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UAE KINDERGARTEN TEACHERS’ MATHEMATICAL BELIEFS AND SELF-REPORTED PRACTICES

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Cover: Raising a child to love mathematics

(Photo: by Mausmi Jadhav)

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Declaration of Original Work

I, Mausmi Dilip Jadhav, the undersigned, a graduate student at the United Arab Emirates University (UAEU), and the author of this thesis entitled "*UAE Kindergarten Teachers' Mathematical Beliefs and Self-Reported Practices*", hereby, solemnly declare that this thesis is my own original research work that has been done and prepared by me under the supervision of Dr. Shashidhar Belbase, in the College of Education at UAEU. This work has not previously formed the basis for the award of any academic degree, diploma or a similar title at this or any other university. Any materials borrowed from other sources (whether published or unpublished) and relied upon or included in my thesis have been properly cited and acknowledged in accordance with appropriate academic conventions. I further declare that there is no potential conflict of interest with respect to the research, data collection, authorship, presentation and/or publication of this thesis.

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Abstract

Research stresses that young children must be nurtured and encouraged to develop cognitive processes of higher order thinking skills from a young age in order to excel in later years. According to the joint position statement issued by the National Association for the Education of Young Children and the National Council of Teachers of Mathematics (2010), which was endorsed by the Ministry of Education, UAE, all kindergarten teachers should practice developmentally appropriate mathematics instruction to promote mathematical thinking. However, there is a paucity of research that reflects the beliefs and confidence of the UAE kindergarten teachers in facilitating developmentally appropriate mathematics practices. A mixed-method study was conducted in order to explore the beliefs, practices, and confidence of UAE kindergarten teachers in teaching mathematics. The study analyzed surveys from ninety teachers employed in public and private schools and interviewed four teachers. According to the findings, the participants believed that kindergarten mathematics was developmentally appropriate and necessary, and that kindergarten students were ready for it. However, while most teachers shared similar beliefs, their practices differed. The other noteworthy finding from this study was that participants had higher levels of PCK for number sense, operations, and measures than for shapes, spatial connections, patterns, and classifications. As a result, it is recommended that teachers should undergo continuous professional development and training that allows them to learn, critically assess, and contemplate mathematics contents, as well as their beliefs, prejudices, and pedagogy.

Keywords: kindergarten teachers' beliefs, developmentally appropriate mathematics practices, PCK, mathematical thinking.

Title and Abstract (in Arabic)

المعتقدات والممارسات الذاتية في مادة الرياضيات لمعلمي رياض الأطفال في دولة الإمارات العربية المتحدة

الملخص

تؤكد الأبحاث أنه يجب تربية الأطفال الصغار وتشجيعهم على تطوير إدراكهم لمستويات تفكير عليا منذ سن مبكرة لأجل التفوق في السنوات القادمة. وفقًا لبيان الموقف المشترك الصادر عن الجمعية الوطنية لتعليم الأطفال الصغار والمجلس الوطني لمعلمي الرياضيات (2010)، والذي أقرته وزارة التربية والتعليم في دولة الإمارات العربية المتحدة، يجب على جميع معلمي رياض الأطفال تدريس الرياضيات بشكل يعزز نمو التفكير الحسابي. ومع ذلك ، فهناك ندرة من الأبحاث التي تعكس معتقدات وثقة معلمي رياض الأطفال في دولة الإمارات العربية المتحدة في تيسير الممارسات الحسابية المناسبة تنمويًا. من أجل معرفة معتقدات وممارسات وثقة معلمي رياض الأطفال في دولة الإمارات العربية المتحدة ، تم إجراء دراسة مختلطة الأساليب. حللت الدراسة استطلاعات رأي تسعين معلمًا يعملون في المدارس الحكومية والخاصة وأجرت مقابلات مع أربعة معلمين. وبناءاً على هذه النتائج، يعتقد المشاركون أن رياضيات رياض الأطفال مناسبة من الناحية التنموية وضرورية وأن طلاب رياض الأطفال جاهزون لها. ومع أن معظم المعلمين يتشاركون معتقدات متشابهة ، إلا أن ممارساتهم اختلفت. الاكتشاف الآخر الجدير بالملاحظة في هذه الدراسة هو أن المشاركين لديهم مستويات أعلى في معرفة المحتوى التربوي لمعنى الأرقام والعمليات والقياسات مقارنة بالأشكال والوصلات المكانية والأنماط والتصنيف. نتيجة لذلك ، يوصى بأن يخضع المعلمون للتطوير المهني المستمر والتدريب الذي يسمح لهم بالتعلم والتقييم النقدي والتفكير في محتوى الرياضيات ومعتقداتهم وأحكامهم المسبقة وطرق التدريس.

مفاهيم البحث الرئيسية: معتقدات معلمي رياض الأطفال، ممارسات الرياضيات المناسبة تنمويًا، التفكير الرياضي.

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Mausmi Jadhav is a daughter, a wife, a mother, and a life-long learner. She has 18 years of experience teaching mathematics at elementary, middle grades, secondary levels, and college levels. After completing her Bachelor of Education, she joined IAT/ATHS as a mathematics teacher and was soon promoted to a curriculum developer. As a member of the curriculum development unit, she was responsible for aligning mathematics content, professional development of staff, and creating assessments. During her time at IAT and HCT, she also served as a campus pedagogy leader, developing, designing, and implementing integrated project(s) documentation, course learning summaries, and teaching/learning plans. At HCT, she played a key role in the world's largest mobile learning implementation in higher education. She was heavily involved in creating and facilitating training to departmental and inter-departmental faculty teams on various campuses to integrate technology including AR. Her research interests are intellectual development, mathematics education, integrating technology, and teacher-training.

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Dedication

To my beloved son Micah.

I love you to infinity and beyond.

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List of Abbreviations

DAP	Developmentally Appropriate Practices
KG	Kindergarten
KGTB	Kindergarten Teachers' Beliefs
KGTB about DAMP	Kindergarten Teachers' Beliefs about Developmentally Appropriate Teaching Practices
KGTB about TL	Kindergarten Teachers' Beliefs about Teaching and Learning
KGTC about TM	Kindergarten Teachers' Confidence about Teaching Mathematics
MPCK	Mathematics Pedagogical Content Knowledge
PCK	Pedagogical Content Knowledge

Chapter 1: Introduction

1.1 Overview

Science tells us that during the first few years of a child's life, more than a million new neural connections are formed within the brain every second. According to Harvard scholars (Center of the Developing Child, 2007), these neural interactions are precisely what constructs the brain's architecture and lays the foundation for all subsequent learning, behavior, and health. Such studies inform us that a child's environment and early experiences play a significant role in the development of these neurons.

Studies of early cognitive development have led researchers to realize that children begin learning the day they are born (Carey, 2009; Gopnik & Wellman, 2012; Spelke & Kinzler, 2007). Such studies on developing minds have now been embraced by the field of early childhood education, which has acknowledged that a young child's early childhood experiences are critical to their long-term development and health. Furthermore, the studies emphasize that children learn in developmental sequences and hence early childhood education is essential at an early age, as the studies clarify that the brain develops at the fastest rate between birth and age eight, making early experiences critical to a child's success (IOM & NRC, 2015). Early childhood education is therefore regarded as one of the major stages of human development, the stage where cognitive, social, emotional and personal characteristics are developed. Children's ability to construct new knowledge, adapt to new situations, learn, and gain new skills and experiences are particularly noticeable during this period.

Evidence suggests that young children have the potential to grasp a range of mathematical principles well before entering school (Clements &

Sarama, 2007; Klein, Starkey, Sarama, Clements, & Iyer, 2008). Numerous studies have revealed that preschool mathematics knowledge is a strong predictor of subsequent high school mathematics achievement (Koponen, Salmi, Eklund, & Aro, 2013; Passolunghi, Vercelloni, & Schadee, 2007; National Mathematics Advisory Panel, 2008; National Research Council, 2009). As a result, there has been a shift in the needs and demands of early childhood programs which are now more than ever expected to incorporate mathematics teaching in preschools (Clements & Sarama, 2008; NAEYC, 2009; Lee & Ginsburg, 2007). Given the increasing importance of overall academic success (Sadler & Tai, 2007), early childhood mathematics programs have drawn international interest, as seen in increased support for programs such as curriculum development (Clements & Sarama, 2007), enriching teacher quality (Thornton, Crim, & Hawkins, 2009), and examining the willingness of young children to engage in mathematical reasoning (Baroody, Lai, Li, & Baroody, 2009; Baroody, Lai, & Li, 2008).

In recent years, the United Arab Emirates (UAE) has become increasingly mindful of the importance of early childhood education. The UAE Ministry of Education (MoE) has recognized the 0-6 age group as the definition of the early childhood period. This encompasses the years leading up to compulsory education (Grade 1), which begins at age 6 in accordance with UAE federal law (MoE, 2021). Acknowledging the critical importance of early childhood period in the human development cycle, early mathematics education and the levels of young children's mathematics knowledge have received increased attention from UAE educators, researchers, and policymakers. UAE stakeholders support the belief that young children are born ready to learn and that they possess remarkably broad, complex albeit informal math knowledge (Baroody, 2006; Clarke, Clarke, & Cheeseman, 2006; Clements, Swaminathan, Hannibal, & Sarama, 1999; Fuson, 2004; Thomson, Rowe, Underwood, & Peck, 2005) and are capable of learning complex mathematics (Boaler, 2019; Zippert & Rittle-Johnson, 2018), to the extent that they can learn more in their preschool years than was previously thought (National Research Council, 2001) .

