes must be designed for both the qualitative and quantitative components of these studies” (Onwuegbuzie & Collins, 2007, p. 290). To quell this complexity and select sampling strategies that are appropriate for the research design and germane to the study itself, decisions about mixed methods sampling process must be derived from the study’s goal. The goal of this study is to examine the processes that compel or negate middle grades students’ willingness and ability to make and learn from their mistakes; thus, the population of interest includes current middle

grades students and educators who have personal and proximal experience with this phenomenon.

To ensure separation between quantitative and qualitative data collection and analysis, sampling strategies must adhere to traditional schemes that are associated with both quantitative and qualitative methods. For this study, I used quantitative measures to examine the relationships among known variables and qualitative methods to expand my knowledge of those same variables that were previously hidden or unknown (Arnault & Fetters, 2011). This complementary use of collecting data through both quantitative and qualitative methods for the purpose of assessing the same phenomenon is known as triangulation, and is a major strength of a concurrent mixed methods design (Greene et al., 1989).

Quantitative Sampling and Sample

For the purposes of quantitative data collection, all middle school students at the research site (N = ~135) were invited to complete a validated and original survey tethered to the a priori codes of the Mistake Literacy construct. Middle grades students are uniquely qualified for participation in this study. Middle grades students have a surging capacity for self-awareness, self-expression, and self-reflection, but do not yet have the solidifying sense of self that secondary students possess (Erikson, 1968). Moreover, they have logged a considerable amount of seat time in classrooms, thus lending a credibility to their experiences (McCaslin et al., 2016). Middle grades students possess the experience and openness that this study calls for.

Student selection for the quantitative phase of data collection was open to all students who are enrolled in the middle school at the research site, whose parents/guardians provided consent for their participation, and who were present at the research site when the survey was administered. Thus, the sample was a convenience sample based on who opted to participate.

Qualitative Sampling and Sample

Qualitative data collection consisted of two phases. The first, semi-structured interviews with middle school faculty members, took place concurrent to the administration of the student survey; the second, a semi-structured focus group interview with students, took place following the survey. One potentially complicating factor in the sampling process was my role as the Middle School Principal at the study site. As the principal, there was a risk of bias, which could have undermined the ethical foundation of the study. However, in a mixed methods study, the harm from such a conflict of interest is only for researchers who fail to disclose their connections (Billups, 2021). In addition to disclosing the potential bias of my role, I sought ensure impartiality by implementing appropriate sampling schemes, in addition to drafting and sharing a Coercion Mitigation Plan with participants (Appendix A).

The inclusion of teachers in a study that sought to explicate students' experience may appear inessential, but as the late author David Foster Wallace wisely imparted to the graduating class of 2005 at Kenyon College, "The most obvious, important realities are often the ones that are hardest to see and talk about" (Wallace, 2009, p. 10). For all of their experience, it is this very experience that has the potential to result in students painting an incomplete picture of the phenomenon being studied. Teachers strike that fine balance between a professional closeness to the phenomenon and a personal separation from it. As such, teachers are not only uniquely and especially qualified to lend language and perspective to their students' experience, but play a vital role in completing that picture of how students learn from their mistakes by offsetting the tightly correlated relationship between age and meta-cognitive awareness and elaborative capabilities (Craig & Yore, 1995). To integrate the voice and perspectives of teachers into my study, I opted to employ a convenience sample by inviting all faculty members at the research

site to participate. Ultimately, I determined the optimal number of faculty participants by my real-time and reflexive evaluation of whether sufficient saturation of emergent categories had been achieved.

I used opportunity sampling to select student participants for the semi-structured focus group interview. Opportunity sampling allowed me to offset the bias that my role and proximity introduced, while also obtaining the inclusion of participants from the target population. This sub-sample of student participants were selected based on whether they met the aforementioned criteria for participation in the survey, in addition to whether they completed the survey and were available at the specific time and date when the focus group was conducted.

Site Description

This study was conducted at a PK-12 progressive independent school located in Louisville, Kentucky. The school is a member of the National Association of Independent Schools (NAIS), Progressive Education Network (PEN), and is accredited by the Independent School Association of the Central States (ISACS). The school boasts a student population of 477, 28% of whom identify as part of a historically marginalized population. 17.8% of students receive learning support services, with a comparable percentage of students diagnosed with at least one learning difference. With a 7:1 student to faculty ratio, the school employs 69 faculty members from preschool through high school. This case study research was limited to the examination of the central phenomenon through the experiences of students and teachers who learn and work at this one site. These experiences, and consequent study results, constituted a transferability that can be interpreted and applied to similar settings based on the principle of extrapolation (Billups, 2021; Denise F. Polit, 2010).

Site Access

Consideration was given to striking a suitable balance between access, including the practical needs of the researcher, and the aspirational demands of the research. Given the timeframe and general limitations inherent to any dissertation, I sought to identify a middle grades population of students and teachers at a site that was accessible, thus allowing me to focus my efforts on data collection, organization, and analysis first and foremost.

I initiated site access by meeting with the Head of School at the selected site. Because of the organizational and leadership structure of independent schools, the Head of School is the only person with whom I was required to clear access. Given my position and good standing at the school, no issues of site access were experienced in this study.

Research Methods

Instrumentation and Procedures

Education is a deeply complex domain that represents a deeply human and multidimensional construct (Creswell, 2018). “In order to make clear and concrete as many of the embedded abstractions as possible, mixed methods offer the chance at a comprehensive understanding” (Miller, 2015, p. 56). Of course, coherence does not offer an assurance of quality. Quality hinges on the appropriateness and diversity of data sources to create overlap, convergence, and, ultimately, confidence to overall findings. To accomplish this goal, this study made use an original survey, semi-structured interviews, and semi-structured focus group. The use of multiple data collection tools allowed me to obtain rich and varied data that are different and complementary, which allowed me to best understand the nuanced, multivariant nature of the research problem

Quantitative

An original and novel survey was used as the instrumentation for this study (Appendix B). The design of this survey allowed for the testing of the relationships between the variables of the Mistake Literacy conceptual framework. This survey was administered to middle grades students at the research site in order to gather self-reported data regarding their experiences with the a priori construct of Mistake Literacy. According to Ravid (2015), "a survey is undertaken with the intention to gather information on a selected group of respondents about a topic." In all, the survey includes 46 questionnaire items anchored to a priori codes that form the conceptual framework of Mistake Literacy, which in turn serve as the basis for the structure and flow of the survey across the four previously indicated spokes of the Mistake Literacy axel: contextual conditions, intervening conditions, strategies, and outcomes. In the development of this survey, a survey alignment table was used to evaluate the presence, absence, and extent to which a coherent set of instrument items would prompt the collection of appropriate and high-quality data relating to each of these broad categories.

A four-point Likert-scale was used for each survey item. It is understood that a five-point scale would be best to use for measurement precision with respect to reliability and validity, however given the age of the population and primary purpose of this study, I deemed a four-point scale to be a more practical approach for a couple of reasons. First, the primary concern of this survey is largely to explicate students' experiences. A four-point scale is considered preferable compared to a five-point scale when gathering data pertaining to participants' experiences, as opposed to opinions or preferences (Jebb et al., 2021). Second, because all participants have this lived experience, a four-point scale steers participants away from the expediency, ease, and safety of a neutral midpoint. Rather, the four-point scale requires participants to take the time to honestly reflect on their experiences and make a choice, as

opposed to defaulting to a non-choice. Given the age of participants, a four-point scale subtly and implicitly reinforces the expectation of seriousness and honesty in completing the survey, as opposed to enabling middle grades students to avail themselves of the path of least resistance. Naturally, a criticism of this approach could be that steering participants of any age to a pole creates a forced binary or choice. For this reason, when designing the survey, I worked with my committee members to ensure that equal interval gradation was closely and carefully accounted for and that equal interval distance between the four choice anchors was authentic and balanced. Across the 46 questionnaire items, the anchoring labels on the four-point rating scales varied. Although the anchoring labels varied, the impact on participant responses is considered minimal. Chang (1997) found no significant difference in response variability between respondents using different anchoring labels.

In an attempt to quantify and explain students' experiences with the Mistake Literacy construct, this study designed, tested, validated, and utilized a novel survey instrument. In adherence to established practice and protocols of *The Standards for Educational and Psychological Testing*, the soundness of this survey instrument was measured through a process of collecting, evaluating, and documenting multiple forms of validity evidence to ensure that it cohered to its specified intent (Sondergeld, 2020). Specifically, the pilot survey addressed three forms of validity: content validity, response process validity, and consequential validity.

Content validity assesses whether a test is representative of all aspects of the construct. Content validity was assessed using a representative cross-section of four subject matter experts. These subject matter experts evaluated item-to-construct alignment to assess whether the instrument adequately represented the concept being studied (Chiwaridzo et al., 2017; Sondergeld, 2020). Based on the feedback from this group of subject matter experts, I revised

and updated the survey until the questions and construct were deemed satisfactory. Subject matter experts independently and unanimously agreed that item-to-construct alignment was achieved on the first draft. However, across three iterations of the survey, subject matter experts shared corrective feedback on the semantics of various survey items. Notably, the group found that the language of the survey was too advanced for the target population. In revising the survey, I sought to make it more broadly accessible to a wide range of readers, thus allowing students to formulate thoughtful responses and not expending their cognitive energy decoding and scanning vocabulary. Moreover, one subject matter expert questioned students' meta-awareness of the role that their grade-level would have on their willingness to take risks and learn from mistakes. Students were quick to dispel this query. As one student participant shared during their cognitive interview, "In the Middle School, nothing matters more than your grade-level. As an eighth grader, I'm a leader, and I want other students to see that it's okay to make mistakes. So now, I make mistakes all the time and don't think twice about it." Once these revisions were made and accepted, I proceeded in attaining validity by tapping into the expertise and experience of a cadre of middle grades students to examine response process validity.

Response process validity concerns the "extent to which the actions and thought processes of survey responders demonstrate that they understand the construct in the same way it is defined by the researchers" (Yuhas, 2018, p. 2). To ensure that study participants understood the items and scale as intended, I scheduled individual cognitive interviews with seven students who met the prerequisites to complete the survey. Cognitive interviews afforded me an insight into whether survey questions were comprehensible, linguistically and developmentally accessible, and established a reliable, trustworthy relationship between measure and response. "A clearly specified research question should lead to a definition of study aim and objectives that set

out the construct and how it will be measured" (Chiwaridzo et al., 2017, p. 2). For each cognitive interview, I introduced students to a think-aloud protocol and put them through a low-stake formative think-aloud exercise to acclimate them to the process. I then worked through the survey with the student item-by-item. During this process, I looked for convergence between item response and the student's contemporaneous explanation. These cognitive interviewers were recorded and transcribed. After the cognitive interviews, I listened to the recordings and reviewed the transcripts to identify common themes and outlier responses. In addition to the content of the responses themselves, hesitations, pregnant pauses, and repetitions were coded.

Based on the themes and outlier responses that emerged, these cognitive interviews alerted me to the need to review the language of the rating scale to make it more colloquial, adjust the section headers to more clearly signify the intention and context for subsequent questions, and to eliminate instances of redundancy to shorten the length of the survey.

For questions 11-15, 18-19, 21-35, the second and third anchor labels were previously written as, "Slightly influential" and "Influential." Based on student feedback, I updated these two anchor labels to incorporate more colloquial descriptors that further strengthened equal interval distance. The second and third anchor labels are now written as, "Kind of influential" and "Pretty influential"—labels that more nearly reflect the parlance with which early adolescents are familiar.

The section headers were updated to move away from the more academic language that I had pulled directly from my literature streams and use language that was more accessible, invitational, and cohesive. Based on student input, I changed the first section header from the more professorial "Demographic descriptors" to the more informal "Tell me about yourself." All section headers were changed in kind for these purposes of accessibility and continuity.

Finally, student responses indicated that the repetitious nature of the survey needed to be addressed. Previously, survey items asked students about the variables that influence their "willingness to take risks" and separately "learn from mistakes." I had initially made this choice to prevent the presence of double-barreled items. However, not a single response to a single survey item for any participant deviated from one set of questions to the next. As such, I chose to merge the two sets of questions. This change was an important one because multiple participants shared that they had "lost focus" when taking the survey due to its length. Following these cognitive interviews, I sought consequential validity.

Consequential validity describes "the aftereffects from a particular assessment or measure" (Slomp et al., 2014, p. 278). For a survey to have consequential validity, it cannot have a negative impact on participants. To collect consequential validity evidence, I concluded each cognitive interview by asking participants three questions: 1) Did any item or parts of the survey make you feel uncomfortable? 2) Did you feel like you wanted to stop at any point while completing this survey? 3) Did your experience completing this survey feel differently or similarly to when completing other surveys you have taken in the past? There was no feedback from these series of questions that alerted me to any changes that would have to be made to the survey. Participants stated that they never felt uncomfortable when taking the survey, did not feel compelled to stop at any point, and noted that the survey felt similar to others they had taken. Having collected consequential validity evidence, I was able to proceed with administering the Mistake Literacy student survey.

All middle grades students at the research site were invited to complete the survey. Students were invited to participate through parental emails. They were invited to complete the survey via email (Appendix C). The survey was administered during a 50-minute period during

the school day and was supervised by the researcher. Informed assent was obtained prior to participation in the survey after reviewing a written statement as part of the invitation (Appendix D). This written statement outlined elements of assent and include a brief summary of this aspect of the research methodology, which reinforced the voluntary nature of participation (Cook, 2018). Data was collected and recorded via Qualtrics.

Qualitative

The first qualitative data collection tool used in this study was a semi-structured focus group, which was conducted synchronously via Google Meet. Video conferencing affords participants a flexibility in time and location that makes coordination and scheduling simpler for all parties involved. Students who participated in the survey and met the aforementioned inclusion criteria were invited to participate in the semi-structured focus group. The focus group protocol included seven questions tethered to an exploration of the processes that inform a student's inclination and ability to learn from their mistakes, specifically examining the distal and proximal variables that exist both within and beyond the classroom and within and beyond the individual student's control.

A focus group is widely considered to be a primary qualitative data collection method because it provides opportunities for participants to interact both with one another and with the data, which can enrich findings or even galvanize new insights (Russ-Eft & Preskill, 2011). Focus group participants often motivate each other in ways that are likely to elicit useful data that will corroborate, challenge, extend, or surface unexpected findings (Yin, 2014). The unique consonant and disconsonant thinking that this group process yields proved beneficial in confronting erroneous components and sharpening latent strengths of the Mistake Literacy construct. Moreover, focus groups have been cited as being the preferred and most practical data

collection method when working with students: “Focus groups promote self-reflection and allow students to see that they are not alone in the way they feel about a topic. They are more likely to be candid in a group, especially if others willingly share similar feelings” (Billups, 2012, p. 9).

In this study, the semi-structured focus group consisted of seven open-ended questions designed to facilitate dialogue. The goal was to have between three and six participants in the focus group. In the end, the focus group had six participants. A group smaller than this size could have presented difficulty in engaging interest, leading to less rich data. A group with more participants could have proven challenging to manage (Liamputtong, 2011).

Focus group participants were invited to participate via email (Appendix D). Informed assent was obtained prior to participation in the interview after reviewing a written statement as part of the invitation. This written statement outlined elements of consent and included a brief summary of this aspect of the research methodology, which reinforced the voluntary nature of participation (Cook, 2018). This written statement further offered assurances of confidentiality, though it explicitly stated that for the purposes of this study anonymity could not be granted. Data was collected through the use of notes, audio recording, and verbatim transcription. The focus group followed a semi-structured interview protocol (Appendix E) and was recorded using the recording and transcription software Otter.ai. Transcriptions were completed concurrent to the interviews using Otter.ai. I reviewed all transcriptions to check for accuracy. Transcription documents were saved, backed up, and stored using NVivo 12.

The second qualitative data collection tool was semi-structured one-on-one interviews, which were conducted synchronously and virtually via Google Meet. Interviews were scheduled for a mutually agreed upon time outside of school hours. Intensive interviews are considered to be an integral qualitative data collection method because they serve as a useful way to obtain

holistic, integrated, and rich information about a phenomenon by creating an opportunity for "connection, reflection, disclosure, and emergence" (Miles et al., 2014, p. 205). In this study, semi-structured one-on-one interviews were used to examine the Mistake Literacy construct against teachers' proximal experiences.

The interview protocol included six open-ended questions designed to initiate and facilitate dialogue. These six questions were tethered to an exploration of teachers' perceptions of the processes that inform a student's inclination and ability to learn from their mistakes, specifically examining the distal and proximal variables that exist both within and beyond the classroom and within and beyond the individual student's control. Given the flexible and responsive nature of semi-structured interviews, these six interview questions were supplemented and enriched by probe questions that were used to maintain momentum in the interview dialogue and produce more elaborate responses (Billups, 2021). The purpose of including probes is to refine the emerging interpretation of the data by clarifying ambiguities and seeking interpretation from participants to help filter and guide the emerging data (Desjardins, 2019). Moreover, through the use of constant comparative analysis from one interview to the next, questions and probes changed and evolved to become progressively more focused and relevant.

Interview participants were invited to participate via an email that provided a brief overview of the study, listed eligibility requirements, detailed informed consent, and reiterated the voluntary nature of participation (Appendix F). Informed consent was obtained prior to participation in the interview after reviewing a written statement as part of the invitation. This written statement outlined consent and included a brief summary of this aspect of the research methodology, which reinforced the voluntary nature of participation (Cook, 2018). This written

statement further offered assurances of confidentiality, though it explicitly stated that for the purposes of this study anonymity could not be granted. Data was collected through the use of interviewer notes, audio recording, and verbatim transcription. Each interview followed a shared semi-structured interview protocol (Appendix G) and was recorded using the recording and transcription software Otter.ai. Transcriptions were completed concurrent to the interviews using Otter.ai. I reviewed all transcriptions to check for accuracy. Transcription documents were saved, backed up, and stored using NVivo 12.

Data Analysis

A mixed methods case study design is a research approach that combines both quantitative and qualitative methods to collect and analyze data from multiple sources. The aim of this approach is to provide a comprehensive and detailed understanding of a particular case or cases, or develop cases for comparative analysis. By integrating both quantitative and qualitative data, researchers can gain a more nuanced and in-depth understanding of the phenomenon under study (Creswell & Clark, 2018). This mixed methods concurrent triangulation study gathered, verified, analyzed, and integrated quantitative and qualitative data. Quantitative and qualitative data strands were collected and analyzed concurrent to, but independent from, one another. Following these independent analyses, I integrated the results of the two strands to examine the case by seeking points of convergence, divergence, contradictions, and relationships between the two databases (Creswell & Clark, 2018). To meet its stated goals, this study leveraged the elaborative, complex, and inclusive elements of a mixed methods case study research design to test the novel conceptual framework of Mistake Literacy.

Given the bifurcated nature of a concurrent mixed methods research design, this section will be divided into quantitative data analysis, qualitative data analysis, and data integration (Aucoin, 2013). In a concurrent design such as this one, quantitative and qualitative data are equally weighted. As such, it is worth mentioning that opening with quantitative data analysis should not be interpreted as the researcher lending greater weight to that method. Rather, it is the debris of chance colliding with choice.

Quantitative Data Analysis

Data analysis requires multiple statistical tests. As such, I used a combination of data analysis techniques. For research question #1, I used a Pearson Product-Moment Coefficient to measure the strength of the relationship between two variables; for research question #2, I used an Analysis of Covariance (ANCOVA) to determine whether there are statistically significant differences between more than two means from unrelated socio-cultural dimensions; for research question #3, I used a simultaneous multiple regression to test and interpret the distinct components of the Mistake Literacy construct in an integrated and equally weighted manner; for research question #4, I used descriptive statistics to measure central tendency and measures of variability. Finally, to ensure that there was a coherent throughline from each research question to its corresponding data analysis technique, I developed, drafted, and continually revisited a survey alignment table (Appendix H). The data was analyzed using Drexel University's SPSS, version 28.

Qualitative Data Analysis

The qualitative data analysis phase abided by procedures specific to the method. Of course, sense-making from a plethora of raw data is a menacing prospect if an organization system is not established and adhered to. To aid in this recursive and iterative process of

qualitative data collection and analysis, I prioritized a strict memoing routine wherein I took contemporaneous notes following each interview and focus group. According to Saldana (2021) memoing is a key heuristic tool to capture emergent themes and ideas. In this way, a memoing routine not only helped me track the evolution of themes, but also helped me to know when new properties or dimensions were no longer being introduced. As such, memoing served as the bedrock for qualitative data analysis procedures.

During the first coding cycle, I took a deductive approach to coding the text, employing a structural coding method using a priori codes, which enabled me to harmonize emerging codes with the conceptual framework of Mistake Literacy, and facilitate an analysis that directly answered my research questions (Saldana, 2016). Structural coding segments and categorizes the larger data corpus in order to examine emerging commonalities, differences, and relationships. This approach proved useful in focusing and framing the data by surfacing and naming data points that were concordant and discordant to the a priori codes. I chose a structural coding method because it best suits my data collection method, and has been noted as being especially appropriate for novice qualitative researchers (Saldaña, 2016). Structural coding proved particularly relevant in generating thick, rich descriptions of the processes being studied.

I listed the resulting codes using the nodes feature in NVivo 12. I analyzed the list to bundle repetitious codes, note outliers, and sort transcription excerpts. I began by rereading each of the transcripts without making any notations. This approach allowed me to reacquaint myself with the transcripts and form overall impressions. In subsequent readings of the transcripts, I used an integrated approach, using the framework of the research question and inductive methods to code the text. After initial coding was complete, I progressed from coding to theorizing by engaging in second cycle coding.

The primary goal of second cycle coding is to develop a sense of conceptual organization by merging, replacing, reassembling, and subsuming codes into categories that are more salient representations of the concepts identified throughout the coding process (Saldaña, 2016). This symbiotic relationship between first and second cycle coding is a lot like cooking. First cycle coding is when you go to the grocery store, purchase ingredients, and prepare your *mise en place.* Second cycle coding is the cooking, dishing, eating, and enjoyment of the meal. Second cycle coding builds on and is beholden to first cycle coding. For this study, I used axial coding to prepare the proverbial meal.

Axial coding's purpose is "to determine which [codes] in the research are the dominant ones and which are the less important ones . . . [and to] reorganize the data set: synonyms are crossed out, redundant codes are removed and the best representative codes are selected" (Boeije, 2010, p. 51). Axial coding links first and second cycle coding by discerning a categorical axis, with spokes, or sub-categories, extending from this "core" axis. Categories are related to one another and give way to contextual and intervening conditions, strategies, and outcomes, thus sharpening a priori codes to challenge and cohere to the conceptual framework of Mistake Literacy (Saldaña, 2016).

