Understanding COVID-19 pandemic related effects on secondary mathematics teachers' perception of their professional identity

by

Denis W. Sheeran

B.A., Trinity International University, 1999
M.Ed., Northeastern Illinois University, 2004

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF EDUCATION

Department of Curriculum and Instruction
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Abstract

In March, 2020 the Covid-19 pandemic resulted in nationwide school closures and a sudden, unexpected transition to remote teaching and learning for teachers and students across the US. These changes permeated the teaching experience during the 2020-21 school year. Educators in different areas of the country returned either to fully virtual learning environments, various versions of a hybrid school model and, in some cases, fully in-person schooling. In New Jersey, school districts were given the freedom to design virtual or hybrid teaching and learning environments for the 2020-21 school year, deciding on which modality and structure would best fit their community. The purpose of this study is to investigate how secondary mathematics teachers feel about their experiences as teachers in a virtual or hybrid classroom during the Covid-19 pandemic and to explore the effects of the pandemic on the meaning and manifestation of their ongoing professional identity. This study is guided by the theoretical framework principles of phenomenology. This qualitative interpretive phenomenological study was used to describe an event or phenomenon and the lived experiences of the participants in that event, in this case, the lived experiences of secondary mathematics teachers during the Covid-19 pandemic. Semi-structured interviews were conducted with seven secondary mathematics teachers from New Jersey and interpretive phenomenological analysis was performed. The findings show that despite initial feelings of confusion, uncertainty and inadequacy, participants felt that the experience of teaching remotely through the Covid-19 pandemic improved their teaching and brought to light aspects of their personality, instruction, and capabilities that they would choose to continue to foster, or in some cases, eliminate. Participants ultimately did demonstrate a change to their professional identity, pointing toward growth as nurturing teachers, empathetic to student needs, and as practitioners able to acclimate to change and adopt new

methodologies and technologies for teaching. The study informs professional development and leadership within schools to the means whereby teachers navigate sudden or extreme change, and leaves room for further study in other content areas or grade bands.

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Dr. J. Spencer Clark

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Dedication

Covid-19 had such a significant impact on education that I firmly believe we won't know the full extent of it for years to come. To that end, I dedicate this dissertation to the math teachers who struggled to do the right thing for kids and who hoped for better during a time of extreme challenge, anxiety and depression. To the teachers, those I know and those I do not, you are deeply appreciated for your effort, engagement and empathy during the pandemic, and for your ongoing desire to create a generation of people who value math in a post-pandemic world.

Chapter 1 - Introduction

The Covid-19 pandemic resulted in nationwide school closures and a sudden, unexpected transition to remote teaching and learning for teachers and students across the US. Prior to these closures, the typical days for teachers were already stressful, including heavy workloads, administrator and parent expectations, multiple instructional and administrative roles, and other stressors (Freeman, 2013). Those substantial workloads were then complicated with a rapid shift to online education for which many teachers were unprepared. Alongside the lack of preparation for the new instructional format that teachers were forced to embrace, teachers found themselves implementing new work-at-home protocols that disassembled the boundaries between personal and professional life. The nature of this change placed teachers into closer contact and interaction with their significant others and children who were also navigating this sudden shift in their own lives, adding to the stressors that teachers faced in their professional life (Lai & Jin, 2021).

These changes permeated the teaching experience during the 2020-21 school year. Educators in different areas of the country returned either to fully virtual learning environments, various versions of a hybrid school model and, in some cases, fully in-person schooling. The difference between the experience teachers had during the sudden school shutdown in the spring of 2020 and the opening of school in the subsequent fall was the knowledge that an alternative teaching and learning model had become increasingly likely and therefore preparation had guided teacher professional development and planning (Munday, 2021). Specifically, school districts in New Jersey made decisions about which model to employ based on which was the best fit for the needs of their community and students. Depending on the location within the state, school population, and Covid-19 case and transmission rate, schools were able to decide on

and implement a model of their design, (NJ, June 2020) which teachers then carried out, some with extensive training and others with little to no training. In May 2021, New Jersey Governor Phil Murphy rescinded the option for schools to implement a virtual learning environment in Executive Order #175 (NJDOE, June 22), thereby signaling that the return to school in the fall of 2021 would be a full in-person model only, as some would call “a return to normal.” The 2021-22 school year was carried out in this fashion, with little to no remote learning outside of emergency situations, and a school year of “normal instructional practices.” Through all of this, it is valuable to understand how teachers perceived themselves during the experience of shifting from their established routines and practices to remote teaching in the spring of 2020, then to a temporary school model, and finally back to their pre-pandemic structure in the fall of 2021. The purpose of this study is to investigate how secondary mathematics teachers feel about their experiences as teachers in a virtual or hybrid classroom during the Covid-19 pandemic and to explore the effects of the pandemic on the meaning and manifestation of their ongoing professional identity.

Background

Over the past 20 years, a growing body of research has emerged regarding the concept of professional identity and, in particular, professional identity as it pertains to educators. Included in this body of research is teacher professional identity and, more specifically, the development of identity in preservice education and the early stages of the teacher career. Beijaard et al., (2004) reviewed much of the literature on the development of professional identity within the field of teaching and teacher education at the time and, following the review, studies on the interrelationship between the major components of professional identity began to add to the field of knowledge. It is of value to discuss the implications of those studies and further developments

in teacher professional identity within two major categories; exploring and understanding teacher professional identity, and exploring and understanding the changes to teacher identity when shifting from a face to face (f2f) learning environment to either a blended or virtual learning environment.

The phrase, “I am a teacher” has always had an emotional and personal association with the person speaking it. To be a teacher has been described as a noble profession, a calling, and many would say “it’s just who I am.” For teachers, personal identity has been difficult to disaggregate from professional identity. Yet “teacher professional identity, a rich, nuanced appreciation of what it is to ‘be’ a teacher, is critical to understanding the heart of modern schooling. Teachers’ work, encompassing the decisions they make on both a short and long term basis about approaches to such things as curriculum design, pedagogy, and assessment (to name a few), is framed by and constituted through their understanding and positioning of themselves as a product of their professional identity” (Mockler, 2011). Also contributing to teacher identity is the balance between the personal (home and family life), professional (social and policy expectations of what makes a good teacher), and situational (the direct working environment of the teacher) dimensions, the weights of which will contribute to the emergence of different professional identities (Canrinus et al., 2012).

Central to the review by Biejaard and the studies by Mockler and Canrinus were the themes of teacher self-efficacy and relationship satisfaction as major contributors to the professional identity of the teacher, and inquiry-based professional development as a means for re-forming that identity throughout a teacher’s career in authentic metacognitive ways through the development of strategies for reflection and growth. These variables of development and growth of teacher professional identity are supported by research using the Teacher Identity

Measurement Scale (TIMS) in pre-service programs, identifying motivation, self-image, self-efficacy, and task perception as paramount in the development of teacher identity (Hanna et al., 2020).

According to Biejaard's review, "identity formation is a process of practical knowledge-building characterized by an ongoing integration of what is individually and collectively seen as relevant to teaching" (Beijaard et al., 2004). Teachers who have individually chosen to navigate from f2f instruction to a blended learning model, or whose school districts have mandated that course redirection and provided training and support, have undergone a noticeable change in their professional identity. Jonker, Marz, and Voogt (2018) noted that teachers fell into four distinct categories of professional identity during the change process based on whether or not they were willing to accept the change to blended learning or avoid it, and whether they would take an active or passive approach to that change. "The patterns represented four categories: facilitators of student learning, transmitters of knowledge, personal coaches, and communicators. For each category, teachers expressed specific opinions about a teacher's task, showed typical similarities in their daily routines, made use of specific knowledge/skills in order to do their task, and structured the blend in a specific way." Connected also to the idea of these four emerging identities is the concept of how teachers appropriate the virtual learning environment and tools to adapt to their own identities and methodologies. A study by Derboven, Geerts, and De Grooff (2017) showed how teachers repurpose specific, dedicated educational tools into more general communication tools. This finding provides an alternate explanation to the observation that teachers often adopt only a limited set of tools and functionalities in virtual learning environments. Instead, teachers can appropriate any set of educational tools and creatively design instructional materials using them and their component functions. In fact, many

teachers see aspects of the blended and virtual learning tool that may have value for their concept of the blended learning environment, take just that feature of the tool and use it either authentically or creatively to match their desired design of the learning environment. This supports Biejaard's description of identity formation.

Problem Statement

In March 2020, school districts across the United States began to undergo emergency closures due to the pandemic caused by the SARS-CoV-2 coronavirus and its associated disease, Covid-19. At the time of the emergency closures, teachers were asked to make the leap from f2f classroom learning environments to either blended or virtual classrooms without any of the identity development strategies necessary to plan for and effectively implement a shift to this environment. Teacher self-efficacy was undermined, relationship satisfaction was disjointed, personal boundaries were blurred, and the professional and situational dimensions of the teaching career became unclear. Effective modes for understanding how to develop and even manipulate teacher professional identity are necessary to explore, as well as the ways in which components of the structure of teacher professional identity interact with each other. Without research into the formation and development of post-pandemic teacher professional identity, the field of education runs the risk of settling back into prior practices when instead, the pandemic teaching experience can inform improved practices in classrooms as well as a deeper understanding of the individuals who teach students every day. In the current pandemic timeline, there is room to study how teacher professional identities are reformed during a crisis, and this study leaves room for identifying the components of teacher professional identity that remain throughout the process and emerge as consistent even after a return to traditional face to face learning.

Purpose Statement

While research exists concerning identity formation and growth in traditional pre-service and active service teaching environments (Atemnkeng et al., 2020), there is a gap in the literature regarding events like the Covid-19 pandemic that cause unexpected but mandatory identity changes and the effect that those events have on the immediate and long term professional identity of teachers. Supporting our understanding of professional identity is literature regarding the reasons these professionals entered the field, their expectations regarding the profession before entering it and during their service, and the perceptions of others regarding the roles of secondary math teachers (Beswick, 2007; Ngoepe, 2014). Yet there is movement in society, which began even before the Covid-19 pandemic events and closures, for a shift in the instructional approaches, procedures and technologies used in secondary mathematics classrooms (Boaler, 2015). This movement had begun shaking the stability of mathematics teachers' professional identity as well. The Covid-19 pandemic revealed a new gap in the literature that this dissertation hopes to partially fill, which would investigate teacher perceptions of their professional identity and the variables that affect their professional identity most. The purpose of this study is to produce contextual knowledge about the concept of secondary mathematics teachers' professional identity as it relates to the changes made to their educational environments due to the Covid-19 pandemic and to more deeply understand the implications of professional identity transformation for this population.

Research Questions

The central research question is this: How do secondary mathematics teachers perceive their professional identity following the Covid-19 pandemic? The following questions will help guide the qualitative interpretive phenomenological study.

RQ1a: How do teachers describe their teaching experience and professional identity prior to the Covid-19 Pandemic?

RQ1b: How do teachers describe their lived Covid-19 pandemic teaching experience?

RQ1c: How do teachers perceive their current professional identity?

RQ1d: How do teachers describe the change agents most influential to their identity formation?

Methodology Overview

This study will follow a qualitative research approach, specifically within the theoretical framework of phenomenology, which is often the perspective chosen by qualitative researchers (Bogdan & Biklen, 2004). A qualitative interpretive phenomenological study is used when researchers want to describe an event, activity, or phenomenon and the lived experiences of the participants in that event (Creswell & Poth, 2016). In this type of study, a combination of methods including interviews, observations, on-site visits, document analysis, and video or audio recording review is used to help the researcher understand the meaning participants place on their experience of that event while relying on the participants' own perspectives for insight into their motivations. A phenomenological study usually begins without a formed hypothesis but instead uses conducted interviews to form themes supported by a significant data set in order to determine and validate findings.

The data collected in a qualitative study is collected through interview transcripts and recordings, field notes, observations, written responses, available records and documents, and more, and then undergoes analysis, reflection, and further analysis. Unspoken information is also collected through the documentation of expressed feelings and attitudes, facial expressions, settings, and behaviors or other indicators. After collection, the data is coding and themed and

analysis of data begins, followed by further refined collection, coding, theming and analysis (Glaser & Strauss, 1967). As the nature of qualitative research is exploratory, this approach encourages the researcher to be flexible and reactive, able to redirect a line of inquiry for further investigation or end a line of inquiry when it is no longer relevant. (Blumer, 1999). Rather than provide an exact truth, conclusions drawn out of qualitative research are summarized and inferred and help to provide valuable context. And so because of that, qualitative research is typically viewed as exploratory in nature. Qualitative research allows the researcher to get behind the story of the data and the experience, and phenomenological studies in particular focus on the lived experiences of dynamic events in the lives of the participants in the attempt to add more depth and context to the data. Due to the nature of the study, the experiences and analysis are approached with bracketing and epoché so that the personal experiences and potential biases of the researcher do not affect either the questioning or interpretation of the experiences expressed by participants in the study. Bracketing, as described in the methodology section below, plays a significant role in both the literature review and data analysis phases of this study.

Chapter 2 - Literature Review

Introduction

In many states, the title of secondary math teacher is loosely defined as either a teacher of grades 9 through 12 (high school) or as a teacher of grades 5 through 12 (middle school and high school). The US federal government defines secondary education in the United States as “the last seven years of statutory formal education grade 6 (age 11–12) through grade 12” (Sen et al., 2005). In New Jersey, there are two teacher certificates for mathematics. The first is the Mathematics Standard Certificate #1900, which certifies teachers K-12 (NJ, 2022). In most

cases, this certificate is viewed as a secondary teacher certificate, as it is primarily sought by those interested in teaching grades 9-12 and is obtained without requiring specific coursework in K-8 general education instruction and methods. The second certification that specifically endorses mathematics is the Middle School with Subject Matter Specialization: Mathematics Grades 5 – 8 Standard Certificate #1102. This certification is for students who have completed a degree program which focuses on grades K-8 general education but who've also completed extra coursework in mathematics education, but it specifically does not allow for teaching mathematics in grades 9 -12 (NJ, 2022). In most literature searched, a secondary math teacher was defined as one teaching high school mathematics. This review will also define "secondary mathematics teacher" as one engaged in full-time mathematics teaching at the high school level.

School districts construct different schedules, course loads, and responsibilities for secondary math teachers according to school leadership, enrollment, experience and other local factors. In many cases, secondary mathematics teachers instruct multiple courses daily and class period lengths vary according to school district, ranging from 41 minutes per class period (Carteret, 2022) to 60 minutes per class period (Morris Hills, 2021) in traditional schedules where students meet daily, to longer, unique class periods where students meet in a block schedule either fewer days per week or daily but for only one semester per complete course (Long Branch, 2022). During the course of instruction, secondary math teachers have identified and demonstrated distinct beliefs about the mathematics teaching and learning experience. They believe that mathematics is about connecting ideas, sense-making, and fun as well as that students' learning is unpredictable, but that all students have the capacity to learn mathematics. Beliefs about teachers themselves include that the teacher has responsibility to structure classroom behavior and classroom discourse as well as to actively facilitate and guide students'

construction of mathematical knowledge while inducting students into widely accepted ways of thinking and communicating in mathematics (Beswick, 2007). The role of the secondary mathematics teacher therefore includes a juxtaposition and integration of skills related both to the instruction of mathematics to students and the management of non-instructional components of the profession.

Teacher professional identity is a concept that is not directly observable, but is theoretically constructed through individual experience as a learner, pre-service education student, and through the lived experiences of professional teaching (Beijaard et al., 2004; Beijaard et al., 2000; Connelly & Clandinin, 1999). Teaching is considered to be a "caring" profession more frequently than a "status" profession in most educational and psychological research (Hargreaves & Goodson, 1996), being reinforced by studies showing teachers' personal commitment to the profession (Zemblyas, 2003). A recent study that ranked the prestige of teaching, as perceived by teachers, found that an average of only 26% of teachers agreed or strongly agreed that the teaching profession is valued by society (Schleicher, 2019). In contrast, teachers themselves are often outwardly praised for their passion, effort, and care for their students' learning and well-being (Hargreaves, 1998). While those qualities are all part of the teacher's identity, a teacher's professional identity involves a complex and dynamic interwoven tapestry including interpretation, self-evaluation, reinterpretation, and change based on lived experiences. Lasky (2005) defines teacher professional identity as "how teachers define themselves to themselves and to others." The idea of identity, then, refers to the means by which individuals reflexively and emotionally navigate their own influences and responsibilities, differently from the concept of the role of their professional self which was constructed through social and cultural expectations for the nature of that role.