However, the shift to a belief that the early childhood program should provide cognitive development experiences has created a misalliance between the teachers' and the growing expectations of various stakeholders. The main concern guiding the development of early childhood mathematics education programs in the UAE is the need for teachers to link content knowledge and knowledge of major developmental milestones to instructional practices and provide a high-quality learning environment to support children's growth in mathematics. Then again, the successful execution of a pre-school mathematics program is largely dependent on the teachers since they are the ones who eventually decide the mathematics learning activities that will be incorporated into their instructional practice (NAEYC, 2009). Besides, studies have revealed that suggested best practices for teacher educators are almost inevitably filtered through the prism of teachers' personal beliefs, influencing their teaching practices (Lee & Ginsburg, 2007). Additionally, efforts to reform or strengthen teaching practices without taking into account teachers' beliefs have often culminated in superficial changes laden with misunderstandings and misinterpretations (Ryan, 2004), or, much worse, strong resistance to change (Bailey, 2000). To realize high-quality mathematics education in kindergarten classrooms, it is more important than ever to understand the beliefs, knowledge, and instructional practices of kindergarten teachers in relation to the teaching and learning of mathematics. Thus, this study aims to investigate the beliefs and practices of UAE kindergarten teachers to gain a better understanding of how mathematics is taught and learned.

1.2 Statement of the Problem

A study carried out by Booz and Company revealed that “lack of well-trained teachers, outdated teaching methods, curricula that are neither relevant nor innovative, limited use of technology in the classroom, and little in the way of academic advice or career counseling are contributing to the mismatch between the outputs of the GCC’s education system and the needs of the employment market” (Arabian Gazette, 2013). In the following year, an updated report from Programme for International Assessment (PISA) published by the Organization for Economic Cooperation and Development (OECD) stated that UAE students were far below their global peers in mathematics and problem-solving (OECD, 2015). These findings did not go unnoticed by UAE policymakers and educators and in 2016, systematic changes to the K-12 program for public schools were announced by the Ministry of Education in order to meet the UAE’s 2021 National Agenda goals (UAE Vision 2021 National Agenda, n.d.).

The UAE’s recent reform initiative promotes student-centered teaching practices that lay emphasis on creativity, inquiry-based learning, problem solving, comprehension and discussion (NCTM, 2000; 2014; UAE Vision 2021 National Agenda, n.d.; UAE Centennial 2071, n.d.). A study carried out by Little (1993) suggests that, reform efforts aimed to enhance or foster educational practices often require teachers to abandon some of their founded beliefs and existing practices. Teachers' beliefs and practices must be consistent with the curriculum's or reform effort's fundamental ideas; because only if the teachers believe in them, will they lead the way in adopting them (Battista, 1994). In some instances, it was also observed that even though teachers’ beliefs aligned with the reform ideologies, the conventional nature of the educational systems made it difficult for the teachers to transform their beliefs into practice, therefore, making studies on teachers' beliefs and practices critical to consider when adopting reform agendas (Handal, 2003). Beswick (2012) informs us that, "beliefs related to specific aspects of the particular context in which a teacher is working can also influence which other beliefs are most influential in terms of shaping their practice in that context" (p. 129).

In light of current curricular reform to advance science, technology, engineering, arts and mathematics (STEAM) education and due to the complex nature of teachers' beliefs about mathematics teaching and learning, it is more important than ever before to understand the UAE kindergarten teachers' beliefs in order to realize high quality mathematics practices in kindergarten classrooms. In addition to these concerns around UAE kindergarten teachers' beliefs about mathematics teaching and learning, searches appear to reveal that there is no existing research that examines how the UAE kindergarten teachers design learning experiences to support preschoolers' progression along the learning trajectories in mathematics.

1.3 Purpose of the Study

In response to the recent reforms announced by the UAE government and to fill in the gap in existing research, the focus of this study is to measure the UAE kindergarten in-service teachers' knowledge of pre-school students' mathematical development and explore their beliefs on teaching mathematics to young learners. Teachers can provide a high-quality, positive learning environment for young children in order to build the necessary foundation for lifelong mathematical learning. However, teachers' previous educational experiences in mathematics (Ball, 1998) and their perceptions about the developmental ability of young learners are some issues that undermine the quality of mathematics in kindergarten programs.

At the onset of this study, it was speculated that kindergarten teachers had less favorable mathematical experiences and may have concerns about their ability to teach mathematics effectively. The study examines the relationship between teachers’ beliefs about mathematics, their mathematics teaching practices and their confidence in teaching mathematics to kindergartens. The following research questions were developed to better understand the in-service kindergarten teachers’ beliefs and practices about the teaching and learning of mathematics.

Research Questions

1. What are UAE kindergarten teachers’ beliefs about the nature of teaching and learning of mathematics to kindergarteners (4 to 6 years)?
2. What are UAE kindergarten teachers’ beliefs about the nature of developmentally appropriate mathematics practices?
3. How confident are UAE kindergarten teachers in helping kindergarteners learn math?
4. Is there a correlation between teachers’ mathematical beliefs, teaching practices and teachers’ confidence?

1.4 Significance of the Study

National and international educational policymakers (NAEYC, 2020; NCTM, 2014; OECD, 2020) have recognized the importance of mathematical competency in young children, advocating for high quality mathematics programs. And in recent times, there has been a noticeable change in UAE national policymakers' attitudes toward the importance of cognitive development and quality education in the kindergarten years (MoE, 2021). Thus, this study is of particular importance, because there are so few studies in general, on the beliefs of practicing kindergarten educators. Preservice teacher beliefs about mathematics teaching have been the subject of several study agendas (Jung, Brown, & Karp, 2014; Hudson, Kloosterman, & Galin, 2012; Lee, 2017) and have provided valuable insights into the efficient delivery of professional learning programs for mathematics teachers. There is, nonetheless, a scarcity of studies on the beliefs of current teachers in the field. In addition to these concerns, most previous studies in the field have taken place in Western countries and are therefore largely dictated by Western beliefs, values and perceptions. There is very little mixed-methods empirical evidence available to date from non-Western countries, and none from the UAE. As such, findings identified in previous studies conducted in Western contexts may not necessarily, or at least not fully, reflect the actual relationship of the UAE kindergarten teacher beliefs.

In view of this gap in the literature, the aim of this research is to examine the relationship between practicing kindergarten teachers' beliefs toward mathematics, their mathematics teaching practices and their confidence in teaching mathematics to kindergartens. Findings will thus provide rich evidence for the understanding of how teacher beliefs and knowledge of pre-school students' mathematical development guide instructional practices. These findings can contribute to the field of teacher training and professional development for both pre-service and in-service kindergarten teachers in the UAE. Moreover, as teachers gain more understanding of young children's cognition and brain development, they will then be able to create high-quality learning environments. These high-quality, mathematics rich, learning spaces will increase mathematics interactions between students and teachers (Reinking, 2015) and will help children in realizing their mathematics potential (Doig, McCrae, & Rowe, 2003; Thomson, Rowe, Underwood, & Peck, 2005).

1.5 Definitions

Beliefs and Knowledge: Pajares (1992) juxtaposed beliefs to knowledge, and stated, "belief is based on evaluation and judgment; knowledge is based on objective fact" (p. 313).

Cognitive Knowledge: Cognitive development is a way of addressing the changes in thinking, or cognition, that "emerge over the course of ontogeny as a result of the dynamic and reciprocal transactions between a child's biological constitution, including genetics, and his or her physical and social environment" (Bjorklund, 2013, p. 449).

Developmentally appropriate practices (DAP): DAP is defined as recognizing multiple assets about child development, including each child's social, physical, cognitive, emotional and motor domains of development, in order to make informed decisions during the teaching process to promote children's learning and development (NAEYC, 2009).

Kindergarten students: Programs for children (from ages 4 to 6) that "take place in children's own homes and in public schools and in private preschools" (Bowman, 1993, p. 101).

Teachers Beliefs: Beliefs, as noted by Philip (2007) are characterized as "psychologically held understandings, premises, or propositions about the world that are thought to be true" (p. 259).

1.6 Review of Literature

In recent years, the UAE's early childhood education sector has received increased attention, especially early childhood teachers and the quality of education they offer to their residents. These developments necessitate increased accountability with regard to high-quality, developmentally appropriate and culturally responsive teaching. As a result, the early childhood teacher’s pedagogy has undergone considerable change, with reforms to the national kindergarten curriculum and practices, as well as amendments to the accountabilities of kindergarten teachers' responsibilities and functions (MoE, 2021).

Literature relevant to this study is drawn from research on cognitive development, teachers’ beliefs in the context of early mathematics education and learning and developmentally appropriate practices. The guiding principle for this review is that teachers' teaching approaches and decisions are driven by their own personal experience and belief systems (Vartuli S. , 1999), rather than theoretical understanding of child development and learning. Teachers usually teach subject matter based on the beliefs they hold of the subject itself. As such, the study was framed around the assumption that teacher beliefs are conditioned by a) the teacher's implicit theories in guiding instruction, b) the teachers’ experience and qualifications, and c) the teacher's situated pedagogical awareness and beliefs. The review is organized in two board sections, namely, the theoretical framework within which this study was carried out and existing research on teachers’ beliefs.

1.6.1 Theoretical Framework

Early childhood education in the UAE is rooted in constructivism. Constructivist approach to teaching and learning is a combination of cognitive psychology research and social psychology research. Cognitive constructivism was founded from the work of Jean Piaget and Jerome Bruner, while Vygotsky's approach to child development was social constructivism in nature. According to constructivist theorists the core concept of constructivism is that learning is an active, social and reflective process (Bruner, 1973; Piaget, 1950; Piaget, 1953; Vygotsky, 1978) and it occurs through opportunities initiated by the teacher through "social interaction within the community of learners such that the learners may move from what they know to what they don't yet know, from their own experiences to a new understanding of the disciplines represented by the content they are studying" (Celce-Murcia, 2001). Constructivism perceives learning to be a process of making sense and meaning of new knowledge (Vacca et al., 2006).