First and second cycle coding might be sequential, but they are not hierarchical. Structural and axial coding were used in a contemporaneous and recursive manner. In essence, I used these complementary methods to employ both inductive and deductive thinking strategies in order to verify the relationships that emerged, continuously check new data against the relationships created among existing data, and verify the relationships between categories and subcategories. Through the continuous application of constant comparative analysis, I was able

to conclude that categories were appropriately broad, conceptual, and inclusive, excluding no major theme in the transcript data.

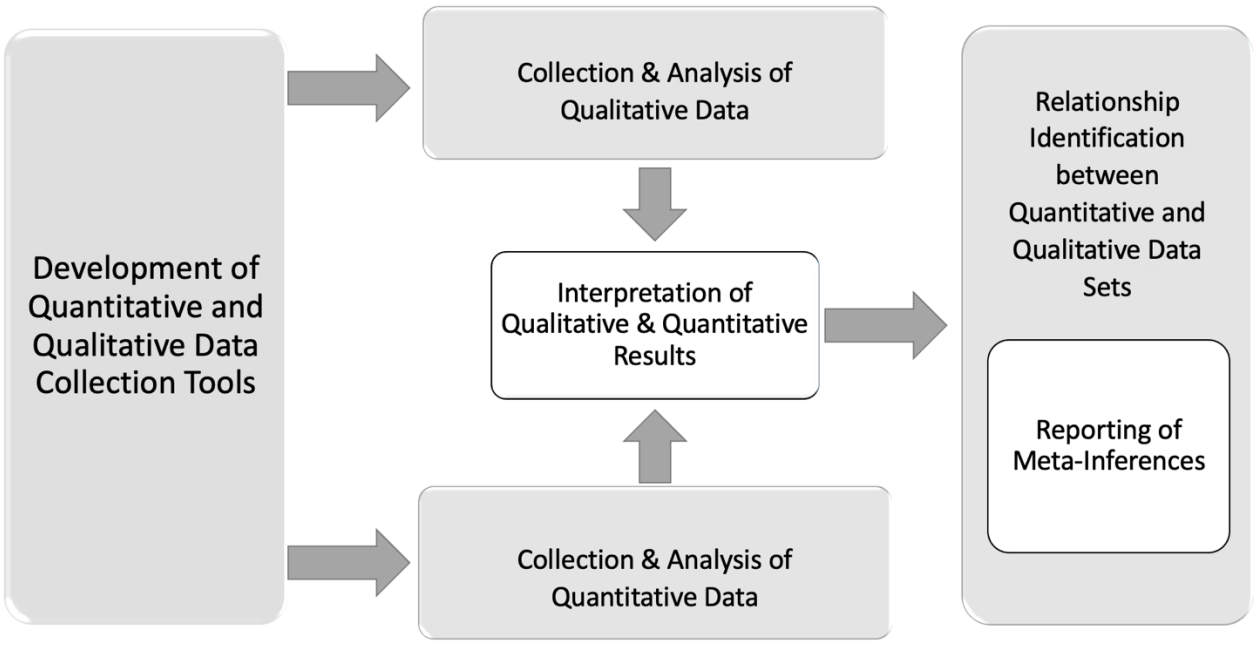
Data Integration

The final step in analyzing the data in a concurrent mixed methods case study is to integrate the quantitative and qualitative results. Integration in a concurrent mixed methods study occurs at the inference stage and involves bringing together quantitative and qualitative sources of information. "With a concurrent design at the core, the integration of quantitative and qualitative findings occurs when the researcher brings the results from the two databases together to form and interpret the case. This design provides a complex, in-depth understanding of the case" (Miller, 2015, p. 58). This simultaneous integration process is intended to elucidate results that might otherwise remain hidden. And yet, given the contrasting strengths of each method, surfacing such novel findings is contingent on a seamless analytic procedure that allows for quantitative and qualitative findings to be in conversation with one another. Fortunately, several such procedural models exist.

For this study, I chose to continue to lend equal weight to the two datasets by "identifying content areas represented in both datasets and compare, contrast, and synthesize the results and discuss the extent to which the two types of data converge, diverge, relate to each other, and produce a more complete understanding" (Creswell & Clark, 2018, p. 382). Through this process of interpretation, meta-inferences emerged. A meta-inference is an "overall conclusion, explanation or understanding developed through an integration of the inferences obtained from the qualitative and quantitative strands of a mixed method study" (Teddlie, 2009, p. 101). Simply put, generating meta-inferences is the sought-after outcome of a concurrent mixed methods study. I represented and described these meta-inferences in a narrative display. In a narrative

display, quantitative and qualitative findings are woven together to illuminate and illustrate the major themes of these integrated conclusions (Fetters et al., 2013; McCrudden et al., 2021). A narrative display makes the most sense for this study because quantitative and qualitative data collection examined identical aspects of the same phenomenon.

Figure 1



Note. Figure 1 Concurrent Triangulation Research Flow (Adapted from Creswell & Plano Clark, 2011)

Stages of Data Collection

This bounded case study took place in an educational setting. As such, data collection was limited by the tempo of the school year. At the specific site where this case study research took place, the school year begins in mid-August and ends the day before the Memorial Day Weekend. Moreover, the concurrent nature of this research design means that multiple data collection methods took place on an overlapping timeline. Given all these mediating variables, the timeline for this study was as follows:

Activity	Date
IRB Approval Certification	December 2022
Recruitment of participants	January 2023
Survey, interviews, and focus groups	January-February 2023
Data analysis	March 2023
Report findings (C.4 & 5)	April 2023
Revisions/editing	April 2023
Dissertation Orals (“Defense”)	May 2023
Graduation	June 2023

Ethical Considerations

Ethical considerations were integrated into the research design. As part of the research process, approval for this study was received by the Institutional Review Board (IRB) from the sponsoring institution, Drexel University. This process ensures compliance with all policies and issues related to ethical standards. Permission was secured from all study participants via consent and assent forms, which provided an overview of the research methodology and clarified that involvement is voluntary and can be discontinued at any time. Given the goals of this study, data was kept confidential. Confidentiality was ensured through assigning a pseudonym to each participant. All physical and digital copies of raw data and transcriptions were secured on a server not connected to the internet. Audio recordings were erased upon the completion and acceptance of this dissertation.

Summary

Mixed methods are far from monolithic. There are myriad matching epistemological methods that are equally valid. For a researcher, the question is not which method is best, but which method best aligns to the researcher's and research's axiology. The goal of Chapter 3 was to present and justify the research methodology and corresponding methods that will inform the collection, organization, analysis, and integration of quantitative and qualitative data. The goal of Chapter 4 will be to provide the study results and demonstrate that the methodology described in Chapter 3 was followed.

Chapter 4: Results and Discussion

In Chapter 3, I presented the methodology, data collection methods, and analysis techniques used in this research. This plan was followed, with adjustments and improvements made as I progressed through the data. This iterative and dynamic approach, informed by intuition and responsiveness to emerging findings, allowed me to refine and revise my analysis process to respond to the complexities and subtleties of the data. This approach facilitated the generation of meaningful insights and conclusions that were tailored to the research's specific context, generating a robust final product.

Overall, the success of my research relied on the balance between following a recipe as a foundation and deviating from it, guided by my own tastes, intuition, and creativity. This flexibility and ability to adjust to the data ultimately contributed to the efficacy and credibility of the research. Thus, just as in cooking, research requires the recipe as a starting point, but it is the responsiveness and creativity of the researcher that determine the success and satisfaction of the final product.

Chapter 4 will summarize and make sense of the study data, answer the research questions, test the hypotheses, examine the foreshadowed problems, and explore relevant conjectures. This chapter represents the crux and apogee of my mixed methods concurrent triangulation design. This design is a robust data collection and analysis approach that involves gathering quantitative and qualitative data simultaneously and analyzing them concurrently. This procedure aims to enhance the credibility and completeness of the research through triangulation, where the findings from both types of data are compared, contrasted, and integrated to generate comprehensive insights.

Furthermore, in this chapter, I first present the quantitative and qualitative findings independent of one another. By presenting the results separately, I ensure that each is given the necessary attention to analyze, visualize, and discuss the outcomes comprehensively. The numerical summary measures that include central tendencies, dispersions, and statistical significance will be described within the discussion of the quantitative findings. This section of the chapter sheds light on the patterns and relationships within the data collected. The qualitative results allow a more subjective exploration of the participants' attitudes, values, beliefs, and experiences. In this section, I report critical themes derived from the interview responses, which reflect the students' and educators' perspectives on the factors influencing their learning experience.

Finally, the chapter concludes with a presentation of meta-inferences that integrate both types of data. This meta-inference section aims to compare and contrast the results of the qualitative and quantitative data analyses to provide a comprehensive understanding of the research problem. Here I identify similarities, contrasts, and confirmations between quantitative and qualitative data analyses. These comparisons allow me to triangulate the results and create a rich and insightful interpretation of the data.

Findings

Quantitative Findings

The current study is concerned with the following four quantitative research questions regarding middle grades education, Mistake Literacy, and mistake-learning efficacy:

RQ1: Is there a significant relationship among the components of Mistake Literacy for middle grade students?

RQ2: To what extent are statistical differences in Mistake Literacy components mediated by the contextual conditions of middle grades students?

RQ3: Is there a significant relationship between Mistake Literacy components and Mistake-Learning Efficacy for middle grades students?

RQ4: What are the components of a classroom environment on middle grades students' willingness to make and learn from their mistakes?

Sample

The final sample included 55 responses to the study survey, however full data were only available for 50 participants regarding most variables. This discrepancy arose from an unattributable glitch with the digital survey that affected five participants. These participants encountered the glitch when answering the latter portion of the questionnaire, after having responded to the initial 18 questions without incident. As such, these five participants completed the remainder of the survey in a second session. In all, 50 respondents is sufficient for satisfying the assumptions of normality to use parametric statistical procedures (Salkind, 2008).

The sample was almost equally composed of students from grades five through eight, was majority male (56.00%), white/Caucasian (78.00%), and most likely to be the oldest child (36.00%). A full accounting of demographic variables, as well as descriptive statistics for the majority of study variables can be found in Table 1.

Table 1

Demographics	Frequency	Valid percent (%)
Grade		
5th grade	13	26.00
6th Grade	13	26.00
7th Grade	13	26.00
8th Grade	11	22.00
Gender		
Female	17	34.00

Male	28	56.00
Non-binary/third gender	5	10.00
Ethnicity		
Asian / Pacific-Islander	1	2.00
Black / African American	4	8.00
White / Caucasian	39	78.00
Multiracial	6	12.00
Birth order		
Oldest child	18	36.00
Middle child	12	24.00
Youngest child	12	24.00
Only child	8	16.00

Study variables	Mean	SD
Parental involvement	3.14	0.50
Growth mindset	3.41	0.77
Mistake repair	3.14	0.84
Learner empowerment cycle	3.19	0.84
Mistake-learning efficacy	3.58	0.53

Summary of Findings

In order to address the first research question regarding significant relationships among the components of Mistake Literacy, a series of correlations were performed. Specifically, correlations using Pearson's Point-Moment Coefficient (r) were evaluated for all possible pairings of growth mindset, mistake repair, and learner empowerment cycle. Among these, the correlation between mistake repair and learner empowerment cycle was statistically significant, meaning there was a statistically valid relationship between these two components of Mistake Literacy. The correlation was moderate-to-strong, and positive ($r(48) = 0.64$, $p < .001$). These findings tell us that there is a high amount of intercorrelation between mistake repair and learner empowerment cycle, which tells us that as scores on one variable increased, scores on the other variable tended to increase, as well. In practice, this means that if the score on one of the

variables increased by a standard deviation, the score on the other variable would increase by .64. The full results of the correlational analyses can be found in Table 2.

Table 2

Correlations Between Components of Mistake Literacy

	Mean	SD	1.	2.	3.
1. Growth mindset	3.41	0.77	-		
2. Mistake repair	3.14	0.84	.19	-	
3. Learner empowerment cycle	3.19	0.84	.14	.64***	-

Notes: $n = 50$ for all. SD = Standard Deviation. *** $p < 0.001$.

In order to address the second research question and evaluate the extent that statistical differences in Mistake Literacy components are mediated by the contextual conditions of middle grades students, a series of analysis of covariance (ANCOVA) tests were performed. This method allows the researchers to examine differences in a continuous variable (i.e., Mistake Literacy components) between different groups (i.e., demographics and parental involvement) while controlling for another continuous variable (i.e., the perceived importance of the demographic variables and perceived importance of parental involvement). To better convey the value of ANCOVA, consider this scenario: Suppose there are three different school models and a researcher wants to understand how each model affects students' standardized test scores. Naturally, the researcher would want to control for average household income. In this case, it would be highly advantageous for the researcher to conduct an ANCOVA test. By doing so, they can effectively disentangle the impact of the quality of each education model on standardized test scores from the influence of household income and other potential confounding variables. This enables the researcher to generate more precise and reliable findings that are specifically linked to the quality of education being delivered, unencumbered by the effects of other factors.

For the second research question, the first ANCOVA analysis tested the difference in growth mindset between grade levels, while controlling for the perceived importance of grade level (e.g., “Based on your experience, how has your grade-level influenced your willingness to take risks in the classroom?”). All subsequent ANCOVA analyses were performed in this same configuration, with the substitution of other Mistake Literacy components as the dependent variables, other demographics or parental involvement groups as the independent variable, and the perceived importance of the respective demographics or parental involvement as covariates.

Concerning grade level, no effects were observed for growth mindset ($F(8, 41) = 0.45$, $p = 0.88$) or mistake repair ($F(8,41) = 1.05$, $p = 0.41$), but significant results were observed for learner empowerment cycle ($F(8,41) = 2.22$, $p < 0.05$). The overall model accounted for 30% of variance in learner empowerment cycle, meaning 30% of the variance between individual participants can be ascribed to grade-level. Concerning learner empowerment cycle, a significant main effect for grade level ($F(3,41) = 3.26$, $p = 0.03$) was observed. Follow-up analysis revealed that those in sixth Grade and eighth Grade were significantly lower in learner empowerment cycle scores than those in fifth Grade ($p = 0.01$) and seventh Grade ($p = 0.03$). A significant interaction between grade level and the perceived importance of grade level ($F(3,41) = 2.87$, $p < 0.05$) was also observed, indicating significant mediation. A full accounting of results can be found in Table 3.

Table 3

Differences in Mistake Literacy Components by Grade Level Controlling for Grade Level Importance Beliefs

	Growth mindset		Mistake repair		Learner empowerment cycle	
	df	*F*	*df*	*F*	*df*	*F*
Corrected model	8, 41	0.45	8, 41	1.05	8, 41	2.22*

Grade level	3, 41	0.63	3, 41	2.17	3, 41	3.26*
Grade level imp.	1, 41	0.99	1, 41	0.01	1, 41	1.61
Interaction	3, 41	0.69	3, 41	1.72	3, 41	2.87*
R^2		.08		.17		.30

Follow-up: Learner empowerment cycle	Mean	Std. Error	MD 1.	MD 2.	MD 3.	MD 4.
1. 5th grade	3.49	.22	-			
2. 6th grade	2.69	.21	0.80*	-		
3. 7th grade	3.40	.22	0.09	0.71*	-	
4. 8th grade	2.83	.26	0.66	0.14	0.57	-

Note: n = 50 for all. Imp. = Importance, MD = Mean Difference. *$p < 0.05$.

Concerning gender, the overall model was unable to find meaningful differences in growth mindset ($F(6,43) = 0.90$, $p = 0.90$) or mistake repair ($F(6,43) = 0.74$, $p = 0.62$). There was a significant effect for learner empowerment cycle ($F(6,43) = 2.93$, $p = 0.02$). Examining the effects of learner empowerment cycle, a significant main effect is observed for gender ($F(2,43) = 4.20$, $p < 0.05$) with other effects being non-significant. The full model accounted for 29% of variance in earner empowerment cycle. Follow-up analysis reveals male students are significantly higher than female students ($p = 0.04$), with non-binary students not being significantly different from either. A full accounting of results can be found in Table 4.

Table 4

Differences in Mistake Literacy Components by Gender Controlling for Gender Importance Beliefs

	Growth Mindset		Mistake Repair		Learner empowerment cycle	
	df	*F*	*df*	*F*	*df*	*F*
Corrected model	6	0.90	6	0.74	6	2.93*
Gender	2	0.59	2	0.68	2	3.87*
Gender importance	1	0.75	1	2.14	1	4.20*
Interaction	2	0.78	2	0.29	2	1.88
R^2		0.05		0.09		0.29

Follow-up: Learner empowerment cycle	Mean	Std. Error	MD 1.	MD 2.	MD 3.
1. Female	2.84	0.18	-		
2. Male	3.35	0.15	0.51*	-	
3. Non-binary	3.27	0.46	0.43	0.08	-

Note: n = 50 for all. MD = Mean Difference. *p < 0.05.

Concerning ethnicity, no significant effects were observed for any of the components of Mistake Literacy. The overall models for growth mindset (F(1,45) = 0.66, p = 0.62), mistake repair (F(9,40) = 0.68, p = 0.61), and learner empowerment cycle (F(4,45) = 1.29, p = 0.29) were all non-significant. A summary of these results can be found in Table 5.

Table 5

Differences in Mistake Literacy Components by Ethnicity Controlling for Ethnicity Importance Beliefs

	Growth mindset		Mistake repair		Learner empowerment cycle	
	df	*F*	*df*	*F*	*df*	*F*
Corrected model	4, 45	0.66	4, 45	0.68	4, 45	1.29
Ethnicity	1, 45	1.13	1, 45	0.49	1, 45	0.09
Ethnicity importance	1, 45	0.00	1, 45	2.17	1, 45	1.76
Interaction	1, 45	1.36	1, 45	0.66	1, 45	0.01
R^2		0.06		0.06		0.10

Note: n = 50 for all.

Similarly, no ANCOVA models were significant for birth order, meaning there was no observed effect of birth order on components of Mistake Literacy. This pattern was consistent for growth mindset (F(9,40) = 0.55, p = 0.83), mistake repair (F(9,40) = 1.28, p = 0.28), and learner empowerment cycle(F(9,40) = 1.42, p = 0.21). These findings are summarized in Table 6.

Table 6

Differences in Mistake Literacy Components by Birth Order Controlling for Birth Order Importance Beliefs

	Growth mindset		Mistake repair		Learner empowerment cycle	
	df	*F*	*df*	*F*	*df*	*F*
Corrected model	9, 40	0.55	9, 40	1.28	9, 40	1.42
Birth order	3, 40	0.24	3, 40	1.39	3, 40	2.02
Birth order importance	1, 40	0.54	1, 40	0.00	1, 40	1.09
Interaction	3, 40	0.16	3, 40	1.28	3, 40	1.76
R^2		0.11		0.22		0.24

Note: n = 50 for all.

The final examination of possible differences in Mistake Literacy components and investigations of possible mediations was performed for parental involvement. Because parental involvement is a continuous measure, groupings were created using a median-split to create High and Low groupings. A median-split was chosen as the relatively low variance of the variable (*SD* = 0.50) made splitting the variable into triads or quartile impractical by either creating groups that were too small, groupings based on trivial score differences, or needing to arbitrarily assign participants with the same scores to different groups.

Of the three models evaluating significant differences in Mistake Literacy components by parental involvement, and possible mediation through perceived importance, the results for learner empowerment cycle ($F(3,46) = 2.89$, $p = 0.04$) were significant, while results for growth mindset ($F(3,46) = 2.29$, $p = 0.09$), and mistake repair ($F(3,46) = 0.68$, $p = 0.57$) were not significant. In the case of learner empowerment cycle, the observed significant effect was the covariance term for parental involvement importance alone ($F(1,46) = 4.70$, $p = 0.04$), this result means that there is a significant relationship between the two variables. Specifically, parental involvement was reverse coded so that higher levels of agreement indicate lower levels of

parental involvement, meaning the less involved a student perceives their parent to be, the higher their score on learner empowerment cycle. Because the observed relationship was with the covariance term, follow-up analysis within the ANCOVA framework was conducted. A summary of these results can be found in Table 7.

Table 7

Differences in Mistake Literacy Components by Parental Involvement Controlling for Parental Involvement Importance Beliefs

	Growth mindset		Mistake repair		Learner empowerment cycle	
	df	*F*	*df*	*F*	*df*	*F*
Corrected model	3, 46	2.29	3, 46	0.68	3, 46	2.89*
Parental involvement	1, 46	1.51	1, 46	0.43	1, 46	3.61
PI importance	1, 46	3.76	1, 46	0.60	1, 46	4.70*
Interaction	1, 46	1.90	1, 46	0.06	1, 46	2.96
R^2		0.13		0.04		0.16

Note: $n = 50$ for all. PI = Parental Involvement. * $p < 0.05$.

To address the third research question addressing whether or not there is a significant relationship between Mistake Literacy components and mistake-learning efficacy, a simultaneous multiple regression was conducted. The overall model was significant ($F(3,46) = 20.37$, $p < 0.01$) and accounted for 57% of total variance in mistake-learning efficacy. Learner empowerment cycle ($t = 5.08$, $p < 0.01$). proved to be the most significant predictor of mistake-learning efficacy, with a relationship between the two variables that was moderate-to-strong and positive ($\beta = 0.65$), meaning that while growth mindset and mistake repair contribute to the relationship, the model's significance is largely derived from learner empowerment cycle. The full accounting of these results can be found in Table 8.

Table 8

Multiple Regression Predicting Mistake-Learning Efficacy

	β	*t*	*p*
Predictors			
Growth mindset	0.12	1.20	0.24
Mistake repair	0.11	0.86	0.39
Learner empowerment cycle	0.65	5.08	< 0.01
F	20.37		
df	3, 46		
p	< 0.01		
R^2	0.57		

Note. $n = 50$.

To address the final research question regarding which components of a classroom environment have the greatest influence on the willingness of middle grades students to make and learn from their mistakes, a battery of descriptive statistics were calculated and examined. The first set of items concerned a teacher's outlook, response, and attitude towards establishing an error tolerant classroom environment. The results indicated that among a teacher's responses to a mistake, the highest average ratings were given to Teacher is Kind ($M = 3.63$, $SD = 0.66$), Teacher Does Not Allow Other Students to Make Fun of Me ($M = 3.53$, $SD = 0.76$), and Relationship with My Teacher Remains Unchanged ($M = 3.51$, $SD = 0.81$).