Within the role of secondary math teacher, content knowledge is a significant contributing factor to teacher confidence, perceived ability, and student achievement (Shulman, 1986). Shulman broke down content knowledge into several cooperative categories: content knowledge, curricular knowledge, general pedagogical knowledge, specific pedagogical content knowledge, knowledge of learners, and knowledge of educational contexts and ends. While this work was not specifically focused on mathematics, it laid the groundwork for Sowder who presented two common misconceptions regarding mathematics teaching: that the content knowledge teachers need can be obtained through regular mathematics coursework, and that mathematical knowledge is the only knowledge that a math teacher needs (Phillip et al., 2007). From this, mathematics for teaching, not just knowledge of mathematics content, was described by Ball et al., (2008) as the special kind of knowledge needed to be able to teach mathematics, and included everything a teacher does to support student learning of mathematics. For example, lesson planning, assessment, evaluation, questioning, family contact, etc. all involve the mathematical knowledge for teaching. Both Philip et al., (2007) and Ball et al., (2008) present that there is a tangible difference between knowing mathematics and being able to teach mathematics. In an attempt to determine the connection between content knowledge and pedagogical knowledge in mathematics classrooms, Baumert et al., (2010) investigated whether each makes a unique contribution to student achievement and teacher instruction. Their result determined that pedagogical content knowledge determined the mathematical learning opportunities, but those opportunities were informed by the mathematical content knowledge held by the teacher, and therefore the two were inseparable when measuring contribution to teaching. Math teachers, no matter the approach to teaching, could not make students understand content they did not themselves deeply, profoundly understand (Ma, 1999).

The definition of secondary mathematics teacher by both the individual and society, as well as the beliefs, description, and preparation for that role are all compartments of the individual which, when aggregated, present us with a unit of analysis that allows us to concentrate on the whole rather than on part of the individual and allows focus on becoming and transformation instead of knowing and achievement (Stenthoft & Valero, 2009). “Research into teacher identities is important as a means of furthering understandings of the job of teaching and what it means to be a teacher in different policy and personal contexts at different times” (Day & Kington, 2008). The following review of literature will examine and connect existing knowledge on the development of teacher professional identity with the impacts that systemic change, both intentional and unforeseen, have on the professional identity of secondary mathematics teachers. This will leave an opening to explore how the teachers, themselves, perceive their professional identity after having managed a severe crisis, the Covid-19 Pandemic, within their professional atmosphere but outside of their professional control.

Becoming a Secondary Math Teacher

In the process of understanding the identity formation and transformation of secondary mathematics teachers, we must consider the reasons why individuals choose to become math teachers at all. Studies examining the factors that motivate individuals to become teachers in general have shown that desire to contribute to society, prestige, attraction to the profession, and a preference for teaching over other options are recurring themes (Balyer & Özcan, 2014). Deeper examination of these factors has resulted in motivations for choosing teaching that can be broken into several categories: altruistic, intrinsic, extrinsic, and identification with others including peers and family (Avgousti, 2017). As a profession, teachers help individuals progress in life while helping them understand the world they interact with, which indirectly leads to the

development and fostering of a better society (Akpochafo, 2020). The desire to help children progress in this way and the need to nurture their individual and unique needs are altruistic motivations for becoming a teacher. Teachers may also desire to confront the shortcomings of the educational system from the inside in order to improve the system as a whole. Intrinsic motivations are, in general, most often noted by teachers when discussing reasons for entering the profession (Atemnkeng et al., 2020). Self-fulfillment, realization of personal and professional destiny, sharing a love for the profession and the subject matter, and the opportunity to engage in a profession that allows personal expression of creative talents all contribute to the intrinsic motivating factors (Ngoepe, 2017). Others indicate that interacting with children brings joy and fulfillment on a daily basis in a dynamic and vibrant professional setting (Balyer & Özcan, 2014). Even though the salary for teachers is typically not high until either advanced degrees or significant experience is obtained, there are still numerous extrinsic motivators when considering teaching as a profession. The leading extrinsic factor would be characterized as the terms of employment, which in most cases guarantee more vacation time, amenable daily schedules, shorter work weeks, child rearing opportunities and schedule compatibility, retirement planning and job security (Watt & Richardson, 2012). Teachers are also seen as respected and appreciated in the community as educated individuals (Atemnkeng et al., 2020). Another extrinsic motivation when choosing teaching as a profession is the ease with which one can enter the profession. College admission to teacher preparation programs is less stringent than for other programs and the curriculum and coursework needed to obtain the degree and certification is also seen as less difficult (Baker et al., 2014). In many cases, individuals become teachers because of the importance of the teaching profession to others connected to their lives. Many who become teachers were raised in families where the adults in the home were teachers or other influential

family members were teachers. Or, in some cases, many of the teacher's peers made the decision to become teachers, influencing their own decision making (Julius & Kambeyo, 2020). In other cases the individual may identify with another teacher who was either a positive role model in teaching, or a negative influence as a teacher and thereby a reason for the individual to become a better teacher than they'd experienced (Mutluer & Yüksel, 2019).

The high intellectual requirements required for studying mathematics are even more important for teaching it. Mathematics teachers need to have advanced skills including divergent thinking, the ability to apply research and questioning processes while solving problems, and the ability to use suitable reasoning and make appropriate hypotheses (Picker & Berry, 2000). These factors, in addition to the more exclusive admission requirements for mathematical studies and mathematics teaching, indicate that there may be a unique profile of the secondary mathematics teacher as compared to general education or pre-secondary teachers. For individuals who fit this profile there are still motivations for choosing to teach mathematics which are based on their personal experience as students. Some secondary math teachers have expressed sympathy to students who find learning mathematics difficult and have chosen teaching mathematics in order to relieve that struggle and make learning mathematics accessible. Others may want to change the accepted norms of the mathematics teaching community while some, after having had an experience with one they considered to be a poor math teacher, hope to fill that void with their own excellent math teaching. Specific to secondary mathematics teachers is the report of a love and interest in mathematics itself and the exhilaration in moving from learning mathematics to teaching mathematics (Watt et al., 2007).

Professional Identity Formation

The motivational factors which guide a teacher's decision to become a teacher are closely interrelated with the descriptors of teacher professional identity and could be categorized similarly. The discussion around teacher professional identity in existing literature has pointed toward three areas of interest: the individual, including the teacher's background, biography, and decision making, the interpersonal, which incorporates professional and social relationships and practices, and the cultural, which includes societal and organizational norms and expectations for teachers (Iannaccone et al., 2008; Ligorio & Tateo, 2008). While research exists investigating and connecting the interplay and relationships of the characteristics of teacher professional identity (Canrinus et al., 2010), direct research connecting motivational factors (altruistic, intrinsic, extrinsic, connection to others) to teacher professional identity characteristics is scarce, and is also not the focus of this study, but is nonetheless of interest. When forming and reforming a professional identity, teachers refer to the stories they tell others and themselves about their personal narrative. Connelly and Clandinin (1999) identify that when making sense of what teachers care most deeply about when telling their stories, their narrative connects together their knowledge, context, and professional identity. Professional identities are shaped by the stories teachers tell, and are, in turn, influenced by those stories. The constant cycle of formation and reformation (or evolution) of professional identities are what Connelly and Clandinin (1999) described as "stories to live by."

However, there is also a deep emotional impact on teacher identity. Emotions embody the center of work for most teachers who exemplify caring, concern for students, empathy, and other intangible qualities of good teachers (Zembylas, 2003). Conflict can arise when these intangible qualities are seen as valuable by the teacher, student, and community, but are not measurable, nor are they valued by existing teacher evaluation systems. In NJ, the AchieveNJ teacher evaluation

system (NJ Scoring Guide, June 2022) accounts 85% of a teacher evaluation score to “teacher practice,” which is measured by one of several state-approved evaluation instruments, and the remaining 15% to “student growth objectives,” which are academic improvement goals implemented over the duration of a school year, set by each teacher, and directed toward the measurable improvement of their students in their classes. For secondary mathematics teachers, this system does not include any aspect of the qualities and characteristics described above and results in an evaluation that devalues the components of teacher professional identity that all stakeholders find significant to good teaching. “The notion, embedded in much education policy, that ‘what works’ is ‘what counts’ privileges that which is simple and easy to measure over the more complex and untidy dimensions of this very human enterprise” (Mockler, 2011). This dichotomy of values creates tension in schools and within the personal identities of teachers in those schools. Attending to these tensions can inform narrative inquiry into the lives of teachers (Clandinin et al., 2008) and can also inform identity formation and navigation in the midst of personal or professional change (Avidov-Ungar & Forkosh-Baruch, 2017).

Change in Teacher Professional Identity

The notion that teacher professional identity is constructed and developed through multiple means and experiences (Sardabi et al., 2018) and is reformed through the application of the narrative stories of teachers (Clandinin, 2004) points to the idea that teacher professional identity is inherently malleable and can be changed, either in reaction to experience or intentionally, through personal professional decision making or through institutional directives and training. In each case, the question of how one navigates a change to teacher professional identity, a concept deeply tied to personal identity, becomes paramount but often ignored (Constanti & Gibbs, 2004). For the past two decades, an understanding of educational theories

in mathematics teaching has emerged (Simamora & Saragih, 2019) including an interest in mathematics teacher education programs (Anhalt & Cortez, 2016). For much of the history of teacher education programs, a process-product model was the focus, identifying what teacher actions led to student learning (Freeman, 2013). These positivist conceptions of teacher education supported the view that learning to teach meant mastering the content to be taught (Richards, 2008), as well as mastery of the techniques necessary for teaching (Richards & Farrell, 2005). Beliefs held by teachers prior to entering preparation programs and their personal agency were disregarded in favor of the programmatic information prescribed by experts' theories (Safari & Rashidi, 2015). Yet, in more recent years, a much more constructivist view of the complex nature of teaching and teacher development has emerged which views teachers as "active, thinking decision-makers who make instructional choices by drawing on complex, practically-oriented, personalized, and content-sensitive networks of knowledge, thoughts, and beliefs" (Borg, 2003). Teachers were becoming increasingly seen as able to generate their own theories about teaching as well as implement self-designed strategies which support student learning and achievement.

Teacher professional identity development parallels the constructivist views on teacher development, being described no longer as static once obtained, but complex and dynamic (Trent, 2010), guiding the method whereby teachers engage with their professional responsibilities and job functions. Mockler (2011) explains that teachers' professional identities are also undeniably influenced by the political factors within their lives and social structures. The professional identity of novice teachers, in particular, is often guided mostly by assumptions made about their profession (Hsiao, 2018) and their personal schooling experiences as recalled and connected during teacher training. Yet change to teacher identity can be intended and

executed during teacher training programs. When implementing a critical agenda which included not only the content related components of teaching, but the political, ethical, and emancipatory dimensions of teaching, pre-service teachers were successfully able to turn from their views of professional identity as, initially, an attitude of compliance and service to the school and program and then move to a humanistic conception of teaching where they had a personal voice and professional capacities (Sardabi et al., 2018).

When navigating change in professional identity during times of significant restructuring of educational and governmental policy, it was noted that two distinct discourses, democratic professionalism and managerial professionalism emerged (Sachs, 2001) and impacted teacher professional identity development. The latter points to the implementation of practices typically found in private sector employment as effective management techniques for public sector settings, as well as brings attention to efficient management as a professional problem solving approach. Teachers in this setting are then seen as “professional” by adhering to policies, rules, regulations, and timelines, thereby devaluing instructional and human components of teaching in favor of managerial task completion. The use of a corporate model also changed the nature of school leadership. According to Sachs (2001), “recent restructuring has meant that the principal has moved from the role of senior colleague to one of institutional manager.” Democratic professionalism, on the other hand, emerges from teachers themselves and focuses on collaboration and cooperation between teachers and stakeholders (Sachs, 2016) as well as incorporates those for whom decisions were traditionally made by including students, parents, and other members of the educational community in the alliances formed on behalf of the student and teacher population (Apple, 1996) which also now layer inclusion, responsibility, and advocacy as components of professionalism (Anderson & Cohen, 2018). Independent

professional organizations began to connect the democratic professionalism with training to improve teacher identity formation through collaborative work with teachers intended to strengthen teacher professional voice and policy making involvement (De Clercq, 2013).

Teachers for whom managerial professionalism is either a fit or a construct have typically been categorized as having the entrepreneurial identity, while those for whom democratic professionalism is natural fall into the activist identity (Sachs, 2001). The individual teacher's professional identity has been described as having three subsets, being, doing, and having. The being component describes the concept of the teacher, while the doing component describes the practical actions of the teacher and the having component indicates the professional environment and supports available to the teacher (Avidov-Unger & Forkosh-Baruch, 2017). These three modes of existence are present in both the entrepreneurial and activist professional identity and can shed light on how a teacher engages in professional change and identity reformation (Beijaard et al., 2004). How teachers respond to stimuli and the ensuing changes made to themselves and their environment are guided by these modes of existence and are unique to the individual (Reichenberg, Kleeman, & Sagee, 2013). In the past decade, instructional technology use and the capacity to leverage it for teaching and learning has grown to become commonplace in most classrooms, and as a result, teachers have become expected to use these technologies with various levels of implementation as required by schools or desired by the individual. As a result, professional identity needs to be viewed through a different lens as well, now incorporating the role of innovator and researcher of best practices (Niess, 2015; Tsybulsky & Levin, 2017). And while the “being” mode of existence typically dominates professional identity components of teachers, when technological innovations are involved, the “having” mode and the support of the school institution when “assisting in implementing techno-pedagogical

innovation in the spirit of the digital age is vital in establishing the professional identity of teachers and in perceiving and implementing pedagogical innovation in teacher training" (Avidov-Unger & Forkosh-Baruch, 2017).

The adoption of technology, whether supportive or innovative, is influenced by extrinsic factors like time, materials, and training, as well as by intrinsic factors like teacher beliefs about technology and its instructional value. A teacher's understanding of their own skills and self-efficacy when implementing technology also may influence its adoption. Multiple studies have identified these intrinsic factors as a significant barrier to adoption (Lai & Jin, 2021) even after institutional barriers have been overcome. In most cases, teachers are presented with a technological tool or innovation and either trained on its implementation or, if discovered by the teacher, further independent research and training on its use is conducted. The lens through which these instructional technologies are viewed is the orientation of teacher professional identity regarding their existing understanding of themselves as educators and the new practices implied by the technology. These orientations contribute positively when learner centered role orientation is present, or negatively when teacher centered role orientation is present (Tondeur, et al., 2017). In each case, technology was either presented as required or found and implemented without mandate in a known or controlled timeline. In fact, Lai and Jin (2021) "found that the interaction of different discipline-specific professional identity orientations accounted for a significant proportion of the variation in teachers' technology use for content delivery and for learning enrichment (60%–90%) and found that the broad and learner-focused professional identity orientations were the major determinants of technology use for content delivery and the sole determinants of technology use for learning enrichment and for learning transformation."

Bracketing

This literature review has intentionally focused on the concepts involved in the formation and reformation of teacher professional identity, as well as aspects of the nature of becoming a secondary mathematics teacher and the implications of technology on both teaching and identity. The focus of this study, however, is on how secondary mathematics teachers perceive their own professional identity having accumulated lived experiences before, during, and after the school related closures and changes associated with the Covid-19 pandemic. While research is now beginning to be presented on many topics related to teaching and learning that is associated with the unique lived experiences of teachers during the pandemic, this literature review does not contain that research and this approach is discussed further in the next section.

Placement of Research

Despite the abundance of research on teacher professional identity presented above, including pre-service identity development through in-service guided implementation of technological innovations, there exists a gap in the research regarding how teacher professional identity is affected by unexpected crisis or change. Change to teacher professional identity in tension and conflict (Clandinin et al., 2010), and in the era of school shootings (Wender & DeMille, 2019) are available, but the scale of the crisis and immediate environmental shifts made at the start of March, 2020 and lasting through June, 2022 has not yet been measured. Many teachers have been asked to make changes to their instructional environment, but typically they are not forced to make those changes while their leadership was also unprepared for the change. The perceptions of the current professional identities of secondary mathematics teachers is timely.

Chapter 3 - Methodology

Introduction

The purpose of this study is to produce contextual knowledge about the concept of secondary mathematics teachers' professional identity as it relates to the changes made to educational environments due to the Covid-19 pandemic and to more deeply understand the implications of professional identity transformation for this population. While research exists regarding identity formation in pre-service teachers and identity transformation when teachers intentionally move from face to face classrooms to virtual or hybrid classroom environments, there is a gap in the research regarding how teachers perceive their identity when change to their professional and practical work is made outside their control. This research may be beneficial to the field of education change management and to those interested in leveraging the changes brought about by the Covid-19 pandemic school closures and adjustments for future school system change while considering the human resources effects of that change. The research question is: "How do secondary mathematics teachers perceive their professional identity?" and lies within the exploration of the phenomenological experience of the Covid-19 pandemic. A phenomenological interpretive method will be used to address the research question. This methodology section provides information regarding the settings and participants, the design and data collection methods, the analysis methods, and a researcher positionality statement.

Setting and Participants

Using metrics based on variables including enrollment, standardized test scores and high school graduation rate, US News and World Report has given New Jersey a public school education ranking of #1 in the nation for three consecutive years, 2019-2021 (Zeigler, 2021).

There are 599 public school districts that enroll approximately 1.28 million students and employ approximately 130,000 full-time teachers (NJDOE, 2021).