In the UAE, cognitive developmental theories have served to inform reform policies, developmentally appropriate teaching practices and professional development in the UAE early childhood education context. These standards and guidelines have influenced how teachers approach children's development and learning. Embedded in the curricular reforms is the view that children are active learners who learn through interactions with their physical environment, a notion put forward by Jean Piaget (1953). Research has revealed that teachers' philosophy and beliefs have an impact on teaching and learning (Fang, 1996), and that teachers use their beliefs and understanding to determine what children need to learn in the classroom (Munby, 1982). Hence, to better understand classroom practices there is a need to examine how teachers perceive children's ability to learn (Bell, 1990; McLachlan-Smith & St. George, 2000; Miller & Smith, 2004).

To gain a wholesome understanding of children's growth and thought processes, it is necessary for pre-school teachers to understand the underlying principles of cognitive development theories. These theories address a wide range of topics, including social interaction, learning and memory, information storage and recall, language and expression, and they influence how teachers arrange physical environments and structure their approaches to support pre-school children's learning (Dewey, 1938; Piaget, 1950). The complexity of the environment a teacher creates to promote a pre-school student's learning is influenced by the teacher's perception and comprehension of child development.

The purpose of this study’s theoretical framework is to uphold that a sound command of children's cognitive development and learning should be an essential part of every early childhood educator's knowledge base, since they offer teachers a thorough understanding of all aspects of a child's development, including physical, cognitive, social, educational, and emotional development. The scientific interpretation of how young children grow and learn will help teachers to improve their teaching philosophy and beliefs. It is beyond the reach of this initial study to cover every aspect of the psychology literature and cognitive development. Therefore, this section offers a comprehensive summary of the literature only on early childhood cognitive development and how the theories can be used to examine their contribution to teachers’ practices and beliefs.

1.6.1.1 Cognitive Development

The term cognitive development relates to how people think as they grow older. And because there are no distinct borders separating thinking from other mental operations, cognition is an elusive concept. Problem solving, comprehending, classifying, remembering, planning, and other higher mental functions are all part of thinking. However, thinking also includes more fundamental mental processes, such as information processing, interacting with the environment, spatial abilities, reasoning, language and memory (Gottfredson, 1997). Thus, cognitive development in early childhood years is about how young children think, explore and construct knowledge, as well as about the development of the brain.

Early cognitive abilities have been found to predict subsequent cognitive competence (Rose, Feldman, Futterweit, & Jankowski, 1998) and have shown to affect academic accomplishment, career success, and social adjustment (Fergusson, Horwood, & Ridder, 2005). Thus, the primary goal of cognitive development research and theory is to characterize the development of children's core conceptions across time and to explain the process by which these concepts are learned and employed (Carpenter, 1979).

In the twentieth century, Piaget (1950) and Vygotsky (1978) proposed two hugely influential, detailed theoretical frameworks, which even today continue to guide the majority of cognitive developmental research. Recent contributions to cognitive development theories include information-processing theory, which focuses on how information is stored into human memory, and neuroconstructivism, which focuses on the formation of representations in the developing mind.

The study of cognitive development, as represented by the works of Piaget and his successors from an organismic perspective, is the study of the development of cognitive systems. The field of cognitive development is extensive and impossible to clearly define here. The majority of research that has the greatest potential impact on mathematics teaching and learning is based on Piaget's work. Therefore, in order to evaluate teachers' practices and beliefs, it is necessary to examine Piaget's theory in the context of early childhood development.

1.6.1.2 Piaget's Theory

The cognitive stage theory devised by Jean Piaget, is one of the most well-known perspectives on cognitive development. Flavell, Miller, and Miller in their book about theories of development stated that: "theories of cognitive development can be divided into B. P. (Before Piaget), and A. P. (After Piaget), because of the impact of his theory on the theorizing that came thereafter" (Flavell, Miller, & Miller, 2002, p. 8), and added that Piaget had "the greenest thumb ever for unearthing fascinating and significant developmental progressions" (Flavell, 1996, p. 202).

Piaget observed and tested how children learn to think critically and scientifically over time. He dedicated his life answering fundamental philosophical questions about how children acquire knowledge. While other theorists focused on what children learned, Piaget was intrigued by the complexity of how children think (Piaget, 1948). His cognitive growth theory, or constructivism, focused on a child's age-stage development is still used as a framework for early childhood pedagogy. According to Piaget's constructivist perspective, children are active constructors of their knowledge and develop intellect as a result of their active engagement with the world (Piaget, 1953). Sensorimotor intelligence (18 – 24 months), preoperational thinking (2 – 6 years), concrete operational thinking (7 – 12 years), and formal operational thinking (13 – adulthood) are the four main phases of cognitive learning suggested by Piaget. He concluded that children's cognitive development followed a sequential pattern and accordingly their intellectual capacity expanded (Piaget, 1950, 1952, 1953, 1959).

Piaget's theory was based on the principle of equilibration, which he explained as all cognitive growth (both intellectual and affective development) advanced towards more nuanced and stable forms of development. According to Piaget (1932), equilibration occurred as a result of the assimilation of new knowledge into current cognitive structures and the accommodation of that information by the creation of new cognitive structures. For example, even though a learner understood that multiplying by ten is to multiply by one and then add a zero: 11 x 10 = 110, there are certain constraints. As such, assimilating lead to a misconception: 1.1 x 10 =

1.10, because although this method works with whole numbers, it does not work well with all types of numbers. Accordingly, learners must adapt their existing cognitive structures to accommodate the newly learned material to address the new type of problem (Piaget, 1952). Piaget (1950, 1952) affirmed that children advanced through the preoperational stage by overcoming conflicts between existing mental constructs and new understanding, which allowed them to develop new mental structures. This equilibrium between assimilation and accommodation, was the basis for constructing new knowledge (Martin, 2000). Piaget's constructivist philosophy revolutionized curriculum design, emphasizing exploration learning and children actively constructing their own knowledge to make sense of the world. As a result of Piaget’s theory, terms like "readiness", "assimilation", "accommodation", "sensorimotor", and "preoperational" are now increasingly used to associate early childhood development, learning and developmental practices.

Piaget identified three forms of knowledge: physical knowledge, social-conventional knowledge, and logico-mathematical knowledge (Piaget 1952, 1968). He referred to physical knowledge as the knowledge constructed by children about the physical objects found in the environment. Piaget believed in challenging a child’s abilities and using physical interactions with objects to teach (Furth & Wachs, 1974). He stated that concepts and knowledge cannot be transmitted from teacher to learner. Instead, it was essential that the learner constructs his or her own knowledge derived from concrete experiences. For him social-conventional knowledge involved the interpretation of concepts and labels that people constructed as truths (ex: days of the weeks, numerals, etc.). And logico-mathematical knowledge he referred to the creation of relationships. According to Piaget, young learners did not gain mathematical knowledge from others, including teachers, but rather they build mathematical knowledge by drawing associations between existing knowledge and new information and experiences. Piaget believed that the root of this form of information was situated within the child, and each child constructed it inside his or her own brain. For Piaget learning numbers was not an innate characteristic, but rather something that was built inside the minds of human beings. Piaget reckoned that “the explanation of cognitive behavior by means of innate ideas is, in general, a facile and rather lazy solution” (Piaget, 1968, p.978). He reasoned that numbers were constructs of relationships and assumed that numerical cognition was inherent to humans. Piaget considered the teacher's position to be primarily as a facilitator of students and remarked that the teacher should not be manipulative or authoritative.

Piaget (1952) emphasized the necessity of children learning not just how to count but also how to understand numerical relationships, especially cardinal and ordinal numbers. Piaget argued that children must be able to comprehend the cardinal and ordinal properties of numbers in order to truly understand their meanings. According to Piaget, young children's counting was a prime indication of them employing words without comprehending what they meant. His conclusion was drawn on evidence gathered during his well-known conservation, transitivity, and seriation studies. He conducted a series of conservation experiments with preschool children and concluded that young children do not comprehend one-to-one correspondence and so have no grasp of cardinality. Similarly, he conducted seriation and transitivity experiments and claimed that young children were incapable of dealing with a series of relations. Through these experiments Piaget proved that preschoolers are unable to comprehend the number sequence as an increasing magnitude sequence i.e. children are unable to grasp that if A is greater than B and B is greater than C, then A is also greater than C. Piaget also asserted that children's comprehension of number is dependent on their grasp of the additive composition of number. For instance, he claimed that knowing how to calculate 3 + 2 = 5 and 5 – 3 = 2 was not enough, but young children should also comprehend how one operation cancels out the other (Piaget, 1952). Thus, Piaget’s main focus was on how young children process information rather than what specific knowledge they possessed at any given time. His research concentrated on logical inference principles like conservation, transitivity, and seriation, which appeared to be closely linked to fundamental cognitive mechanisms. Piaget was less concerned in determining which addition facts were mastered by most first graders or determining the age at which most children learned two-digit addend addition.

Piaget's theory has made significant contributions to our understanding of children's social development and its implications for teaching and learning. A well-rounded classroom atmosphere that meets the needs of children can be created by drawing on the Piagetian framework (Simatwa, 2010). In order to capitalize on the opportunities for the successful integration of Piagetian approach, it becomes indispensable to assess pre-school teachers’ knowledge, beliefs and practices about the principles and tenets of young learners’ cognitive processes prior to delving into any form of pedagogical or curricular reforms.

1.6.1.3 Implication for Education

According to researchers, constructivism is a result of the move from behaviorism to cognitive thinking. The most significant aspect of constructivism philosophy is that the learner should be the center of attention during the learning process and must actively increase their knowledge and take responsibility for their own progress.