The second set of items concerned a suite of instructional strategies and pedagogical preferences that teachers have at their disposal to cultivate a high-error learning climate. When considering these aspects, the highest-rated options, on average, were Teacher Provides Feedback on a Regular Basis ($M = 4.00$, $SD = 0.00$), Feedback Is About My Learning, Not Me ($M = 3.76$, $SD = 0.44$), and Teacher Allows Collaboration Between Students ($M = 3.75$, $SD = 0.44$). A full accounting of all results can be found in Table 9.

Table 9

Descriptive Statistics of Classroom Environment

	n	Mean	SD	Agreement	Median	Mode
When I make a mistake, my . . .						
Teacher is kind	50	3.63	0.66	94.12%	4.00	4.00
Teacher does not allow other students to make fun of me	50	3.53	0.76	88.24%	4.00	4.00
Relationship with my teacher remains unchanged	50	3.51	0.81	88.24%	4.00	4.00
Teacher does not call me out in front of the class	50	3.44	0.97	86.00%	4.00	4.00
Teacher remains calm	50	3.42	0.76	88.00%	4.00	4.00
Teacher is patient	50	3.41	0.64	92.16%	3.00	4.00
Teacher is curious about where i went wrong	50	3.00	0.85	68.63%	3.00	3.00
Teacher responds with humor	50	2.80	1.06	64.71%	3.00	3.00
Teacher tells me about mistakes they have made	50	2.59	1.06	54.90%	3.00	3.00
In the classroom, my . . .						
Teacher provides feedback on a regular basis	50	4.00	0.00	100.00%	4.00	4.00
Teacher provides feedback about my learning, not about me	50	3.76	0.44	100.00%	4.00	4.00
Teacher allows collaboration between students	50	3.75	0.44	100.00%	4.00	4.00
Teacher cares more about my learning than my grades	50	3.48	0.74	90.48%	4.00	4.00
Teacher makes sure i am appropriately challenged	50	3.28	1.07	75.86%	4.00	4.00
Teacher allows retakes	50	3.17	1.03	78.57%	3.50	4.00
Teacher allows time to reflect	50	3.14	0.76	78.57%	3.00	3.00
Teacher allows me to try my own approach before telling me the answer	50	3.14	1.05	73.81%	3.50	4.00
Teacher cares about what i want to learn	50	2.94	0.73	67.22%	2.00	2.00

Note. Agreement is percent of responses using higher half of four-point response scale.

Conclusion

To summarize all findings, the only significant relationship between the components of Mistake Literacy for middle grade students is a moderate-to-strong relationship between mistake repair and learner empowerment cycle. The only observed effect of contextual conditions on Mistake Literacy components exist for grade level and gender's effect on learner empowerment cycle; there is some mediation observed for grade level but not gender. The only significant

relationship between Mistake Literacy components and mistake-learning efficacy is a moderate-to-strong relationship with learner empowerment cycle. Lastly, the components of the classroom environment seemingly related to students' willingness to make and learn from mistakes have to do with their teachers' kindness, equanimity and predictability, protection from ridicule, frequent and recurring learning-oriented and learner-centric feedback, and allowing students to collaborate with their peers.

Qualitative Findings

The current study is concerned with the following two qualitative research questions regarding middle grades education, Mistake Literacy, and mistake-learning efficacy:

RQ1: How do students describe the socio-cultural conditions, classroom conditions, and strategies that influence their ability to learn from mistakes?

RQ2: How do educators describe the socio-cultural conditions, classroom conditions, and strategies that influence their students' ability to learn from mistakes?

To answer these two research questions, I conducted in-depth interviews with six middle school teachers and a focus group with six students. The teacher group consisted of three female, two male, and one non-binary teacher, including one Black teacher. The student focus group included one Black student, one transgender male student, and one non-binary student, as well as students from White backgrounds across various grades, including two fifth graders, one sixth grader, one seventh grader, and two eighth graders (see Table 10).

Table 10

Student demographics	Frequency	Valid percent (%)
Grade		
5th grade	2	33.33
6th Grade	1	16.67
7th Grade	1	16.67
8th Grade	2	33.33

Gender		
Female	2	33.33
Male	3	50.00
Non-binary/third gender	1	16.67
Ethnicity		
Black / African American	1	16.67
White / Caucasian	5	83.33
Birth order		
Oldest child	3	50.00
Middle child	1	16.67
Youngest child	1	16.67
Only child	1	16.67

Teacher demographics	Frequency	Valid percent (%)
Gender		
Female	3	50.00
Male	2	33.33
Non-binary/third gender	1	16.67
Ethnicity		
Black / African American	1	16.67
White / Caucasian	5	83.33

During the interviews, I employed a combination of scripted and non-scripted questions to gain a comprehensive understanding of the research topic. I took detailed handwritten notes throughout the conversations, which enabled me to organize and later transcribe them. This approach allowed me to identify and explore common themes related to socio-cultural factors shaping middle school students' learning experiences, cross-referencing them with the audio playback and reading of the transcripts later.

At one point during the interviews, I provided participants with a definition of what it means to learn from a mistake. From this, I initially extracted 469 lines of codes across five

dimensions, which I narrowed down to fewer than 50 over the second round of coding from interviews with teachers. Similarly, the focus group generated 372 lines of codes.

The next step involved iteratively listening to the interview recordings and reviewing the transcriptions. I ensured that I highlighted key elements of the data, including important words, phrases, and ideas. This process involved eliminating, absorbing, and growing codes until fewer than 50 remained. To facilitate this, I used a combination of a corkboard, index cards, and NVivo 12. Additionally, I incorporated anchor quotes to increase transparency and validity.

In the third step, I used structural coding to segment and categorize the larger corpus of data into a priori categories, one transcript at a time. This allowed me to examine emerging commonalities, differences, and relationships in the data in relation to my research questions in isolation from one another. This step involved concurrent analysis of the coded list, bundling repetitious codes, identifying outliers, and sorting transcription excerpts. This iterative and dynamic approach to data analysis allowed me to continuously refine and revise my categories and interpretations as I progressed through the data, without interference from other interviews. I conducted this process separately for each of the six interviews, plus the focus group.

The fourth step, axial coding, served the purpose of identifying the dominant and less important codes in the research study and reorganizing the data set accordingly. Through this process, I eliminated synonyms and redundant codes and chose the best representative codes. I accomplished this by discerning a categorical axis, with sub-categories extending from this core axis, which links the first and second cycle coding. The resulting categories were related to one another and provided insight into contextual and intervening conditions, strategies, and outcomes. This enabled me to sharpen my a priori codes and challenge them to cohere with the conceptual framework of Mistake Literacy (Saldaña, 2016). Overall, axial coding facilitated the

development of a coherent and comprehensive analysis of research data, which was essential for drawing meaningful conclusions and informing future research. I used axial coding as the basis for answering the first and second qualitative research questions.

Finally, I presented the findings to the participants and shared my definition of what it means to learn from a mistake. This was well-received, and there was a universal consensus among the interviewees. Sharing the findings with participants not only affirmed the credibility of my research but also created a sense of rapport between myself and the interviewees. It demonstrated the value of involving participants in the research process and gave them a sense of ownership of the findings.

Social-Cultural Factors

Teacher Interviews. As I delved into the interviews with middle school teachers, a clear theme emerged: *Socio-cultural factors* have a significant impact on the decisions students make regarding learning, risk-taking, and prioritizing academics. In fact, the dominant category that emerged from the data was *social consequences*, which is defined as the impact that group dynamics, prejudices, social hierarchies, and interpersonal relationships have on shaping and dictating individual students' actions, risk-taking preferences, and academic priorities. A full breakdown of this category and its subcategories, definitions, and examples is provided in Table 11.

Table 11

Teacher Interviews: Socio-Cultural Factors Within the Central Axis of Social Consequences

Category	Subcategory	Definition	Example quote
Social dynamics	Peer influence	The impact that a middle schooler's friends and classmates can have on their willingness and ability to learn from their mistakes, either positively or negatively.	"It's amazing to see how much of an impact peers can have on a student's mindset. When their classmates are supportive and encouraging, students are much more likely to embrace

			feedback and use it to improve their work."
Minority students			
	Rejection sensitivity dysphoria	Especially at Predominately White Institutions (PWIs) where social options may be perceived as limited, minority students may interpret what they think others are thinking of them, which can result in a desire to keep up appearances and a risk-aversion.	"There's a real concern about what their peers think of them. I don't even think there would be social consequences, but they don't see it that way. They're constantly worried about it."
	Imposter syndrome	This psychological condition may be most pronounced for minority students at PWIs, amplified and multiplied by the model minority stereotype and resulting in a strong desire to maintain the status quo.	"Another issue I see is imposter syndrome. They feel like they have to constantly prove themselves to their peers, and that pressure can really take a toll on their mental health and academic performance."
Parental involvement			
	Overbearing	Parents' excessive investment in their child's academic performance. This can include taking control over their child's education, and hindering their child's ability to learn from mistakes	"Overly involved parents do more harm than good. It's good that they want to be a part of their kid's life, but there's a fine line and too often I see it crossed."
	Laissez-fair	Parents who do not provide enough guidance, support, or accountability, leaving their child feeling directionless in the learning process.	"I've also had parents who are completely hands-off when it comes to their child's education. They don't show up to parent-teacher conferences, they don't check their child's backpack for homework, and they don't ask questions about what their child is learning in school."
	Light-touch	Parents provide the security of support while also allowing their child the space to learn the lessons of a skinned-knee.	"It's all about striking a balance. As parents, you're just always trying to find that bowl of warm porridge."

One sub-category that stood out during the analysis of data from teacher interviews was social dynamics. This category highlights the profound impact that friends and classmates can have on a student's willingness to learn from their mistakes. As one interviewee noted, "Peer influence is fascinating to witness. Supportive classmates can boost a student's confidence and

encourage them to take risks. In contrast, negative peer influence can cause a student to become risk-averse, avoiding challenges altogether." This reinforces the idea that social dynamics play a crucial role in shaping students' mindsets.

In exploring the socio-cultural factors that influence learning experiences, teachers expressed that minority students face unique challenges. Particularly in Predominately White Institutions (PWIs), where these students may feel pressure to conform to social norms and maintain the status quo to avoid ridicule or ostracization. As one teacher noted, "Minority students frequently express a significant concern about what their peers think of them. They are always worried about whether or not they will be accepted." These concerns are often amplified by popular stereotypes, such as the model minority label. Consequently, these factors can significantly impact a student's academic performance and general mental health.

Parental involvement was another sub-category that emerged from the data. According to the teacher interviewees, parents have a tremendous influence on their child's academic performance, but there must be a balance between too little and too much involvement. On the one hand, overbearing parents can limit their child's opportunities to learn from their mistakes by taking too much control. On the other hand, absent parents may not provide the right levels of support, guidance, or accountability, which may result in a lack of direction in the learning experience. A delicate balance must be struck. The teachers held a common belief that parents must provide the necessary guidance and support for their child while still allowing them the space to learn and grow from their mistakes.

In conclusion, the data from the teacher interviews revealed that socio-cultural factors including social dynamics, minority identity, and parental involvement play significant roles in shaping individual students' learning experiences. These factors need to be carefully considered

when developing educational policies and programs aimed at improving academic success. By taking these factors into account, we can gain a deeper understanding of how to create a more effective and inclusive learning experience for all.

Student Focus Group. As I pored over the results of my focus group with middle grades students, a clear theme emerged: *Social dynamics* had a pervasive influence on students' behavior and interactions within the classroom. This mirrored the theme that emerged in the teacher interviews and it became evident that social dynamics was the primary category that impacted the learning experience for each student. Social dynamics represents the patterns of behavior within a group that are heavily influenced by factors such as familiarity, trust, and perceived social status. Examining this category illuminated how students behaved and interacted within the classroom and how they responded to various academic challenges (see Table 12).

Table 12

Student Focus Group: Socio-Cultural Factors Within the Central Axis of Social Dynamics

Category	Subcategory 1	Definition	Example quote
Trust			
	Self-assuredness	A confidence that is not easily swayed by the opinions or social standing of those around them.	"I pretty much agree with what people are saying, but I think it also depends on who you're around. With some people, like my close friends, I know they won't care if I make a mistake, so I don't really think about what I say. But with others, I'm more cautious and think more about what I'm going to say before I say it."
	Carefree	An inclination to share thoughts, even if they're mistaken, because respect and relationships won't be threatened.	"There are definitely people who I feel more comfortable talking to, where I can just say the first thing that comes to my mind. With my close friends, I don't worry about making mistakes because I know they know me and won't judge me for it. But with people I'm not as close with, I'm more hesitant to share

			my mistakes because I don't know what they'll think of me."
Grade-level			
	Familiarity	The level of comfort that students feel when with students in other grade-levels	"I'm more trusting with people I know well, but I'm more cautious around people I don't know as well. For example, if I don't really know a seventh grader, I might be friends with them, but I'll still be more cautious around them."
	Expectations	The standards that students hold themselves to depending upon the grade-level they're in.	"5th grade is the first year of middle school here, so I feel like I should be making mistakes."
Parental involvement			
	Continuum of involvement	The idea that the level of parental involvement should strike a balance between indifference and excessive pressure, ideally landing on a "supportive nudge."	"Finding a balance of caring without over-pressuring allows for learning from mistakes."
	Unflappable	The ability of parents to remain calm and composed in the face of their kid's mistakes by being inquisitive instead of lecturing.	"My parents are supportive of learning from mistakes, but not to the point of stressing me out. Other parents who overreact can cause anxiety and panic."

In particular, the category of *trust* and subcategories of *self-assuredness* and *carefree behavior* revealed how critical building trust is in the creation of a positive learning environment. Students reported that trust enabled them to develop a level of comfort and self-assuredness within a group setting, which instilled a confidence that could not be swayed by others' opinions or social status. Relatedly, carefree behavior led to an inclination to share thoughts, ideas, and doubts without fear of being ridiculed or rejected. As one student astutely observed,

> With some people, like my close friends, I know they won't care if I make a mistake, so I don't really think about what I say. But with others, I'm more cautious and think more about what I'm going to say before I say it.

Additionally, the subcategory of *parental involvement* emerged from the student focus group as another critical factor in shaping a student's learning experience. It became clear that parental involvement needed to strike a careful balance between indifference and excessive pressure, ideally landing on a "supportive nudge." One student defined this as, "Finding a balance of caring without over-pressuring allows for learning from mistakes." Encouragingly, the findings revealed that parents could play a positive role in promoting students' academic success by remaining unflappable and inquisitive when faced with their child's mistakes. As one student noted, "My parents are supportive of learning from mistakes, but not to the point of stressing me out. Other parents who overreact can cause anxiety and panic." These results support the premise that parental involvement characterized by a steady but soft hand is an essential element in shaping a student's academic success.

In summary, this study highlights the critical impact of socio-cultural factors, particularly social dynamics, on a student's learning experience. By examining the subcategories, including trust, self-assuredness, carefree behavior, and parental involvement, we can begin to understand how these factors create a positive learning environment that promotes risk-taking, growth, and achievement. It is essential to incorporate these findings into the design of educational policies and programs that prioritize empathy, support, and guidance to help all students flourish in their educational journey.

Instructional Strategies

Teacher Interviews. The findings for instructional strategies focused around the central axis of *connections*, which refers to building relationships, fostering trust, and cultivating a shared sense of purpose and mutual respect that creates the conditions for teachers to facilitate deep, personal, and meaningful learning experiences to inspire student growth and

transformation. Teachers recognize the importance of developing positive connections with their students as a foundation for learning. One teacher stated, “I try to build relationships with my students because I know that when they feel respected and valued, they are more willing to take risks and learn from their mistakes.” Subcategories, definitions, and example quotes for this central axis are summarized in Table 13.

Table 13

Teacher Interviews: Instructional Strategies Within the Central Axis of Connections

Category	Subcategory	Definition	Example quote
Feedback		A process in which teachers take on various roles that are carefully tailored and deployed in response to the unique needs of individual learners and a vehicle through which mistakes become learning experiences.	
	Formative feedback	Providing frequent, progress-oriented feedback	“As a middle school teacher, I think it’s super important to give feedback that helps my students progress. So, I try to provide them with feedback all the time, you know?”
	Personalized feedback	Gaining insights into students’ aptitude, ability, and personality to better personalize the learning experience.	“I use conferences as a way to casually connect with my students and engage them in meaningful conversations without them even knowing it . . . to give my students feedback that’s really personal. This way, I can get to know them better and make sure they’re learning in a way that works for them.”
	Relevance	Demonstrating the real-world applicability of what is being learned, thus positioning students to better understand why repairing their mistakes matters	“I always try to show my students why what they’re learning matters in the real world. You know, it helps them see why fixing their mistakes is important and how they can use what they’ve learned in their lives.”
Sensory-rich learning experience		A pedagogical approach that seeks to immerse students in an atmospheric, experiential, and resonant learning environment that	

		encodes memory fabricates a reference point for their future learning endeavors and meets students in their zone of proximal development.	
	Experiential learning	Allowing students to explore, investigate, discover, and incorporate hands-on and project-based learning experiences. This makes room for trial and error.	"When students can engage in hands-on, experiential learning, they're more likely to internalize the lessons they're taught."
Time		The allocation of time in the classroom implicitly signals to students their teacher's priorities. Time encompasses a diverse array of characteristics and functions, including the segmentation and sequencing of lessons, the establishment of clear routines and expectations, and the provision of opportunities for preparation, practice, processing, and reflection.	
	Lesson design	Creating time for students to prepare, practice, process, and reflect on their learning.	"When I design my lessons, I make sure to give my students enough time to really sink their teeth into the material. It's not just about cramming information into their heads, it's about giving them the space to prepare, practice, process, and reflect on what they're learning."
	Productive failure	Segmenting and sequencing learning into an exploratory and inquiry-based phase followed by an instructional phase	"Productive failure is a key part of my teaching approach. I create opportunities for my students to explore and inquire on their own, so they can develop a deeper understanding of the material before I come in and provide more formal instruction."
	Predictability and clarity	Students know what to do, when to do it, how to do it, and why they're doing it.	"I believe that predictability and clarity are absolutely essential for effective learning. If students don't know what to do, when to do it, or why they're doing it, they're not going to be able to engage fully with the material."
	Reassessment	Continual practice opportunities, which provide	"Reassessment is crucial for ensuring that students are truly learning and growing. By providing continual practice opportunities, I give my

		learners with multiple opportunities to further refine and grow their understanding.	learners the chance to refine and develop their understanding over time."
Choice		Choice involves options and opportunities for students that are carefully curated by the teacher as a means of motivating students and, in turn, increasing their level engagement in the learning process by offering them opportunities to exercise agency, demonstrate ownership and learn non-linearly.	
	Learning pathways	Individualized learning pathways based on students' learning profiles, proclivities, and passions that give students curricular choice.	"I've found that providing students with individualized learning pathways based on their interests and strengths can really spark their passion for learning. It's all about meeting them where they are and giving them the resources they need to succeed. When they're able to see their progress and take ownership of their learning, it's really something special."
	Learning menus	A collection of resources and assignments designed to offer students a variety of modalities to access and engage with course content at their own pace and level of rigor through challenge by choice.	"Learning menus are a powerful tool for allowing students to work at their own pace, access course content in various modalities, and take ownership of their learning."
Depersonalize mistakes		Depersonalizing mistakes is a teaching strategy that aims to redirect attention away from a student's individual flaws and towards the learning process. By doing so, students can cultivate a more constructive outlook on risk-taking, mistake-making, and mistake-repair.	
	Rubrics and checklists	Provide students with clear and objective criteria for their learning, so they can filter their mistakes through a framework for growth and improvement.	"I use rubrics and checklists to give my students a clear idea of what they need to learn and how to improve, so they can see their mistakes in a constructive way."
	Error analysis	Analyze, categorize, and code the types of mistakes made by students, identifying patterns and areas for improvement.	"I have my students analyze their mistakes on tests and homework to see where they're struggling and how I can help them improve. I have them categorize based on the nature of the

			mistakes. This way, we can begin to identify patterns and I can provide targeted support."
	Questioning strategies	Use open-ended questioning techniques to encourage students to discuss their thinking and understanding.	"I ask a lot of questions like 'Tell me about' or 'How do you to encourage my students to discuss their thinking and understanding."
	Exemplars and anti-examples	Use both positive and negative examples to illustrate key concepts and help students identify mistakes and areas for improvement. Like rubrics, this allows students to see discussions of mistakes not as a criticism but as something tied to an objective set of criteria.	"I use both good and bad examples to illustrate key concepts, so my students can see what they should do and what they should avoid."
	Impermanence	Using tools such as whiteboards and avatars can help students understand that mistakes are not permanent, and to emotionally distance themselves from their mistakes.	"Whiteboards are the best! Students love them because they can just erase their mistakes. That impermanence makes them more willing to make mistakes in the first place."
Student-centered collaboration		Student-centered collaboration involves intentionally designing learning experiences that foster reciprocal learning among peers and encourages team-oriented approaches to learning and problem-solving.	
	Cooperative learning	Using grouping and teaming strategies to encourage students to work together to complete a task or solve a problem and learn from each other.	"I've found that when students work together in a group, they not only learn from each other, but they also feel more invested in the learning process. Cooperative learning is all about building that sense of community and responsibility."
	Peer feedback	Encouraging students to give and receive feedback from their peers on their work. Sometimes this means encouraging students to take on the role of teacher and tutor their peers in areas where they excel.	"Peer experts can be a game-changer. When students take on the role of teacher and tutor their peers, they not only reinforce their own understanding of the material, but they also gain confidence and leadership skills. It's a win-win situation."

The first category that emerged was *feedback*. Feedback is a process wherein teachers take on various roles that are carefully tailored and deployed in response to the unique needs of individual learners. Feedback is seen as a vehicle through which mistakes become learning experiences. Teachers recognize the importance of providing frequent, progress-oriented feedback that is both personalized and relevant. One teacher observed,

> I use conferences as a way to casually connect with my students and engage them in meaningful conversations without them even knowing it . . . to give my students feedback that's really personal. This way, I can get to know them better and make sure they're learning in a way that works for them.

The second category that emerged from teacher interviews related to the central axis of connections was *sensory-rich learning experience*. This category involves a pedagogical approach that seeks to immerse students in an atmospheric, experiential, and resonant learning environment that encodes memory, fabricates a reference point for their future learning endeavors, and meets students in their zone of proximal development. Sensory-rich learning experiences allow students to explore, investigate, discover, and incorporate hands-on and project-based learning experiences. One teacher stated, "When students can engage in hands-on, experiential learning, they're more likely to internalize the lessons they're taught."