The goal of this research was to study the professional identity of secondary mathematics teachers (grades 6 - 12) in New Jersey who had experience teaching for at least two consecutive years prior to the 2020-2021 school year. Participants have remained in their position for that school year, and are currently employed as a secondary mathematics teacher. Although it is preferable to be in the same school or district as during their pandemic experience, it is not required. This sampling choice was used to establish a timeline surrounding the Covid-19 event connected to the ongoing development and not the initial formation of teacher professional identity. These descriptors were informed by Creswell and Poth (2018), who suggest that several aspects should be taken into consideration when selecting participants for purposeful sampling: people, actions, events, and processes. Typical qualitative research of this nature has a sample range of 6 - 25 participants (Mason, 2017) which was met by selecting for contact an initial group of seven secondary mathematics teachers via purposeful sampling, from a contact list of 25. The homogeneity technique for purposeful sampling was selected to minimize the variation in the career backgrounds of the participants as well as to narrow the focus to a group of secondary math teachers with similar backgrounds and school settings. I initially contacted 25 potential participants who were selected from secondary math teachers in New Jersey with whom I had a prior relationship in order to build on established rapport and familiarity when gathering interview data (Palinkas et al., 2015). If fewer than six participants had agreed to participate, then a second round of requests would have commenced. However, small sample sizes are common within qualitative research (Creswell & Parker, 2013) and any guidelines for determining the sample size are unnecessary since the nature of the research is exploratory

(Patton, 2002). Since this study received IRB exemption, each person who agreed to the interview was not required to read and sign an informed consent form prior to participating but was promised complete anonymity.

In phenomenology, participant selection is guided by the understanding that the self is constructed through interactions between internal perceptions and the outside world, so the impact of context is critical to consider (Henriques, 2014). Ideally, participants should have similar experiences to share and should be able to create reciprocal understanding through sharing ideas, such as in a focus group setting (Moustakas, 1994). For these reasons, sampling in this study was heavily influenced by the context-specific nature of the research design. Seven participants were selected via purposeful sampling after initial requests were made to participate. Three of the participants identify as female while four identified as male. All of the female participants were teachers in high school, grades 9 - 12. Of the male participants, two were high school teachers and two were middle school teachers, one teaching grade 7 and one grade 8. Further demographics are available in Table 1.

Research Design and Data Collection

This dissertation approached the research using a phenomenological design. While many researchers use ethnographic research or case studies to qualitatively approach the concept of teacher identity and teacher experience, I argue that a phenomenological approach is valid as the Covid-19 pandemic has caused a unique, lived experience for teachers. This research seeks to describe the essence of this phenomenon by exploring it from the perspective of those who have experienced it (Teherani et al., 2015). This research was conducted using the theoretical framework principles of phenomenology. A phenomenological study is used when researchers want to describe an event, activity, or phenomenon and the lived experiences of the participants

in that event. In this type of study a combination of methods including interviews, observations, on-site visits, document analysis, and video or audio recording review can be used to help the researcher understand the meaning participants place on their experience of that event while relying on the participants own perspectives for insight into their motivations. A phenomenological study usually begins without a formed hypothesis but instead uses conducted interviews to form themes supported by a significant data set in order to determine and validate findings.

While the key founders and builders of phenomenology as a movement were Husserl, Heidegger, and Merleau-Ponty, this branched to include Stein, Dreyfus and many others. In 1900/01 Husserl's first phenomenological work was published in two volumes, titled Logical Investigations followed in 1913 by his second work, Ideas. Heidegger, a colleague of Husserl's for a time at Freiburg, published Being and Time in 1927, which was his treatise on phenomenology and which differed significantly from Husserl's despite their work together. Merleau-Ponty published the Phenomenology of Perception in 1945, in which he defines phenomenology as the study of essences, including the essence of perception and of consciousness, labeling perception as the background of experience which guides every conscious action. In these transcendental phenomenological studies, the data collection and meaning making occur at the same time. Phenomenological approaches to research are often much more effective at describing subjective experiences rather than explaining them. The challenge to the researcher is then "To describe things in themselves, to permit what is before one to enter consciousness and be understood in its meanings and essences in the light of intuition and self-reflection. The process involves a blending of what is really present with what

is imagined as present from the vantage point of possible meanings; thus, a unity of the real and the ideal." (Moustakas, 1994)

According to Vagle (2014) efficient data collection includes interviews conducted in the participants' natural setting, so data collection methods included semi-structured interviews, either in-person or virtual via video conferencing software using open-ended, exploratory research questions. These interviews initiated in the fall of 2022 with unstructured interview questions like, "What was it like to be a teacher during the 2020-21 school year?" Questions like this often generate responses that, with clarifying or redirecting questions, will generate a wide variety of topics over the interview timeframe. I conducted seven initial interviews, one per person, and two participant follow-up interviews were conducted during the first half of the 2022-23 school year to gain further insight into their initial responses and for data validation. Interviews lasted between 55 and 125 minutes and were conducted using an informal, conversational format. Interviews were recorded using an audio capture device for in-person and a distance based recording device when virtual. Responses to these questions guided the study after careful, systematic analysis of transcripts and observations. I gathered field notes during all interactions with the participants as well as during the review of transcripts and recordings. Ongoing data analysis took place throughout the study. All of the recorded interviews, comments, and field notes were digitally stored and I used both Microsoft Excel and NVivo, a software program for qualitative researchers, to organize and analyze the data, codes, and themes. I then organized those notes into similar patterns or themes and finally integrated these themes and data points into a complete, cohesive story (Smith & Nizza, 2022). I anticipated the emergence of comments regarding the use of specific blended learning tools for mathematics instruction as well as instructional strategies used during the pandemic teaching experience.

These themes, or others like them, may be pursued for quantitative analysis regarding the frequency of use, user experience, and instructional effectiveness in future studies. In connection with the research questions, the use of particular tools or strategies may have an effect on the lived experience of the subjects and, in turn, may affect their perceptions of their current professional identities. Hard copies of all digital files of data will be destroyed upon completion of the study.

After transcripts were available, I used member-checking. Three interviewees were randomly selected to review the transcripts of the interviews for both clarity and accuracy. Most corrective feedback included minor changes to dates, names, locations but member checking indicated that the transcripts accurately represented both the participant's thoughts and feelings on the topic of the questions asked, ensuring validity of the results (Creswell & Poth, 2018). Data collection occurred during the 2022-2023 school year fall and spring semesters.

Data collection consisted primarily of semi-structured interviews, which are usually formed by the sub-questions of the study but framed in a way that makes them understandable to the participants (Creswell & Poth, 2018). The semi-structured interview protocol is "an effective method for data collection when the researcher wants: (1) to collect qualitative, open-ended data; (2) to explore participant thoughts, feelings and beliefs about a particular topic; and (3) to delve deeply into personal and sometimes sensitive issues" (DeJonckheere, 2019). I chose to use interpretive phenomenological analysis (IPA) because of its emphasis on getting participants to share in-depth, personal reflections on their experiences with the phenomenon in question (Pietkiewicz & Smith, 2014). In this case, the phenomenon being studied is the Covid-19 pandemic as well as the teachers' perceptions of its impact on their professional identity. The participants have the shared experience of teaching mathematics through the pandemic school

closures. This design is appropriate because the nature of qualitative methodology is inherently relational (Saldaña & Omasta, 2018) and supports inquiry into participants' experiences as they work to create and connect personal and professional identities. Phenomenology is flexible and oriented around participants, encouraging them to tell stories about their experiences to learn more about themselves or larger concepts (Alase, 2017).

Data Analysis

Similar to the data analysis procedures in many other forms of qualitative research, this study used both manual and computer aided organizational techniques. Computer software, such as Microsoft Excel and NVivo were used during the organization and analysis of data, and in order to develop a clear purpose, logical theme deduction, and to maintain transparency, Wickham and Woods (2005) encourage the importance of developing a Computer Aided Qualitative Data Analysis Protocol (CAQDAP) while analyzing the data (Wickham & Woods, 2005). The primary goal during the data analysis time period is to deduce meaning from the data by identifying themes through manual and computer aided coding. Creswell and Poth (2018) summarized this thematic analysis as "preparing and organizing the data (i.e., text data as in transcripts, or image data as in photographs) for analysis; then reducing the data into themes through a process of coding and condensing the codes; and finally representing the data in figures, tables, or a discussion." This process includes six steps. After collecting data, the first step in the analysis process is transcription of the semi-structured interviews and any other qualitative datasets. After the transcriptions are complete, the researcher then focuses on organizing the data to make sense out of the significant volumes of rich text in order to try to develop a storyline. Saldaña (2015) reminds us that during the data organization process, the researcher should keep the bigger picture in mind by focusing on the purpose of the study. The

next step in the process is coding of the data that has been collected and organized. Coding is a way to systematically organize and understand the data (Tracy, 2013) which creates a set of codes to use as the basic components for labeling and reorganizing the data. Codes link to the data and can be connected into categories. Recoding is also encouraged when primary coding has not been effective at creating emerging themes. As such, codes have the potential to split or group data into categories and subcategories for further analysis. Once codes are identified, the next step is connecting them into categories which may be built on commonalities, or similar aspects which sometimes include not what is in common, but what is missing. After deducing the categories of the data, the next crucial step in the phenomenological process is identifying common themes or patterns and interpreting them, linking them to the purpose and bigger picture in order to create a cohesive storyline to deduce the meaning that the participants have attached to their experience of the phenomena, in this case teaching secondary mathematics through the Covid-19 pandemic. The final step parallels the first five, as it is that the researcher maintains a reflective journal throughout the process in order to address any potential biases, establish credibility during the research process, and outlines and examines the researcher's decision making process. Journaling helps maintain researcher transparency and adds to the validity and credibility of the study. Therefore, data collected in this study, which includes initial and follow-up interviews, was transcribed, organized using NVivo software, coded, and organized into themes. These themes connect through the qualitative phenomenological framework to teacher perceptions of professional identity and were compared to previous research on the formation of teacher professional identity in secondary mathematics classrooms, including face to face, blended, and virtual learning environments.

Bracketing

In phenomenological studies, the researcher detaches or brackets themselves from the data in order to avoid their own researcher prejudices when analyzing the data. The researcher suspends all judgment derived from preconceived stereotypes and experiences through epoché, as Husserl described in *The Crisis of European Sciences and Transcendental Phenomenology* (1970). In order to suspend all judgment, the researcher must also make no assumptions about the initial meaning of statements made by subjects, but must instead research the meaning of the statements after they are made in an attempt to determine the meaning (Bogdan and Biklen, 2004). This study is unique in that the researcher had no option but to live the Covid-19 phenomenon in question alongside the participants. Therefore, as suggested by Chan et al., (2013), bracketing began at the initiation of the study and included deciding on the scope of the literature review in order to manage preconceptions yet meet the requirements for posing these research question. The literature review allows the researcher to gain more understanding and insight into the questions of the proposed study, but "knowledge gained through the process of literature review may inevitably affect our preconceptions on the topic under study" (Chan, et al, 2013). Therefore the literature review process ended when there was sufficient understanding of the research topic to both justify the proposal and maintain room for curiosity and exploration. It has been suggested that the literature review be entirely delayed until after the data collection and analysis by Hamill and Sinclair (2010) so that the researcher not ask questions or analyze data in ways which connect to themes that already exist in the literature. This study, however, proposed a limited literature review that presenedt enough of a compelling case for the research yet maintained a distance from the particular events in the phenomenological experience to effectively bracket the researcher during the collection and analysis stages of the study. Additional supporting and newly published recent literature related to this topic may be

incorporated into the literature review after the completion of data analysis. The literature review has intentionally focused on the concepts involved in the formation and reformation of teacher professional identity, as well as aspects of the nature of becoming a secondary mathematics teacher and the implications of technology on both teaching and identity. The focus of this study, however, is on how secondary mathematics teachers perceive their own professional identity having accumulated lived experiences before, during, and after the school related closures and changes associated with the Covid-19 pandemic. While research is now beginning to emerge on many topics related to teaching and learning that are associated with the unique lived experiences of teachers during the pandemic, the literature review does not contain that research. The literature reviewed was then intentionally limited to that which was unrelated to pandemic experiences and in most cases was conducted and published prior to 2020.

Positionality Statement

As an emerging researcher in the field of education as well as an educator whose career has moved through the path of secondary mathematics teacher, mathematics supervisor and administrator, professional development specialist, and university mathematics education faculty, I bring my own background to the research as the foundation for understanding teacher professional identity. Although this may bring potential bias to the research, the statement of the awareness of this potential bias is intended to add credibility to the study (Noble & Smith, 2015). I also bring a desire to understand the concept of the nature of teacher professional identity to support my current work as a professional development specialist. Understanding how teachers view their situation as it relates to their holistic identity can better prepare me to engage them in professional growth and learning opportunities. I believe that the outcome of this research is not only pertinent to my immediate fieldwork but is also applicable to the field of teacher education

and professional development and may apply as a support to work being done in change theory as it connects to education.

Assumptions and Limitations

There are a significant number of components that may influence data collection and analysis when one explores the experiences of teachers during a phenomenon such as the Covid-19 pandemic. As such, the assumptions being made are a) participants have experienced a different than previously experienced teaching year during 2020-2021, b) participants were and are still employed as teachers in a secondary mathematics classroom setting, c) participants have taught for no fewer than three consecutive school years, and d) the size of the school district does not influence the classroom teaching experience of the participants. The assumptions and method summaries provide the foundation for selecting samples for this qualitative research. Qualitative research is not, however, without its own limitations. As the sample size will be small and the interpretations subjective, Creswell and Poth (2018) point out that the results of this work may not be generalizable to larger populations. This research is intended to be a description of the perceptions of the professional identities of secondary mathematics teacher participants as they lived through the Covid-19 pandemic experience and therefore lies within an interpretivism structure. Other factors may be limiting to the research as well. It was assumed that the teacher's willingness to share their thoughts and feelings were authentic and their memory regarding past experiences was complete and accurate and reflected the participants feelings, thoughts and opinions. It was also assumed that rushed or hasty interviewing may lead to less depth and possible misconnections of concepts, so adequate time was planned for interviews.

Conclusion

This dissertation uses a phenomenological methodology to understand and describe secondary math teachers changing professional identity as it relates to the lived experience of teaching through the Covid-19 pandemic. Participants were selected by the purposeful sampling of secondary math teachers in New Jersey in the summer of 2022. Once the participants were selected and provided consent to the interview protocol (Appendix B) they participated in a semi-structured interview with the researcher. Audio recordings from these interviews were thematically organized after transcription and coding had taken place. Member checking and follow-up interviews were used to validate the data and add to the depth of understanding of existing themes as well as to serve the ultimate purpose of answering the research question.

Chapter 4 - Findings

Introduction to Findings

This chapter contains the findings of the data collection process and the results of the interpretive phenomenological analysis conducted on the interview data. Data are presented in light of the need to answer the overarching research question: How do secondary mathematics teachers perceive their professional identity following the Covid-19 pandemic? The research subquestions were the following:

RQ1a: How do teachers describe their teaching experience and professional identity prior to the Covid-19 Pandemic?

RQ1b: How do teachers describe their lived Covid-19 pandemic teaching experience?

RQ1c: How do teachers perceive their current professional identity?

RQ1d: How do teachers describe the change agents most influential to their identity formation?

This chapter presents an overall summary of the interview data including alignment with the IPA and how the data attempts to answer the research questions. Data is presented first by the individual participant, including demographic data, followed by interview data organized by themes arising from IPA.

Seven secondary mathematics teachers from New Jersey who had experience teaching before, during, and after the Covid-19 pandemic were selected for this study, which fulfilled the research design of having between 6 - 10 participants. The participants were invited to participate in a live or virtual, semi-structured interview to answer the research questions. One participant chose to meet in-person while the remaining six participants opted to meet virtually via the Zoom conferencing platform. Participants were made aware that the interviews would be

recorded and were provided with background and context for the study as well as the purpose of the research prior to the interview. Interpretive phenomenological analysis was used to understand the qualitative data received from the participants during the interviews. Results are presented first by individual participants in order to illustrate the narrative of the development of each interviewee's professional identity throughout the Covid-19 pandemic-related school closures, then presented by codes and themes as they emerged from the analysis.

Interview Results

Participants.

Although purposeful sampling was conducted to obtain participants for this study, demographic data was collected in order to gain deeper insight into the individuals and their various experiences. Of the seven participants, four identified as male and three as female. Ages ranged from 27 - 45 with an average of 38.4 years old, while experiences ranged from 7-24 years of teaching with an average of 16.7 years of experience. Further breakdown showed the average age and experience of male participants to be 35.8 years and 14.5 years respectively. For female participants, the average age and experience were 42 years and 18.75 years respectively. Two of the four male participants taught middle school mathematics (grades 7 & 8) while the remainder of the participants taught high school mathematics (grades 9 - 12). Two of the participants have a Bachelor's Degree while the remaining five have obtained a Master's Degree, with one currently enrolled in a doctoral program. While relative consistency emerged in the demographics of the interviewed participants, some consistent themes also emerged during data analysis. However, prior to addressing those themes and codes, it is important first to examine each participant's narrative individually in accordance with the interpretive phenomenological inquiry design of this study. In the following section, each participant's description of the development of their

professional identity as teachers, their experiences being a teacher during Covid-19 related school events, and their views of their current post-Covid professional identities will be described.