Piaget’s theory continues to have a profound impact on the educational ideologies, curricula, and teaching methods used in UAE classrooms today. Piaget had idiosyncratic beliefs on how children learn mathematics and how it should be taught (Alabdulaziz & Higgins, 2017). Notably, the work of Piaget has influenced current cognitive development studies (e.g. neuroconstructivism). For this purpose, Piaget’s theoretical framework is important for understanding how the experiences of children with their teachers enrich and grow the cognitive representations into a sophisticated cognitive system. Piaget’s theoretical construct stresses the value of a healthy and high-quality learning environment. In the UAE, the theory adaptations and practices have undergone some alterations considering the cultural values, geographical region and religion. However, the curriculum design and teaching approaches have retained much of the essence of the contributions listed prior.

1.6.2 Cognitive Development and DAP

Understanding the broadly accepted guidelines for high-quality early childhood education (ECE) practice, known as developmentally appropriate practice (DAP), is essential to understand the dynamics that influence teachers' instructional preferences. The DAP guidelines were first published by NAEYC in 1987. An updated DAP edition was published in 1997, based on Piaget’s (1952) theory, which articulates children as active learners and Vygotsky's (1978) social constructivist perspective, which emphasizes the critical role of teachers in children's development.

Following the publication of the DAP guidelines, a slew of quantitative empirical research that examined its impact on children's cognitive development surfaced (e.g., Jones & Gullo, 1999; Stipek et al., 1995). Researchers who studied DAP in connection to academic achievement and cognitive performance, concluded that there appeared to be support that DAP had an influence on children’s cognitive development (Brown & Lan, 2013; Camilli, Vargas, Ryan, & Barnett, 2010; Fuligni, Howes, Huang, Hong, & Lara-Cinisomo, 2012; Huffman & Speer, 2000).

Huffman and Speer (2000) studied the effects of DAP on children’s academic achievement and reported that DAP promoted academic success. In a meta-analysis study including 3–5-year-old children enrolled in a Head Start program, Camilli and colleagues (2010) observed a significant effect on children's cognitive development when teachers engaged in DAP. Fuligni et al. (2012) evaluated the math reasoning abilities of two groups of children in classes with varied degrees of DAP. Throughout the school year, both groups improved their numerical reasoning skills, but neither group improved more than the other. These findings suggest that overall DAP had a favorable influence on student’s mathematical thinking skills. In a qualitative metasynthesis study, conducted by Brown and Lan (2013), the researchers reviewed twelve qualitative studies on teacher’s engaging in DAP and its influence on children’s cognitive development. They concluded that teacher’s using DAP had a favorable impact on children's cognitive development, whereas practices that contradicted this notion had a negative impact.

While some studies stated optimistic outcomes (Brown & Lan, 2013; Camilli et. al., 2010; Fuligni et. al., 2012; Huffman & Speer, 2000), there were studies that reported mixed/no effect (Jones & Gullo, 1999; Stipek et al., 1998; Van Horn & Ramey, 2003), and unconstructive outcomes on children’s cognitive development (Stipek et al., 1995). In addition, some experts (Van Horn & Ramey, 2003; Van Horn, Karlin, Ramey, Aldridge, & Snyder, 2005) questioned the findings of the available research, by drawing attention to the design shortcomings (e.g., self-reports vs standardized measures) of many of the acclaimed studies.

In summary, the use of DAP was overall supported by research, however there was often a disconnect between the research on the use of DAP and teacher's teaching philosophies (Parker & Neuharth-Pritchett, 2006).

1.6.3 Teachers' Beliefs About Teaching and Learning

The role of the teacher is complex, dynamic and multifaceted. Teaching generally requires a diverse range of abilities that go beyond just translating knowledge into practice (Black & Halliwell, 2000; Muijs & Reynolds, 2002). In addition, the teacher makes subtle choices about what happens in the teaching and learning environment on a regular basis to ensure instructional efficacy. Beliefs have long been known as a valuable underpinning for early childhood educators (Garvis, Twigg, & Pendergast, 2001), especially because they have a profound influence on teachers' judgements and decision-making process (Bandura, 2006). Research interests in teachers' beliefs has evolved gradually over the years.

Researchers believe that teachers' beliefs have an effect on the decisions they make, their thinking patterns, and their practices (Chang-Kredl, 2015; Spodek, 1987; Vartuli, 2005). Lortie (2002) takes the stand that a person's past experiences shape their own beliefs, elaborating that past interactions act as filters through which subsequent learning is viewed, eliciting a selection mechanism of what should be preserved and what should be discarded (Feimen-Nemser, 2001; Zanting, Verloop, & Vermunt,, 2001). Kagan (1992) adds that, creative ideas that teachers stumble across are processed via their pre-existing beliefs, and then rejected or incorporated. Phillips (1995) notes that, teachers' understanding of their roles are based on their reconstructions of memories of past personal experiences, whereas their beliefs are shaped by their perceptions of classroom experiences (Aguirre & Speer, 1999). Vartuli (2005) further elaborates that the decisions teachers make are influenced by their beliefs, and informed by education, experience and personal convictions (see figure 1).

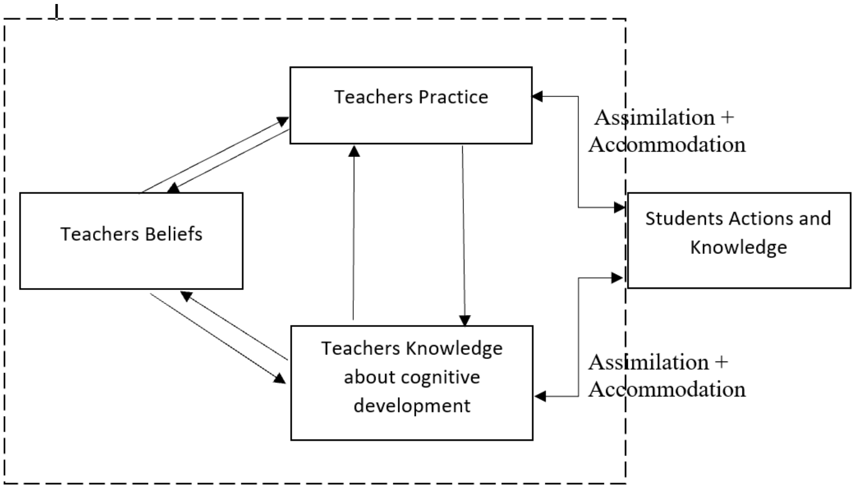


Figure 1: A model of the interplay and relationship between beliefs, knowledge and instructional practices. The dotted area represents the scope of this study.

According to Pajares (1992), teachers' beliefs have an effect on what unfolds in their classrooms and, therefore should be a focus of research on teaching. He also claims that the concept of beliefs in educational research has become a "messy construct" (p.307), partly due to researchers' lack of clarity over the particular beliefs they are researching. The focus of this study is to measure the UAE kindergarten teachers’ knowledge of pre-school students’ mathematical development and explore their beliefs on teaching mathematics to young learners. The study will explore the relationships between teachers' beliefs and their teaching practices. Furthermore, this study is more inclined towards the cognitive rather than the emotional, affective, or attitudinal facets of beliefs.

1.6.2.1 Beliefs About Development

Several studies on early childhood teachers' perceptions about children's learning have been conducted in recent years, with a focus on preschool teachers' beliefs about children's development (Le-van & Lakshina, 2021). Findings from Smith and Shepard's (1988) study indicated that teachers' beliefs about human development can be classified along a scale ranging from nativism to environmentalism. Nativists teachers believed that development was a natural phenomenon and that there was nothing they could do to help a child who was falling behind his or her peers and so they lowered their expectations for that child. Environmentalists; believed that development could be influenced and these teachers were further categorized into three groups namely, diagnostic-prescriptive teachers, interactionist teachers and remediation teachers (Smith & Shepard, 1988). According to them, in general, the teachers adapted their beliefs in response to the culture of the schools in which they taught. The Smith and Shepard (1988) research is significant for the study reported in this paper because it describes kindergarten teachers' beliefs about how children learn and how teachers can help them learn. The research established that the connection between beliefs and practice is not conclusive.

1.6.2.2 Beliefs About Teaching and Learning of Mathematics

Teachers' beliefs about mathematics refer to their "conscious or subconscious beliefs, concepts, meanings, rules, mental images, and preferences concerning the discipline of mathematics" (Thompson, 1992, p. 132). In addition, teachers' beliefs about mathematics teaching and learning refer to their beliefs as to how mathematics is taught and learned, such as their views of ideal classroom teaching activities, the strategies and mental activities involved in mathematics learning, and what composes appropriate and ideal mathematics learning activities (Ernest, 1989; Thompson, 1992), and instructional innovations (Lin, Chuang, & Hsu, 2014) used in the classroom.

Beliefs "act as cognitive and affective filters through which new knowledge and experience are interpreted," (Handal & Herrington, 2003, p. 59). In one particular study, changes in knowledge, beliefs, and practice are interconnected and appear gradually, with changes in one context leading to changes in others (Carpenter, Fennema, Franke, Levi, & Empson, 2000). In another study that examined changes in the beliefs and instruction of teachers, the researchers construed that changes in the teachers' knowledge were major contributors to changes in their beliefs and instruction (Fennema et al., 1996). The research added to the body of evidence that changes in understanding, values, and experience are related. Ernest (1989) posited that the beliefs of mathematics teachers have a major influence on their teaching practices. A series of studies that looked at the relationship between teacher beliefs and teaching practices found that teachers' beliefs are in accordance with their teaching practices (Kul & Celik, 2017; Polly, McGee, Wang, Lambert, & Pugalee, 2013). Conversely, several other studies have also reported that teachers' beliefs are not quite in sync with their teaching practices (Mellado, 1998; Simmons et al., 1999). In a four-year longitudinal study conducted by Fennema et al. (1996) that investigated changes in mathematics teachers' beliefs and teaching practices, the researchers concluded that "the relationship between change in instruction and beliefs was complex and could only be understood in terms of specific teachers" (p. 33).