The third category that emerged was *time*. Time encompasses a diverse array of characteristics and functions, including lesson design, productive failure, predictability and clarity, reassessment, and segmentation and sequencing of lessons. Teachers recognized the importance of creating time for students to prepare, practice, process, and reflect on their learning. One teacher explained,

> When I design my lessons, I make sure to give my students enough time to really sink their teeth into the material. It's not just about cramming information into their heads, it's about giving them the space to prepare, practice, process, and reflect on what they're learning.

The fourth category was *choice*. The interviewed teachers recognized the importance of offering students opportunities to exercise agency, demonstrate ownership, and learn non-linearly. The category involves options and opportunities for students that are carefully curated by the teacher as a means of motivating students and, in turn, increasing their level of engagement in the learning process. One teacher noted,

> I've found that providing students with individualized learning pathways based on their interests and strengths can really spark their passion for learning. It's all about meeting them where they are and giving them the resources they need to succeed. When they're able to see their progress and take ownership of their learning, it's really something special.

The fifth category that emerged when analyzing teacher interview data related to instructional strategies and connections was *depersonalize mistakes*. This teaching strategy aims to redirect attention away from a student's individual flaws and towards the learning process. Teachers recognized that depersonalizing mistakes can help students cultivate a constructive outlook on risk-taking, mistake-making, and mistake-repair. One teacher noted, "I use rubrics and checklists to give my students a clear idea of what they need to learn and how to improve, so they can see their mistakes in a constructive way."

The final category that emerged was *student-centered collaboration*. This category involves intentionally designing learning experiences that foster reciprocal learning among peers

and encourages team-oriented approaches to learning and problem-solving. Teachers recognized the importance of cooperative learning and peer feedback. For example, one teacher observed, "When students work together in a group, they not only learn from each other, but they also feel more invested in the learning process. Cooperative learning is all about building that sense of community and responsibility."

In summary, instructional strategies that emerged from the interviews with middle grades teachers are grounded in the central axis of connections. Teachers recognized the importance of building positive connections with students as a foundation for learning. Strategies such as providing feedback, cultivating sensory-rich learning experiences, wisely allocating time, offering choice, depersonalizing mistakes, and prioritizing student-centered collaboration were all named as effective in promoting deep and meaningful learning experiences for students.

Student Focus Group. One of the central themes that emerged from the student focus group on the topic of instructional strategies was the importance of allowing students to have a *choice* in their learning (see Table 14). The students reported that when they have the opportunity to choose what they are learning, when they are learning it, and who they are learning with, they are more motivated to put forth their best effort and learn from their mistakes. As one student explained, "When I get to choose what I'm learning, I feel like I have more control over my education and it's easier to stay motivated."

Table 14

Student Focus Group: Instructional Strategies Within the Central Axis of Choice

Category	Subcategory	Definition	Example quote

Practice		Providing students with repeated opportunities to engage with content and apply their knowledge, without the pressure of being graded.	
	Formative assessments	Regular feedback and check-ins that create opportunities for students to demonstrate their knowledge on an individualized timeline and so they know where they stand.	"We practice during class like, we'll go over what we learned before. And then we'll try and we'll do it again. Until we can like get it in the rhythm of remembering it immediately"
Transparency		Ensuring students have a clear understanding of what they are expected to learn and how they will be assessed, enabling them to make informed decisions about their learning.	
	Clear expectations	Communicating clear and consistent expectations for learning goals and assessments through formal rubrics and conversations.	"He is just so clear. He does a really good job of explaining the criteria to us. Overall, it's just really transparent."
Mastery-based progressions		Allowing students to advance through the curriculum at their own pace, without sacrificing high standards.	
	Self-paced instruction	Students are given the autonomy to move through the curriculum at their own pace, with guidance from their teacher.	"I don't have to work on the same thing as my friends. I can work on what I want, when I want."

The first category that emerged within this central axis was the importance of providing students with opportunities to *practice* without the pressure of being graded. This involves giving students repeated opportunities to engage with content and apply their knowledge until they master it. As one student stated, "We practice during class, and then we'll try it again until we can remember it immediately." Formative assessments also play a vital role in this category, as

they provide regular feedback and check-ins to help students demonstrate their knowledge on an individualized timeline.

The second category that emerged was *transparency*. According to the focus group, transparency involves ensuring that students have a clear understanding of what is expected of them and how they will be assessed, which empowers them to make informed decisions about their learning. Clear expectations can be communicated through formal rubrics and conversations. As one student reflected, "He [the teacher] does a really good job of explaining the criteria to us. Overall, it's just really transparent."

The third category that emerged was the use of *mastery-based progressions and self-paced instruction*. One student described this as: "I don't have to work on the same thing as my friends. I can work on what I want when I want." This approach allows students to advance through the curriculum at their own pace without sacrificing high standards, while still benefiting from guidance from their teacher.

In conclusion, this study has shown that allowing students to have a choice in their learning is a critical instructional strategy that promotes engagement and motivation, leading students to be more willing to learn from their mistakes. Providing opportunities for repeated practice, regular formative assessments, transparency, and mastery-based progressions with self-paced instruction are important practices to implement.

Teacher Dispositions and Attitudes

Teacher Interviews. Through interviews, I explored middle grades teachers' dispositions and attitudes towards learning from mistakes in the classroom. This section highlights the central axis that emerged, which was the *student-teacher relationship*. Several categories and subcategories also emerged from this interview data, including approachability, equanimity, and

modeling. Table 15 provides a summary of the full findings from teacher interviews related to teacher dispositions and attitudes.

According to the interviewees, student-teacher relationships thrive when the teacher is approachable, demonstrates equanimity, and is curious about their students. The teachers believed that the strength of their relationships with students creates a comfortable space where bidirectional trust and empathy can flourish. Further, they asserted that teachers who are accountable for their actions and willing to admit to their mistakes make the classroom a safe and inclusive learning space. One teacher mentioned in the study that "by admitting to our mistakes, we show that we're human too, and it validates what we expect of our students in owning up to their own mistakes."

Table 15

Teacher Interviews: Teacher Dispositions and Attitudes Within the Central Axis Student-Teacher Relationship

Category	Subcategory	Definition	Example quote
Approachability		The cultivation of a positive, safe, and inviting learning environment that challenges traditional power dynamics between students and teachers by creating an inclusive and respectful space where judgment is suspended and positive intent is assumed.	
	Supportive presence	The approach taken by educators to create a supportive learning environment that nurtures students' academic and emotional needs. This involves providing the necessary resources, tools, and guidance that enable students to succeed academically, socially, and emotionally, while remaining open to students' needs and concerns.	"We need to be more than just educators, we need to be nurturers too. We should provide the necessary resources and tools that students need to succeed academically and emotionally."

	Inclusive classroom	Efforts made by educators to create a classroom culture that embraces diversity and values different perspectives, identities, and experiences. This involves incorporating diverse materials, creating a safe and welcoming space, and actively listening to students' needs, and addressing issues of bias and discrimination.	"An inclusive classroom is essential in today's world. We need to embrace all perspectives, identities, and experiences in our classroom culture, and this starts with us."
	Purposefully deployed spontaneity	The intentional use of unscripted remarks and actions by educators to create a more relaxed and engaging learning environment. This approach involves using spontaneous comments and actions to respond to students' needs, build rapport, and create a sense of community and trust.	"Sometimes, some spontaneity can really help break down the barriers that often exist between us and our students. When we go off-script, we create a more relaxed and engaging learning environment."
Equanimity		Equanimity involves emotional regulation, emphasizing and exhibiting patience, and the cultivation of a learning environment in which students feel comfortable, safe, and capable of navigating challenges with composure and self-assuredness.	
	"Take your work seriously, but never take yourself too seriously"	Emphasizing the importance of being committed to teaching, but maintaining a lighthearted perspective and incorporating humor when appropriate.	"Using humor in the classroom is a great way to make students feel comfortable. But it's important to use it appropriately and be mindful of students' individual boundaries and comfort levels. When done right, humor can create a really positive and enjoyable learning experience."
	Suspending judgement	Holding off on forming opinions or telling oneself stories until further information is available.	"I think it's important as a teacher to suspend judgement and remain open-minded. It's easy to jump to conclusions, but we owe it to our students to give them the benefit of the doubt."
	Getting curious, not certain	Encouraging a sense of curiosity and questioning, rather than assuming absolute knowledge or certainty	"Instead of assuming we have all the answers, we should encourage our students to ask questions and explore new ideas. It's through this process of inquiry that learning takes place anyway."

	Patience	Responding to student urgency with a sense of perspective and understanding	"Patience is key when working with middle schoolers. They can be a little intense at times, but it's important to respond with understanding and perspective. We need to remember that they're still learning and growing, and it's our job to support them through the ups and downs."
Curiosity		A state of mind characterized by openness, active listening, and genuine interest in exploring and understanding students' perspectives without certainty or judgement.	
	Being open	Willingness to consider new ideas and feedback without biases or judgments. Showing genuine interest in student perspectives by asking open-ended questions.	"Being open is really important in this line of work. You can't just shut out new ideas or feedback because it doesn't fit into what you already know. You have to be willing to learn and grow alongside your students."
	Active listening	Paying full attention to what students are saying, setting aside their own agenda or assumptions	"Active listening is key. Sometimes we get so caught up in what we want to say or what we think is best, that we forget to actually listen to our students. But when you really pay attention to what they're saying, it can completely change the way you approach teaching."
Modeling		Teachers' intentional efforts to model certain behaviors and mindsets that they feel are helpful for students to engage with for their learning.	
	Admitting mistakes	Modeling how to respond to mistakes by acknowledging and taking responsibility for them.	"I believe that predictability and clarity are absolutely essential for effective learning. If students don't know what to do, when to do it, or why they're doing it, they're not going to be able to engage fully with the material."
	Accountability	Creating clear expectations, providing constructive feedback, and cultivating a warm and supportive learning environment that emphasizes the non-linear nature of the learning journey.	"Accountability is a form of love. We need to hold our students accountable, and the best way I know how to do that is by equipping them with the

	skills to hold themselves accountable."

Approachability is an important component of the student-teacher relationship, according to the interviewees. Approachability is the cultivation of a positive, safe, and inviting learning environment that challenges traditional power dynamics between students and teachers by creating an inclusive and respectful space where judgment is suspended and positive intent is assumed. The teachers asserted that the supportive presence of educators in creating a safe and nurturing learning environment that meets students' academic and emotional needs is integral. As one teacher put it, "We need to be more than just educators. We need to be nurturers too. We should provide the necessary resources and tools that students need to succeed academically and emotionally."

Inclusive classrooms that value diversity and embrace different perspectives, identities, and experiences emerged as an essential factor for creating a learning environment that is conducive to the student-teacher relationship. Incorporating diverse materials, creating a safe and welcoming space, and actively listening to students' needs and concerns were seen by the teachers as fundamental practices. One teacher shared the strategy of purposefully deploying spontaneity in unscripted remarks and actions to help break down barriers that often exist between teachers and students, ultimately creating a more relaxed and engaging learning environment: "Sometimes, some spontaneity can really help break down the barriers that often exist between us and our students. When we go off-script, we create a more relaxed and engaging learning environment."

Equanimity emerged as another crucial component of the student-teacher relationship. This subcategory involves emotional regulation and creating a learning environment in which

students feel comfortable, safe, and capable of navigating challenges with composure and self-assuredness. It entails emphasizing and exhibiting patience and modeling how to handle challenging situations. One teacher shared,

> Patience is key when working with middle schoolers. They can be a little intense at times, but it's important to respond with understanding and perspective. We need to remember that they're still learning and growing, and it's our job to support them through the ups and downs.

Suspending judgement was another key disposition cited for creating a comfortable learning environment. One teacher in the study shared, "It's important as a teacher to suspend judgment and remain open-minded. It's easy to jump to conclusions, but we owe it to our students to give them the benefit of the doubt." Teachers believed in the importance of delaying the formation of opinions until further information was available. They expressed the necessity of approaching each situation with an open mind and be accepting of different perspectives.

Curiosity is a state of mind characterized by openness, active listening, and genuine interest in exploring and understanding students' perspectives without certainty or judgement. Teachers' willingness to be open, consider new ideas and feedback without biases or judgments, and actively listen to what students are saying emerged as fundamental to the student-teacher relationship. One teacher eloquently described the importance of active listening:

> Active listening is key. Sometimes we get so caught up in what we want to say or what we think is best, that we forget to listen to our students. When you really pay attention to what they're saying, it can completely change the way you approach teaching.

Modeling was another essential component of the student-teacher relationship according to the interviewees. This involves intentional efforts by teachers to model certain behaviors and

mindsets that they feel are helpful for students to engage with for their learning. Admitting mistakes and taking responsibility for them teaches students how to respond to their own mistakes. One teacher shared, “Accountability is a form of love. We need to hold our students accountable, and the best way I know how to do that is by equipping them with the skills to hold themselves accountable.” A warm, supportive learning environment that emphasizes the non-linear nature of the learning journey enables students to hold themselves accountable.

In conclusion, the dispositions and attitudes of middle grades teachers towards learning from mistakes in the classroom are essential for creating an environment where student-teacher relationships can flourish. By being approachable, equitable, and curious about students, teachers can foster the trust and empathy needed to create a safe and inclusive learning space. Practices such as inclusive classrooms, displaying equanimity, suspending judgment, and modeling are fundamental for creating a comfortable learning environment that meets students’ academic and emotional needs. With the central axis and categories discussed above, teachers can learn to appreciate the value of self-reflection, be receptive to information and feedback, and actively prioritize creating a safe space for their students.

Student Focus Group. One of the central themes that emerged from the focus group discussion was the importance of the *student-teacher relationship*. The participants described a positive and respectful connection that was built on trust, communication, and transparency (see Table 16). They emphasized the importance of an inviting and welcoming space that focuses on learning and progress, not just grades. This type of environment is characterized by equanimity, humor, accountability, and patience. As one participant stated, “Math is where I’m most comfortable making mistakes. I think it’s because our teacher is really open to helping us figure out where we went wrong and remains calm no matter how many times she has to explain it.”

Table 16

Student Focus Group: Teacher Dispositions and Attitudes Within the Central Axis of Student-Teacher Relationship

Category	Subcategory	Definition	Example quote
Emotional regulation		The creation of a learning environment that is high-functioning, predictable, and relaxed	
	Equanimity	A teacher's ability to remain calm, composed, and level-headed, and not be baited by the changing emotions of their middle schoolers.	"Math is where I'm most comfortable making mistakes. I think it's because our teacher is really open to helping us figure out where we went wrong and remains calm no matter how many times she has to explain it."
Accountability		Teachers hold students to high standards and ensuring that they are accountable for their learning.	
	High expectations	A teacher's belief in their students' ability to achieve success and hold students accountable to those standards no matter what.	"In music theory, I wrote my piece in the wrong scale, but my teacher didn't yell at me or make me delete it. He just let me know that I had to fix it and reminded me how to. I'm not ashamed of making mistakes because it's how we learn."
Positive classroom dynamics		A teacher's duty to nurture a welcoming and inclusive learning environment.	
	Humor	The appropriate use of light-hearted, individualized jokes to lift the mood and make students feel as though they're seen by the teacher.	"My art teacher is really friendly and always joking around. He teases me sometimes, but it's like an inside joke."
	Enthusiasm	A teacher's excitement when their students demonstrate progress. Enthusiasm can be contagious.	"I love how excited she gets for us. I do something well and it's like she did it well, too."

	Culture of belonging	The creation of a supportive and inclusive learning environment that values diversity and fosters a sense of community	"I feel so welcome social studies. He really sees us for who we are and what we bring to the table."

The first category that emerged under the student-teacher relationship central axis was *emotional regulation*. Participants described a learning environment that is high-functioning, predictable, and relaxed. According to the students, this type of environment allows for mistakes to be made and for students to learn from them. Furthermore, *equanimity* was emphasized as a teacher's ability to remain calm, composed, and level-headed, and not be baited by the changing emotions of their middle schoolers. As one participant described, "Our history teacher never gets mad or emotional. He just takes what we say and moves on. It makes me want to work harder."

The second category that emerged was *accountability*. Participants emphasized the importance of teachers holding students to high standards and ensuring that they are accountable for their learning. High expectations were described as a teacher's belief in their students' ability to achieve success and hold students accountable to those standards no matter what. As one participant explained,

> In music theory, I wrote my piece in the wrong scale, but my teacher didn't yell at me or make me delete it. He just let me know that I had to fix it and reminded me how to. I'm not ashamed of making mistakes because it's how we learn.

The third and final category that emerged was *positive classroom dynamics*. Participants emphasized a teacher's duty to nurture a welcoming and inclusive learning environment. Humor was described as the appropriate use of light-hearted, individualized jokes to lift the mood and make students feel as though they're seen by the teacher. Enthusiasm was described as a

teacher's excitement when their students demonstrate progress. Enthusiasm can be contagious. As one participant stated, "I love how excited my science teacher gets for us. I do something well and it's like she did it well too." Lastly, the culture of belonging was described as the creation of a supportive and inclusive learning environment that values diversity and fosters a sense of community. One participant expressed, "I feel so welcome in social studies. He really sees us for who we are and what we bring to the table."

In summary, the focus group participants emphasized the importance of creating a positive and respectful student-teacher relationship that is built on trust, communication, and transparency. This type of environment is characterized by emotional regulation, accountability, and positive classroom dynamics. Emotional regulation allows for a learning environment that is high-functioning, predictable, and relaxed. Accountability emphasizes holding students to high standards and ensuring that they are accountable for their learning. Positive classroom dynamics emphasize humor, enthusiasm, and fostering a culture of belonging. When teachers create this kind of environment, students are more likely to learn from their mistakes and progress in their learning.

Student-Initiated Strategies

Teacher Interviews. The central axis that emerged from the middle grades teachers' interviews was the importance of *preparedness and self-regulation* for students in the classroom (see Table 17). Preparedness and self-regulation can be defined as a suite of cognitive and behavioral skills that enable students to approach mistakes with composure and respond to mistakes with intentionality. Preparedness involves having a plan of action and being ready to face challenges, while self-regulation involves the ability to manage one's thoughts, emotions, and behaviors to achieve specific goals.

Table 17

Teacher Interviews: Student-Initiated Strategies Within the Central Axis of Preparedness and Self-Regulation

Category	Subcategory	Definition	Example quote
Confidence		The belief in oneself to take risks, advocate for learning needs, and, ultimately, learn from mistakes.	
	Feedback seeking	The drive to actively seek and embrace feedback to convert mistake-making into mistake-learning	"I've learned that feedback is a two-way street. It's not just about giving feedback to my students, but it's also about seeking feedback from them."
	Advocacy	The assertive act of expressing one's own needs, challenges, and learning preferences to facilitate a learning environment that is tailored to a student's individual preferences.	"Advocacy is key. I want my students to be assertive and outspoken and communicate what they need and when they need it. Otherwise, how can I help them?"
	"Those who venture, gain"	Stepping out of one's comfort zone by asking clarifying questions, taking deliberate risks, and being willing to be wrong in front of others.	"What would you do if you knew you could not fail? I ask my students this question at least once per week. Stepping out of your comfort zone can be scary, but it's where true growth happens. That's why I encourage my students to ask questions, share their ideas, and be open to the possibility of being wrong. After all, those who venture, gain."
Growth mindset		The ability to detach oneself from the fear of failure and embrace the potential for growth that lies in every mistake, knowing that progress is always a possibility.	
	Tenacity	An unrelenting determination to achieve a goal, even in the face of setbacks or obstacles, driven by a deep sense of purpose and a belief in oneself.	"It's not about being perfect or getting everything right the first time, but rather having the drive and determination to keep pushing forward, even when faced with setbacks."
Intrinsic motivation		The innate drive to pinpoint misunderstandings, engage in reassessment, grow and leverage	

	their reflective capacity, and set progress-oriented goals.	
Reassessment	The timely act of taking advantage of classroom opportunities to revise and improve upon previous efforts.	"All of my students have the chance to reassess on any assignment, no matter what grade they earned, and it's the students who reassess frequently who are learning how to learn from their mistakes."
Reflection	The metacognitive practice of noting what causes dysregulation and developing a box of tools to cope with it or quell it altogether.	"As a middle schooler, the best thing a student can do is really take the time to reflect on what dysregulates them. If they can figure that out, they're going to be just fine in high school."
Goal-setting	The data-rich and progress-based process of setting personal, measurable, and attainable objectives.	"We set goals all the time in the middle school. The key is getting students to do it without adult intervention. If our kids were starting their days by thinking about what they wanted to accomplish that day, there's no telling what they actually would accomplish."

Preparedness and self-regulation are intertwined with the student-initiated strategy of *confidence*. Confidence involves the belief in oneself to take risks, advocate for learning needs, and, ultimately, learn from mistakes. It is the drive to actively seek and embrace feedback to convert mistake-making into mistake-learning. As one teacher observed, "I've learned that feedback is a two-way street. It's not just about giving feedback to my students, but it's also about seeking feedback from them." Confidence also involves the assertive act of communicating one's own needs, challenges, and learning preferences to facilitate a learning environment that is tailored to a student's individual preferences. Another teacher remarked, "Advocacy is key. I want my students to be assertive and outspoken and communicate what they need and when they need it. Otherwise, how can I help them?" Lastly, confidence involves

stepping out of one's comfort zone by asking clarifying questions, taking deliberate risks, and being willing to be wrong in front of others. As another teacher shared,

> What would you do if you knew you could not fail? I ask my students this question at least once per week. Stepping out of your comfort zone can be scary, but it's where true growth happens. That's why I encourage my students to ask questions, share their ideas, and be open to the possibility of being wrong. After all, those who venture, gain.

The second category that emerged from the interviews was *growth mindset*. Growth mindset is the ability to detach oneself from the fear of failure and embrace the potential for growth that lies in every mistake, knowing that progress is always a possibility. It is also an unrelenting determination to achieve a goal, even in the face of setbacks or obstacles, driven by a deep sense of purpose and a belief in oneself. As one teacher noted, "It's not about being perfect or getting everything right the first time, but rather having the drive and determination to keep pushing forward, even when faced with setbacks." According to the teachers, having a growth mindset is critical for students to be able to approach mistakes as opportunities for growth rather than failures.