Participant 1

Participant 1 described an early association with the desire to be a teacher being developed through family, of which two direct members were teachers. This led to a consistent presence of the idea that being a teacher was a viable option as a potential career. This was further developed through relationships with university professors who, both by indirectly modeling excellent teaching practices and by directly engaging Participant 1 in supportive conversations about becoming a middle school math teacher, had strong influence on the ultimate choice to enter the teaching profession. They said,

I feel like it was almost like natural for me to want to go into the profession, too.

Upon entering teaching, Participant 1 faced significant district instability, both in colleague turnover and administrative changes. This instability led them to shift the nature of their role as math teacher into one of senior leader, even though their longevity in the district was limited. This environment caused them to question themself, because an internal struggle emerged between the teacher they were perceived to be and the teacher they believed they should be. This struggle had a significant impact on an intentional shift of professional identity from expected self to authentic self. Participant 1 chose to navigate a purposeful integration of their true self into their everyday teaching practices, citing a powerful impact both on their own confidence and satisfaction and their students willingness to participate in their classroom and build relationships with their teacher, saying,

> The more comfortable I became with myself, the more comfortable I became with my kids, and my students know that I care about them, that I'm supporting them, and that I'm here for them.

This understanding had become the secure professional identity of Participant 1, taking on a role of constant supporter, relationship builder, and guide of student learning instead of presenter to an audience of students.

When it was apparent that the Covid-19 event would result in school closures, Participant 1 leaned on developed relationships with students to continue their mathematics learning experience through the end of the 2020 school year. But, they cite the announcement that the 2020-21 school year would be conducted virtually as having an instant impact on their teaching and their approach to teaching. They said,

> Talk about taking a hammer and crushing your classroom. This school year was even harder because at least in 2020 you got to know your kids and you built a relationship with your kids. I didn't know any of my kids in 2021. When I started off that school year it was a huge learning curve of how do you build connections with someone that you've never met where you're literally just talking to a picture.

While the changes to the teaching environment and experience were significant, the professional identity of a self-actualized, caring and supportive teacher that had been developed prior to Covid-19 seemed to remain present in Participant 1. Their focus was less on whether or not students were actually learning mathematics content at a level comparable to that of students prior to the closures, and was instead on their well-being, their physical and psychological needs, and their safety. The pandemic related teaching experience presented them with a need to learn teaching modalities they had not previously used or been trained to use, as well as to create learning experiences for students in an online environment. The most influential affront to their established professional identity at this time was the absence of the ability to closely connect with and build relationships with their students, many of whom never turned on their screen in

the virtual classroom or who had home related issues that made it difficult for them to even attend class sessions.

When describing their professional identity after the Covid-19 pandemic related teaching experience had ended, Participant 1 stated, “I am a better teacher now.” Participant 1 described their attempts to purposefully maintain their human approach to teaching and their students, and several factors added to their understanding of themself as a teacher. The need to support students' prior academic needs and prerequisite skills had been of secondary importance prior to this experience, but the knowledge that students would be entering their classroom with fewer acquired skills and understandings than they had in the past forced an intentional focus on remediating those skills. That pursuit became part of this teacher’s new set of primary importances for all students moving in this and future years, noting that structure should be built into the teaching routine for this. Actions that support this in the classroom were described as necessary and added importance to the data-based practitioner component of their teacher identity that had been previously overlooked. Additionally, Participant 1 noted the influence of an open mind on their teaching, stating,

> Who would have thought we could have video meetings, check in with students in Hangouts and be creative like this. Home instruction totally changes, and I learned I can roll with the punches, expect anything, be flexible and it’ll work out.

Participant 2

Participant 2 described the development of their professional identity beginning with an interest in and passion for mathematics from an early age, noting that early in high school they’d decided that they wanted their career to be in mathematics. At first, this goal was focused on a career in aeronautical engineering until several universities in consideration described their programs as hands-on instead of heavily mathematical. Their desire to have mathematics in their

career in a more theoretical way instigated a shift in their career focus, which was then further directed toward teaching by experiences working with teenagers in summer camps and activities. They said,

> I knew I liked working with sort of the educational side of things through either boy scouts or through school programs. So that's when I sort of made the shift right, as I was finalizing my applications to colleges, that I wanted to go into teaching and teach math specifically. It kind of all fell into place there and I've stuck with that ever since.

Participant 2 faced similar challenges as Participant 1 in the early years of teaching. Having moved from a middle school teaching position to a high school position one year later, while department and building leadership frequently changed, they began to build a secure professional identity in their own, singular teaching experience. This was built on “having more confidence than was warranted as a new teacher, more like an arrogance,” relying on their own mathematics knowledge and perceived teaching ability. They believe that the major influences on their teacher identity over time have been personal research into teaching practices, an awareness of more modern methods for teaching mathematics, and the recent implementation of a mathematics program, Illustrative Mathematics (IM), which fostered an inquiry based learning approach that connected with their teaching and learning preferences. This provided motivation for continued personal development as a teacher at a time when stagnation had been creeping in. Participant 2 was able to take hold of their teaching practices prior to the Covid-19 pandemic and its associated effects on teaching mathematics due to the ideologies and procedures embedded in the new program (IM).

Participant 2 relied on their success with and understanding of this new program, as well as the availability of online programs like Desmos (a graphing calculator and activity building open resource), when Covid-19 forced the shutdown of their school. At the onset of the school closures, despite an awareness of the likelihood of the closures becoming apparent, Participant 2

felt that momentum that had been generated by the implementation of IM was lost and that “all the important parts were locked out” when face to face learning and instructional feedback were unable to occur due to district policies. During the 2020-21 school year, Participant 2 attempted to regain control of their professional identity by working to create systems that would best be able to emulate the pre-Covid classroom they’d established. Another significant factor impacted their professional identity development at this time, which was the increased collaboration between department members and involvement in an online community of teachers using the IM program. This department collaboration added an ad hoc identity layer of Teacher Leader to Participant 2. They valued this role as on-call professional development provider to colleagues in the mathematics department, but also had to place limitations on the role as time to provide support was constrained by daily school routines.

In reflecting on their experience, Participant 2 spoke of how the new collaborative nature of the mathematics department would remain a welcome addition to the teaching environment. They felt as though their contribution was being matched by the contributions of other colleagues, creating not only a supportive environment, but also one that was more fun. Yet still, Participant 2 communicated that their individual beliefs about teaching and learning mathematics; that math is fun and exciting and worthy of study as well as that teachers must have a secure understanding of skills and concepts and a central belief that all students can learn mathematics, were still within their decision making matrix. So when reflecting on the activities that had guided instruction during the 2020-21 school year, they weighed the importance of components like technology, which had been heavily relied on during the closures, the structure of the IM program, and their self-reflection on activities that were no longer needed in their learning environment, becoming “more focused on the important aspects of what works for

students. There's no room for the other stuff anymore." They now "use technology when it is needed and enhances the lesson" instead of using it as a daily delivery and interaction tool, and also stated,

> I actually I think of all the things that came out of the pandemic that one of the better ones was the ability to host a class in that way and get students involved. It's less traditional, but better.

To them, a math teacher was now much more than a provider of information, but facilitated an environment of mathematical discovery from less formal to more formal, providing guidance and feedback and supportive resources, including technology, when necessary, where both wasted time and unwarranted confidence were unwelcome.

Participant 3

After completing a major in mathematics, Participant 3 was uncertain of the career path that would follow. Despite several members of their family holding careers as math teachers, they initially pursued a career in the corporate world, interviewing for various positions. It was through a dissatisfaction with those interviews and reflection on the experiences of teaching family members alongside the experiences they'd had with teachers in their own past that a decision was made to enter teaching through an alternate route certification process. They believe now that "I accidentally stumbled into what I was meant to do." They noted that teaching was a way for them to work with a subject they loved, but in a meaningful way, having felt that a corporate use of mathematics was of less value to society as teaching had an impact on individuals while also contributing to the betterment of society through education. Their professional identity formation was significantly impacted by the philosophical value they place on education, mathematics, and good teaching, to the point of being disappointed with a

perceived “lowering of the bar” in education today, both for student performance and for new teachers entering the field, noting “it should be harder to become a teacher.”

During the 2020-21 school year, Participant 3 describes a feeling of increasing frustration and sadness. They felt unable to reach students, felt less effective as a teacher, and also unable to successfully figure out ways to engage students in either meaningful or even basic ways. This rattled their self confidence as a teacher, which until this time had been relatively secure and growing over their career. This secure view of their self-efficacy began to break down as repeated efforts to figure out how to make the best of this unexpected and unrequested situation failed.

> I couldn’t figure out how to get kids to work the way I wanted them to and the way I valued. I tried to figure out ways to engage them, but for the life of me, I couldn’t. I couldn’t figure out how to do my job, and it was maybe the first time in my career that no one could help me, either.

In response to these feelings, Participant 3 decided to resort primarily to direct instruction. While they describe a preference for presenting engaging learning opportunities for students, they realized that these were not occurring no matter how varied the attempt, so direct instruction of mathematics concepts and skills would be the most effective way to make sure that students who demonstrated an interest in continued learning of mathematics would have the experience and resources they needed and those that didn’t demonstrate that interest would be less of an obstacle during the lessons. This was a temporary pivot in professional identity for Participant 3.

They described a recognition that, during this time, technology had taken on a significantly more important role in mathematics teaching and learning as well as in student engagement. They’d turned away from technology in their classroom in the past, supporting a preference for paper-and-pencil mathematics. Following the 2020-21 school year, Participant 3 was determined to adjust their teaching identity to include more consideration of their students

preferred methods for learning, including incorporating more technology as a path of least resistance for engagement as well as a means for personal professional development in preparation for everyday teaching and potential future situations like Covid-19. They said,

> It doesn't matter that I'm not personally comfortable with the technology. I was forced into using more technology and that's shown me the importance of using that to reach the kids because that's how they perceive the world.

They stated several times that the frustration with teaching during Covid-19 has reignited their purpose to change the nature of the mathematics classroom from one of repetition to one that produces thinkers.

As a post Covid-19 teacher, Participant 3 describes themselves as "more adventurous" and "willing to check my ego and try new things." They also spoke often about finding a compassionate balance during frustrating times and have become more open to seeking help from others, even those who seemed "less professional" but may have techniques they can add to their toolbelt. They noted that often they asked themselves "why" regarding students who weren't engaging or coming to class sessions, or techniques that seemed like they'd work but didn't. This repeated self questioning has become part of their ongoing teacher identity, allowing them to focus on the unseen student, the unexpected method of engagement, and the personal need for compassion or for growth as a teacher.

Participant 4

Participant 4 describes their single gender private high school experience as "very college-like," which began their love for work in an academic setting. During their time in high school Participant 4 was inspired by a particular teacher who connected learning to the real world, made learning an enjoyable experience, and connected with students in a personal way that made them feel valuable.

> I wanted to make students feel that way. I wanted to make students feel like they could change the world and that they were just great, you know. So that was why I wanted to teach.

Participant 4 also spent time during high school as the resource that peers came to for help learning their mathematics. Although teaching math was not certain at this time, they describe the joy and satisfaction felt when they helped classmates understand math. The knowledge that they wanted to be a teacher was clear, but they describe an uncertainty as to what subject they would teach, first believing it to be history or social studies. During university courses, math stood out as more interesting and transferable, which was further supported by Participant 4's parents who strongly believed in a good education and also believed that "math teachers will always have a job." These variables were cited as narrowing their focus to a career teaching mathematics. While all of the other participants have teaching experiences limited to the state of New Jersey, Participant 4 began teaching in Vermont, first to middle school students and then to high school students. After a move to Chicago, they pursued certification through Teach for America and taught high school mathematics in an inner city school environment. One event in particular was shared as pivotal in their professional identity formation. Upon being hired to teach algebra at their new school in Chicago, the principal asked them to begin immediately, the same day. Without notice or preparation, they taught a full day of classes, mostly building relationships with students, but realizing the importance of those relationships and the power of their own personal courage. This experience is described as significantly influential in the development of their teaching identity.

Participant 4 attributes much of their ability to teach to their first colleagues in Vermont and to the examples set by high school teachers and university professors. In addition to these influences, when realizing that the community and demographic of their Chicago teaching

environment was significantly different than they'd previously experienced, Participant 4 chose to embed themself within the community in order to intentionally mold their professional identity into a teacher who understood and belonged to their community. They describe their efforts as motivating and hopeful, as reading about the community, attending church there, visiting with families, and learning about the background of the area all pointed to an understanding that students were capable of learning mathematics, but the traditional school classroom setting may have been a stumbling block for many of them. This led Participant 4 to discover ways to teach less traditionally, with more flexibility and responsiveness to student situational needs. It was during their time at this school that two new pursuits entered into primary focus in Participant 4's teaching: special education and social emotional wellness. Participant 4 began teaching special education math in a NJ high school in 2019, just prior to the onset of the Covid-19 pandemic.

Prior to the onset of the pandemic, Participant 4 describes their teaching as following the *I do, we do, you do* structure, although loosely. Classes began with bell ringers, notes and examples were presented in different ways, and students practiced their skills in a variety of ways as well. The stability of school structure and the seemingly indestructible nature of the education system led them to believe, after hearing about the potential related effects of the spread of Covid-19, that schools wouldn't close, but would be resilient and able to adapt. So, when school closures became a reality, they describe that "it felt weird, like preparing for a summer break or a snow day." Participant 4 seems to have been able to adapt to the extreme change of the situation within the understanding of what it means for them to be a teacher. Flexibility, responsiveness, and curiosity were leading their approach to their new circumstances. They said,

> It was, it was very different. It was hard to get kids to, you know, want to put their screens on, want to talk, you know, it was very different. But at the same time, like there are parts of that that were cool. Like, I was able to show a different side of myself, I felt like, what could I now bring into the classroom.

During the 2020-21 school year, Participant 4 focused on connection and the integration of themself into the everyday life of teaching and their classroom environment. While prior to this time, personal interests may have been separated from their professional identity, the virtual environment made it possible for them to integrate them into school. They focused on sharing their music interests, their pets, and their home, both as a means of motivating attendance and participation, and as a conscious effort deconstruct the work/home balance and present themselves authentically, as other participants have stated. Participant 4 described their pandemic teaching experience without describing the teaching of mathematics. When answering questions about the virtual or hybrid teaching experience, they focused on relationships, connection, student psychology, engagement, and mental health.

> I was able to have unseen one-on-one conversations with students who usually don't talk in class. They were enjoying this. They were enjoying school. I was able to show a lot more of myself to them and they could open up to me. We may not have learned as much math, but I think it was good for a lot of kids.

Like several of their fellow participants, Participant 4 incorporates instructional techniques and strategies learned during the Covid-19 school closures into their post-Covid classroom. They discussed using these techniques and strategies as a means to removing roadblocks to student success. For example, technologies like videos and interactive math practice programs make direct instruction both easier and more enjoyable for the students, so they provide them to students and focus their time on facilitating those experiences. They also stated that they were "lowering their expectations, but not in a bad way." They've made shifts to their classroom policies and expectations based on SEL practices, including not requiring all students to

complete all assignments, allowing retakes on assessments, having flexible deadlines for student work, and maintaining an overarching mindset that mathematics is not every student's favorite subject, and it's alright for some students simply to complete their experience without loving the subject. While they felt that every student has the capacity to learn math, they felt that an acceptance of student perspectives was their responsibility in order to be able to teach math most effectively.

Participant 4 emphasized how the Covid-19 pandemic teaching experience reinforced beliefs about what is important to their teacher professional identity, noting that empathy for students was of paramount importance, as was their overall mental health and living experience. However, the virtual/hybrid teaching experience of seeing students in their homes and non-classroom environments made empathy and connection more possible. They noted,

> I don't see myself as just a math teacher, but as a teacher who teaches math. I see myself as much more of an SEL manager than before. I need my kids to be OK to be able to do anything. I am also less stressed about not getting to things. I can let go of that.

Participant 5

Participant 5 began their pursuit of teaching based on an interest in keeping the schedule a teacher keeps. They'd obtained lucrative summer employment and wanted to be able to retain that for as long as possible, so it became apparent that teaching was the most likely career that would allow this. However, they described the formation of their professional identity as a mathematics teacher as being heavily influenced by the comments and mentorship of a high school calculus teacher who saw potential for success in them. They said,

> He realized I had a real aptitude for helping other students out and being able to verbalize some difficult concepts and I sort of had in the back of my mind like, maybe I'd be a teacher anyway but he really pushed me and said you need to be. He's like "you're explaining complex topics better than I can to other students because you're talking at

> their level.” So that was the last push that I needed to believe I was going in the right direction.

Participant 5 also described their identity development as being strongly impacted by the support of administrative leadership in their first school who recognized the limitations this teacher faced. Leadership supported Participant 5 when they considered leaving the school, knowing that they would remain limited in their capacity to pursue and implement their preferred instructional and learning experience if they stayed in their current position. Participant 5 moved into this new middle school teaching position and has remained there for the duration of their career to date.