Numerous studies have claimed that teachers' beliefs about mathematics dominate the way teachers approach mathematics instructional practices (Stipek, Givvin, Salmon, & MacGyvers, 2001; Fang, 1996; Thompson A. G., 1992; Pajares, 1992). Studies that focused on teachers' personal epistemological beliefs about mathematics teaching and learning, predominantly grouped teachers' beliefs into two groups: (1) a knowledge transmission (or traditional) view, in which mathematics teachers tend to perceive knowledge as being passively transferred from teacher to students (Berthelsen, Brownlee, & Boulton-Lewis, 2002), and (2) a constructivist and child-centered approach, in which mathematics teaching is seen as facilitating students' knowledge construction (Kameda, 2017; Teuscher, Moore, & Carlson, 2016; Walters, 2017; Wilkie, 2016). In one such study, the researchers Peterson, Fennema, Carpenter, and Loef (1989), discovered very clear links between beliefs and practices. They highlighted that some preschool teachers who believed that children learn mathematics by constructing their own understanding in the process of solving problems (inquiry-based learning constructivist approach) worked on more word problems with their students and spent time developing students' counting strategies before teaching number facts compared to preschool teachers who believed that children learn mathematics by memorizing facts about mathematical operations in discrete units (traditional approach).

The studies discussed in this segment indicate that perceived beliefs about children's teaching and learning are linked to teachers' teaching practices. The review depicts that the relationship between teachers' beliefs and practices is not quite a straight-forward causal one, as many may believe, but is complex, multi-dimensional and interlinked. Furthermore, there is evidence that teachers' beliefs are affected by their prior mathematical experiences, beliefs of students they teach, interactions with their peers, influences from both within and outside their classrooms, and by teacher preparation programs and professional development trainings.

1.7 Summary

Teachers construct awareness of teaching in the same way as children do, by drawing correlations between their existing knowledge, beliefs and new information and experiences. Longitudinal case studies have revealed that teachers' knowledge, beliefs, and instructional practice shift and transform overtime as they work with students. Since there is no governing theory that helps one to capture what occurs in someone's subconscious, it is impossible to explore a teacher's specific feelings, beliefs, and perceptions directly. The most effective means of documenting these personal constructs is by studying teachers' various actions, conversations, and experiences with their surroundings (Taylor & Medina, 2011). In this study, teachers' beliefs that might influence mathematics teachers' decision making in the context of their instructional practice will not be examined as it is beyond the scope of this study. The study will instead focus on the correlations between teachers' beliefs, instructional methods, and confidence in teaching mathematics to young children.

1.8 Organization of the Study

This study is organized into five chapters. Chapter 1 introduces the thesis topic and presents the problem, research questions and significance. Key terms pertinent to this research are defined and an overview of the context of this UAE study is provided. Finally, a critical review of the relevant literature addressing topics such as research on cognitive development, teachers' beliefs and the influence of teachers' beliefs and knowledge of pre-school students' mathematical development on their teaching practices is addressed. The chapter concludes with a thesis organization overview.

Chapter 2 explains the research design, data collection instruments, and analysis techniques. The chapter also describes the study settings, and the ethical considerations related to the study.

Chapters 3 and 4, report and discuss the study findings in detail.

Chapter 5 focuses on the recommendations, limitations, and need for further research, as well as the study's conclusion.

Chapter 2: Methodology

2.1 Overview

The research examined the beliefs and practices of UAE kindergarten teachers, to get a more in-depth understanding of how mathematics is taught and learned. The main purpose of the study was to examine the relationship between practicing kindergarten teachers' beliefs about the nature of teaching and learning of mathematics to kindergarteners, their mathematics teaching practices and their confidence in teaching mathematics to kindergartens. A secondary purpose of this study was to find out if there is a correlation between KG teachers' beliefs, practices, confidence and also to examine if teachers encourage higher order thinking among their students.

This methodological chapter provides a detail account of the processes and the sampling techniques employed during the timeframe of this study. This chapter includes the description of the research design, subjects, data collection procedures, instruments, and data analysis. Throughout the chapter, the carefully selected measures to increase the reliability and credibility of the findings are interlaced. A discussion on ethical considerations relevant to the study as well as a summary is provided at the end of the chapter.

2.2 Setting

The study was carried out in all seven emirates that make up the UAE. During the 2020-21 school year, the UAE employed nearly 8,500 public and private kindergarten teachers (UAE MoE, 2021) serving almost 200,000 kindergarten students. According to UAE MoE guidelines (MoE, 2021), four-year-old children and above were eligible to enroll for kindergarten programs. Kindergarten programs in public schools were free for students who satisfied all the eligibility conditions. Those who did not meet the criteria had the option of enrolling in a tuition-based kindergarten.

2.3 Participants

Research into the beliefs and practices of kindergarten teachers was carried out with in-service kindergarten teachers employed within the public and private school systems in the UAE during the academic year 2021- 22. The process of selecting participants was carried out with criterion sampling (i.e., selecting participants that satisfy a predetermined condition). Chain sampling (Creswell, 1998, 2007) was then applied, which is an approach in which the researcher pin downs initial participants and requests recommendations for additional participants who meet the ascertained selection benchmarks. As a part of the recruitment process the researcher contacted the school administrative staff, requesting assistance in recruiting kindergarten teachers for the study. An email invitation with the survey link and description of the study was sent to 30 schools across the UAE employing roughly about 150 kindergarten teachers. A total of 136 questionnaires were completed of which 90 were usable. The sample for this study consisted of 20 public school kindergarten teachers who met the eligibility requirements and 70 private school kindergarten teachers, bringing the total to 90. Four teachers participated in the qualitative phase of the study.

The subjects of this study were teachers having one or more years of experience in a kindergarten setting (M= 2.100, SD= 1.122) from the following emirates: Abu Dhabi (60%), Dubai (22.2%), Sharjah (10%), Ajman (2.2%), Ras Al Khaimah (3.3%), and Fujairah (2.2%). No teachers from the emirate of Umm Al Quwain participated in the study. All of the participants were females whose age ranged from 21 to 55 (M= 3.311, SD=

1.215). Table 1 shows the frequency and percentages of the emirates in which the participants teach.

Table 1: Frequencies and percentages of emirate categories

Emirate	***f***	%
Abu Dhabi	54	60.0
Dubai	20	22.2
Sharjah	9	10.0
Ras Al Khaimah	3	3.3
Ajman	2	2.2
Fujairah	2	2.2

In terms of experience, 67.8% of teachers indicated that they had ten or fewer than ten years of kindergarten experience, while 32.2% had more than ten years of experience as a kindergarten teacher. In regards to qualifications, 9% held higher diploma degrees, 64.4% of the participants had bachelor’s degrees, 22.2% held master’s degrees, and 4.4% held PhD degrees. Finally, 22.2% of the teachers were employed in the public sector, while 77.8% taught in private schools. A detailed description of the participants is provided in the next chapter. Table 2 displays the frequencies and the percentages of professional descriptors.

Table 2: Teachers' demographic profile

Teachers (n=90)	***Age***		***Education***		***Experience***	
	21 – 30	31 and above	Diploma and Bachelors	Masters and PhD	1 – 10 years	11 years and more
Public (n=20)	4	16	13	7	12	8
Private (n=70)	18	52	53	17	49	21
Total	22	68	66	24	61	29

2.4 Research Design

Teachers' beliefs, practices and attitudes are important for understanding and improving educational processes and have long been studied using both, qualitative and quantitative methods. This study acknowledges that, each teacher is unique and that a teacher's instructional ideas and practices are contextually constrained and are impacted by a variety of internal and external variables (Pajares, 1992) that are difficult to control. In addition, a teacher is likely to hold a wide range of beliefs and knowledge regarding young children's developmental abilities and these beliefs, for that matter, might be held either consciously or subconsciously (Pajares, 1992; Thompson A. G., 1992), and may not be necessarily aligned with one's actions (e.g., Jorgensen et al., 2010). Thus, the study was led by the premise that teachers' knowledge and beliefs change over time as a result of their unique experiences and the meanings they derive from them.

The present investigation utilized a cross-sectional survey approach. This approach, according to Creswell (2008), necessitates data collection at a single point in time. In this study beliefs, adopted practices and knowledge of UAE kindergarten teachers' regarding preschool children's mathematical development were examined. These statistics may be at odds with the teachers' literal knowledge, beliefs and practices, thus qualitative data on teachers' beliefs, practices, pedagogical content knowledge (PCK) and teacher's understanding of children's mathematical development was also solicited in order to conduct a robust study. As such, "the use of both quantitative and qualitative methods, in combination," (Creswell, 2008, p. 552) was deemed relevant and effective for this study in order to "provide a better understanding of the research problem and questions than either method by itself" (Creswell, 2008, p. 552). Thus, to try and maintain equilibrium, increase the validity of the findings (Frechtling, Frierson, Hood, & Hughes, 2002) and help the researcher gain a holistic picture of kindergarten teachers' knowledge, beliefs and practices towards mathematics teaching and learning, mixed-methods research design was identified as being the most relevant for the particular questions posed in this study.

2.5 Validity and Reliability

Validity has been described as the extent to which the content measures what it is expected to measure and whether or not the instrument draws out precise information (Schultz & Whitney, 2005). Reliability refers to the consistency of results when a survey is repeated on a sample. In the development of survey instruments, both validity and reliability were critical. Reliability is ineffective without validity and validity is futile without reliability.

For the development of the current study's survey instrument, cross-referencing numerous instruments was used to establish content validity. To strengthen this, related literature was reviewed that measured either the same or comparable aspects of teachers' personal belief systems. These reviewed aspects were teachers' beliefs, developmentally appropriate mathematics practices, and teachers' confidence in their mathematics ability. Subsequently, accuracy and appropriateness of the survey questions were examined in order to design a comprehensive survey instrument that would provide meaningful data to answer the research questions. To do so, the survey and interview questions were discussed with the supervisor, two mathematics education professors at the UAEU, a fellow master's student, and two mathematics lecturers at the Higher Colleges of Technology.