The third category that emerged from the interviews was *intrinsic motivation*. Intrinsic motivation is the innate drive to pinpoint misunderstandings, engage in reassessment, grow and leverage one's reflective capacity, and set progress-oriented goals. It involves taking advantage of classroom opportunities to revise and improve upon previous efforts. As one teacher shared, "All of my students have the chance to reassess on any assignment, no matter what grade they earned, and it's the students who reassess frequently who are learning how to learn from their mistakes." Intrinsic motivation also involves the metacognitive practice of noting the causes of dysregulation and developing strategies to cope with or quell it altogether. As one teacher

observed, “As a middle schooler, the best thing a student can do is really take the time to reflect on what dysregulates them. If they can figure that out, they’re going to be just fine in high school.” As another teacher noted, “We set goals all the time in the middle school. The key is getting students to do it without adult intervention. If our kids were starting their days by thinking about what they wanted to accomplish that day, there’s no telling what they actually would accomplish.” This refers to the data-rich and progress-based process of setting personal, measurable, and attainable objectives that is a key part of intrinsic motivation.

In conclusion, the data from the interviews with middle grades teachers revealed that students who possess preparedness and self-regulation benefit from a suite of student-initiated strategies such as confidence, growth mindset, and intrinsic motivation. The teachers saw the ability to approach mistakes with composure and respond to mistakes with intentionality as essential for students to learn from their mistakes in the classroom. Therefore, educators must engage students in activities that promote preparedness and self-regulation. This can be achieved by providing opportunities for students to engage in activities that develop these skills, such as setting personal goals, seeking feedback, and engaging in reflective practices.

Student Focus Group. The focus group study revealed various strategies that students employ to learn from their mistakes. The strategies are categorized into three central axes, one of which is *mindset* (see Table 18). The mindset of a student refers to their attitudes, beliefs, and ways of thinking when confronted with mistakes, challenges, and setbacks. This chapter summarizes the findings of the study focusing on the student-initiated strategies and provides insights on how each strategy contributes to students’ learning experiences.

Table 18

Student Focus Group: Student-Initiated Strategies Within the Central Axis of Mindset

Category	Subcategory	Definition	Example quote
Growth mindset		Believing that mistakes can be opportunities for learning and growth and that learning from a mistake is within the student's control.	
	Valuing effort and perseverance	To learn from a mistake, there has to be an acknowledgment that success is not solely based on natural ability or talent, but also on the effort and perseverance put into achieving a goal.	"Remind yourself of the growth mindset and that you can learn from mistakes."
Positive self-talk		Students knowing how to speak to themselves when they make a mistake. It is about speaking to oneself the way you'd speak to a best friend.	
	Progress over perfection	Prioritizing incremental improvements, recognizing that mistakes and setbacks are part of the learning process.	"Recognize that mistakes don't define me. They're just mistakes, not world-ending, and it's better to learn from them before they become worse."
	"We are more than our mistakes"	Students should remind themselves that mistakes do not define them.	"I'm only a middle schooler. I don't have to know everything."
Help seeking		A student recognizing when assistance is needed and knowing how to ask for assistance.	
	Seeking feedback	Actively seeking critical friends to identify areas for improvement.	"Backtrack to fully understand your mistake, then reflect on how not to repeat it. You can figure it out yourself or ask a teacher for help."
	Valuing collaborative learning	Acknowledging that working with others presents students with a valuable opportunity to learn.	"Occasionally, I ask a classmate for help, particularly if I've missed something."

One of the critical findings from the study is that students' mindsets play a significant role in their ability to learn from mistakes. Students with a growth mindset understand that mistakes are opportunities for growth and learning. These students believe that their abilities are

not solely based on talent but are also influenced by effort and perseverance when working towards their goals. Through a growth mindset, students can create a positive attitude toward setbacks or challenges, making it easier to learn from their mistakes. One of the participants stated, “Remind yourself of the growth mindset, and that you can learn from mistakes.”

Another strategy that students use to learn from their mistakes is *positive self-talk*. This refers to the practice of how students speak to themselves when they make a mistake. For example, one participant spoke about the fact that when they perform poorly on a test, they may tell themselves that they are not good enough, which can reduce their chance of learning from their mistake. On the other hand, this same student suggested that they’ve gotten better at treating themselves with kindness and patience, which they feel enables them to work through struggles with a positive attitude. One participant suggested, “Recognize that mistakes don’t define me. They’re just mistakes, not world-ending, and it’s better to learn from them before they become worse.”

Lastly, the study highlighted that students believed those who seek help when they experience difficulties are more likely to learn from their mistakes. Help seeking includes recognizing when assistance is needed and knowing how to ask for it. Additionally, students who seek assistance actively engage with critical friends who identify areas for improvement. One participant shared, “Occasionally ask a classmate for help, particularly if I’ve missed something.” This active engagement provides students with valuable opportunities to learn from their mistakes. Moreover, recognizing when to ask for help can save students a lot of time and reduce frustration. One participant suggested, “Backtrack to fully understand your mistake, then reflect on how not to repeat it. You can figure it out yourself or ask a teacher for help.”

Additionally, seeking assistance can come from classmates, providing a valuable opportunity to work together and learn from one another.

In conclusion, the findings from this portion of the study show that students use different strategies to learn from their mistakes, including a growth mindset, positive self-talk, and help seeking behaviors. These student-initiated strategies help students to frame their failure as opportunities for growth and learning. Additionally, these strategies encourage students to focus on the process of learning rather than the outcome. Through the understanding and application of these strategies, students are better equipped to overcome challenges and setbacks, leading to a more positive learning experience.

Learning from Mistakes

After conducting thorough interviews with both teachers and students, I presented my own articulated definition of "learning from a mistake," to which all participants responded positively and unanimously. It was essential to involve the participants in the sharing of these findings as doing so supported the credibility of my research and strengthened the sense of connection between us. This enabled participants to assume pride and ownership in the findings, which is a critical aspect of participatory research.

In essence, "learning from a mistake" is a complex and multifaceted process with different participants emphasizing various facets of the process. The procedure requires the engagement of cognitive and behavioral elements, and it is essential to understand the interplay between these dimensions to develop strategies for effective teaching and learning. Respective definitions from teacher and student participants can be found below.

Teacher Definition for "Learning From Mistakes." Learning from mistakes is a complex and multifaceted phenomenon that involves a range of cognitive and affective factors.

At its core, it is a mindset defined by a student's wiliness to engage in a recursive cycle of recognizing and understanding their mistakes, taking corrective action, and adapting and assimilating newly acquired knowledge for future application. A student's engagement with this cycle can be demonstrated by reducing the time gap between committing an error and taking corrective action, or the growing diversity of problem-solving strategies in their toolkit.

Student Definition for "Learning From Mistakes." Learning from a mistake is a process that involves reflecting on the situation, recognizing what went wrong, and taking action to prevent the same mistake from recurring. Personal proclivities and passions can influence how someone learns from their mistakes. For example, if a student lacks motivation in a particular class or is not engaged by a certain teacher, they may not be inclined to invest in the learning process and derive valuable lessons from their mistakes, and that "aha" moment won't matter and may go unrecognized.

Conclusion

The process of data analysis is a critical aspect of any research study, and it is particularly important when seeking to comprehend the underlying themes and patterns that emerge. Through meticulous examination of the data, researchers can gain a profound understanding of their research topic, which can ultimately lead to meaningful insights and conclusions that enhance the existing knowledge base in their field. While the data analysis process can be both time-consuming and challenging, it is essential to ensure that the research results are both valid and reliable.

To provide a clear and detailed account of the data analysis process used in this study, a research plan that involved several crucial steps was followed. These steps included transcribing

and organizing notes, identifying and highlighting essential elements of the data, segmenting and categorizing the data using structural coding, and refining and revising the categories and interpretations using axial coding. By employing this meticulous approach, I was able to derive insights and conclusions that made a significant contribution to the body of knowledge in my field.

As I began presenting my findings from teacher interviews and student focus groups, it became apparent that there were points of divergence, convergence, congruity, and incongruity, as well as friction and cohesion, within the data. These points are essential to examine further, and I will do so in the next section of Chapter 4, which focuses on data integration and the presentation of meta-inferences. In this section, I will provide an in-depth analysis of the data, considering the ways in which these points of divergence, convergence, congruity, and incongruity contribute to a more nuanced understanding of the research topic. By doing so, I hope to shed light on the complexities and nuances of the data and the conclusions that can be drawn from it.

Data Integration/Meta-inferences

Meta-inferences are the holy grail of a concurrent triangulation mixed methods dissertation design, representing the ultimate goal of merging qualitative and quantitative strands. These overarching conclusions provide a unified understanding of the study's major themes. Meta-inferences emerge through a laborious process of interpretation, wherein the researcher seeks to create a coherent and cohesive narrative that is both understandable and insightful. The meta-inferences must then be conveyed clearly through narration that adds to the richness and depth of meaning-making. Overlaying both qualitative and quantitative data through

a narrative display illuminates the integrated conclusions and creates a more comprehensive understanding of the studied phenomenon. A mixed methods study can result in a richer, deeper, and more connected understanding of the research topic, where meta-inferences emerge to expand and deepen researchers' knowledge of the underlying phenomenon. In all, there are five dominant meta-inferences to be presented for this study, as described below.

Learner Dispositions vs. Learning Conditions

Consider the free throw. A basketball player stands on a designated spot in relative proximity to the basket. There are no defenders present. Rather, would-be defenders are reduced to mere spectators. Whereas an offensive player normally has 24 seconds to shoot the ball, on the foul line, time is suspended. The conditions dramatically favor the offensive player. In fact, they favor the offensive player by such a substantial margin that the value of making a foul shot is worth only half what it would be under normal playing condition. And yet, irrespective of how optimal the conditions, offensive players are still liable to miss a free throw. Conditions can only take a player so far. One's ability to learn from a mistake at any given time is reliant upon numerous factors, both internal and external. Teachers, family, and broader societal factors can conspire to facilitate learning, but it is ultimately dependent upon the individual to make a choice that learning is their sought-after outcome. There are certain dispositions that will encourage students to pursue learning following a mistake, rather than be deterred by it. These *learning dispositions* make it more likely that the learner will choose to pursue learning. In the student survey and focus group, students emphasized incidental and environmental factors influencing their learning experience rather than the personal dispositions that support learning from mistakes. They recognized the need to take ownership of their learning, but viewed it as a more

indirect variable, demonstrating a preference for guidance rather than assuming full responsibility for their learning process. As one student commented,

> We're only middle schoolers. We're still learning how to be responsible. I feel like people always tell us to take ownership for our learning, but they kind of forget that it's their job to create the kind of classroom where I actually learn how to take ownership. I'm not saying I don't have a role to play, just that I'm still learning and my teachers are adults, and it's their job to teach me, not expect it of me.

In contrast, teacher interviews highlighted the importance of creating a desirable learning. environment, while also emphasizing students' personal dispositions that support learning, such as reassessment practices, opportunities for reflection, and iterative goal-setting: "I can open the door, but it's my students' job to choose to walk through it."

This difference between student and teacher perspectives suggests that there is a hidden curriculum or set of skills that teachers can explicitly emphasize to support successful learning outcomes. Based on the findings, teachers must focus on a curriculum that explicitly prepares students with the necessary dispositions to pursue active learning. This includes emphasizing the importance of goal-setting, reflection, and iterative learning, and encouraging students to take greater ownership of and responsibility for their learning.

Learning from a mistake is a recursive, action-oriented process (DeBrincat, 2015). It cannot be developed and honed so long as it remains a theoretical construct—it requires practice. The frequency and extent to which a learner can practice and, in turn, bring their learning to life is predicated on the value that the adults in their life assign to it. This means that variables like the home and school environment influence whether conditions permit a student to learn from

their mistakes, or whether mistakes are perceived as something to either eradicate or prevent in the first place.

Students have little control over their environment. So long as this research is centered on K–12 learners, their agency is largely dependent upon what the adults in their life will allow them. This finding is further clarified by comparing student survey responses to teacher interviews. While survey results indicate that students do not consider reassessment (mean value ($\bar{x}$) of the Likert scale is 3.17) or reflection (mean value ($\bar{x}$) of the Likert scale is 3.14) opportunities as crucial factors in their willingness and ability to make and learn from mistakes in the classroom, all six teacher interviews highlighted the importance of providing these opportunities.

Study participants viewed learning conditions as being most central to whether a learner would have the opportunity to refine and grow their ability to learn from their mistakes. It was their collective perspective that the learning environment determines whether learner dispositions are operational or will remain dormant and untapped. Since all participants were classroom educators, this shared belief could speak to some measure of controllability bias.

Ultimately, while environmental factors and instructional practices are important for learning outcomes, the personal dispositions students adopt are crucial for successful learning. Hence, it is essential that both teachers and students recognize the importance of developing these dispositions and attributes, which can be achieved by creating a supportive learning environment and an explicit curriculum that encourages and enables students to engage actively in their learning process.

All Learning is Relational

The findings of the surveys, interviews, and focus groups demonstrate that the process of learning is inherently relational, built upon a foundation of dynamic and multifaceted interactions, and reveal that learning from mistakes is deeply rooted in relationships that foster mutual respect, trust, and transparency. This consensus between students and teachers underlines the importance of fostering constructive student-teacher relationships and reasserts the widely accepted, if somewhat cliché, notion that student-teacher relationships are a cornerstone of successful learning engagements: “Having strong relationships with my teachers really makes a difference. When they understand me and care about my success, it’s way easier to take risks and try new things, even if it means making mistakes.”

This research has revealed that the process of learning is fundamentally relational, built on dynamic and multifaceted interactions. This underscores the critical role of constructive student-teacher relationships and reinforces the widely accepted notion that learning from mistakes is deeply rooted in relationships that foster mutual respect, trust, and transparency. As a result, the art of teaching is a complex and multifaceted process that is deeply rooted in such relationships, which are built on qualities like approachability, equanimity, and curiosity.

Both students and teachers recognize the importance of these qualities in fostering strong and positive student-teacher relationships. For example, students appreciate teachers who are approachable and friendly, creating a supportive environment that enables them to ask questions or seek assistance easily. Similarly, teachers place value on patience, active listening, and taking a genuine interest in their students’ lives. As one teacher said, “Do my students know that I care about them? That’s a question I ask myself every day because when [my students] feel valued

and understood, they're more likely to take risks, learn from mistakes, and strive for their personal best."

Through this shared understanding, it becomes clear that a culture of excellence is about more than the teacher's instructional prowess. Students recognize that teachers who are enthusiastic, celebratory, and focused on progress rather than grades can inspire curiosity, engagement, and motivation towards learning. When teachers cultivate enthusiasm and promote student progression, it creates a win-win scenario for both parties.

Therefore, effective learning requires educators to foster strong and positive relationships based on respect, transparency, trust, approachability, consistency, diversity, and inclusivity. These relationships promote a safe, inclusive, and effective learning environment where students feel heard, valued, supported, and motivated to achieve their goals. The teacher's dispositional, attitudinal, and behavioral toolkit—which includes their approachability, equanimity, and curiosity—is an essential component of building and maintaining these relationships. These relationships are the cornerstone of successful learning engagements.

The Latent Power of Mistake Repair

The study's findings indicate that there exists a noteworthy interrelation between mistake repair and the learner empowerment cycle. Further analysis revealed that the learner empowerment cycle is a robust predictor of mistake-learning efficacy. This suggests that goal-setting and reflection, as reported by students, play a subordinate yet pivotal role in improving their ability to learn from their errors. However, student responses in the focus group and survey revealed some contradictory findings. Specifically, when students were explicitly asked on the survey and in the focus group about the importance of reflection and goal-setting in the classroom, they rated it as being comparatively unimportant. In contrast, teachers acknowledged

the role of reflection and goal-setting in facilitating students' learning from their mistakes. The divergence between the beliefs of teachers and students, and the data pertaining to middle-grade students' views on reflection is intriguing. Hence, the discrepancy between students' beliefs and the study's findings lacks a single explanation. Researchers suggest that several reasons, such as limited reflective capacity and inclination, may contribute to this gap.

One significant reason for limited reflective capacity is that reflective skills require practice and guidance, which students may lack. Middle grades students are only on the precipice of possessing the reflective capacity to think about thinking. Due to being in this particular stage of their cognitive development, they do not have the exposure or repetition they would need to consciously correlate time and reflection with successful and desirable outcomes. Students may also struggle to express their thoughts or feelings meaningfully due to unfamiliarity with the language and expectations of reflection. Another explanation is that students' motivation or interests may not align with reflective practices. Suppose students prioritize grades over learning. In that case, they may perceive reflection as a fruitless chore unrelated to their academic performance or personal growth. Additionally, some students may view reflection as challenging their beliefs, thereby exposing them to discomfort or uncertainty, which they may resist. Other students could feel vulnerable or lack confidence and fear being judged or criticized upon reflection.

Another potential explanation for this gap is that reflection may not be valued, supported, or rewarded by students' peers, parents, teachers, or society. Students may see reflecting as a sign of weakness, further impeding their engagement in the process. The limitations elucidated above may contribute to middle grade students' limited reflective capacity or inclination, leading to a gap between their beliefs and latent data.

Nevertheless, researchers have contended that reflection represents a crucial element in learning and development. It promotes the development of crucial attributes, including self-awareness, criticality, creativity, and responsibility. Therefore, it behooves students and schools to initiate strategies aimed at enhancing reflective attitudes and skills, promoting personal growth and academic performance, which is precisely what one teacher suggested:

> At our school, we're constantly stressing the importance of reflection and goal-setting. Although, students often resist the process at first—it really can be like pulling teeth—once they set their goals and revisit their progress, they seem to see the value in it. Many of them are amazed by their own growth. However, it's almost like a fleeting vapor; when it's time for the next reflection session, they groan as if they've forgotten its impact. Nevertheless, I don't deviate from what I know is working. I guess I persist.

Why Peer Influence Trumps Identity in Learning From Mistakes

This study revealed that both students and teachers agreed that a student's gender, ethnicity, or cultural background does not inherently affect their ability or willingness to learn from their mistakes. Instead, they suggested that the social dynamics that emerge in the classroom are more predictive of students' behavior.

For middle grades learners, the process of learning from mistakes can be particularly challenging, as they are still in the midst of an ongoing identity formation process. In terms of social identity, middle grades students are on the cusp of branching out beyond their family unit and beginning to form close associations with other groups. In the absence of these meaningful social connections, they tend to rely on the more visible, external aspects of their day-to-day life to help establish a sense of self. Thus, due to the many hours spent in school, middle grades students tend to form a significant part of their identity around their schooling experience.

Middle grades students' identities are still fresh, vital, and in the throes of fully forming, like a chrysalis taking shape. Consequently, the process of learning from mistakes for these learners involves not only recognizing that they were incorrect but negotiating what meaning that may have for their identity moving forward. The challenge for these students is to learn from the mistake and not allow it to become a fixed part of their self-concept or self-image. Exposure to others in their social and educational environments can have a significant impact on the shaping of their identities, whether it leads to a shift in identity, reinforcement of current identity, or creation of a new one altogether. It is essential to acknowledge that middle grades learners' identity formation is an ongoing process, and the intra-grade or class social dynamics that exist can be a significant factor in influencing their emerging identities.

The concept of social dynamics encompasses various factors including group dynamics, prejudices, social hierarchies, and interpersonal relationships. These contextual aspects can shape the way students interact with one another and influence their capacity to take risks and admit their faults. The social context in which students exist within a classroom, such as group dynamics, prejudices, social hierarchies, and interpersonal relationships, shapes and dictates individual student's actions, risk-taking preferences, and academic priorities.

During the formative years of middle school, learning from mistakes is an essential part of growth and development. However, the ability to admit and learn from one's mistakes is not solely dependent on individual traits and personal motivation. Peer influence can play a significant role in shaping middle-schoolers' attitudes towards mistakes and their willingness to learn from them. Peers are a crucial aspect of adolescent socialization, and their influence extends to academic performance and learning. Students who have a close-knit group of friends are more likely to feel comfortable admitting their mistakes and seeking help to rectify them.

Conversely, those who lack such a support system may feel ashamed and avoid admitting their mistakes, leading to a reluctance to learn from them (Walton, 2011). Moreover, this study has highlighted the impact of social status and familiarity on students' attitudes towards making mistakes. Students with higher social status and more extensive social networks may feel more comfortable admitting their errors without fear of damaging their reputation or relationships with peers. In contrast, those with lower social status may feel a more significant impact on their social relationships, leading them to avoid admitting mistakes altogether. To promote a positive learning environment that fosters open communication and encourages students to learn from their mistakes, it is essential to recognize the influence of peers and create a supportive atmosphere that ensures all students feel safe and supported.

Interestingly, my research has further unveiled how the grade level a student is in can play a significant role in shaping social dynamics, affecting their willingness to learn from mistakes. For example, in grade five, where students are still new to middle school, they may not feel the same pressure to get everything right and may, therefore, feel comfortable making mistakes. As one student described it, "I'm trying on a bunch of different hats to see which ones fit." In contrast, in eighth grade, students may become more self-conscious, feel the need to have everything figured out, and may, therefore, hesitate to take risks and admit their errors: "I want to prove to my teachers and my parents that I'm ready for high school."

Overall, this study underscores the importance of creating a supportive classroom environment that fosters positive social dynamics, promotes risk-taking behavior, and encourages learning from mistakes. It also points to the possibility for teachers to offset the error climate of a student's home culture, especially if their home culture is steeped in high power distance. Inferences from this study are not that ethnicity, race, and gender do not matter, but that

teachers are qualified and capable to be attuned to cultural differences between home and school and seek to counteract them in deference to the mission and culture of the school. As one teacher noted,

> [The student] has learning challenges, but his folks, I gather, expect him to make straight A's, and he's just not capable of that yet. So, I think that the lesson he has to learn at school is to work as hard as he can and make improvements . . . He got an A on his last quiz. I said, '[Name], look what you did! Look at your progress!' I think I can neutralize the messaging he gets at home.

By creating such an environment, educators can help students grow and develop and set them on a path to success.

What It Means to Learn From a Mistake

There were several points of congruence and dissonance that became apparent when comparing the definitions informed and later approved by teachers and students. Both the teacher interviews and the student focus groups emphasized the importance of mistake-making in the learning process. In other words, all participants concurred that every mistake made in the pursuit of learning inherently possesses the potentiality for growth and understanding. Participants also concurred that a degree of meta-cognition is crucial in transforming this latent potential into a valuable learning opportunity. As student participants noted, "Learning from a mistake is a process that involves reflecting on the situation [and] recognizing what went wrong." This finding suggests that a certain level of self-awareness is needed for someone to learn from their mistakes effectively. Both groups of participants additionally agreed that implementing corrective action is the ideal subsequent step after making a mistake, with the student's active involvement being crucial for the learning opportunity to effectively lead to

changes in behavior, strategy, or knowledge. However, there were also clear distinctions between the two definitions.