Participant 5 cited two impactful experiences when describing changes to their professional identity, both occurring in the last quarter of their teaching career. The first experience was being selected to be a part of the first cohort of Desmos Fellows. In 2011, Eli Luberoff launched the Desmos Online Graphing Calculator at TechCrunch's Disrupt New York conference. Since then, the company has received funding from multiple sources and has developed additional features of the calculator as well as teacher activity modules for students to engage with while teachers monitor and interact with their progress. Desmos is a free tool for teachers and schools to use and is available on any computer platform as a web-based tool or mobile app. Students may use Desmos on their own devices or on school district supplied devices such as laptops or chromebooks (Desmos, 2017). In 2016, Desmos created the Desmos Fellows program, selecting 40 teachers fro across the country through an application process to attend a multi-day workshop with Desmos’ team, learn how to best use the features of the graphing calculator and activity builder, and creatively engage in developing new ideas and features for Desmos while engaging in professional conversations with other mathematics teachers from across the country. Participant 5 was selected to this first cohort and states,

> That really changed me as a math teacher. I consider myself to be a confident math teacher, but to be around that staff and the 40 other fellows I was sort of in awe, and it literally put me in my place. I thought I was a good math teacher, but to hear what these other people were doing and their thought process, that was a real awakening for me that I still had a lot of learning to do as a math teacher.

Through this experience, Participant 5 began to navigate a shift from a comfortable, secure teaching environment to a more reflective as well as open-minded and ambitious classroom. Connections to teachers across the country and the world were also cited as having a powerful influence at this time, as a community outside of their immediate school building was created for them to rely on and actively contribute to. Their professional identity at this time was redeveloping based on internal questions like, “Am I being thoughtful in my classroom,” “Am I open to embracing new techniques,” and “Should I do some research and read more about better teaching practices?” This led to a second influential factor on Participant 5’s view of themselves as a professional, which was the reading of the book Building Thinking Classrooms (Liljedahl, 2020). The teaching practices within the book further supported the changes to Participant 5’s view of their teaching and of themselves, encouraging them to “create a more social, collaborative classroom” and deeply understand the value of “facilitating students working in groups.” These changes to Participant 5’s professional identity and teaching practices were in place prior to the start of the Covid-19 pandemic.

Much like Participant 2, Participant 5 was not surprised when the onset of the Covid-19 pandemic school closures came to fruition. They expected changes to their school, including likely virtual learning, and prior to the announcement of the closure in March of 2020, they had prepared and dispensed materials to their students. When school closed, this preparation, partnered with experiences Participant 5 had had running virtual professional development sessions as a Fellow for Desmos and their understanding of virtual tools like Zoom and Google

Classroom, led them to a relaxed, smooth transition into the virtual learning environment. The pride felt from being able to effectively reach students during this time and the accolades received from peers and administrators in their district reinforced their belief in their self-efficacy and professional identity.

During the 2020-21 school year, constraints placed upon their teaching and their control over the learning environment caused a dip in their confidence as a teacher while mounting frustrations accentuated this feeling. Their school had created a schedule where teachers and students came into the school building four days a week, which was more than surrounding school districts did, to maximize student contact time. Participant 5 noted that this "seemed crazy" and created an environment that "wasn't sustainable." They knew that they had the appropriate skills to teach students in a virtual environment, or in-person, but the schedule built by district administration made each of those impossible. An effect of these frustrations and limitations was the seeming strengthening of Participant 5's professional identity. Being unable to complete tasks and create student experiences that they knew and believed were the most beneficial and effective ways to teach students served to add to their resolve to return to those methodologies as soon as they were able. So while their professional identity was temporarily shifted to the role of concurrent learning manager, the permanent foundation of their professional identity was only positively affected by the 2020-21 school year experience.

Participant 5 described the realization of the importance of the classroom community as their most meaningful takeaway from the Covid-19 teaching experience. They said,

> I took for granted the interaction with students and learning as a community. Even though we were in the same classroom, we lost the community feel. Math is best learned as a group, as a community, and I didn't realize it until I came back, but the buzz was gone. This year really made me realize that the buzz, the chatter, is…I like that buzz. It gives me energy.

As a post-Covid teacher, Participant 5 describes themselves as dedicated to the community of their classroom and willing to “spend more time on one problem” and ask what-if questions rather than do many problems of the same type. They’re more interested in pursuing questions their students ask down “roads that I can connect to our math content” whereas “5 - 10 years ago I probably would have just given notes.” They also noted that their interactions with peers and leaders during the 2020-21 school year had given them more confidence to speak out on their own behalf regarding teaching beliefs and classroom values as well as the confidence to share their professional experiences and resources in the broader mathematics teaching community. This layer of teacher leadership was heavily influenced by the frustrated feelings of helplessness during the 2020-21 school year and the desire to help other teachers who may be struggling in similar ways. Participant 5 noted that they’ve now become “more goal oriented regarding their own growth.”

Participant 6

Participant 6 was the first member of their immediate family to attend college and when considering career choices admits that “school was all I knew, so teaching sounds good.” They believed that their strength was in mathematics, having had experiences in high school helping others and excelling in classes, so Participant 6 took on a Mathematics Education major in their undergraduate program. They reflected that at this time, they were wavering between a major in math ed and a major in music, but chose the option with more likely career availability and a tie to their perceived academic strength in the subject. Throughout college, their understanding of the meaning of mathematics and of mathematics teaching grew, fostered by relationships with peers and professors who modeled this experience. However, instead of completing the final

semester of the teacher preparation program, they left school to pursue a performance opportunity outside of teaching.

Upon returning from that opportunity one semester later, they needed to re-enroll in New Jersey's Alternate Route Teaching program to receive their certification, while simultaneously working as a high school mathematics teacher. Participant 6 cites the alternate route program as having some of the most significant effects on their professional identity development. The final courses were taken while they were concurrently teaching, which provided more meaning and utility to the content learned in the courses. They were also taught mostly by local high school teachers as adjunct professors for the teacher education program, which lent credence to their instruction and created a supportive network during the certification process. Participant 6 relied on this practical approach to teaching and the collegial support during their class meetings to successfully navigate their first year as a teacher. However, they also stated,

> Teaching does not fit my personality. I don't think I'm bad at it, but all my life it's always been work. I go home exhausted at the end of every day. I would have done well with a Monday to Friday cubicle job. So I said from day one, I don't know how I'm gonna make it through this career and I'm still saying that now.

Participant 6 cited several factors which guided the development of their professional identity. During their early years of teaching, the leadership and support they experienced sent clear messages regarding their expectations and Participant 6's teaching. They communicated specific aspects of Participant 6's teaching that needed improvement as well as the plan to improve those areas. Also during their first year of teaching, Participant 6 was told to "keep your mouth shut, do the job, and get tenured" by both their mentor and university professors. This led them to take on the role of compliant employee and traditional teacher, reproducing the methods they'd learned from in their current classroom and finding a comfortable role within that structure. It wasn't until just prior to the Covid-19 pandemic that this changed. Having received

professional development on how to implement a student centered learning experience and administrative permission to freely change, they decided to intentionally alter their teacher identity from professional mathematics content expert to professional mathematical experience facilitator. Making this change, “relieved me of those constraints, let me try new ways to teach kids.”

Upon hearing the news that Covid-19 would likely close schools temporarily, Participant 6 felt excitement, like that of a snow-day, but also experienced some fear in how they would be able to teach students virtually. In response, they relied on their developing identity as a learning facilitator and decided to create videos for their students in order to make the best use of their synchronous online learning time. At this time, the importance of the effect of community and relationships also became clear to Participant 6. They’d wanted to meet with their department to collaborate and share ideas for teaching mathematics during this time, but departmental leadership made meetings optional, which discouraged collaborative meetings. They had relied on the interpersonal aspects of teaching, both with colleagues and students, more than they’d anticipated, and the removal of this element from their daily routine made the deliberate recapturing of relationships and collaboration of primary importance upon the return for the 2020-21 school year. Participant 6 stated that,

> The 2020-21 hybrid year was a fantastic year. Students had a delayed opening every day, but we didn’t. We got to meet and plan, and we were implementing Illustrative Mathematics (IM) so we got to talk about what that meant and understand math more deeply. That pandemic year helped my confidence grow a lot.

However, the 2020-21 school year also presented Participant 6 with challenges. The schedule put in place by their school district allowed in-person time to be optional for students. Shortly after this implementation, most students opted for the virtual option, which “made teaching awkward.” Since they’d recently begun approaching the teaching of mathematics differently than

in previous years, Participant 6 took the opportunity to view this school year as a “beta test for new things.” They expressed the impact that this time had on their professional identity, saying,

> Covid forced me to learn new things. It forced me to get creative in ways I probably wouldn’t have before. There are so many great resources out there and Covid made us learn those resources and find what’s valuable for kids. It was a hard year for kids, but professionally, it was a really good year.

Participant 6 views themselves, post-Covid, as significantly more flexible than they were before. The combination of a new curriculum program and the unanticipated need to teach virtually, creatively, and reactively, helped form their view of themselves as a reflective, responsive teacher. They describe themselves as unafraid to try new things, and unwilling to become stagnant and repetitive in their teaching now, knowing that engagement and also usage of mathematics are the keys to student success. However, they also describe a sense of loss, in that many of the relationships within their school have dissipated since the post-Covid approach of many peers is to isolate and not to congregate. They find that an emerging role within their department and school is one of morale booster, and having seen that change within their own teaching and classroom environment is possible through their intentional change efforts, believes that morale and collegiality is recoverable.

Participant 7

Participant 7 has spent the duration of their career in their current school district, teaching Algebra 1 every year. After briefly considering a career in accounting, they entered teaching right out of their college teacher preparation program. Their professional identity at the time was impacted by their personal beliefs and experiences as a student learning mathematics, and on the mentorship of their colleagues at the beginning of their teaching career. Participant 7 expressed the importance of their experience as a student in their identity development, describing a time

when they were told that they were unqualified to take a second math class concurrently with their scheduled class, yet they persisted and enrolled in the course.

> Here I am a junior sitting with seniors, you know, and it was uncomfortable but I didn't care and I sat there and I worked my butt off. I would spend hours doing my homework to the point where I'm erasing the paper with a hole in it, and taping it. Because I have it all written down. Like that was my class. I loved that class.

This experience, culminating in successfully receiving an A on the exam and in the course, defined Participant 7's idea of what a mathematics student can be, and is a consistent narrative in their description of the differences in students in their current mathematics classes. While their personal success was founded on personal desire to learn mathematics, and a personal work ethic that successfully partnered with this desire to learn, they cite their teacher professional identity as part teacher of math content, and part motivator, cheerleader, and teacher of organizational skills and structure. Their experience as a learner has also remained part of their professional experience, in that the state of New Jersey has changed the requirements for Algebra 1 students as well as the evaluations requirements for teachers and the required state assessments multiple times during their career. During those times, Participant 7 has actively sought to learn about the changes, implement them to the best of their ability, and implement a structure that will balance the initiatives and their own teaching beliefs. Underlying their teacher identity is the desire to "be there for a kid who's told he can't do math" and "share my love of math and numbers with them."

Participant 7 also cites the constant influence of student parents in the development of aspects of their professional identity. They believe that they must take on a defensive role of "watch yourself" and "collect evidence" for the time when their teaching, grading, and actions are questioned. Their experience with parents drafting letters challenging their teaching, parents having accommodations added to student 504 plans and IEPs in order to avoid compliance with

their classroom structure and responsibilities, and a general apathy toward supporting the teacher in favor of “making life easy for their kids" as deflating, fatiguing, and requiring regular daily attention. But they also cite the interpersonal relationships with students as some of the most rewarding experiences they have, with that reward often contributing to the motivation to continue to teach through hard times. Students and parents have both contacted Participant 7 after having shared a classroom experience to discuss how they’d learned math, learned how to organize themselves, and feel like they’re better students after having been in their classroom. This continues to support Participant 7’s professional self view of a caring, compassionate human with high expectations for students. They said,

> They may hate me because I’m too structured for them, or because I actually make them do things, but not because I’m a bad person.

During the 2020-21 Covid-19 affected school year, Participant 7 relied on their approach to organized classroom teaching and structure to guide their framework for teaching in their school, which had students in-person part-time and virtual part-time. They noted that “no one was allowed to fail” which, in their reflection, began to change the overall mindset of students and families toward how the school experience would be post-pandemic. This mindset made it difficult for them to retain their beliefs about holding students accountable to certain standards, both of behavior and performance. They allowed exploration of changes to their teaching to accept a new mentality toward student expectations, as well as attempted to incorporate more of the technology based activities students would be more willing to engage with, all the while “trying to maintain the person I was.” Participant 7 describes retaining a strong sense of self and of professional identity, while developing a newer, flexible understanding of student identity than they’d previously defined.

> I want my name on their transcript to mean something. I'm still driven to accomplish their learning, but I know that they're independent learners, too. They're not the same student I was. So I'm willing to incorporate more things that make me uncomfortable, but that they like and will learn from. Even though they may not all like math, I still try to reach every kid.

Interview Themes

Interview transcripts were analyzed through the interpretive phenomenological analysis process (Alase, 2017). This process included reading and rereading the transcripts to familiarize myself with the data. The next step was for me to identify and assign codes to portions of each transcript, noting quotes or statements that seemed meaningful, and then connect codes into emerging themes in the first transcript. I then applied the same process to the next transcripts and searched for patterns among them. In coding, I looked both for a priori codes already established based on the literature as well as new codes that emerged from the data. Four distinct themes emerged from the convergence of codes within the participant interview transcripts. The following is a description of each theme and the codes supporting it.

Theme 1: Teacher Identity Development

The first theme to emerge was Teacher Identity development, which involves the process of individuals constructing and negotiating their identity as a teacher over time, as well as how this process is influenced by various factors such as teacher education and training, personal experiences, and organizational culture (Beijaard et al., 2004). When exploring teacher professional identity, it is important to consider the reasons why an individual chose to enter the profession and to investigate whether there are developmental similarities between participants. This encapsulates the personal, educational, and emotional factors which led to the participants'

decision to become teachers through the lens of initial professional identity formation and the codes supporting this theme are presented below.

Mirroring

Mirroring plays a significant role in developing individuals' coherence and organization, resulting in self-awareness and understanding the relationships between the self and the world (Pines, 1987). From an early age children develop social skills, language, and behaviors by mirroring their parents and caretakers. Individuals tend to imitate the people within a higher status and power structure, mirroring those attributes to their own identities (Mintz, 1985). For example, parents, teachers, and social authorities possess and present a higher degree of power. Several participants shared stories of individuals that both inspired and guided their decision to teach, coded as mirroring. Participant 1 noted that their mother and sister were both teachers, which led to thinking "I feel like it was almost like natural for me to want to go into the profession too." Similarly, Participant 3 stated that their father, uncle, and cousin were all math teachers and that they'd also "had some really good math teachers in the past." Participants 4 and 5 both stated that they'd had teachers in high school that were inspiring, with Participant 4 stating that "I had a teacher who, if I was going to go into teaching, I'd want to be like him." The examples set by family members and teachers were often described and referenced several times throughout the interviews, noting the importance of reflecting the examples set for the participants before becoming teachers. Mirroring seems to have developed a preconceived notion of what a teacher should be, guiding the beliefs of the participants when establishing their early teacher identity.

Mathematical Beliefs

Several participants shared comments and stories about their beliefs about mathematics and mathematics teaching, which, when combined, support the early teacher identity development narrative. An individual's beliefs about mathematics as a student can impact their decisions to enter a career field involving mathematics, including teaching (Kaleva, et al., 2019). Participants 2, 3, 6 and 7 all stated, “I was always good at math.” Each of them connected their mathematical competency and personal interest to the concept that mathematics was valuable. Participant 2 felt that “the educational side of things is where I can do the math, but make a difference.” Similarly, Participant 3 stated that “teaching math would be a great way to work with something I love, but in a meaningful way, making a difference with kids.” Mathematical competency was also stated as a necessary attribute for successful math teaching by multiple participants. Participant 1 stated that “as a teacher, you’ve got to be strong with the math,” and Participant 2 echoed that with “your knowledge base has to be secure.”

While these beliefs about mathematics and mathematical competency laid the groundwork for the decision to enter the field of mathematics teaching, they did not receive as much attention when discussing current teaching as it relates to mathematical beliefs. Participant 6 mentioned that “when I started, I was naive enough to think everyone was a math student like me, but I learned that that wasn’t true really quickly.” Participant 3 recognized that “students learn in different ways and need math presented to them in different ways,” while Participant 4 abandoned the idea that all students were inherently interested in mathematics stating, “math needs to be sold to students, like calisthenics for the brain, something that is good for you.” These updated beliefs about mathematics and mathematics teaching focused not on the teacher’s own competency with mathematics, but instead with their competencies in communicating the

value of mathematics and creating an experience for their students where the learning of mathematics was more important than the production of mathematics. This describes a shift in identity from teachers as transmitters of knowledge to teachers as facilitators of learning.

Professional Identity Definition

Participants described the attributes of a teacher's professional identity within several categories. Mathematical competency has already been mentioned and described. The following characteristics of self-recognized teacher professional identity were mentioned by more than one participant:

- Mathematical knowledge and competency
- Strong work ethic
- Patient
- Desire to be around young people
- Empathetic
- Willing to build relationships
- Growth mindset
- Love of learning

Pre-Pandemic Influence

Identity development is defined in the literature as the ability to build a desired self-perception through self-leadership (Neck & Houghton, 2006). Participants built their professional identities largely through professional learning, experience, models, feedback, and teamwork. Teacher professional identities are malleable and over the course of a career identities adapt to learned behaviors, experiences, and modified beliefs about teaching and learning.