Based on their recommendations, refinements were made to the questionnaire. For example, questions were categorized and grouped under three sub-headings; (1) teacher's beliefs about teaching mathematics to kindergarteners; (2) teacher's beliefs about developmentally appropriate teaching practices; and (3) teacher's confidence in teaching mathematics to kindergarten children. Questions were then reworded and modified. The question style was changed from a question format to statement, e.g., "How appropriate are flashcards to teach math facts to KG students?" to "Math flashcards are appropriate for KG students to teach math facts".

In addition, questions were rearranged, and closer alignments were made between the quantitative and the qualitative questionnaires. And finally, sub-headings and questions were translated using a translation software and the translation was later validated through discussion with the advisor, a fellow master's student, and a mathematics lecturer at the Higher Colleges of Technology. The validity and reliability approaches used to create the instrument are listed in Table 3.

Table 3: Validity and Reliability Procedures Used for the Study

	Development Phase	Pilot Study	Quantitative Study	Qualitative Study
Literature review of young children's mathematical development (N=13, see appendix F)	X			
Item construction (see appendix E)	X	X		
Item selection in consultations with various mathematics education experts	X	X		
Survey administered to a small sample of teachers (N = 9), and interview conducted with one (N = 1)		X		
Administration of the mixed instruments to a larger sample (N=90, see appendix A)			X	X
Validity and reliability are assessed statistically (e.g., Cronbach's alpha)			X	

2.6 Measures

2.6.1 Survey

This study adopted a correlational approach. According to Goodwin and Goodwin (1996), correlational research allows researchers to analyze "nature" as it is and address issues that may not be feasible or pragmatic to investigate using experimental approaches. To address the multifaceted nature of the researcher's area of focus as well as to investigate the link between kindergarten teachers' beliefs about the developmental ability of kindergarteners and developmentally appropriate teaching practices, survey research was utilized. Survey research is defined as "procedures in quantitative research in which investigators administer a survey to a sample or to the entire population of people to describe the attitudes, opinions, behaviours, or characteristics of the population" (Creswell, 2008, p. 388).

The survey approach used in this study involved a questionnaire which focused on teachers' beliefs as independent variables and developmentally appropriate practices and teachers' confidence in teaching mathematics as dependent variables. Additional independent variables, such as teachers' age, years of experience, and degree of education earned by the teacher, were included in the demographic section of the survey.

2.6.1.1 Demographic Form

In the beginning of the survey, participants had to complete an eight-item demographic questionnaire which helped to collect participants demographic information and ensure that they satisfied the requirements for participation. Age, years of kindergarten teaching experience, class demographics and the Emirate they are currently working in were all collected with the demographic form.

2.6.1.2 Teachers Belief, Practices and Confidence Survey

The survey questions from the Mathematical Development Beliefs Survey designed by Linda Platas (2015), the Early Math Beliefs and Confidence Survey developed by Jie-Qi Chen and Jennifer McCray (2013) and the Teachers' Beliefs and Practices Survey (3-5 years old), constructed by Burts et al. (2000), were modified and specifically adapted for use in this study to assess kindergarten teachers' belief about teaching mathematics to preschoolers (see Appendix A). The researcher adapted the wording from Platas's (2015) mathematics beliefs survey, Chen and McCray's (2013) early math beliefs and confidence survey and, Burts et al. (2000) teachers' beliefs and practices survey to be more representative of the population and to allow teachers to reflect and respond. The questionnaire used six-point Likert scale (1 = strongly agree; 6 = strongly disagree) to eliminate a neutral choice. The adapted versions were translated to Arabic and then reviewed after a pilot trial by the researcher.

For the purpose of the study, the survey instrument was divided into three sections. Part 1 of the survey, labelled "Teachers' Beliefs about Teaching Mathematics to Kindergartners," examined kindergarten teachers' beliefs (KGTB) relating to the age appropriateness of teaching mathematics to kindergartners. Part 2 of the questionnaire, titled "Teachers' Beliefs on Developmentally Appropriate Mathematics Practices," inquired about the appropriateness of teaching practices in relation to the beliefs expressed in part 1. The third part, titled "Teachers' Confidence in Teaching Kindergarten Mathematics," was designed to look at teachers' mathematical competency and mathematics anxiety. However, from this point onwards, for identification and statistical analysis purposes, part 1 of the survey instrument will be now labelled “KGTB about T&L”, part 2 will be labelled “KGTB about DAMP” and “KGTC about TM” will represent part 3 of the questionnaire. The terms “KGTB about T&L” “KGTB about DAMP” and “KGTC about TM” will be used throughout the following sections and in Chapter 3, which presents the quantitative results.

The questionnaire (see Appendix A) consisted of 32 questions and was specifically designed to collect quantitative data mainly in the following three areas (1) KGTB about T&L; (2) KGTB about DAMP; and (3) KGTC about TM (see Table 4). As previously stated, the survey's validity was determined by a comprehensive literature analysis and consultation with math education specialists. To determine the internal consistency of the scale domains, Cronbach's alpha was applied to the collected data. The reliability coefficients were all higher than 0.60.

Table 4: Teachers' beliefs subscales and number of items for each subscale

Subscale	***Number of Items***
KGTB about T&L	7
KGTB about DAMP	16
KGTC about TM	9

The questionnaire was translated to Arabic for participants' convenience and better understanding and the questions were worded simply and clearly. MS Office Forms were used to collect survey responses due to their fast response rate, choice of option-boxes, Likert Scale option, easy data collection process, transfers and simplicity of sending reminders to the participants.

The survey approach was chosen because of its potential to quickly and efficiently gather data about teachers' beliefs, practices, attitudes, and demographics. However, following the survey administration, in-depth, semi structured, one-on-one interviews were undertaken to elicit additional categorical data to supplement the survey results.

2.6.2 Semi-Structured Interviews

Questionnaires lack depth and fail to highlight the details of teacher's insights regarding their beliefs and practices with regard to student mathematical development and learning. There is also a possibility of the findings being biased (Frechtling et al., 2002). To bridge this gap in the information and reduce the likelihood of bias conclusions, semi-structured interviews were carried out. Interviews, according to Collis and Hussey (2014), entail probing into data about individual's perspectives, attitudes, feelings, and beliefs. The interviewees were kindergarten teachers who expressed their willingness to participate in the qualitative part of the study.

The data gathered from the interviews was transcribed and analyzed using the principles of grounded theory (Glaser & Strauss, 1967; Strauss & Corbin, 1998).

According to Patton (1990), "there are no rules for sample size in qualitative inquiry. Sample size depends on what you want to know, the purpose of the inquiry, what is at stake, what will be useful, what will have credibility, and what can be done with available time and resources" (p. 184). As such, interested participants were reviewed to optimize diversity in the sample, particularly in relation to the widespread geographic coverage of the UAE. According to Krathwohl (2009), this type of "purposive sampling is most often used in qualitative research to select those individuals or behaviors that will better inform the researcher regarding the current focus of the investigation" (p. 172). And since qualitative studies favor smaller sample sizes (Lincoln & Guba, 1985), four potential participants were contacted by the researcher via email. To comply with the UAE lockdown regulations, all interviews were conducted remotely via video conferencing and were recorded after seeking interviewees' permission. Responses recorded from the survey were used to give directions to the interview.

The researcher made use of four guided questions to conduct the interviews which focused on teachers' beliefs about the developmental ability of young learners and teachers' pedagogical practices to support mathematics learning. One of the significant advantages of conducting semi-structured interviews was, it allowed the researcher to construct additional questions during the interview which were helpful in exploring specific issues in depth (Collis & Hussey, 2014). To collect a range of possible views open-ended questions were incorporated into the study, which inquired about the teacher's beliefs and practices and their perspectives were used to determine the sequence of events and related associations. The semi-structured one-on-one interviews supplied information from which themes were identified within the entire data.

In the second part of the interview, kindergarten teachers' abilities to notice mathematics and encourage higher-order thinking among students were measured using a situation-type approach (Ball, Thames, & Phelps, 2008). A hypothetical scenario was presented to the interviewees and teachers responded to questions that were tailored from the Preschool Mathematics PCK Interview (McCray & Chen, 2012). The scenario was first read to the teacher by the researcher and then the teacher was given adequate time to read the scenario on their own. The researcher then posed a series of questions to the interviewee based on the scenario. The following scenario was presented and is as follows:

> *Mariam and Amna are playing with five dolls in the corner of the class. They want to put their five dolls to bed. There are no doll beds, so they make three beds from the boxes they found in the play area.*
>
> *Mariam says, "We don't have enough beds." Amna responds, "These dolls are younger," picking up three small dolls and setting them near the beds. She picks up the remaining two long haired dolls and says, "These two don't need to nap anymore," and sets them aside. Mariam then picks up the biggest doll from the three and sets her in the largest bed and says, "OK, this baby needs big bed." Amna watches her and then puts the medium sized doll in the medium sized bed and the smallest doll in the smallest bed. They both seemed satisfied with the outcome.*

The reasoning behind the design of the aforementioned instrument was to evaluate kindergarten teachers' skill to: (1) spot mathematical circumstances exhibited in children's play; (2) infer why those particular circumstances are mathematical, and in what way children's play can be associated with mathematical ideas; and (3) enrich children's mathematical processes by moving between concrete to abstract and back. The interview scenario covered a series of early mathematics proficiencies and ideas (e.g., numbers, operations, shapes, spatial relationships, measurement, patterns, and classification). The following table (Table 5) summarizes the meanings of each subtopic of early mathematics ideas (NAEYC & NCTM, 2002, 2010) and skills that are situated in the scenario.