It became clear that the teacher interviews adopted a more comprehensive and technical perspective on the topic of learning from mistakes. They specifically defined the concept as a recurring cycle and emphasized the importance of shortening the time between making an error and taking corrective action:

> At its core, it is a mindset defined by a student's wiliness to engage in a recursive cycle of recognizing and understanding their mistakes, taking corrective action, and adapting and assimilating newly acquired knowledge for future application. A student's engagement with this cycle can be demonstrated by reducing the time gap between committing an error and taking corrective action, or the growing diversity of problem-solving strategies in their toolkit.

This definition underscores the significance of the learning process rather than concentrating solely on the ultimate resolution.

Conversely, the student focus group's definition accentuated the emotional dimension of learning from mistakes, encompassing key elements of motivation and engagement:

> Personal proclivities and passions can influence how someone learns from their mistakes. For example, if a student lacks motivation in a particular class or is not engaged by a certain teacher, they may not be inclined to invest in the learning process and derive valuable lessons from their mistakes, and that "aha" moment won't matter and may go unrecognized.

This perspective underscores potential individual obstacles to effective learning for students, while the teacher interviews maintained a more abstract and theoretical approach.

Although both definitions attempted to highlight the crucial process of learning from mistakes, they offered different perspectives. The teacher interviews focused on the technical details and strategies for achieving a mindset that is conducive to effective learning. Meanwhile, the student focus group emphasized the personal and emotional aspects of learning from mistakes.

Summary

Chapter 4 presented the findings and meta-inferences of the mixed methods study. Quantitative and qualitative data collected, presented, merged, and analyzed suggests that the conditions, dispositions, and socio-cultural factors that activate or dissuade students from being willing to make mistakes and subsequently learn from them are intricate and varied, with multiple points of convergence and divergence in the data. Participants agreed that learning from a mistake is an action that occurs within context. It is the result of an interplay between the individual, their learning environment, and their societal and social setting. It is also an exchange between a range of proximal and distal variables, both within and outside of the individual's control. In this way, participants concluded that learning from a mistake does not look like any one thing, but can look like many things, depending upon these multitude of variables and as informed by their own unique experiences and biases. Ultimately, to effectively learn from mistakes, both students and teachers need to extricate themselves from unproductive patterns and instead concentrate on adopting the actionable strategies and growth-oriented strategies articulated in this chapter.

As I move forward into Chapter 5, I will explore the implications of these findings and their significance for educational theory and practice. Specifically, I will consider ways in which

educators can leverage these insights to enhance the conditions, dispositions, and socio-cultural factors that promote learning from mistakes. I will also examine how these insights can inform larger conversations about the nature of learning, the role of schools, and the broader social and cultural contexts in which learning occurs.

Chapter 5: Conclusions, Implications, and Recommendations

This chapter is designed to thoroughly examine the key discoveries from my research, interpret the results, and derive conclusions based on these findings. In doing so, it connects the outcomes of the study to both the research questions and the existing knowledge base, thereby demonstrating how this study builds upon and situates itself within the framework of existing research into the topic. Specifically, the research focuses on the broader suite of dispositions and conditions that contribute to middle grades students being willing to make and learn from their mistakes, offering valuable insight into the conclusions that deepen our understanding and emphasizing the significance and implications of the study within broader academic and practical spheres.

To achieve this, the chapter will present an executive summary of the study, followed by an in-depth discussion of the results in the context of the research question(s) and existing literature. Additionally, it will highlight the theoretical and practical implications arising from the research findings and explore potential avenues for future research. The chapter will conclude with a summary that encapsulates the study's key insights and their overall contribution to the field.

Quantitative Research Questions

RQ1: Is there a significant relationship among the components of Mistake Literacy for middle grade students?

RQ2: To what extent are statistical differences in Mistake Literacy components mediated by the contextual conditions of middle grades students?

RQ3: Is there a significant relationship between Mistake Literacy components and Mistake-Learning Efficacy for middle grades students?

RQ4: What are the components of a classroom environment on middle grades students' willingness to make and learn from their mistakes?

Qualitative Research Questions

RQ1: How do students describe the socio-cultural conditions, classroom conditions, and strategies that influence their ability to learn from mistakes?

RQ2: How do educators describe the socio-cultural conditions, classroom conditions, and strategies that influence their students' ability to learn from mistakes?

In Chapter 4 of this study, six research questions were answered by presenting meta-inferences that identified points of harmony and divergence between quantitative and qualitative findings, as well as between middle grades students and their teachers. The results revealed that both technical and emotional factors were vital in learning from mistakes, emphasizing the need for teachers to allocate time for student self-reflection and for students to earnestly and proactively engage in that process, planning and taking corrective action accordingly. These findings further highlighted the significance of learner dispositions, learning conditions, constructive student-teacher relationships, mistake repair, and social dynamics in achieving desired learning outcomes. Success depended on both teachers' commitment to fostering optimal learning conditions and individual students' choices to engage in learning within that environment. Positive student-teacher relationships founded on mutual respect, trust, and transparency were identified as essential for harmonizing conditions and character. The study also highlighted the impact of social dynamics and peer interactions on students' attitudes towards learning from mistakes, amplifying, and underscoring the importance of cultivating a supportive classroom environment that promotes positive interactions and encourages learning, irrespective of cultural background.

In essence, this study sheds light on the previously obscured and incomplete understanding of why and how students learn from some mistakes and disregard others. Likewise, these findings reveal the directional vectors for future research, as naturally occurs when we probe middle grades students' motivational, dispositional, and cultural constructs.

Conclusions

This section offers a detailed summary of the key findings from the study, including a statement about each of the research questions and how the data answered and addressed it.

Is there a significant relationship among the components of Mistake Literacy for middle grades students?

To understand whether the different parts of Mistake Literacy are related, I ran a series of tests called correlations. I looked at how Growth Mindset, Mistake Repair, and Learner empowerment cycle are connected to each other. Among these, I found a strong, meaningful, and positive relationship between Mistake Repair and learner empowerment cycle. Mistake Repair is the process of systematically planning to take action by reflecting on what went wrong and setting goals to bridge the gap between one's present understanding and the correct understanding. The learner empowerment cycle is a repeating set of connected attitudes that include making choices, being motivated, and actively engaging in learning. This means that when someone gets better at reflecting on, setting goals around, and ultimately pursuing corrective action around their mistakes, there is a related and relevant increase in their motivation to learn from their mistakes, recognizing that doing so exists within their nexus of control.

To what extent are statistical differences in Mistake Literacy components mediated by the contextual conditions of middle grades students (socio-cultural factors and parental involvement)?

To find out if factors like grade level, gender, ethnicity, birth order, and parental involvement have an impact on how well students learn from their mistakes, I conducted a series of tests called ANCOVAs. These tests help me see if there are differences in Mistake Literacy components (like Growth Mindset, Mistake Repair, and Learner empowerment cycle) among different groups, while also considering other important factors. When examining the impact of grade levels on Learner empowerment cycle, which represents how in control students feel of their learning, I discovered that there were differences between various grade levels. Specifically, fifth and seventh graders scored higher in Learner empowerment cycle compared to sixth and eighth graders. This suggests that students in fifth and seventh grades may feel more in control of their learning and are better at making choices, staying motivated, and actively engaging in their education. Additionally, this effect was influenced by the students' perception of the importance of their grade level. This means that the impact of grade level on Learner empowerment cycle wasn't solely determined by the grade itself, but also by how much significance students placed on their current grade level. For example, students who believed that their grade level had a substantial influence on their willingness to take risks in the classroom may have experienced a greater impact on their Learner empowerment cycle scores. This highlights the importance of considering both the actual grade level and students' perception of its importance when examining how grade level affects their learning experiences and sense of control over their education. I also looked at the effects of gender, ethnicity, and birth order on Mistake Literacy components. The survey results did not find any significant effects on Growth

Mindset, Mistake Repair, or Learner empowerment cycle. This means that, in this study, neither gender, ethnicity, or birth order seemed to have a major impact on students' ability to learn from their mistakes and feel in control of their learning. Lastly, when examining parental involvement, I found that students who felt their parents were less involved had higher scores in Learner empowerment cycle. This relationship was significant, meaning it is important to consider parental involvement when looking at students' learning experiences. Parental involvement was measured in a way that higher agreement indicated lower involvement. So, the results showed that the less involved a student perceived their parent to be, the higher their score on Learner empowerment cycle. Because this relationship was significant within the ANCOVA framework, it suggests that parental involvement plays a meaningful role in students' learning experiences and their sense of control over their learning.

Is there a significant relationship between Mistake Literacy components and mistake-repair efficacy for middle grades students?

To answer the question of whether there is a significant connection between Mistake Literacy components and Mistake-Learning Efficacy (a learner's aptitude, motivation, and belief in their ability to learn from mistakes in different situations), I performed a simultaneous multiple regression. This analysis showed that there was a significant relationship between these factors, and the model explained 57% of the differences in students' Mistake-Learning Efficacy. While Growth Mindset and Mistake Repair also play a minimal role, the most significant connection comes from the Learner empowerment cycle. The Learner empowerment cycle—which consists of a series of interrelated dispositions like choice, motivation, and engagement in learning—accounted for the bulk of the relationship, with the relationship between Learner empowerment cycle and Mistake-Learning Efficacy being moderate-to-strong and positive. This

means that as students' Learner empowerment cycle scores increase, their confidence in their own capacity and capability to learn from future mistakes also improves.

What are the components of a classroom environment that have the greatest influence on middle grades students' willingness to make and learn from their mistakes?

To explore which aspects of a classroom environment have the most significant impact on middle school students' willingness to make and learn from their mistakes, I looked at two sets of factors: a teacher's attitude and approach towards mistakes, and the instructional strategies and methods teachers use to create an environment that supports learning from errors. First, I considered how teachers respond to students' mistakes and how they create a safe and supportive classroom atmosphere. I found that the most important factors in this area were: (a) the teacher's kindness, (b) the teacher ensuring that students do not make fun of someone who made a mistake, and (c) the relationship between the teacher and student remaining unchanged after a mistake. These results suggest that a positive and supportive environment is crucial for students to feel comfortable making and learning from mistakes.

Next, I looked at the different teaching strategies and methods that can help foster a classroom environment where students are more willing to make and learn from mistakes. The top-rated strategies included providing regular feedback, making sure that feedback is about the student's learning and not about the student as a person, and allowing collaboration between students. These findings indicate that when teachers use these approaches, students are more likely to feel encouraged to take risks, learn from their errors, and grow in their understanding of the subject matter. The study's results suggest that there are certain components of a classroom environment that can influence a student's willingness to make and learn from mistakes. These findings highlight the crucial role that teachers can play in creating a supportive and

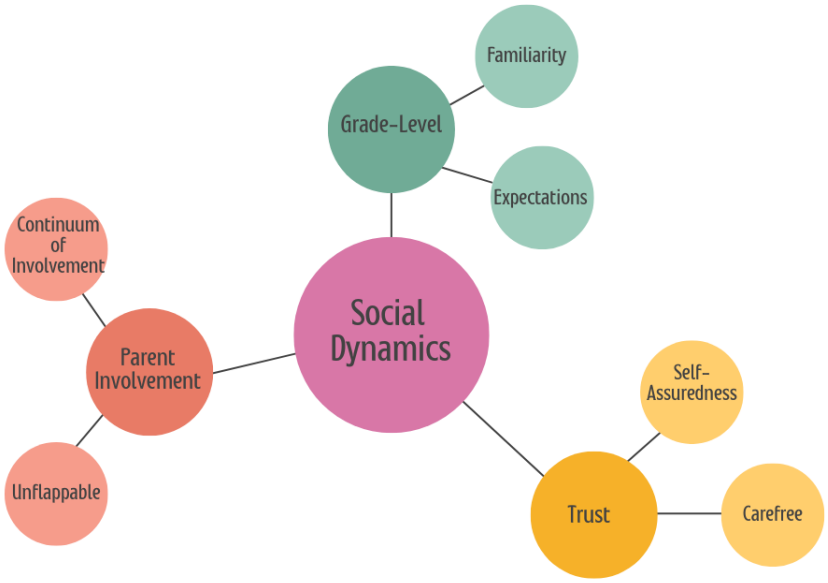
collaborative classroom culture that can ultimately lead to better academic outcomes and confident, capable learners.

How do students describe the socio-cultural conditions, classroom conditions, and strategies that influence their ability to learn from mistakes?

In the focus group conducted among middle-grade students, the influence of socio-cultural factors, instructional strategies, teacher dispositions, and student-initiated strategies on students' ability to learn from their mistakes were examined. From the focus group discussion, it became clear that social dynamics—represented by patterns of behavior within a group influenced by familiarity, trust, and perceived social status—had the greatest impact on students' learning experiences. Trust building, self-assuredness, carefree behavior, and parental involvement were identified as critical factors for creating a positive learning environment (see Figure 1). These factors allow students to engage in academic risks and grow from their mistakes, essential elements in shaping students' academic success.

Figure 1

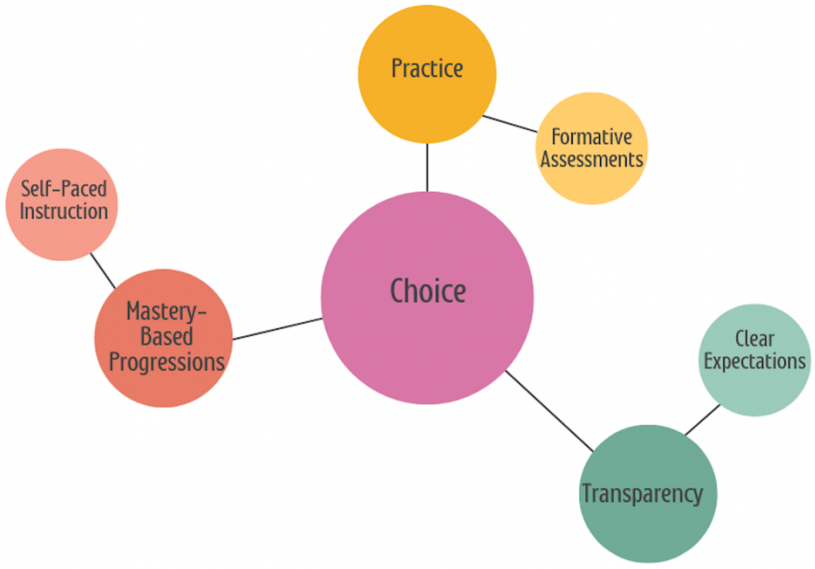
Student Focus Group: Socio-Cultural Factors



Among instructional strategies, allowing students to have a choice in their learning was identified as critical in promoting engagement and motivation (see Figure 2). Providing opportunities for repeated practice, regular formative assessments, transparency, and mastery-based progressions with self-paced instruction were highlighted as important to implement.

Figure 2

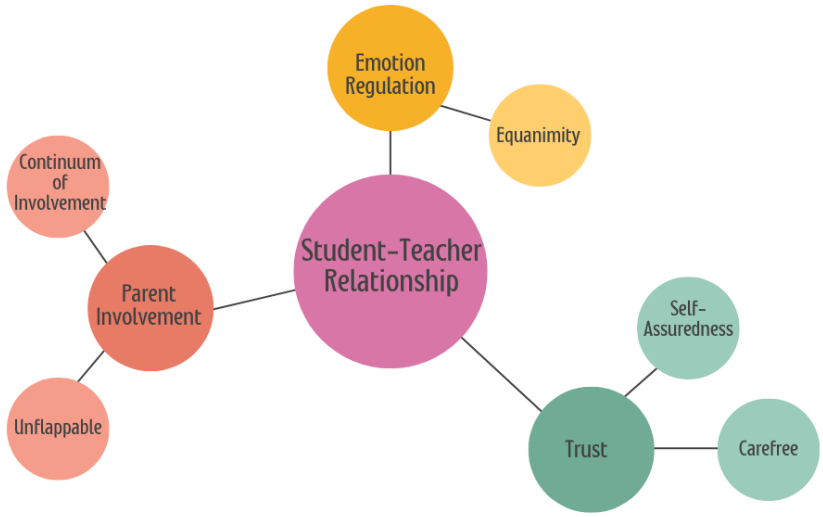
Student Focus Group: Instructional Strategies



Additionally, the importance of student-teacher relationships was emphasized and a positive and respectful connection built on trust, communication, and transparency was found to foster emotional regulation, accountability, and positive classroom dynamics, making students more willing to learn from their mistakes (see Figure 3).

Figure 3

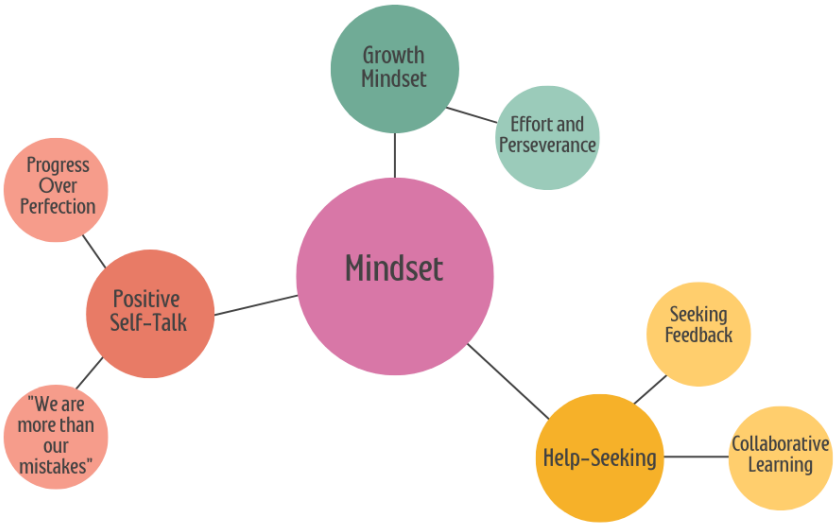
Student Focus Group: Teacher Dispositions and Attitudes



The study also revealed student-initiated strategies that contribute to students' learning experiences (see Figure 4). Mindsets, including growth mindset, that recognize mistakes as opportunities for growth and learning were found to promote a positive attitude toward setbacks or challenges, making it easier to learn from mistakes. Positive self-talk and promoting kindness, patience, and incremental improvements encourage students to recognize that mistakes and setbacks are part of the learning process. Help-seeking strategies including active engagement with critical friends, recognizing when assistance is needed, and knowing how to ask for it, encourage students to focus on the process of learning rather than the outcome, leading to a more positive learning experience.

Figure 4

Student Focus Group: Student-Initiated Strategies

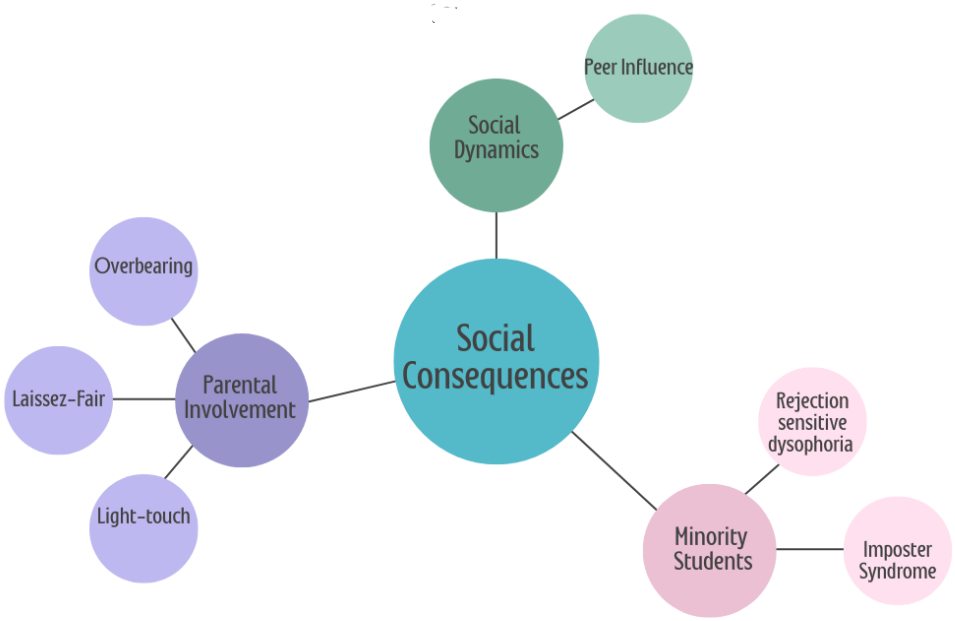


How do educators describe the socio-cultural conditions, classroom conditions, and strategies that influence their students' ability to learn from mistakes?

The research question asks how educators describe the socio-cultural conditions, classroom conditions, and strategies that influence their students' ability to learn from mistakes. Based on the data gathered from interviews with middle school teachers, several themes emerged regarding the factors that influence students' learning experiences, as shown in Figure 5. The first theme is socio-cultural factors, which include social dynamics, minority identity, and parental involvement. Social dynamics refer to the impact that friends and classmates can have on a student's willingness to learn from their mistakes. Minority students in Predominately White Institutions (PWIs) face unique challenges, such as feeling pressure to conform to social norms and maintain the status quo for fear of ridicule or ostracization. Parental involvement is critical, and parents should provide the necessary guidance and support for their child while still allowing them the space to learn and grow from their mistakes.