Participants described the factors influential to their professional identity development prior to the onset of the Covid-19 pandemic.

For many participants, the journey of personal self-discovery impacted their professional identity significantly. Participant 1 noted that “I realized I needed to be my authentic self. That my kids needed me to be. The more comfortable I became with myself, the more comfortable I got with my students.” Participant 3 also stated that “navigating a bad relationship with my father taught me patience and empathy. My journey to understand myself better helped me become more self-aware as a teacher.” While Participant 2 stated that “I don’t bring teacher me home with me, or personal me to school much,” Participant 5 noted that “I’m me. I don’t change myself in the classroom to fit someone else’s view of a teacher. My style and interactions create an experience kids feel comfortable in.” Participant 6 said “I had a very negative first year of teaching. I was scared and worried about what my career would be like. I’m an introvert by nature, so putting on the daily show feels like a marathon.”

Professional development and learning was also noted as influential to the pre-pandemic identity formation of several participants. Participant 5 had attended the Desmos Fellowship program, which not only revealed the self-awareness that they could grow as an individual teacher, but provided a network of support from other teachers in the fellowship across the country which encouraged that growth. This was noted as a “turning point” for Participant 5. Participants 2 and 6 both received professional development and training on the implementation of a problem based learning curriculum from Illustrative Mathematics prior to the onset of Covid-19. The training and implementation of this program had begun the navigation of their professional identities toward a more facilitative teaching role, guiding an inquiry based learning approach.

Theme 2: Motivation

Sinclair (2008) defined teacher motivation as "what attracts individuals to teaching, how long they remain in their initial teacher education courses and subsequently the teaching profession, and the extent to which they engage with their courses and the teaching profession" (2008, p. 37). Dörnyei and Ushioda (2011) highlighted the two dimensions of teacher motivation, namely, the motivation to teach and the motivation to remain a teacher. Their review of the literature delineated four main components of teacher motivation: prominent intrinsic motivation, closely related to interest of teaching; social contextual influences and the impact of external conditions and constraints on teaching; career duration with emphasis on lifelong commitment; and demotivating factors emanating from negative influences.

Satisfaction

A significant intrinsic motivational factor for the participants was their satisfaction with teaching and their professional work. "I love what I do" was a sentiment shared by Participants 1, 3, 4, and 7. Similarly, in response to a question regarding whether or not they'd considered leaving the teaching profession, the sentiment that "I'm making a difference" was shared by all seven participants as a significant reason for remaining a teacher. Participant 4 stated, "every day I feel good. I'm helping people every day, and that's the job." Satisfaction was also connected to the idea that "teenagers are hilarious and fun to be around" by both Participants 4 and 6. The joy and fulfillment of teaching remained a motivating factor throughout early career struggles for several participants, creating a foundation for intrinsic motivation when external factors began to interfere with their view of teaching. Participant 1 mentioned that the State of NJ had implemented "new mandates and paperwork almost every year," adding to the frustrations of the "part of the job that's not teaching." Participant 7 noted extrinsic factors of parents and achievement testing expectations as "guiding more of what I do than I want them to" and

"making me wonder what or who's going to come after me tomorrow." Participant 6 noted that "I didn't know that changing Governor would have such an impact on the profession. I feel like I've got so much more to do now than I did before." While positive job satisfaction was associated with reasons for retention, negative job satisfaction was not described as a reason for leaving the profession, but more as an ongoing component of the job that, as Participant 1 described, is "just something to deal with."

Pragmatism

Another factor in the motivation of continued teaching was the pragmatic nature of retention in the career. Participant 7 noted the importance of the salary and benefits to their family. Participant 2 stated that "while there are other possibilities out there for me, I'm the sole income for my family, so change isn't really an option right now." Participant 5 had support from their family to consider change, but recognized their limited options based on degree level and experience, stating "based on my degree, salary, and position, I'm pretty much stuck." The potential for redefined professional identities was depressed by some of these limiting factors.

Relationship Building

A final reoccuring code in the theme of motivation was that of relationship building. Participants noted a desire to be willing to build relationships with students and colleagues as integral to their professional identity, as well as influential to their ongoing success as teachers. Participant 4 states that "the way you really get to know how you fit into a place is by genuinely trying to connect with everyone…students on a learning level, teachers and administrators on a professional level" while Participant 1 said "I get to know kids because they need to know that I care about them and that I'm supporting them." Participant 4 was proud of their ability to connect with students who don't like school which motivated them to continually "connect to

humans, students as people." When asked to describe some of the moments that made them the most proud to be a teacher, all participants shared stories of personal connection, times when students relied on them to be an important person in their lives, and moments of expressed gratitude from students and/or their parents for the extra effort they put into making sure students were successful and valued. Participants noted that these stories of events were important moments in the securing of their professional identity as a mathematics teacher, reinforcing that the approach to students that they had taken was correct and that they were, in fact, in the right profession. Participant 7 commented, "a parent said 'you had my daughter and it didn't go well' but later mentioned that 'you finally clicked and it turned a corner. She still talks about how you made her a better student.' I know that not every kid will like math, but it's because of times like those that I keep trying to reach as many students as possible."

Theme 3: Effects of the Covid-19 Teaching Experience

Across the United States and the world in the beginning of 2020, it became apparent that the novel coronavirus and its accompanying disease, Covid-19, would impact public life and education significantly. As the virus and disease spread quickly, states chose to act to protect their citizens in different ways. On February 3, 2020, New Jersey Governor Phil Murphy issued Executive Order No. 102, establishing a coronavirus task force (NJ, 2023). On March 21, 2020 via Executive order 107, Governor Murphy directed all NJ residents to remain home, closing all public and private schools until further notice. Many schools had closed as a precautionary measure during the week prior to the executive order. At that time, teachers and schools had to adapt to the current pandemic-related school closures and schedule adjustments. The main research question of this dissertation is how do secondary mathematics teachers perceive their professional identity following the Covid-19 pandemic? Subquestions (b) and (c), respectively,

ask how do teachers describe their lived Covid-19 pandemic teaching experience and how do teachers perceive their current professional identity? After initially coding the interview data, further analysis of the lived experience of the participants converged into three secondary codes: anticipation, adaptation, and acceptance, all of which are presented here to support this theme.

Anticipation

As NJ Executive orders 102 and 107 were approaching, the participants interviewed all had some level of anticipation regarding the upcoming experience and the likelihood of school closures, as well as the mental and practical approach to be taken. None of the participants described a sense of shock or surprise upon hearing that their schools may close due to the spread of Covid-19. Through their role as a teacher in one school district and as a school board member in a neighboring school district, Participant 1 was both aware of the impending closure in the district where they taught as well as was involved in the decision-making and implementation process for the closure of the school district they served. Through this, they described seeing the proposed temporary school closure as “an extended break” and even celebrated with colleagues the evening prior to the closure date. They reflected afterward that “maybe it wasn’t a good idea to be out around so many people, but there was excitement in the change.” Participant 3 also felt that the closure would be “a longer holiday break” and joined with their students in the excitement of receiving an extended spring break. Participant 6 also expressed excitement in the potential for what felt like “a really big snow day coming.”

A sense of disbelief was present in Participants 4 and 7. Participant 4 stated that “even though we were making sub plans, we all kind of thought that ‘this isn’t going to really happen’ so it felt like calling out.” Participant 7 also felt that they weren’t sure how big this would be, but that it “probably would be nothing too serious.” Both participants believed they’d be able to take

things in stride as the situation changed. Conversely, when recognizing the impending closures were likely, Participants 2 and 5 took the direct initiative to prepare for the short and long term closure options. Participant 2 stated, “I knew it was coming. I mean, it’s math. For two weeks I was using the Covid data as examples in my class. The data pointed to the closure, so I prepared for it.” Participant 5 also stated “it was inevitable. The math of it showed it was coming. I prepared weeks in advance. My colleagues didn’t believe me, but when we closed, I had materials ready, online stuff ready, and experience as an online presenter. I was confident about the closure because I was ready to go.” All three of these different responses: excitement, disbelief, and preparation, were conveyed in the interview through the lens of individual confidence. Those who were excited expressed their excitement alongside a responsive readiness for anything and a belief that they could handle it. Those who expressed disbelief did so with a tone that indicated that school was almost indestructible and that they were able to make school work from anywhere. Those who focused on preparation presented an air of confidence in their predicting and decision-making abilities. A combined sense of confusion and overwhelming was also present in anticipation of the closures. Several participants mentioned the sentiment, “what do we do? How do we teach? How do we keep kids engaged?” This was accompanied by an expression of uncertainty regarding the duration and scope of the emergency closures. Participant 1 stated that “this is going to be more than anyone thinks it will be. No one really knows what we’re getting ourselves into.” The anticipation of the school closures seemed to initiate a fight or flight response within the participants. Their professional identities, when challenged by potential changes outside of their control, activated components of their skill set that they felt most confident in and comfortable with in preparation for the announcement of emergency school closures.

Adaptation

Upon recognition that school closures and either a fully virtual or hybrid/concurrent model would be required for teaching beginning with the fall semester of 2020, each participant described some level of adaptation as a professional, including reflection on teaching strategies and techniques, technology use, and student social emotional wellness. Participant 1 stated that "the following school year was even harder because at least in 2020 you got to know your kids and you built a relationship with your kids. I didn't know any of my kids the next year so it was a huge learning curve of how do you build connections with someone that you've never met where you're literally just talking to a picture." Participant 1 also noted the desire to engage students was strong but was tempered by the new need to empathize with the students whose home environment may not be adequate for virtual learning. Participants 2, 4, and 7 shared this experience, noting that empathy was required in new ways for their students, yet it was challenging to be empathetic in a low accountability environment. Each stated that "they didn't have to keep their cameras on so I didn't even know if they were there." Participant 3 felt a significant sense of frustration, saying "I couldn't figure out how to do my job. And for the first time, no one could help me. I didn't know what else to do, so I leaned on direct instruction. At least those listening would get clear math teaching." However, after a short period of time, Participant 3 realized that this approach was not the best approach and was having little effect on student learning and considered "trying something, anything new." Participant 2 taught virtually, from their school building to students at home. Knowing this schedule would be in place, Participant 2 digitized lessons in the Desmos Activity Builder, using Illustrative Mathematics content. They adapted their teaching from a traditional, daily class period to a 2-hour block class every other day noting, "I enjoyed how this worked. It went really well. I gave students access to

each other's work and learned a lot about how to host a class in ways that get students engaged." Participant 6 noted similarly that, "the hybrid year was a great year. After feeling like a bad teacher last spring it was great to have time to meet with teachers, be creative, remove high-stakes testing, and build my confidence. It was like a beta test year." Participant 5 adapted their experience as a professional development presenter to their classroom. Students all came at once instead of in individual class blocks. They were taught math in large group virtual presentations and then met online afterward for small group and individual follow-up with Participant 5. Participant 5 mentioned that they were "glad to have tools like Desmos," which made group interactive learning more accessible. Participant 4 adapted to the changed teaching model by incorporating more personal, relationship-based opportunities into the virtual environment, focusing on the social-emotional component of the hybrid model. They noted, "I was able to show parts of myself that I couldn't before. I could come out of my shell, show my dog, my music, my home. This led to powerful, personal one-on-one conversations with students who probably would never have talked in my classroom." All participants mentioned the need to adapt their grading processes and expectations. Students were not being held as accountable by school leadership during the 2020-21 school year and that directive spilled over into their classroom practices. Most students were "not allowed to fail, anything" as noted by Participant 7, "which made it a real challenge to expect them to do anything." Changes to grading practices included allowing students to submit assignments late, or to resubmit them for better grades, as well as the removal of some assessments and the incorporation of alternative assessment methods. Participant 2 recognized that they now are much more intentional and conscious about the sequencing of student work from less formal to more formal and that arrival at more formal is, "in effect, the assessment."

Acceptance

The need for adaptation in teaching mathematics led participants to, by the end of the 2020-21 school year, accept that there were aspects of their teaching and classroom experience that were in need of improvement, revision, or replacement. At the same time, aspects of their professional skill set were also reinforced as valuable and important to carry into post-Covid classroom teaching. Participant 1 realized that “it’s so important for me to understand prerequisites. I need to be better at connecting math from year to year for kids.” Participant 7 echoed this need to better connect concepts for students, saying “covid has made kids unaware of the meaning behind what they're doing. They go to the internet but don't know why. It's harder to teach math and problem-solving because understanding isn't searchable. I need to do more with understanding.” Participant 7 also noted in this comment that technology has both positive and negative, or at least neutral, power in student learning. At the start of the pandemic closures, educational technology was necessary to teach mathematics virtually. According to Google Trends (n.d.), during the week after the nationwide school closures in March 2020, Google search volume of the phrase “teaching math online” increased by 600% over the first week of March 2020. That phrase, and others similar to it, continued, on average, to have a 100% higher search rate for the next nine months. All seven participants mentioned the significant impact that technology had on their teaching experience during the pandemic. They accepted that technology would have a continued role in their teaching after the return to a regular school schedule, although in different ways. Participant 1 relied heavily on computer technology and calculators and commented, referencing reduced technology usage, that “math is a paper and pencil sort of subject. You can't just rely on a computer to answer each individual question. Yeah, calculators make life a whole lot easier but if you're putting the wrong information into a calculator or the

wrong information into technology then it's essentially that your computation will be right, but your answer might not make any sort of sense." Participant 2 used Desmos and other technology extensively, yet noted that "although it worked for virtual, I won't use it every day, just when it really adds to the lesson." Participant 3 developed a newfound respect for technology in the math classroom, stating that "being forced into using more technology has shown me the importance of using that to reach the kids because that's how they perceive the world." Participant 4 continues to embrace the technology used during the hybrid learning experience, stating that videos made by others and online activities helps make lessons more clear for students and frees them to be able to engage with students more often. "I use a lot of online tools now. I struggle with the tech, so I use stuff others make. I get in there and do the math with kids." Participant 7 also accepted that high-importance components of their math classroom in past years were no longer able to be held to the same standard. "Students always have their phones now, so memorizing things that they can google or calculate isn't as important anymore. Getting them to think more than they do is important, and hard."

Theme 4: Post-Covid Professional Identity Perceptions

Aspects of the professional identities of each of the participants were ultimately changed due to the lived teaching experience during the 2020-2021 Covid-19 Pandemic affected school year. Jonker, Marz, and Voogt (2018) noted that teachers fell into four distinct categories of professional identity during the traditional to virtual classroom change process based on whether or not they were willing to accept the change to blended learning or avoid it, and whether they would take an active or passive approach to that change. The four categories of identities: facilitators of student learning (active acceptance), transmitters of knowledge (passive acceptance), personal coaches (passive avoidance), and communicators (active avoidance), are

used as a priori codes to support this theme. While each participant may not fall into one category holistically, aspects of their descriptions of their altered professional identity may align with these category codes. Navigation to or reinforcement of each identity was present in participant comments regarding changes they made to their ongoing teaching as well as their view of themselves as math teachers.

Facilitators of Student Learning

Facilitators actively accept their blended/hybrid learning environment, recognizing important opportunities to facilitate and stimulate student learning (Jonker, et al. 2018). Facilitators were convinced that continued use of the hybrid tools and skills learned and developed during the pandemic closure would be valuable to their post-covid classroom and adjusted their perception of math teaching and of their role as math teachers to fit this belief. Participant 2 had begun to engage with a more facilitative role prior to the onset of Covid-19 and deepened that belief during the 2020-2021 school year. “I use technology when I know it will be beneficial to the lesson and help my students learn. I have moved to much less traditional teaching and allow much more time for students to complete work now.” Participant 2 describes themselves as the de-facto professional development resource for the math department at their school, a role they appreciate but also resent at times when time and energy supporting colleagues would rather have been spent developing instructional materials and planning. Participants 4 and 5 both describe a willingness to “spend more time on fewer problems" and “follow questions down learning roads” while “letting go of some of my old expectations.” They both embraced the use of technology and reduced formality in the classroom during the pandemic and stated that these were elements they intended to continue in their math teaching. Participant 6 stated “not much was working before this, so I want to do something different. This

gave me the chance to try so many things." This active acceptance of the pandemic teaching model was described as "just how I teach now."

Transmitters of Knowledge

Transmitters passively accepted the pandemic teaching experience, describing it as necessary, but not optimal, and would have preferred f2f teaching as well as training on the best practices for implementing virtual or hybrid learning. Transmitters typically did not change their beliefs about teaching but instead created a workable environment in a time of uncertainty. Transmitters also see their primary role as one who delivers teaching and information to students in effective ways, allowing students to then develop understandings. As such, transmitters recognize that continuing hybrid related teaching practices has potential advantages for students. Participant 1 noted the need to continue "to build prerequisite skills into the curriculum and develop specific targets of low level skills moving on." They also noted that their classroom should have more emphasis on structure and routine. Participant 1 supported the idea that new resources were valuable, exciting, and worth investigating when they said "who would have thought we'd have video meetings like this, or check in with kids on Google hangouts? I'm willing to roll with the punches." Participant 3 also noted that "I'm more adventurous. Covid made me willing to check my ego and try new things." Through the forced engagement with virtual teaching and learning, Participant 3 also developed an understanding that "math teaching needs all these different ways to engage kids, especially if anything like Covid ever happens again." Participant 7 shared that "Covid really helped me recognize that kids are independent learners, too. I'm willing to keep incorporating things I'm uncomfortable with because kids like those things."