Table 5: Early mathematical concepts and skills situated in the play scenario

Content Area	**Mathematical Skills**	**Mathematical Situations**
Number sense	counting, number use, 1 to 1 correspondence	3 beds hold 3 babies
Operations	take away	put two babies aside
Shapes	shape/space match	rectangular boxes = bed
Spatial Relationships	relationships of location/between objects	babies INSIDE box
Measurement	order by size compare/comparison by size	babies & beds by size order babies & beds differ in size
Patterns	rule that repeats, order by size	baby-to-bed by size order
Classification	similarity/logical reasoning, grouping/which go together	sort by hair = age

The interviews lasted between 35 to 50 mins. To reduce the incidence of inaccurate data interpretation, member checks were carried out after each interview. To do so, the interpreted information was summarized and passed on to the participant to comment and determine its accuracy and completeness.

2.7 Data Analysis

2.7.1 Quantitative Data Analysis

The study design necessitated the use of multiple methods of analysis. Prior to the analysis, a data screening was carried out to look for data inconsistencies, outliers, and normality (Green & Salkind, 2017). Box and whisker plots were used to spot for any outliers for each data subscale. The Shapiro-Wilk test was used to determine for normality of each of the dependent variables. The Shapiro-Wilk test was adequate since the sample size was less than one hundred. The results of the Shapiro-Wilk test established that the normality assumption was violated. Thus, the Spearman correlation coefficient test, the one-sample Wilcoxon signed rank test, and the Mann-Whitney U test were used. The Spearman's rank correlation was used as an alternative to the Pearson correlation test, the one-sample Wilcoxon signed rank test as an alternative to the one-sample t-test and Mann-Whitney U test was the alternative to the independent samples t-test. These non-parametric tests are advocated when data is not normally distributed (Green & Salkind, 2017).

Based on responses to the demographic survey, descriptive statistics (e.g., frequencies) were initially used to explain the characteristics of the sample participants. Measures of central tendency (mean, median) and measure of variability (standard deviation) were used to organize the data and summarize the characteristics of the sample set.

A reliability analysis was conducted on the thirty-two item teacher’s beliefs, practices and confidence instrument, as well as on each of the three subscales to determine internal consistency reliability coefficients. The goal was to obtain a Cronbach’s alpha coefficient of 0.60 or higher. The alpha was 0.659 for KGTB about T&L subscale, 0.822 for KGTB about DAMP subscale, and 0.781 for KGTC about TM to preschoolers. The thirty-two item teacher's beliefs, practices and confidence scale had a reliability coefficient of $\alpha = 0.738$ for $N = 90$. The reliability coefficients were all higher than 0.60, which is considered a highly reliable and acceptable index (Nunnally & Bernstein, 1995; Pallant, 2001). The composite subscale scores of KG Teachers' Beliefs, Practices and Confidences Survey were used for statistical analysis. Correlational coefficients were calculated using these scores. The broad aim of the analyses was to determine if teacher beliefs in the nature of teaching and learning mathematics and teachers' confidence in mathematics were significantly correlated to kindergarten teachers' mathematics teaching practices.

A series of tests were computed to examine the research questions that kindergarten teachers' beliefs about the importance of mathematics and teachers' confidence in their mathematics ability were related to teacher's ability to influence mathematics instructional practices. The results of computed correlation coefficients were then examined to explore for an association between teachers' beliefs about the importance of mathematics and teachers' confidence in their mathematics ability.

2.7.2 Qualitative Data Analysis

The central measures used to analyze the data from the semi-structured interviews and the teachers' beliefs and practices questionnaire were thematic coding and categorization. According to Gibbs (2011), coding is the process of defining what the data being examined is about, and codes "form a focus for thinking about the text and its interpretation." (p. 40). This sort of coding technique is situated in grounded theory, where the emphasis is on "inductively generating novel theoretical idea" (Gibbs, 2011, p. 49).

To begin, a spreadsheet was set up to categorize the replies each selected teacher made in the teachers' beliefs and practices survey. Open coding was initially employed to classify relevant categories and recognize common themes based on the research questions of the study. Following that, the survey categories were refined, and themes relating to teaching and learning beliefs began to emerge. The data gathered from semi-structured one-on-one interviews was transcribed and later analyzed using line-by-line coding which is a standard for open coding in grounded theory. The coding of every line of data compels the researcher "to pay close attention to what the respondent is actually saying and to construct codes that reflect their experience of the world" (Gibbs, 2011, p. 52). In other words, coding had to be grounded in the actual or transcribed data and reflect teachers' beliefs about young children's developmental abilities and whether teachers encourage higher-order thinking among their students. To ascertain the presence of certain words, themes, or concepts, the content analysis procedure used by Quesenberry, Hemmeter, and Ostrosky (2011) was adapted.

To prepare the data for analysis, codes were primarily assigned to the data, then compared to summarize the data even further. Following the coding and categorization of all the data, it was sorted and refined hierarchically into themes based on repeated comparison and contrasts. However, some of the labels appeared in more than one category, and there was often far more data than the study's limitations allowed for. Thus, arguments that were most relevant to the study's research questions were identified from which significant data based on the primary concerns addressed could be extrapolated.

For the second part of the interview – the scenario, the participants were awarded one point for accurately identifying the mathematical content area related to the scene. The play scene provided to the teachers had seven mathematical events, and if the participants identified all seven situations, they were awarded seven points. Additional two points were given if the teachers' explanation was accurate, explicit and connected to a mathematical idea specified in Table 6. One point was given if the participant's interpretation of the scenario connected to a mathematical concept was vague, and no points were given if the teacher's view was generic and too broad. In addition, 2 points were granted if the participant correctly identified the mathematical content relevant to the events. Since there were seven skills and seven mathematical situations, the range of possible points was 0 – 28. In addition, the participants' comments were graded on how well they described how to encourage higher order thinking among their students, with 0 – 3 points assigned for each response. The maximum total score was 38 across the four subscales.

Table 6: Scoring sheet for second part of interview

Content Area (1 point for every correct identification)	**Mathematical Skills** (2 points for any one correct identification from the relevant content area)	**Mathematical Situations** (2 points for any one correct identification from the relevant content area)
Number Sense	counting, number use, 1 to 1 correspondence	3 beds hold 3 babies
Operations	take away	put two babies aside
Shapes	shape/space match	rectangular boxes = bed
Spatial Relationships	relationships of location/between objects	babies INSIDE box
Measurement	order by size compare/comparison by size	babies & beds by order babies & beds differ in size
Patterns	rule that repeats	baby-to-bed by size order
Classification	similarity/logical reasoning, grouping/which go together	sort by hair = age

2.8 Ethical Considerations

Any research that involves human participants must take ethical issues into account, both in terms of the gathered data and the methods employed to acquire it. As such, this study was conducted in accordance with the requirements of the United Arab Emirates University (UAEU) policies and procedures, including the Research Ethics Review Board (RERB), that provides oversight for the protection of human subjects through the research process (see Appendix D).

The researcher collaborated with UAEU RERB to construct an informed consent form for participants that detailed the study and its possible implications (see Appendix C). Prior to beginning the study, the UAEU RERB reviewed and approved the plans for research including the consent form.

Before commencing the survey, all participants were asked to give their informed permission electronically. It required participants to accept the conditions by clicking “Agree” before proceeding with the survey. Participants were informed that their participation was entirely voluntary, anonymous, and confidential and that declining to participate would have no negative implications.

Teachers who took part in the interview process were also provided with copies of the informed consent forms to ensure they were fully aware of the study’s purpose. Confidentiality was ensured in addition to informed consent. If they consented to partake in the semi-structured interviews, participants were informed that they would be allotted pseudonyms and that their opinions would be kept confidential in a password-protected file. Finally, participants were informed that their survey responses would only be published cumulatively, and in order to safeguard their privacy, all data files pertaining to them would be obliterated once the study was concluded.

2.9 Summary

The purpose of the study was three-fold; (a) to investigate the relationship between practicing kindergarten teachers' beliefs about the nature of teaching and learning of mathematics to kindergarteners, their mathematics teaching practices and their confidence in teaching mathematics to kindergartens, (b) to find out if there is a correlation between KG teachers' beliefs, practices, confidence and, (c) to study whether teachers encourage higher order thinking among young students.

The correlational design amalgamated data from teachers' beliefs and practices into a self-reported survey that rated teachers' beliefs about the teaching and learning of mathematics for preschool children. The self-reported questionnaire was administered to kindergarten teachers employed across the UAE using criterion and chain sampling techniques. Participants who expressed their willingness to participate in the qualitative part of the study were reviewed to optimize diversity in the sample, particularly in relation to the widespread geographic coverage of the UAE.

The qualitative study sought to explore whether kindergarten teachers provide a high-quality learning environment to support children's growth in mathematics. The results presented in Chapter IV reinforce the documentation of whether kindergarten teachers' mathematics beliefs relate to teachers' exercising high-quality mathematics instructional practices. In addition, the qualitative data on teachers' understanding of children's mathematical development and PCK will help to determine the direction in which reform efforts should be focused.

Chapter 3: Results and Discussions

3.1 Overview

The main purpose of the study was to explore the relationship between in-service kindergarten teachers' beliefs about the nature of teaching and learning of mathematics to kindergarteners, their beliefs about developmentally appropriate mathematical practices and their confidence in teaching mathematics to kindergartens. A secondary purpose of the study was to examine whether teachers encourage higher order thinking among young students.

This chapter discusses the findings of the study's four research questions. The sample demographics, along with the related findings, are described in depth in this chapter. The following datasets were utilized in the analysis: KGTB's overall score for T&L, KGTB's overall score for DAMP, and KGTC's overall score for TM, as well as interviews with a sample of the whole data set.