Figure 5

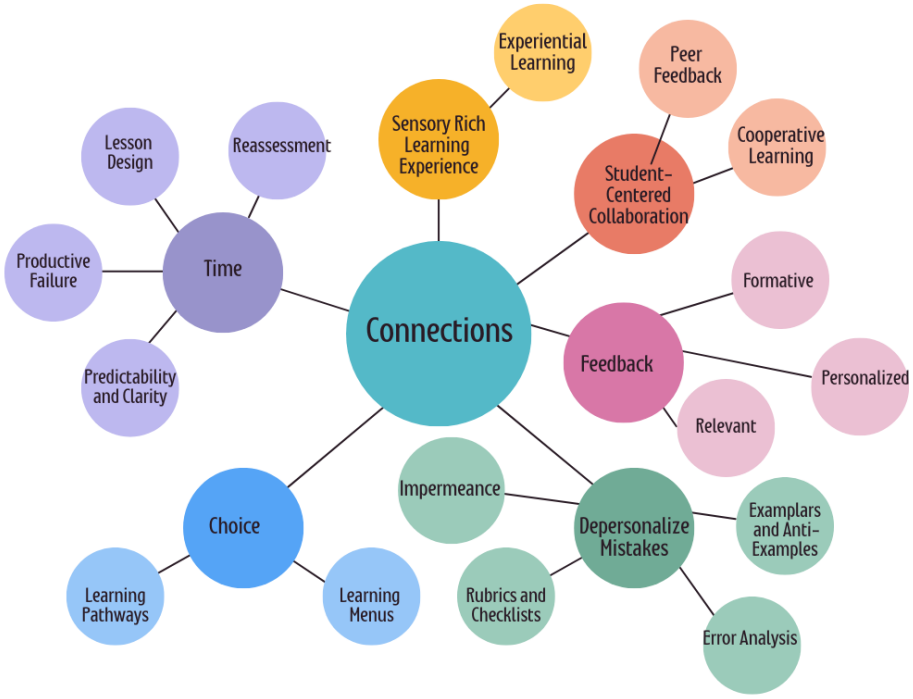
Teacher Interviews: Socio-Cultural Factors



The second theme regarding instructional strategies emerged, and it is grounded in the central axis of Connections. Building relationships, fostering trust, and cultivating a shared sense of purpose and mutual respect create the conditions for teachers to facilitate deep, personal, and meaningful learning experiences that inspire growth and transformation. Teachers recognized the importance of developing positive connections with their students as a foundation for learning. Several categories emerged, including feedback, sensory-rich learning experiences, time, choice, depersonalizing mistakes, and student-centered collaboration (see Figure 6). These instructional strategies effectively promote deep and meaningful learning experiences for students, allowing them to learn from their mistakes.

Figure 6

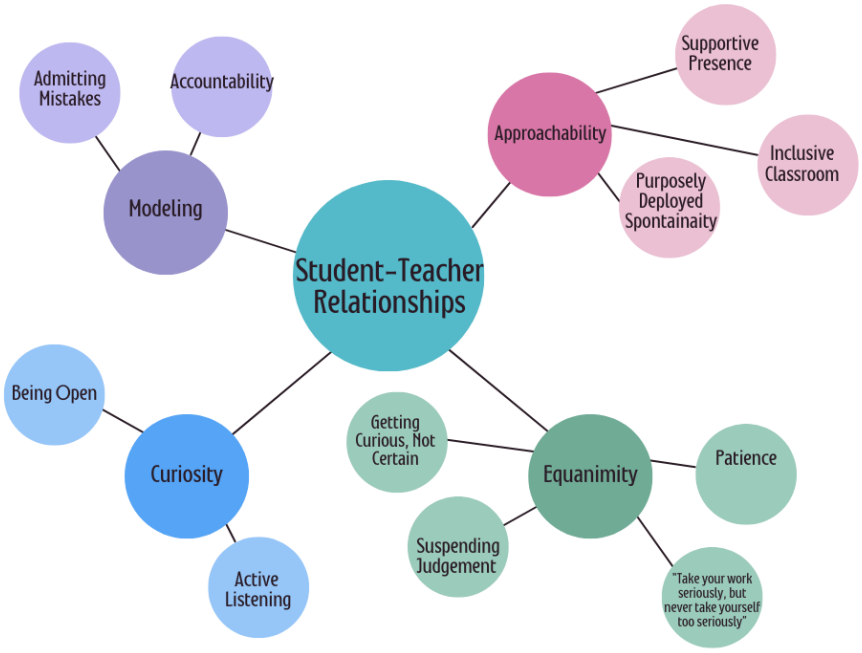
Teacher Interviews: Instructional Strategies



The third theme is teacher dispositions and attitudes towards learning from mistakes in the classroom (see Figure 7). These dispositions and attitudes are essential for creating an environment where student-teacher relationships can thrive. Approachability, equanimity, modeling, curiosity, and suspending judgment are all fundamental for creating a comfortable learning environment that meets students' academic and emotional needs.

Figure 7

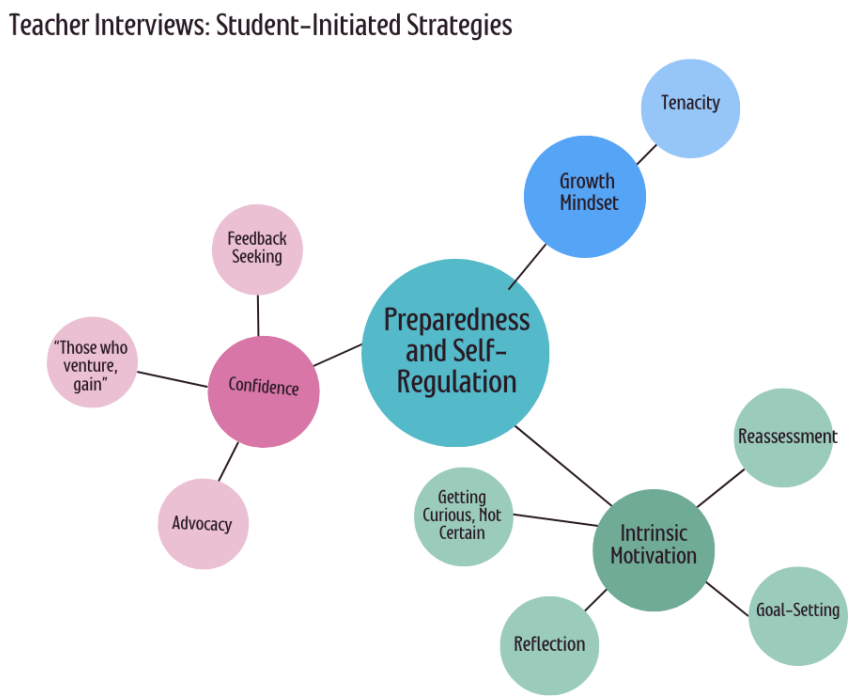
Teacher Interviews: Teacher Dispositions and Attitudes



The fourth and final theme is student-initiated strategies, which include confidence, growth mindset, and intrinsic motivation, as shown in Figure 8. These student-initiated strategies are intertwined with preparedness and self-regulation, which enable students to approach mistakes with composure and respond to mistakes with intentionality. Students who possess preparedness and self-regulation benefit from these strategies by approaching mistakes as opportunities for growth rather than failures.

Figure 8

Teacher Interviews: Student-Initiated Strategies



In conclusion, the data from the interviews revealed that multiple factors influence students' learning experiences. Socio-cultural factors, instructional strategies, teacher dispositions and attitudes, and student-initiated strategies all play critical roles in student learning. Teachers and educators must prioritize building positive relationships with students, providing opportunities for growth, and promoting self-regulation to create an environment where students can learn from their mistakes and develop a growth mindset. By taking these factors into account, educators can create a more effective and inclusive learning experience for all.

Implications and Recommendations

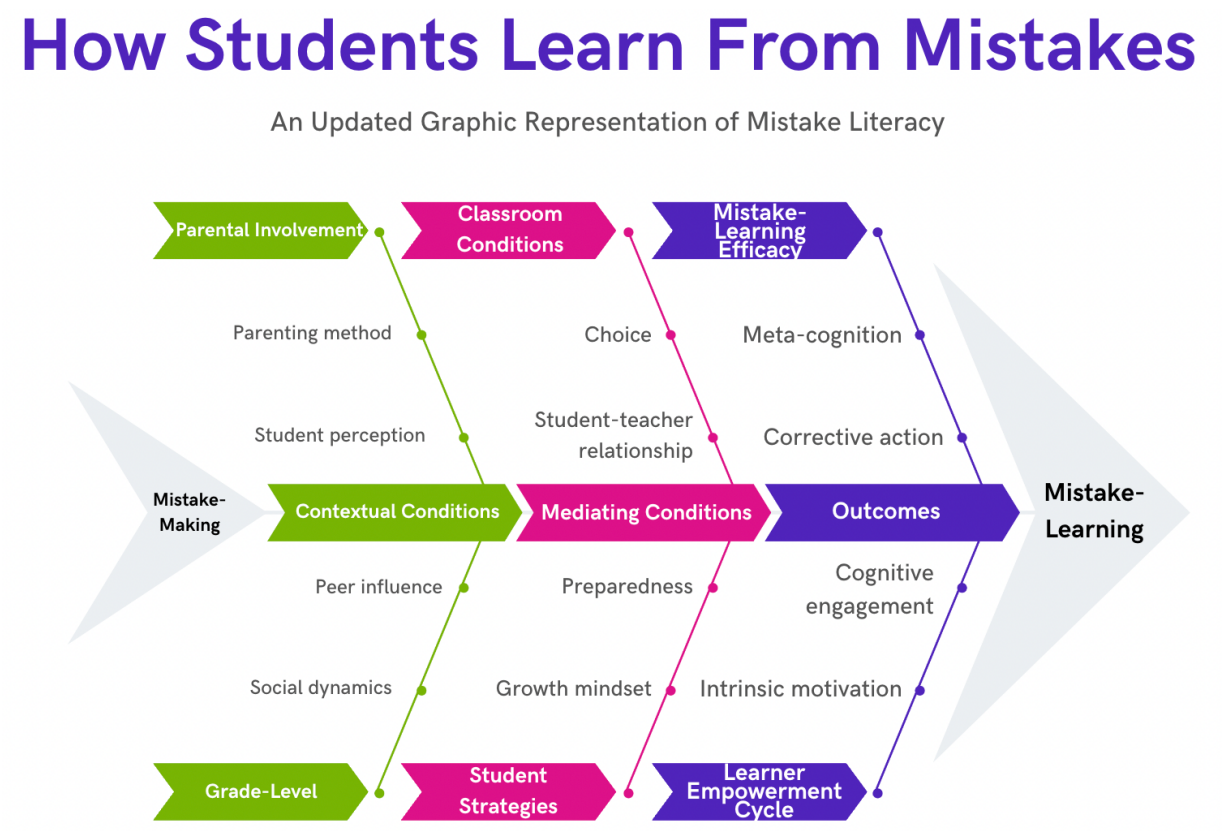
This mixed methods study aimed to extricate the enigmatic factors that either facilitate or hinder middle grades students from consistently and reliably learning from their mistakes in the

classroom. The overall goal in doing so was to corroborate or counter the conceptual framework of Mistake Literacy, thus alerting me to its strengths and flaws.

The following recommendations are based upon the research findings of this study. The recommendations are divided into three sections. The first section addresses the conceptual model of Mistake Literacy in light of my findings. The second section outlines the potential solutions to the original problem statement presented in Chapter 1. The third section outlines future research, including data gathering, piloting, or implementation.

The Conceptual Construct of Mistake Literacy

Figure 1



In examining the evolution of the Mistake Literacy model, it is crucial to compare and contrast the initial provisional conceptual framework (presented in Chapter 1) with the refined

conceptual construct (depicted in Figure 1), which emerged from the mixed methods research study. This comparison enables us to identify the key components that were validated, refuted, or incorporated as a result of data collection and analysis. The study has contributed to a more nuanced understanding of the process by which middle grade students transform mistake-making into mistake-learning. Consequently, the revised and updated model offers a more accurate representation of the factors and stages involved in facilitating this transformation.

The revised conceptual model features notable visual modifications, including the use of three “fish scales” in the Ishikawa Diagram, as opposed to the previous four. These “scales” symbolize the enhancement of learning potential at each stage, as indicated by the progressive increase in text size from the mistake to the resultant learning. The central themes of these scales encompass contextual conditions, mediating conditions, and outcomes. Notably, the intervening conditions and strategies from the initial model have been consolidated into the mediating conditions category, with the defining sub-components radiating from the center.

The decision to merge intervening conditions and strategies stemmed from the data analysis, which highlighted the significant combined role that teachers and classroom conditions play in cultivating an environment that nurtures students’ confidence, comfort, and ability to identify, address, and rectify their mistakes. This consolidation achieves a visual balance between the responsibilities of students and teachers, preventing a hierarchical depiction of importance that was present in the earlier representation.

Points of agreement between the provisional and updated models encompass the fundamental, albeit non-deterministic, influence of contextual conditions, the importance of a growth mindset and student-teacher relationships, and the prominence of the learner empowerment cycle, which enhances mistake-learning efficacy. The recursive nature of the

model is reiterated, as each successful passthrough enhances the probability of a student learning from their subsequent mistake. However, it is important to note that there are no shortcuts in this journey. While familiarity may make the process easier over time, it remains essential for students to follow the prescribed steps, ensuring that the learning experience remains thorough and effective.

Key differences between the models involve the enhanced specificity and clarity regarding socio-cultural factors, with grade-level emerging as the most crucial contextual condition. The updated model also introduces “classroom conditions” as an umbrella term for teacher dispositions, attitudes, and instructional strategies, in response to the challenges participants faced in differentiating between these aspects during interviews and focus groups. Furthermore, “student strategies” now supplant “strategies,” and outcomes emphasize a more specific set of sub-components, such as meta-cognition, corrective action, cognitive engagement, and intrinsic motivation.

In conclusion, the provisional model proved to be a useful starting point for exploration, with many of its elements remaining valid and accurate. Nevertheless, the updated model, informed by the study's findings, offers a more comprehensive, nuanced, and in-depth analysis, establishing a more robust foundation for subsequent research.

Practice

As the Fourth Industrial Revolution unfolds, education must adapt to accommodate the demands of an increasingly technology-driven society. The swift expansion of generative AI and the integration of technology into everyday life necessitate a reevaluation of the conventional classroom. Yet, the rapid rate of technological advancements has consistently posed challenges for districts, schools, teachers, and students to stay current. In order to bridge this gap and furnish

students with the skills required to navigate the contemporary world, schools must deliver an education that aligns with the realities of how students live and work in the 21st century.

Just as the shifting demands of the Technological Revolution of the late-19th and early-20th century laid the foundation for the current model of schooling, today's Fourth Industrial Revolution is transforming the sociocultural context in which learning occurs (Senge et al., 2011; Tyack & Tobin, 2013). Considering the rapid rate of change, it is imperative that students' education is not rooted in regressive, traditional paradigms suited for a bygone era, but rather emphasizes transferable and enduring skills. As Murray (2019) articulates, individuals must develop the ability to "pivot and flourish." Consequently, it is essential for students to acquire the crucial skill of learning from their mistakes. This is why it is essential for students to learn how to learn from their mistakes.

In the face of uncertainty, mistake-making is inescapable; therefore, knowing how to learn from mistakes becomes an invaluable and versatile skill, regardless of the future and workplace that even the most imaginative prognostications might suggest. Mistake-learning serves as the linchpin for students' preparedness for the future. However, the challenge lies not in the argument itself, but in establishing a classroom environment where students can develop this crucial skill. Addressing this challenge necessitates the integration of diverse and occasionally conflicting research to offer teachers practical guidance that is adaptable across various classroom contexts. This is precisely the objective that this study aimed to achieve.

This study discovered that learning from mistakes depends on both individual student dispositions and the conditions established by teachers. The classroom environment and the optimal conditions nurtured by educators significantly influence students' ability and motivation to learn from errors. Consequently, these recommendations highlight aspects within a teacher's

control, rather than concentrating on students' capabilities. In essence, since conditions determine whether students can effectively utilize their dispositions, the focus of this section will remain firmly on the teachers. This approach also recognizes the power dynamic between students and teachers, given that teachers are the authority within the classroom space.

To establish a low power-distance classroom environment that fosters learning from mistakes, educators can employ a range of strategies, as mentioned during the interview portion of this study. Although this list is diverse, it is not exhaustive. Some inventive and less conventional approaches worth noting include:

- In science class, one teacher proposed offering continuous and dynamic peer-to-peer formative feedback opportunities through a flexible grouping model.
- In math, a teacher mentioned creating immersive, sensory-driven learning experiences that leave lasting, indelible imprints in students' memories. This provides an easily accessible reference point to help students more easily access past learning by making the retrieval process less cognitively taxing.
- In language arts, a teacher shared how to depersonalize mistakes by utilizing rubrics and checklists with clear, objective criteria. Additionally, this teacher employs a wall of rotating exemplars and anti-examples wall for students to reference, enabling them to easily self-assess their work and acknowledge their mistakes proactively, privately, and of their own volition.
- In social studies, a teacher highlighted the use of whiteboards to help students learn from errors by implicitly spotlighting the ephemeral and impermanent nature of their mistakes.

Future Research

As with any study, the findings may only serve as a stepping stone towards further inquiry. Therefore, while this particular study has shed some light, it just represents a starting point for future research. Because there had not been a pre-existing theory to examine, this study only marks the starting block. The true benefits will be realized through future research into the individual components and holistic framework of Mistake Literacy.

In this section, I propose several avenues to expand upon the study findings, which illuminate the relationship between students' perception of risk-taking and Mistake Literacy in the context of race, gender, and birth order. While some of the relationships observed were not statistically significant, this could be attributed to factors such as sample size or the age of the participants. A larger sample size and a focus on older students who are more cognizant of the potential intersections between race, gender, and birth order might reveal more about how these factors impact risk-taking and, by extension, Mistake Literacy. This study also inadvertently uncovered potential equity issues when White male students in the focus group appeared less anxious and were more willing to answer questions, suggesting that further investigation into the influence of race and gender on risk-taking and Mistake Literacy is warranted.

Another area of interest lies in the role of growth mindset in Mistake Literacy. In the organization where the study was conducted, the concept of growth mindset is pervasive but not well understood by students. Examining the relationship between growth mindset and Mistake Literacy in a setting where the concept is more deeply ingrained and well-taught could provide valuable insights into how these two factors interact and contribute to student learning.

A longitudinal study that introduces Mistake Literacy in a controlled manner and measures pre- and post-intervention outcomes against a control group would also provide

valuable data on the efficacy of Mistake Literacy in enhancing learning. This would help determine whether the adoption of Mistake Literacy strategies leads to improved learning outcomes for students.

Lastly, this study was conducted at a Predominantly White Institution (PWI), which raises questions about the participants' awareness of the factors that may be holding them back and whether White cisgender students are conscious of any inherent advantages they might have. Notably, White cis male students in the focus group did not perceive any relationship between their race and gender and their willingness to take risks and make mistakes. This discrepancy between their perception and behavior suggests there is room for future research exploring how race and gender might influence students' risk-taking and Mistake Literacy in more diverse settings. Overall, these proposed research directions aim to enhance our understanding of the complex interplay between race, gender, birth order, and Mistake Literacy, ultimately contributing to more effective and equitable educational practices.

Summary

This study set out to test the innovative conceptual framework of Mistake Literacy, employing a multifaceted approach involving a survey, interviews, and focus groups to validate the framework's design and effectiveness. Along the way, the data collection process revealed insights that extended beyond the original scope and intent of the study, highlighting the critical role that mistakes play in the learning process for both students and teachers.

Throughout the study, it became evident that participants recognized the importance of learning from mistakes and acknowledged their essential role in the learning process. Students and teachers alike demonstrated a strong focus on transforming their mistakes into learning

opportunities, actively making choices around when, how, and whether to pursue learning after making a mistake. Participants were able to express the emotional impact of mistakes, discussing the potential for both devastation and reward when learning from them. This topic proved to be meaningful, impactful, and relevant to the lives of the participants both inside and outside the classroom.

The participants exhibited a genuine curiosity about the study's findings, hoping that the results would provide valuable insights into how they could become better learners and more effective in their responses to mistakes. Many people likely desire to learn and grow from their mistakes rather than burying them away in the recesses of their memories. However, the conditions surrounding students sometimes demand and dictate the opposite.

As a result, it is the responsibility of teachers, as the guiding adults and architects of students' learning experiences, to operationalize the findings of this study. By doing so, they can cultivate the optimal conditions for students to recognize, react to, and repair their mistakes through the deliberate implementation of the strategies and dispositions outlined in the Mistake Literacy framework. The validation of the Mistake Literacy framework in this study marks an important step forward, with future research needed to delve deeper into the specific components and intricacies that constitute it. In conclusion, the study underscores the profound significance of embracing mistakes as valuable learning opportunities, ultimately empowering students to become more resilient, adaptive, and effective learners.

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Appendix A: Coercion Mitigation Plan

To ensure that teachers and students do not feel pressured to participate in the research, due to the researcher's position of authority at the research site, the Coercion Mitigation Plan outlines the steps being taken to minimize the possibility or coercion or undue influence.

1) All consent forms will explicitly guarantee that the research is optional.
2) All consent forms will explicitly guarantee that participants can withdraw at any time.
3) All consent forms will explicitly guarantee that not participating in the research will in no way affect either teacher employment, parental involvement with their child, or a child's education or treatment.

Appendix B: Mistake Literacy Survey

Welcome and **thank you** for participating!

This survey is part of a study for Mr. Cohen's dissertation. His dissertation is about exploring the things that influence students' ability to risk failure, make a mistake, and then learn from their mistakes in the classroom. Importantly, this study is only concerned with your experiences here at school. In other words, Mr. Cohen wants to know about your mistakes and your learning in the classroom in the Francis Parker Middle School, not that one time when you touched a hot stove and learned never to do it again. Additionally, when you respond to these questions, please only respond based on your experience. Don't speak for anyone but yourself.

You will also notice that ALL of these questions focus on your "willingness to risk failure" and "learn from your mistakes" in the classroom. These are both big ideas, so let's define them so that we're all on the same page.

Willingness to risk failure = You try something even if you don't know what the end result will be. An example of this is you raising your hand to answer a question, even if you're not sure that it's correct.

Learn from your mistakes = You understand what you did wrong, know how to fix it, and attempt to fix it. An example of this is when you get feedback on an essay, and you revise it based on the feedback you received.

When you approach this survey, I ask that you do so with sincerity and seriousness. I also ask that you approach this survey with confidence. Even though these survey questions are rooted in research, I am studying YOUR experience, which means YOU are the expert! Trust yourself; trust your experience; and, please provide honest responses.

Section 1: Tell me about yourself

These questions will be about your willingness to take risks and learn from your mistakes in the classroom. Specifically, these questions will focus on your parents/guardians, your race, gender, ethnicity, and birth order.

Directions: Read each item and select your answer

What grade-level are you in?

- ◯ 5th Grade
- ◯ 6th Grade
- ◯ 7th Grade
- ◯ 8th Grade

How do you describe yourself?

- ◯ Male
- ◯ Female
- ◯ Non- binary
- ◯ Prefer to self-describe:

What is your race/ethnicity?

- ◯ Black/African-American
- ◯ White/Caucasian
- ◯ Asian-American/Pacific Islander
- ◯ Hispanic/Latinx
- ◯ Multiracial/Biracial
- ◯ Other

What best describes your birth order?