Personal Coaches

The personal coach passively avoided the hybrid experience, attempting to carry out their teaching in familiar ways. Aspects of the hybrid/virtual learning environment were far worse than in-person teaching because the emphasis on personal interaction and adaptive responses to students was in constant challenge and difficult to employ. The personal coach would try to use technology and virtual teaching techniques but were generally not very confident in their ability to teach as effectively as in a traditional classroom. Participant 7 stated that “some of the tech has helped, but much of it has hindered teaching.” They also claimed “I’m still me, and what I value hasn’t changed. I’m still driven to accomplish their learning, but I’m still the hated teacher because I make them do things. I’m willing to try new things, but I also know what works.”

Chapter Summary

Chapter 4 detailed the findings from semi-structured interviews with seven participants. Interview data indicated that secondary math teachers' professional identities are significantly impacted by life experience prior to teaching, active teaching experience including leadership and environment during teaching, and extreme events like Covid-19. Interviews also showed that participants were comfortable with their professional identities prior to the pandemic teaching experience, but that an established component of their secondary math teacher professional identity was already growth and change as a practitioner, thus securing malleability as essential to their professional identity. Participant narratives about professional identity development in interviews were similar in that many of the teachers interviewed relied on experience, reflection, and feedback when building their identities. Based on IPA analysis of individual interview data, final themes of teacher identity development, motivation, effects of the Covid-19 teaching experience, and post-covid professional identity perceptions were added based on sub-codes and

a priori codes already identified from the literature. Interviewees cited technology, empathy, confidence, and collaboration as essential for post-Covid professional identity development. The themes present an explanation of how each participant encountered and perceived their lived experience as a secondary math teacher during the Covid-19 affected 2020-21 school year. Chapter 5 will discuss those findings as they relate to the research questions and as they have implications to relevant theories and current practice. Included in Chapter 5 will be additional literature not originally included in Chapter 2, but intentionally excluded within the bracketing approach taken for this research. Chapter 5 will also reveal limitations to the study and make recommendations for future research.

Chapter 5 - Discussion, implications, and conclusion

Introduction to Discussion, implications, and conclusion

The unexpected onset of Covid-19 affected school districts across the United States. In New Jersey, school districts were instructed to cease in-person instruction on March 21, 2020, an order which remained in effect for the remainder of the 2019-2020 school year. As a former secondary mathematics teacher and current mathematics education university faculty member, the lived experience of secondary mathematics teachers during the pandemic closures and school alterations was of particular interest to me. While schools in NJ currently continue to focus on learning loss and achievement test results, I sought to bring to the forefront how certain teachers' professional identity has been affected by the 2020-21 Covid-19 pandemic related experience. The idea of professional identity as a potential indicator of change agency recurs in the literature and while professional identity is an autonomous characteristic (Bair, 2014), change through collaboration and innovation can lead to greater satisfaction, growth, and self efficacy (Darling-Hammond, 1995). In this chapter, I will present a summary of the study findings, my interpretation of the research findings, implications of the theoretical framework and for practice, share new literature connected to the research questions, and make recommendations for research and practice.

The purpose of this study was to produce contextual knowledge about the concept of secondary mathematics teachers' professional identity as it related to the changes made to their educational environments due to the Covid-19 pandemic and to more deeply understand the implications of professional identity transformation for this population. Teachers narrated their identity development experiences, listed their beliefs about the important characteristics and

qualities of the professional identities of secondary mathematics teachers, and discussed the influence of the Covid-19 pandemic on their professional identities for this qualitative study. The research was conducted using semi-structured interviews of secondary mathematics teachers in New Jersey who had all experienced teaching during the 2020-2021 pandemic affected school year, an imposed phenomenon leading to virtual and hybrid learning environments. The central research question was: How do secondary mathematics teachers perceive their professional identity following the Covid-19 pandemic? The study also had four research subquestions.

RQ1a: How do teachers describe their teaching experience and professional identity prior to the Covid-19 Pandemic?

RQ1b: How do teachers describe their lived Covid-19 pandemic teaching experience?

RQ1c: How do teachers perceive their current professional identity?

RQ1d: How do teachers describe the change agents most influential to their identity formation?

During the initial responses from the onset of the interview protocol, participants regularly directed their comments toward the pandemic teaching experience. While descriptions of background, career development, and teaching experience were independent of the pandemic, participants framed their commentary with relationships to the 2020-21 Covid-19 timeline. These results led to greater emphasis on the relationship between the pandemic teaching experience and pre-pandemic teaching during the continuing interview protocol. The protocol was designed to determine whether the professional identity of the participants would be affected by an imposed change to their teaching experience, and in what ways. The IPA analysis provided me with a structure in which to analyze the qualitative data and identify the most important themes.

Interpretation of the Research Findings

Overarching Research Question: How do secondary mathematics teachers perceive their professional identity following the Covid-19 pandemic?

The major theme that was revealed through the interview data regarding the overarching question was that the participants believed that they were better teachers now after having lived the pandemic teaching experience. Throughout the interviews, participants described areas in which they'd improved due to the skills and mindsets they'd acquired during the pandemic. Those included becoming more open-minded toward instructional tools and methods that they may not have previously considered. They categorized themselves as better questioners, able to elicit thoughtful responses to mathematical questions as well as thoughtful responses about mathematical thinking. This was coupled with their indications that they'd become better at providing useful feedback to students during the learning process. The participants also expressed a desire to dwell on single math problems longer while giving students a chance to make their thinking visible to others in the classroom during the process instead of completing multiple problems individually. One participant stated "I am definitely a better teacher," while another said, "I've grown in my understanding of the math, how to teach it, and as a colleague to the other teachers I work with." Participant 6 noted that "Covid opened so many doors for me. I'm much more willing to try things in the classroom and give kids space to work the math out," while Participant 5 shared that "Five or 10 years ago if this happened, I'd just send out packets. But now I'm ready for anything, as long as I can help kids learn the math." However, changes to teaching experience and context do not always produce identity change (Vähäsantanen, 2015). Participant 7 stated, "I'm still me and what I value hasn't changed."

Research has identified two types of identity reconstruction processes for teachers when faced with sudden and dramatic changes and layers of difficulties: situational context and interactional context (Zhang, Hwang, 2023). Changes to the situational context associated with remote teaching, altered daily schedule, limited access to materials, modified expectations, and limited training impacted the professional identity of the participants in several ways. The participants describe a reformation of their identities through the practice of teaching in their new situational context. Prior to the pandemic, they'd been using digital tools in various ways in teaching mathematics. Participants shared that they'd assigned digital homework, shared resources through Google Classroom, used the Desmos Activity Builder for interaction and engagement, and enlisted other various tools at their discretion. The pandemic teaching experience changed their situational context to be one where these tools were no longer available as a support, chosen at their leisure, but were now necessary, indispensable, and primary teaching resources. Added to this list of resources was video conferencing, a new tool to all but one of the participants who'd used it during professional development seminars. Interview data showed that using the digital tools, video conferencing software and learning management systems to teach and interact with students reinforced or in some cases, constructed the problem solver component of their teacher identity. Changes to the interactional context, primarily associated with the difficulties of communicating with students in an online environment as well as technological constraints, also impacted the professional identity perceptions of the participants. Participant 4 stated "I don't see myself as a math teacher, but as a teacher who teaches math. I spend much more of my time on SEL now, because kids need it." Participant 1 also stated, "sure I teach math, but I've got to remember that I'm a big part of their support system," while Participant 3 noted, "a lot of these kids don't want to be here. What does that mean for how I interact with them?"

This finding revealed that the situational and interactional changes of teaching during the pandemic altered their beliefs about math teaching, which aligns with the perspective that teacher identity shifts over time and experience (Varghese, et al., 2005).

Upon reflecting on the decisions made during the pandemic and the influence of both the situational and interactional context shifts of pandemic teaching, the participants constructed a compromise of teaching practices that they valued prior to the pandemic and those that were learned during the pandemic in order to move professionally into future teaching practices. Participant 2 stated, “I use technology more now, but mostly to do the things I can’t do, or when it really enhances the lesson.” Participant 3 noted that technology was how students “perceive the world” and should be considered when planning lessons. Others will continue to use video conferencing “to check in with students,” learning management systems “for teaching and not just file sharing,” and digital tools as a way to “meet the unique needs of students.” Two of the interview questions asked were intended to glean understanding regarding these compromises as well as the beliefs established about teacher professional identity during the pandemic.

Participants were asked to describe their ideal math class if they had no restrictions. Responses to this question showed that the participants were willing to make significant changes to both their situational and interactional contexts if given control over those changes. Four participants would have expanded their class block time significantly, one noting “having a big chunk of time during the pandemic made teaching more relaxed and was hard to give up after coming back.” Participant 3 went so far as to mention that “we should consider opening up the schedule for flexibility. Maybe this way isn’t the right way anymore.” Several participants requested more technology in their classrooms, including multiple projection boards, student devices, and subscriptions to digital tools they valued, with two participants noting necessary

infrastructure changes, “to make sure it all works.” The virtual environment also created an awareness of the social aspect of learning, which Participant 5 mentioned, requesting “lots of whiteboards and space for students to be social and work together.” Participant 6 echoed this saying, “we need space and time to teach kids how to have math conversations, then let them have them.” Participant 2 also noted that “during the pandemic I had much smaller class sizes. I never realized how important that was. I’d want smaller classes in the future.” Participants were also asked to share two pieces of advice they would give a new teacher presently entering math teaching in a post-pandemic context. Their responses indicated factors they believed would be significant in forming a new teacher’s identity, some of which pointed toward deeply held beliefs about teaching and being employed in a school setting, while others pointed toward new mindsets about teaching gained from experience. Regarding the former, participants advised that as a new teacher, one should learn the math well and not be overconfident about their ability right away as “arrogance is not a good thing in a new teacher.” They also advised new teachers to observe, talk to, and learn from veteran colleagues and mentors, as “their work and experience and methods will save a lot of effort.” Advice stemming from newer mindsets toward math teaching included comments about being your true self in the classroom. Participant 1 said, “you take ownership of your classroom by being yourself. Inject your real life into your classroom to connect with students,” and Participant 3 said, “be yourself to figure out the most natural way to run a class. Find what you like and don’t like.” Participants also advised new teachers to be open, try new things, avoid stagnation, and be OK with making a lot of mistakes for a few years. Instructionally, no participant advised new math teachers to take on the role of an authority figure or behavior manager, but instead Participant 2 advised to “be a facilitator and not be too controlling. Students are more than capable of doing the math, you’ve just got to get out of their

way," and similarly Participan 5 described taking on the role "of a sherpa, not a gatekeeper for kids. Carry the load, but lead them to the peak." Finally, several participants stated that as a new teacher in a post-Covid school setting, it is easier to become sequestered in your own classroom because all the tools are available online, but that it was important not to let that happen, but instead to connect to students, colleagues and administration in personal ways. "The school is a community, and we lost that community during Covid, so we have to work hard to get it back," Participant 6 mentioned when describing the challenge of regenerating the social culture of the workplace.

RQ1d: How do teachers describe the change agents most influential to their identity formation?

Research subquestions a, b, and c have been addressed in the previous sections, but subquestion d requires specific treatment as it leads to the implications for future research as well. Changes to the professional identity of the teacher participants mentioned in the previous section were the result of many factors, some situational, some interactional, some personal. The direct impact of each of the factors is not measurable in this study, but the participants used language during the interview which demonstrated the impact of three significant factors: technology, instructional technique, and time.

The adoption of technology is influenced by extrinsic factors like time, materials, and training, as well as by intrinsic factors like teacher beliefs about technology and its instructional value. A teacher's self-efficacy awareness when implementing technology also may influence its adoption. Multiple studies have identified these intrinsic factors as a significant barrier to adoption (Lai & Jin, 2021) even after institutional barriers have been overcome. In typical cases, teachers are presented with a technological tool or innovation and either trained on its

implementation or guide their own learning regarding its use. The lens through which these instructional technologies are viewed is then the orientation of teacher professional identity regarding their existing understanding of themselves as educators and the new practices implied by the technology. During the pandemic teaching experience, participants were unable to apply the traditional technology implementation process of selection, training, practice, all within a reasonable time frame. Instead, technology adaptation was left to the individual expertise and comfort level of the teacher. In some cases, participants looked for technology that could replace aspects of their traditional classroom. Participant 4 said, “I used Khan Academy, because I couldn’t give good lessons online, so I used theirs instead. Why redo what was already available?” while Participant 6 created their own videos. “I set up a whiteboard in my basement and started making videos right away to be ready.” Four participants used various online practice websites for homework to replace textbook or worksheet assignments. In other cases, participants used technology not to replace components of their classroom teaching experience, but instead to create a new version of the classroom environment in a digital space. Six of the participants discussed the impact of the Desmos Activity Builder on their teaching experience, noting that it made math accessible to their students from a distance and that they were able to create powerful lessons for their students to engage with. Participant 2 created “all my lessons in Desmos” and Participant 5 went so far as to say, “I’m not sure we could have done what we did without Desmos.” Khan Academy and Desmos were the only digital teaching and learning tools mentioned for continued use in the participants’ post-pandemic classrooms.

Instructional technique during the pandemic remote/hybrid learning context was also noted as having an impact on teacher professional identity redevelopment. The individual teacher's professional identity has been described as having three subsets, being, doing, and

having. The being component describes the concept of the teacher, while the doing component describes the practical actions of the teacher and the having component indicates the professional environment and supports available to the teacher (Avidov-Unger & Forkosh-Baruch, 2017). The doing component of the teacher's professional identity was challenged at the onset of the pandemic closures. Participants 2, 5, and 6 had all begun navigating change to their instructional technique just prior to the pandemic, at the start of the 2019-2020 school year. The problem-based constructivist curriculum program of Illustrative Mathematics and teaching methodology of Peter Liljedahl in his book, Building Thinking Classrooms had developed the participants toward significantly more facilitative roles as mathematics teachers. These practices were leveraged during the virtual and hybrid teaching sessions and were described by Participant 2 as, "the best way to teach. It felt like we almost lost it all when we closed, so I worked to create the same experience the best I could." Participant 6 also referred to their experience with Illustrative Mathematics, noting that they'd tried this program because nothing else was working so far and that, "it totally transformed the way I thought about teaching, and myself as a teacher. Everything I did during Covid was trying to keep teaching like this."

The third factor described as having significant impact on the professional identity formation of the participants, post-pandemic, was their experience with the flexible use of time during the 2020-2021 teaching experience. When schools were closed in March, 2020, several participants were told that they were not able to interact with students virtually until the school district had decided on appropriate protocols for that interaction. During that time, approximately two weeks, participants describe that they were able to develop a plan of action for teaching their students and in some cases, collaborate with each other to create materials, understand and familiarize themselves with potential technology, and discuss teaching with administrators and

special education co-teachers. Participant 6 noted, “I’ve never had that much time to plan before. It was weird, but I felt really ready to come back,” and Participant 2 echoed that sentiment. Participant 4 said, “they told us to make two weeks of sub plans, so I did, but then got busy planning with Khan and IXL so I’d be able to hit the ground running. I used the time to plan.” While the participant responses indicate an increased feeling of confidence and professionalism, extended breaks during the school year, as described in most single-track year-round school models, has not been shown to have any significant impact, positive or negative, on student achievement (McMullen & Rouse, 2010). This does not indicate that there is no impact on teacher professional identity. The second discussion of time as a factor of impact comes with the change to the daily school schedule for participants. Participants 2, 3, 5, 6, and 7 all experienced changes to their daily schedule which elongated individual class periods, although except in the case of Participant 5, students met with teachers only every other day instead of daily. Participants 2, 3, 5, and 6 all noted the increase of student engagement and personal satisfaction during the longer class periods, including a desire for schedules like this when returning to regular instruction. Participant 2 shared that, “it changed the way I see time. There’s no time for wasted things anymore. Why give 20 problems to check in the back of the book when you can work hard on two or three.” Participant 3 requested more flexible timing for teaching in the future and valued it in their identity development enough to state their willingness to change teaching locations saying, “I’m not sure my school will ever change like that. Maybe that means I look for a school that will.”

Implications for Practice and Professional Development

The most relevant results of this study and ones like it are for improvements to practice and professional development. This study examined the lived experiences of seven secondary

math teachers during and after the Covid-19 pandemic and its related closures and alterations to the regular school setting. When schools in NJ closed in March 2020, the participants had little to no time to prepare for and adjust to pandemic teaching and as such, found themselves in need of support and direction (Marshall, et al., 2020). Unfortunately, school leadership and local government had not experienced a situation similar to this yet and had little leadership to offer. Participants expressed feelings of uncertainty and in some cases inadequacy due to the suddenness of the change to remote learning, the limited training and preparation received, and the changing nature of school and government announcements regarding regulations and protocols for covid. Although participants describe their personal development of the use of educational technologies, mathematics specific tools, and remote learning, teachers would benefit from ongoing professional development in emerging technologies and teaching techniques in preparation for both unexpected occurrences like Covid-19 and for school district change initiatives which include planning and rollout. This training is intended to build capacity for change and awareness of identity navigation techniques. Several participants noted that the transition to remote learning would have been much smoother with even small amounts of training and preparation, which could have been achieved through professional development (Hill-Berry, 2016).

Participants also noted the importance of social emotional learning for students as well as support for themselves. Peer relationships were impacted by the secluded nature of remote teaching, and participants noted the energy and intention necessary to regain those peer relationships. School leadership should also recognize their role in developing peer collaborative relationships among teachers, creating opportunities for time to be spent with colleagues both regularly and during extended closures, should they arise. However, in order to realize

professional identity development, teachers should be empowered to lead themselves and each other as well (Darling-Hammond et al., 1995). Leadership must support both the development of relationships and the establishment of a collective culture. Lack of this support has had a critical impact on teachers (Hales et al., 2018) and leadership support has been identified as critical to mitigating identity development tensions and roadblocks (Pillen et al., 2013).

In his presentation to NCTM 2016 conference attendees, Andrew Stadel describes time as the “dirty, four letter word that teachers say every day” (The Math Forum at NCTM, 2016). Providing collaborative time for teachers has been a challenge for school leaders for decades, so the request for more professional collaboration and a schedule that allows for extended blocks of time for reflection and planning could be put aside without pragmatic methods for incorporating it into the current school culture and schedule. I recommend that school leaders perform an analysis of the use of time in their current building schedules to first find ways to construct schedules that allow for common planning time among teachers and that also maximize time students to use effectively, eliminating wasted time where possible and incorporating regularly scheduled opportunities for uninterrupted teacher collaboration, possibly in the form of half day or early release days, for example. The implications of time changes like these will reach into other aspects of the school management system, including transportation, food services, and teacher contractual obligations, but should be investigated nonetheless. A second investigation should be conducted into the complete overhaul of the annual school schedule to one that considers the nature of the use of time. There are existing year-round school model exemplars which have incorporated more frequent groupings of time for teacher collaboration and student investigations that school leaders can research and modify for their community (School of Education, 2020).

Limitations and Additional Literature

This research comes on the heels of a very unique time period during what many may consider to be a once in a lifetime event. At such a time in history, this research may be limited in scope and transferability which should be considered when applying these results. While this study is not limited to a singular school district, it is a small sample of seven participants, limited only to secondary mathematics teachers in the State of New Jersey, which may create limitations regarding transferability to another location or context. Participants were not interviewed during the pandemic, so all accounts are based on active memory of pandemic related events. All participants indicated a feeling of growth and maturity as well as positive effects to teaching based on their pandemic experience. Reasons for this are various, and due to the voluntary response nature of this purposeful sample of teachers, the results may have been more aligned than if the sample was randomized. I have established, professional relationships with the participants in the study, which may have affected their responses, although hopefully regarding their willingness to be more open and not less. And while demographic information of the participants was shared, it was not accounted for or analyzed in any detail for relationships or patterns.

Additional Literature

The focus of this study was on how secondary mathematics teachers perceive their own professional identity having accumulated lived experiences before, during, and after the school related closures and changes associated with the Covid-19 pandemic. While research has now emerged on many topics related to teaching and learning that are associated with the unique lived experiences of teachers during the pandemic, the literature review did not contain that research. The literature reviewed was then intentionally limited to that which was unrelated to pandemic

experiences and in most cases was conducted and published prior to 2020, for the purpose of bracketing my approach to data analysis. The following contains a brief review of additional literature surrounding this topic.

Prior to the Covid-19 pandemic of 2020, most literature on the topic of teacher professional identity change focused on the factors and variables that support the ongoing, long term navigation of the establishment of teacher identity over the course of a career or career move (Beijaard et al. 2004). Some research was established on the topic of teacher identity during the move from in-person face to face teaching to a fully online environment under the supervision of district level change (Jonker et al., 2018). Emerging after the onset of the pandemic and its effects on teachers, students, and schools, is literature on teacher professional identity that can best be categorized using the situational context and the interactional context. In what was described as Emergency Remote Teaching (ERT), the situation teachers found themselves in during the onset of school closures was not what had previously been identified as online or hybrid teaching (Hodges et al., 2020). Online teaching, as experienced most often by university faculty, was often approached by providing a semester or longer for preparation and creation of course materials and instructional approach, and Hodges et al. (2020) notes that many faculty members only develop confidence teaching those online courses after the second or third attempt. Marshall et al. (2020) found that 92.4% of teachers surveyed from mid-March to early April 2020 had never taught online prior to the pandemic and very few had received any formal training in online, remote teaching. This disconnect between prepared online teaching and ERT generated anxiety for many teachers. In a study following the professional training approach of two teachers, one experience and one novice, different components of the training provided were most beneficial to the preparation for remote teaching. When the experienced teacher reflected

on troubles with student homework completion associated with her online teaching methods, she sought training. The novice teacher sought videos, online resources and assessment feedback to generate further training (Huang et al., 2022). While expressing feelings of inadequacy, teachers "were positive about their change in identity in terms of their own learning and growth during the pandemic" (Pinard, 2022). They also requested more training in Social Emotional Learning and expressed a desire to build on their use of technology for future classroom instruction.

A study on Language Teacher Identity showed that "Teachers' past teaching experience is an essential factor for different agentic behaviors although all participants had no online teaching experience before the pandemic. Through practice, teachers reconstruct their identity as a solution seeker, a positive learner, and a confident professional. The results suggest that simply moving face-to-face teaching practice to an online format is not sufficient. Online teaching requires teachers' ability to practice pedagogical flexibility" (Zhang & Hwang, 2023). These additions to the literature support the investigation into pandemic related teacher professional identity redevelopment, including the content area specific investigation of secondary mathematics teachers.

Recommendations

The interpretive phenomenological analysis of the interview data revealed recommendations for further research in several areas. First, recommendations to address research limitations and transferability are made, followed by recommendations for research topics which could enhance the results of this study. Recommendations for practice were made in the Implications section.

Recommendations for research

To address the limitations of this research, it is recommended that the study be replicated in different locations and multiple contexts to better understand the transferability and validity of the results. It is also recommended that this research commence quickly, as the effects of the Covid-19 pandemic on school contexts becomes less measurable over time. It is recommended that the study be replicated on a larger scale, incorporating other content areas than mathematics, or other grade levels including elementary and middle school. School leaders may wish to perform this research within one K-12 school district in order to see if similar themes emerge across grade level bands. Using qualitative or quantitative methods to study participants, such as leaders and teachers with various demographics, could provide a more robust view of teacher professional identity within the lens of pandemic teaching. Although the interview data presented here provides an initial connection between professional identity and unexpected change, a mixed-methods study could also provide strong evidence of a link to the factors which most directly impact identity development, adding more to the body of knowledge on teacher professional identity.

This study also revealed that certain technologies have a broad impact on teaching mathematics. It is recommended that future scholars research the impact that Desmos and the Desmos Activity builder have on mathematics teaching and learning. In particular, what are the effects of using this tool on teacher confidence and teacher professional identity development and reformation? Also, what are the impacts on student achievement and are they correlated to the use of the Desmos Activity Builder, improved teacher confidence, or both?

Worthy of research, as well, is the connection between memory and professional identity, particularly in teachers. Studies have shown that active retrieval of memories often bind the new

circumstances at the time of retrieval to the memory itself (Bridge & Voss, 2014). During the interviews, participants often moved from discussions of their experiences prior to Covid-19 directly into connections with their experiences during the pandemic, without being guided to do so by the question or interviewer. There may be room for investigating the nature of trauma or crisis informed memory development as an agent of change in teacher professional identity.

Reflections

As I reflect on my own professional identity I recognize an ever present desire to become a teacher, myself. For a time, I considered becoming a music teacher, but mathematics continued to emerge as the content area I was most passionate about teaching. My father was a teacher and I had many positive experiences with teachers in my youth that led me to consider teaching. I had negative experiences as well, also leading to my desire to become a math teacher who would not create similar negative experiences for my students. After teaching for over a decade, my career has moved through the path of secondary mathematics teacher, mathematics supervisor and administrator, professional development specialist, and university mathematics education faculty. Although my background creates a lens to the research, I bring a desire to understand the concept of the nature of teacher professional identity to support my current work as a professional development specialist. Understanding how teachers view their situation as it relates to their holistic identity can better prepare me to engage them in professional growth and learning opportunities as well as improve my ability to train future teachers. During the interviews, I saw the passion of the participants for math teaching, as well as the frustrations, emotions, exhaustion, depression, strength and joy of the individuals I spoke with. There is a deep, connected community among math teachers that is often overlooked. It is my hope that this

research not only adds to the field of relevant literature, but also encourages others to look into a much bigger question: Who are my math teachers?

Conclusion

This study investigated how secondary math teacher identity is challenged and reconstructed during and after a crisis affecting all of the school environment. The findings have important implications for schools which are considering moving all or a portion of their teaching to an online modality. There are also implications for change agency and professional development programs which may not have taken into account the identity changes associated with curriculum, technology, or location change for teachers. Teacher professional identities are not easily shaken, so when change is needed, one must consider how to approach established identities. This study reveals that despite initial feelings of shock, uncertainty, and ineffectiveness, secondary mathematics teachers responded to challenges to their identity with a problem solving approach, looking for solutions that best fit their needs as teachers and the needs of their students within their local community. Six out of seven of the participants noted an identity shift to a more nurturing, empathetic individual. Identity theory suggests that a person's identity is significantly impacted by their societal context, which was universally affected by statewide closures. The findings also show that teachers sought support during this time, finding each other when leadership wasn't present. This indicates the importance of a true collaborative culture within schools, and also between teachers from different schools but with similar circumstances. Taken together, the experiences and insights presented point toward a whole teacher approach to growth and change, as well as a whole person approach to pre-service teacher development by creating and nurturing a supportive, collaborative, flexible environment for teacher professional identities to be built and rebuilt.

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Appendix A - Participant Demographics

Appendix A

Participant Demographics

Participant ID	Age	Gender ID M/F/NB	No. Years Teaching	Years at Current School	Highest Degree Level
Participant 1	27	M	7	7	Master’s
Participant 2	34	M	12	12	Master’s
Participant 3	44	F	20	12	Bachelor’s
Participant 4	37	M	15	4	Master’s
Participant 5	45	M	24	20	Bachelor’s
Participant 6	40	F	19	19	Master’s
Participant 7	42	F	20	20	Master’s

Appendix B - Semi-Structured Interview Protocol

Denis Sheeran
Semi-Structured Interview Protocol

Introduction script:
“Good morning/afternoon. My name is Denis, and I’m a graduate student at Kansas State University studying for a doctorate in curriculum and instruction. During this interview, you will be asked about your experience being a teacher. I’m interested in your experiences relating to your choice to become a teacher and your experience as a professional since then. The questions will ask you to think about your decision to become a teacher, your experience as a teacher, and also your experience as a teacher as it relates to the recent Covid-19 pandemic. If some questions do not apply to you, please let me know that. Also know that your answers will remain confidential, meaning that only I will know to whom the responses belong, which is necessary should the need for a follow-up interview arise. Take a moment to get a pencil and piece of paper we’ll need for a question. If you’re ready, I’ll begin.”

Demographic
-How old are you?
-What courses do you currently teach:
-How many years of teaching experience do you have?
    Have they all been at your current school?
-What is your highest level of education?
-Is your educational background in mathematics education, or did you switch from another profession?
-What grade levels do you teach?

Teaching Career so Far
-Can you give an overview of your teaching career so far?
-Why did you decide to go into teaching, specifically math teaching?

    Probe: Family history, current family needs
    Probe: other reasons or interests that arise in the answer.

-Has there ever been a time you considered leaving teaching?
-What factor or factors have made you stay in the field of teaching?

-Can you talk about periods you felt less confident? What factors contributed to these feelings?
    probe : in-person or virtual
-Can you talk about periods when you were more confident? What factors contributed to your increased confidence?
    probe : in-person or virtual

-Has your perception of teaching changed since you first began?
-How?

COMMENT SCRIPT:
“Thank you for sharing your responses so far. I’d like to shift now to some of your views on yourself as a teacher, and teachers in general.”

Teacher Identity
-How would you define teacher professional identity?

-How would you identify yourself as a person and as a teacher?

-Discuss any positive or negative experiences affecting the formation of your teacher identity.

-Do you think there are different kinds of teachers? If so, what kinds?

-What qualities do you think make a good teacher?

-What defines you as a teacher, specifically a mathematics teacher?

-How do you think others, not-teachers, see teachers?

-Talk about your first day in the classroom.

-Talk about your best experience as a teacher

-Are there moments in your teaching that you would like to forget

-Do you ever feel proud to be a teacher?

-What makes you feel proud? What factors contribute to this feeling?

COMMENT SCRIPT:
“Thanks. I appreciate your personal thoughts in that section. I want to move on now to your experiences over the past year as they relate to Covid-19 and your teaching experience.”

Pandemic Specific Experiences
-Can you describe a typical day for you as a teacher prior to the spring pandemic closures

-Can you describe a typical day for you as a teacher in the post-pandemic closure school environment?

-Can you tell me about how you felt the day you heard school would close due to Covid-19?
-Describe your emotions regarding the two experiences.

-Tell me about your experience specifically as a teacher in a virtual/hybrid classroom.

-How has teaching through the covid-19 pandemic affected your view of math teaching?

-How has teaching through the covid-19 pandemic affected your view of yourself as a math teacher?

-What aspects of the covid-19 teaching experience have made the most impact on your teaching?

COMMENT SCRIPT:
“I’d like to close with a few more questions regarding your view of the future of your teaching experience. This is clearly speculation, but please be as honest as possible in your responses. Take your time as you think and respond.”

-Please describe what you would like an ideal math class to be if you had no restrictions?

-If you had 2 pieces of advice to give a new math teacher in your school, what would they be?

-Describe any other ways you believe you’ve changed, for the better or the worse or both, as a result of the pandemic.
As a teacher?

Closing Script:
“Thank you again for taking the time to meet with me for this interview today. I appreciate your responses and openness regarding your experiences as a teacher. If I have any follow-up questions for further research, I may reach out to you for a second interview. Before we close, do you have any final thoughts that you wanted to share with me but did not come up in our questions? Do you have any questions for me? Thank you again, you have been very helpful.”

Appendix C - Research Request

Denis Sheeran

To: Denis Sheeran

Fri 9/30/2022 4:56 PM

Bcc: [redacted]

Hi!
I hope the start of your school year is going great. I'm reaching out to you in the hopes that you'll be able to participate in my dissertation research study about Secondary Math teachers' perspectives on Post Covid-19 math teaching. I'd be honored if you were open to participating in this study.

If you're willing to participate, I'd like to schedule a one-on-one interview with you at a time that works for you, either in person or over Zoom. During the interview, you will be asked to share about your teaching experience before, during, and after Covid-19 closures and also about your perceptions of yourself as a teacher. The interview will be audio recorded with your permission and will take approximately 60 minutes.

Please complete this form to indicate if you're willing to participate or if you decline, and also select your interview availability.

If you have any questions regarding this study, please contact me at dsheeran@ksu.edu.

Thank you for considering participating, and I hope to be able to talk with you soon!

Sincerely,

Denis Sheeran
Doctoral Student
Kansas State University
Curriculum & Instruction
This study has been approved by the Kansas State University Institutional Review Board (IRB-11317).

Appendix D - IRB Approval

KANSAS STATE UNIVERSITY | University Research Compliance Office

TO: J. Spencer Clark
Curriculum and Instruction
Manhattan, KS 66506

Proposal Number: IRB-11317

FROM: Lisa Rubin, Chair
Committee on Research Involving Human Subjects

DATE: 09/20/2022

RE: Proposal Entitled, "Understanding Covid-19 Pandemic Related Effects on Secondary Mathematics Teachers' Perception of Their Professional Identity."

The Committee on Research Involving Human Subjects / Institutional Review Board (IRB) for Kansas State University has reviewed the proposal identified above and has determined that it is EXEMPT from further IRB review. This exemption applies only to the proposal - as written – and currently on file with the IRB. Any change potentially affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Based upon information provided to the IRB, this activity is exempt under the criteria set forth in the Federal Policy for the Protection of Human Subjects, **45 CFR §104(d), category:Exempt Category 2 Subsection ii.**

Certain research is exempt from the requirements of HHS/OHRP regulations. A determination that research is exempt does not imply that investigators have no ethical responsibilities to subjects in such research; it means only that the regulatory requirements related to IRB review, informed consent, and assurance of compliance do not apply to the research.

Any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Committee on Research Involving Human Subjects, the University Research Compliance Office, and if the subjects are KSU students, to the Director of the Student Health Center.

Electronically signed by Phill Vardiman on 09/20/2022 5:26 PM ET
On Behalf of IRB Chair