- ◯ I am the oldest child
- ◯ I am a middle child
- ◯ I am the youngest sibling
- ◯ I am an only child

How involved are your parents/guardians in your life?

- ◯ Not at all involved
- ◯ Slightly involved
- ◯ Pretty Involved
- ◯ Very involved

How involved are your parents/guardians in your learning?

For example, helping you with homework, attending parent-teacher conferences, checking your progress reports.

- ◯ Not at all involved
- ◯ Slightly involved
- ◯ Pretty Involved
- ◯ Very involved

How involved are your parents/guardians in supporting your learning at home?

- ◯ Not at all involved
- ◯ Slightly involved
- ◯ Pretty Involved
- ◯ Very involved

When you make a mistake at home, how do your parents/guardians respond most of the time?

- ◯ They fix it themselves
- ◯ They tell me what to do to fix it
- ◯ They help me figure out how to fix it
- ◯ They let me figure out how to fix it

To what extent do your parents/guardians influence your willingness to take risks in the classroom?

- ◯ Not at all influential
- ◯ Kind of influential
- ◯ Pretty influential
- ◯ Very influential

Based on your experience, how has your gender identity influenced your willingness to take risks in the classroom?

For example, if you are male, how does being male influence your willingness to take risk in the classroom?

- ◯ Not at all influential
- ◯ Kind of influential
- ◯ Pretty influential
- ◯ Very influential

Based on your experience, how has your race/ethnicity influenced your willingness to take risks in the classroom?

For example, if you identified as white/Caucasian, how does being white/Caucasian influence your willingness to take risk in the classroom?

- ◯ Not at all influential
- ◯ Kind of influential
- ◯ Pretty influential
- ◯ Very influential

Based on your experience, how has your grade-level influenced your willingness to take risks in the classroom?

For example, if you're in the 8th grade, how does being an 8th grader influence your willingness to take risk in the classroom?

- ◯ Not at all influential
- ◯ Kind of influential
- ◯ Pretty influential
- ◯ Very influential

Based on your experience, how has your birth order influenced your willingness to take risks in the classroom?

For example, if you are the oldest sibling, how does being the oldest sibling influence your willingness to take risk in the classroom?

- ◯ Not at all influential
- ◯ Kind of influential
- ◯ Pretty influential
- ◯ Very influential

Section 2: Tell me about your teachers

This set of questions will ask you to think about your willingness to take risks and learn from your mistakes in the classroom. These questions will be about your teachers.

Directions: Read each item and select your answer

Think about a class where you are comfortable taking risks and feel most capable learning from your mistakes. In the space below, please write the name of the class or name of the teacher that you are thinking about.

In classes where you are most willing to take a risk and learn from your mistakes, please rate how influential the following factors are in creating that classroom environment:

	Not at all influential	Kind of influential	Pretty influential	Very influential
When I make a mistake in this class, **my teacher is patient**	○	○	○	○
When I make a mistake in this class, **my teacher is kind**	○	○	○	○
When I make a mistake in this class, **my teacher responds with humor**	○	○	○	○
When I make a mistake in this class, **my teacher remains calm**	○	○	○	○
When I make a mistake in this class, **my teacher tells me about mistakes that they have made**	○	○	○	○

When I make a mistake in this class, **my teacher does not allow other students to make fun of me**	○	○	○	○
When I make a mistake in this class, **my teacher does not call me out in front of the entire class**	○	○	○	○
When I make a mistake in this class, **my teacher is curious about where I went wrong**	○	○	○	○
When I make a mistake in this class, **it does not change my relationship with this teacher**	○	○	○	○

In classes where you are most willing to take a risk and learn from your mistakes, please rate how influential the following factors are in creating that classroom environment:

	Not at all influential	Kind of influential	Pretty influential	Very influential
My teacher lets me try my own approach before telling me the solution	○	○	○	○
My teacher lets me retake assessments until I demonstrate an understanding of the topic	○	○	○	○

	Not at all influential	Kind of influential	Pretty influential	Very influential
My teacher cares about what I want to learn about	○	○	○	○
My teacher makes sure that I am appropriately challenged	○	○	○	○
My teacher provides me with feedback on a regular basis	○	○	○	○
The feedback my teacher provides is about my learning, not about me	○	○	○	○
My teacher lets me collaborate with my classmates	○	○	○	○
My teacher is more concerned with my learning than with my grades	○	○	○	○
My teacher gives me the time I need to reflect on my learning	○	○	○	○

Section 3: Tell me what you believe (Part I)

This set of questions will ask you to think about your willingness to take risks and learn from your mistakes in the classroom. These questions will be about you.

Directions: Read each item and select your answer

I have a certain amount of intelligence, and I can't really do much to change it

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

My intelligence is something that I can't change

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

I can learn new things, but I can't really change my basic intelligence.

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

When I make a mistake in class, I see it as a learning opportunity

- ◯ Untrue of what I believe

- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

When I make a mistake in class, I am motivated to work on it

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

When I make a mistake in class, I believe it's important to take time to reflect on what I can learn from it

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

When I make a mistake in class, I believe it's important to set a goal around how to learn from it

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

Section 4: Tell me what you believe (Part II)

This set of questions will ask you to think about your willingness to take risks and learn from your mistakes in the classroom. These questions will also be about you.

Directions: Read each item and select your answer

When I make a mistake in class, I know that I am capable of learning from it

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

When I make a mistake in class, I know I can ask others for help

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

As a student, I know that I am more than the mistakes I make in class

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

I am confident in my ability to learn from the mistakes I make in class

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

Even when it is tough, I know that I can still learn from the mistakes I make in class

- ◯ Untrue of what I believe

- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

Even when it is tough, I know that I can still learn from the mistakes I make in class

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

I know that I am responsible for the mistakes I make in class

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

I know that I am responsible for learning from the mistakes I make in class

- ◯ Untrue of what I believe
- ◯ Kind of true of what I believe
- ◯ Pretty true of what I believe
- ◯ True of what I believe

Appendix C: Parent Consent Form

1/23/2023

Good Morning, Middle School Parents/Guardians -

I am contacting you today in my role as a doctoral candidate at Drexel University. I am conducting a study on how students learn from their mistakes. I am asking for your consent for your child to participate in this research study.

The purpose of this study is to test the novel conceptual framework of Mistake Literacy, which seeks to understand the factors that influence a student's ability to learn from their mistakes. Your child's participation in this study is voluntary. Your willingness or refusal for your child to participate in the study will have no bearing on current or future interactions we may have in my role as Middle School Director.

If you consent, your child will take a digital survey that will last for about 30 minutes. The survey will be administered in person during What I Need (WIN) on Wednesday, February 8, 2023. Following the survey, your child will be invited to participate in a focus group conducted virtually on another date outside of school hours, the date of which will be discussed with participants' parents/guardians.

The survey contains 46 questions, each of which relates to your child's experience making and learning from mistakes at school. These questions will provide insight into your child's thinking, individual experiences, and perceptions about the topic.

To provide consent for your child to participate, please read, sign, and return the attached consent form. Only students whose parents/guardians have signed and returned the consent form will be permitted to complete the survey. You can return the signed consent form by scanning and emailing it to zcohen@francisparkerlouisville.org. Or you can print the form and return it to me in person.

If you have any questions, please do not hesitate to contact me.

Best regards,

Zachary Cohen
Doctoral Student
Drexel University School of Education
(502) 909-6795

You are being asked to consent to your child to take part in a research study. This document provides a concise summary of this research. It describes the key information that we believe most people need to decide whether to take part in this research. Later sections of this document will provide all relevant details.

Title of research study: Learning by Mistake: A Mixed Methods Approach to Constructing the Conceptual Framework of Mistake Literacy

Researcher: Zachary Cohen

What should I know about this research?

- Someone will explain this research to you.
- Taking part in this research is voluntary. Whether your child takes part is up to you.
- If your child doesn't take part, it won't be held against you or your child.
- If your child doesn't take part, it will not affect your involvement with the school or your child's education or treatment.
- Your child can take part now and later drop out, and it won't be held against you or your child.
- If you don't understand, ask questions.
- Ask all the questions you want before you decide.

Why is this research being done?
The purpose of this mixed methods case study is to test the novel conceptual framework of Mistake Literacy, which seeks to articulate and individuate the proximal and distal variables that influence students' ability and inclination to reliably convert their mistakes into learning in the classroom. Mistake Literacy aims to demystify and simplify the opaque alchemy of how learning can become a promised byproduct of mistake-making. Your child is being invited to take part in a research study. Your child's participation will deepen the researcher's understanding of his proposed dissertation topic through the lens of a quantitative survey and qualitative focus group.

What happens to me if I agree for my child to take part in this research?
If you agree for your child to participate in this study, your child will complete a single online survey. The duration of the survey will last roughly 30 minutes and will take place in person during study hall on (add time/date). Survey responses will be recorded using Qualtrics; and this data will be used to complete this research study.

Following the survey, your child will be invited to participate in a roughly 60-minute semi-structured focus group conducted virtually on another date outside of school hours at (add time/date). The focus group will be recorded using two devices and transcribed verbatim; and this data will be used to complete this research study

Could being in this research hurt my child?
There are no known risks to participating in this study.

Will being in this research benefit my child?
Beyond the study benefitting from you sharing your experience and perceptions, there are no known benefits to others from your participation in this research.

Will it cost me money to take part in this research?
There will be no cost associated with your participation in this research.

What other choices do I have besides taking part in this research?
You may decide not to take part in the research, and it will not be held against you.

What happens to the information collected for this research?
Your private information will only be shared with the researcher and Drexel University that conduct or watch over this research, including:

- The research sponsor: Dr. Mary Jean Tecce DeCarlo, Drexel University, School of Education
- The Institutional Review Board (IRB) that reviewed this research
- Drexel University and its affiliates

We may publish the results of this research. However, we will de-identify any personal information during data analysis and reporting, and keep any identifying information confidential.

We protect your information from disclosure to others to the extent required by law.
Data collected in this research will be de-identified and used for future research or distributed to another investigator for future research without your consent.

Who can answer my questions about this research?
If you have questions, concerns, or complaints, or think this research has hurt you or made you sick, talk to the research team at the phone number listed above on the first page.

This research is being overseen by an Institutional Review Board ("IRB"). An IRB is a group of people who perform independent review of research studies. You may talk to them at (267) 359-2471 or HRPP@drexel.edu if:

- You have questions, concerns, or complaints that are not being answered by the research team.
- You are not getting answers from the research team.
- You cannot reach the research team.
- You want to talk to someone else about the research.
- You have questions about your rights as a research subject.

Can I be removed from this research without my approval?
The person in charge of this research can remove you from this research without your approval. Possible reasons for removal include:

- ***It is in your best interest***

We will tell you about any new information that may affect your health, welfare, or choice to stay in this research.

What happens if I agree to be in this research, but I change my mind later?
You may decide not to take part in the research, and it will not be held against you. If you decide to leave this research, contact the researcher so that he can recruit a replacement for you.

Will I be paid for taking part in this research?
You will not be paid for taking part in this research.

Statement of Consent:
All children are required to assent.
If assent is obtained, have the person obtaining assent document assent on the consent form.

Your signature documents your permission for the individual named below to take part in this research.

Printed Name and Signature of adult subject capable of consent, child subject's parent, or individual authorized under state or local law to consent to the child subject's general medical care	Date
Printed name of subject (not required if subject personally provided consent)	Date
Signature of second parent (Required unless this subject is an adult, the second parent is deceased, unknown, incompetent, or not reasonably available, or the parent providing consent has sole legal responsibility for the care and custody of the child)	Date
Printed Name and Signature of person obtaining consent	Date

I have explained the study to the extent compatible with the subject's capability, and the subject has agreed to be in the study.

Printed Name and Signature of subject	Date

Appendix D: Assent Form

I'm Mr. Cohen. I am completing my doctoral research at Drexel University. You are being asked to take part in my research study. Your parents know we are talking about this study. This document will tell you about my study to help you decide whether or not to participate in it.

What is this study about?
This study is about learning from mistakes in the classroom. Mr. Cohen wants to know about the things that influence your ability to learn from your mistakes

What are you being asked to do?
If you decide to be in this study, you will be asked to complete a survey. The survey is 46-questions long. You will be complete the survey during a study hall period on (date/time). All of the questions on the survey relate to how you learn from your mistakes in the classroom. After you complete the survey, you will be invited to participate in a focus group. A focus group is basically a small-group discussion that Mr. Cohen will lead. All of the questions during the focus group will also relate to how you learn from mistakes in the classroom. The focus group will take place virtually outside of school hours. You do not have to participate in the focus group. In fact, you can participate in the survey and not participate in the focus group.

Do I have to be in this research?
Taking part in this research is voluntary. The choice is yours. If you do not take part, it will not be held against you. It will not affect our relationship or your education. You can change your mind anytime if you decide you do not want to be in this study anymore.

Can anything bad happen if I am in this research?
No. There are no risks to being in this study.

Who can answer my questions about this research?
If you have questions or concerns, you can ask me or you can ask your parents. I can be reached at zc368@drexel.edu. This research is being overseen by an Institutional Review Board ("IRB"). An IRB is a group of people who perform independent review of research studies. You may talk to them at (267) 359-2471 or HRPP@drexel.edu, if you have questions about your rights in the study.

What does my signature on this consent form mean?

- You understand the information provided
- You have been able to ask the researcher questions and state any concerns
- The researcher has answered your questions and concerns
- You believe you understand the research study and the potential benefits and risks that are involved

If you want to be in this study, sign and print your name below:

Sign Your Name	Date

Print Your Name	Date

Statement of Person Obtaining Assent

I have carefully explained to the child taking part in the study what he or she can expect.
I certify that, to the best of my knowledge, the child understands the purpose, procedures, potential risks and benefits of the study and his or her rights as a participant.
I also certify that the child:
Speaks the language used to explain the research
Reads well enough to understand this form or, if not, this child is able to hear and understand when the form is read
Does not have any problems that could make it hard to understand what it means to take part in this research.

Signature of Person Obtaining Assent	Date

Appendix E: Focus Group Protocol

Project:

Time of Interview:

Date:

Place:

Interviewer:

Participant:

[**Prompt for Interviewer**]

Open session by reminding focus group participants:

- Purpose of the study
- Potential length of the interview
- What data are being collected
- Remind participants that all information is confidential and no real names will be included in the study

[**Turn on recording device – test**]

Questions:

1) Tell me about a time when you made a mistake and then learned from it.
    a. What evidence convinced you that you had learned from the mistake?
2) Tell me about a time when you made a mistake and did not learn from it
    a. How did you know that you didn't really learn form that mistake?
3) Do you think that your gender identity impacts your willingness and ability to learn from mistakes?
    a. Do you think that your race or ethnicity impacts your willingness and ability to learn from a mistake?

4) Think about your parents/guardians: do you think that they influence your willingness and ability to learn from mistakes?
5) Think about all of your classes: what are the things that your teachers do that influence your willingness and ability to learn from mistakes?
6) Think about yourself as a student: what are the things that you can do in the classroom to influence your own willingness and ability to learn from mistakes?
7) In your own words, and as based on your experiences, what does it mean to learn from a mistake?

Appendix F: Teacher Consent Form

1/23/2023

Good Morning, MS Faculty -

I am contacting you today in my role as a doctoral candidate at Drexel University. In partial fulfillment of the requirements for a Doctor of Education degree, I am conducting my doctoral

research on how students learn from their mistakes. You are being provided this letter and being contacted to possibly be a participant in this research study.

The purpose of this study is to test the concept of "Mistake Literacy," which aims to understand the factors that influence a student's ability to learn from their mistakes. Your inclusion in this study can help to clarify students' lived experiences by answering the research question: how do educators describe the conditions and strategies that influence their students' ability to learn from mistakes?

Participation in the study is voluntary. Your willingness or refusal to participate in the study will have no bearing on current or future interactions we may have in my role as Middle School Director.

If you agree, you will participate in a single interview that will last for roughly 60 minutes. The interview will be conducted virtually at a mutually agreed upon time that takes place outside of school hours and off school grounds.

To consent to participate, please read, sign, and return the attached consent form. You can return the signed consent form by scanning and emailing it to zcohen@francisparkerlouisville.org. Or you can print the form and return it to me in person.

If you have any questions, please do not hesitate to contact me. Thank you for your time. I look forward to your response.

Best regards,

Zachary Cohen
Doctoral Student
Drexel University School of Education
(502) 909-6795

You are being asked for your consent to take part in a research study. This document provides a concise summary of this research. It describes the key information that we believe most people need to decide whether to take part in this research. Later sections of this document will provide all relevant details.

Title of research study: Learning by Mistake: A Mixed Methods Approach to Constructing the Conceptual Framework of Mistake Literacy

Researcher: Zachary Cohen

What should I know about this research?

- Someone will explain this research to you.
- Taking part in this research is voluntary. Whether you take part is up to you.
- If you don’t take part, it won’t be held against you.

- If you do not take part, it will not affect your employment.
- You can take part now and later drop out, and it won't be held against you.
- If you don't understand, ask questions.
- Ask all the questions you want before you decide.

Why is this research being done?
The purpose of this mixed methods case study is to test the novel conceptual framework of Mistake Literacy, which seeks to articulate and individuate the proximal and distal variables that influence students' ability and inclination to reliably convert their mistakes into learning. Mistake Literacy aims to demystify and simplify the opaque alchemy of how learning can become a promised byproduct of mistake-making. You are invited to take part in a research study. Your participation will deepen the researcher's understanding of his/her proposed dissertation topic through the lens of qualitative interviewing.

What happens to me if I agree to take part in this research?
If you agree to participate in this study, you will participate in a roughly 60-minute semi-structured interview conducted virtually. If you do not take part, it will not affect your employment. The interview will be scheduled for a mutually agreed upon time that takes place outside of school hours. Interviews will be recorded using two devices and transcribed verbatim; and this data will be used to complete this research study.

Could being in this research hurt me?
There are no known risks to participating in this study.

Will being in this research benefit me?
Beyond the study benefitting from you sharing your experience and perceptions, there are no known benefits to others from your participation in this research.

Will it cost me money to take part in this research?
There will be no cost associated with your participation in this research.

What other choices do I have besides taking part in this research?
You may decide not to take part in the research, and it will not be held against you.

What happens to the information collected for this research?
Your private information will only be shared with the researcher and Drexel University that conduct or watch over this research, including:

- The research sponsor: Dr. Mary Jean Tecce DeCarlo, Drexel University, School of Education
- The Institutional Review Board (IRB) that reviewed this research
- Drexel University and its affiliates

We may publish the results of this research. However, we will de-identify any personal information during data analysis and reporting, and keep any identifying information confidential.

We protect your information from disclosure to others to the extent required by law.
Data collected in this research will be de-identified and used for future research or distributed to another investigator for future research without your consent.

Who can answer my questions about this research?
If you have questions, concerns, or complaints, or think this research has hurt you or made you sick, talk to the research team at the phone number listed above on the first page.
This research is being overseen by an Institutional Review Board ("IRB"). An IRB is a group of people who perform independent review of research studies. You may talk to them at (267) 359-2471 or HRPP@drexel.edu if:

- You have questions, concerns, or complaints that are not being answered by the research team.
- You are not getting answers from the research team.
- You cannot reach the research team.
- You want to talk to someone else about the research.
- You have questions about your rights as a research subject.

Can I be removed from this research without my approval?
The person in charge of this research can remove you from this research without your approval. Possible reasons for removal include:

- ***It is in your best interest***
- ***You are unable to keep your scheduled appointments***

We will tell you about any new information that may affect your health, welfare, or choice to stay in this research.

What happens if I agree to be in this research, but I change my mind later?
You may decide not to take part in the research, and it will not be held against you. If you decide to leave this research, contact the researcher so that he can recruit a replacement for you.

Will I be paid for taking part in this research?
You will not be paid for taking part in this research.

Statement of Consent:

Your signature documents your permission for you to take part in this research.

Printed Name and Signature	Date

Printed Name and Signature of person obtaining consent	Date

Appendix G: Interview Protocol

Project:

Time of Interview:

Date:

Place:

Interviewer:

Participant:

[**Prompt for Interviewer**]

Open session by reminding the interviewee:

- Purpose of the study
- Potential length of the interview
- What data are being collected
- Remind interviewee that all information is confidential and no real names will be included in the study

[**Turn on recording device – test**]

Questions:

1) Tell me about a time when a student of yours made a mistake and then learned from it.
    a. What evidence convinced you that the student learned from the mistake?

2) Tell me about a time when a student of yours made a mistake and did not learn from it

    a. How did you surmise that the student did not learn from the mistake?

3) In your experience do socio-cultural variables impact the ways students approach learning from mistakes? For example, have you seen any gender differences?

    a. Have you noticed any differences in the way students from different racial and/or ethnic backgrounds approach learning from mistakes?

    b. Have you noticed any differences in the way students in different grade-levels in the middle school approach learning from mistakes?

4) Have you noticed factors within your control in the classroom that seem to influence students' willingness and ability to learn from mistakes?
5) Have you noticed factors within students' control in the classroom that seem to influence their willingness and ability to learn from mistakes?
6) In your own words, and as based on your classroom experience, what does it mean for a student to learn from their mistakes?

Appendix H: Survey Alignment Table

RQ	Variables	Survey Items	Analysis

RQ1: Is there a significant relationship among the components of Mistake Literacy for middle grades students?	**V1:** Growth Mindset **V2:** Mistake Repair **V3:** Learner empowerment cycle	Question 21-23 24-25 26-27	Pearson's Point-Moment Coefficient
RQ2: To what extent are statistical differences in Mistake Literacy components mediated by the contextual conditions of middle grades students?	**IV1:** Grade-Level **IV2:** Gender Identity **IV3:** Race/ethnic identity **IV4:** Birth order **IV5:** Parental involvement **DV1:** Growth mindset **DV2:** Mistake-repair **DV3:** Learner empowerment cycle	3, 12 4, 13 5, 14 6, 15 7-11 21-23 24-25 26-27	ANCOVA
RQ3: Is there a significant relationship between Mistake Literacy components and mistake-repair efficacy for middle grades students?	**IV1:** Mistake Literacy components **DV1:** Mistake-repair efficacy	21-27 29-35	Simultaneous multiple regression
RQ4: What are the components of a classroom environment that have the greatest influence on middle grades students' willingness to make and learn from their mistakes?	Classroom conditions (e.g., teacher dispositions and instructional strategies)	18a-i; 19a-i	Descriptive statistics (e.g., mean, median, mode, SD)