3.2 Assumption Tests

Pearson's Correlation Coefficient and Spearman's Correlation Coefficient are the two most common approaches for analyzing correlation. One of the prerequisites for using Pearson correlation is that the data must satisfy the normal distribution assumption. A further characterization of the data included checking for *skewness and kurtosis*. Spearman's correlation will be applied if an assumption was violated. The dependent variables of kindergarten teachers' beliefs about the nature of teaching and learning mathematics to kindergarteners (KGTB about T&L), kindergarten teachers' beliefs about developmentally appropriate mathematical practices (KGTB about DAMP), and kindergarten teachers' confidence about teaching mathematics to preschoolers (KGTC about TM) were inspected for outliers and irregularities (Gall et al., 2007). A quick initial assessment of the data was done by examining the boxplots to assess the normality of the three variables.

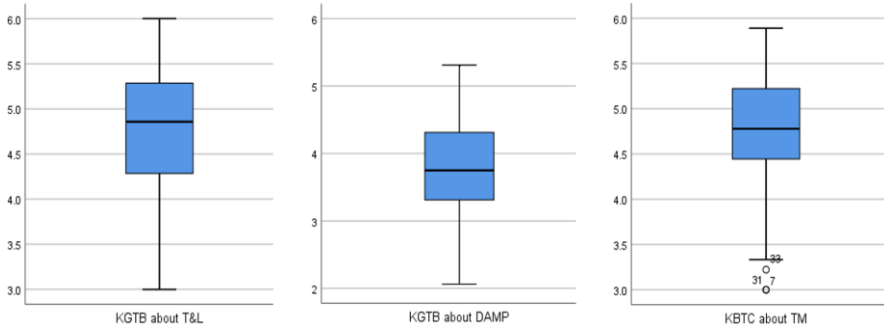


Figure 2: Boxplots for the three subscales (N=90)

The boxplot (see Figure 2) for KGTB about DAMP was pretty consistent with a normal distribution boxplot, with median close to the box's center and both whiskers about the same size. However, skewness was visible in the KGTB boxplot about T&L and outliers were visible in KGTC boxplot about TM. And since Pearson's correlation is sensitive to both outliers and skewness, doubts over normality were established through the observation of boxplots. As such, skewness coefficients were examined to see if there was further evidence to suggest whether either of the variables was skewed.

A simple check was carried out to check if the absolute values of the skewness coefficients were less than two times their standard errors. Using this guide, the KGTB about DAMP data skewness was checked and was reported as consistent with the data being normal. However, the KGTB about TL and KGTC about TM data skewness coefficients appeared to be large enough to warrant concern that there was skewness present (see Table 7).

Table 7: Mean, SD, Skewness and Kurtosis test results for teachers' belief subscales (N=90)

Subscale	Mean	SD	Skewness		Kurtosis	
			Stats	S.E.	Stats	S.E.
KGTB about T&L	4.76	0.67	-0.645	0.254	0.210	0.503
KGTB about DAMP	3.76	0.70	-0.160	0.254	-0.582	0.503
KGTC about TM	4.77	0.68	-0.581	0.254	0.054	0.503

Tests of normality were then applied to the subscales to determine if the normal distribution assumption were met. The Shapiro-Wilk Test (see Table 8) was used to examine the assumption of normal distribution for KGTB about T&L score, KGTB about DAMP score, and KGTC about TM score. The Shapiro-Wilk test results for KGTB about DAMP was n=90, M= 3.76, skewness -0.16, p = 0.348. The data was presumed to be normally distributed because the p-value was larger than 0.05. Conversely, the p-value for both; KGTB about T&L and for KGTC about TM was p = 0.013 and p = 0.004 respectively. In the view of the fact that p-value was less than 0.05, it was assumed that the data was not normally distributed. Since there were concerns over the normality of the data, non-parametric tests were used. Moreover, the data was collected on an ordinal scale and Spearman's rank correlation test was the ideal correlation analysis as it made no assumptions about data distribution (Muijs, 2004).

To further evaluate the data, one-sample Wilcoxon signed rank test and Mann-Whitney U test were carried out. When conducting a one-sample Wilcoxon signed rank test, the six-point Likert scale scores of every item were compared with a hypothesized median (median = 3.5).

Table 8: Tests of Normality results for teachers' belief subscales (N=90)

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
KGTB about T&L	.121	90	.002	.964	90	**.013**
KGTB about DAMP	.060	90	.200*	.984	90	.348
KBTC about TM	.097	90	.034	.955	90	**.004**

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The Mann-Whitney U test required four assumptions that had to be satisfied in the research design. As per the first assumption the dependent variable(s) should be measured at continuous or ordinal level. This assumption also applied to one-sample Wilcoxon signed rank test. The dependent variables in this study were analyzed at the ordinal level. Participants used a 6-point Likert scale to answer a series of questions on each of the dependent variables (KGTB about T&L, KGTB about DAMP, and KGTC about TM), and their responses were averaged to yield a single value for that variable. The second assumption was that each independent variable entailed two categories. The independent variables for this study, education level and teaching experience, had two categories each. The third premise was that observations were independent, implying that there was no link between each group's findings. Since each participant had her own score and only belonged to one group, the individuals in this study maintained observational independence. The fourth assumption was that each group's score distribution would have a similar shape. (Gall et al, 2007, Warner, 2013). Levene's Statistic based on median was used to examine if the data satisfied this premise. All three variables met this assumption for both independent variables, education and experience, as the p-value was greater than 0.05 (see Table 9).

Table 9: Levene's median based tests of Homogeneity of Variance results for teachers' belief subscales factored by experience (N=90)

Homogeneity of Variance					
		Levene Statistic	*df1*	*df2*	*Sig.*
Factors	Dependent Variables	**Based on Median and with adjusted df**			
Education	KGTB about T&L	0.550	1	87.883	**.460**
	KGTB about DAMP	0.007	1	83.902	**.932**
	KGTC about TM	0.336	1	86.249	**.564**
Experience	KGTB about T&L	0.034	1	82.012	**.855**
	KGTB about DAMP	1.629	1	87.777	**.205**
	KGTC about TM	0.891	1	84.438	**.348**

3.3 Descriptive Statistics

The participants for this research study included a total of 90 in-service female kindergarten teachers. All participants were currently employed as kindergarten teachers across the seven emirates in the UAE. The majority of the participants (60%) taught in the emirate of Abu Dhabi, the largest and densely populated city in the UAE and no participants participated from the emirate of Umm Al Quaim. One of the reasons could be because it is the least populated emirate in the UAE with not many kindergarten schools.

The senior age group (over 35 years) accounted for more than half of the sample (51.1%), while the youngest age group (21-25 years) had the lowest frequency (11.1%). On the contrary, only 32.2% of participants had over 10 years of experience, while 67.8% had less than 10 years of experience. Finally, three-quarters of the participants (77.8%) reported they worked in private schools, and the majority of the sample (71.1%) indicated they had a higher diploma or a bachelor's degree in education.

Analysis of the descriptive statistics of the subscales were conducted in order to determine the differences in means among KGTB about T&L, KGTB about DAMP and KGTC about TM. Responses to the survey items were summed to obtain a score for each item. In order to obtain an accurate score, the ratings of seven questions that the instrument identified as KGTB about T&L questions (see Table 11) were added together and divided by the number of questions to obtain the mean score of the belief related questions. Likewise, to compute KGTB about DAMP score, the ratings of 16 items (see Table 14) were included in the calculation and to evaluate the mean of KGTC about TM (see Table 17), scores of nine item ratings were added together and divided by the number of questions. The descriptive data of the three belief subscales are displayed in Table 10.

Table 10: Means, medians, standard deviations and Cronbach’s alpha for Early Mathematical Developmental Beliefs and Practices Survey subscales (N=90)

Belief Subscales	***Mean***	***Median***	***SD***	***α***
KGTB about T&L	4.771	4.778	0.677	0.659
KGTB about DAMP	3.757	3.750	0.699	0.822
KGTC about TM	4.757	4.857	0.667	0.781

The mean of 4.77 and the median of 4.78 in the subscale of KGTB about T&L indicated that teachers felt mathematics instruction was age appropriate for kindergarten children. KGTB about DAMP averaged 3.76 with a median of 3.75, indicating that mathematical teaching was more teacher-centered than student-centered. The subscale for KGTC about TM to kindergarten students had a mean of 4.76 and a median of 4.86, suggesting that teachers had limited anxiety about mathematics and deemed themselves as having enough knowledge about the subject.

3.4 Research Question 1

What are UAE kindergarten teachers' beliefs about the nature of teaching and learning of mathematics to kindergarteners (4 to 6 y/o)?

Participants of this study answered seven questions on beliefs about the nature of teaching and learning mathematics to kindergarteners (KGTB about T&L). A 6-point Likert scale was used to answer each item, indicating the level of their agreement with the statement. The phrase "Strongly Disagree" was expressed by items with a 1 score and "Strongly Agree" was represented by items with a 6 score. The Cronbach alpha reliability coefficient for this subscale was $\alpha = 0.659$. The descriptive statistics for the seven belief items relating KGTB about T&L are reported in Table 11. The statements, *"Math is worthwhile and necessary subject for KG students"* (M = 5.20) *and "KG students learn a great deal about math through everyday math activities"* (M = 5.20) received the most agreement from the participants. These views were also reported statistically significantly positive at 0.05 level of significance according to the one-sample Wilcoxon signed rank test results. The items, *"Mathematical activities are an inappropriate use of time for KG students, because they aren't ready for them"* (M = 2.06) and *"KG students do not have the cognitive abilities to learn math"* (M = 2.09) had the lowest levels of agreement. However, the teachers were undecided when asked if *"Literacy is more important for KG students than math"* (M = 3.54, $z = -0.301$, $p = 0.763 > 0.05$).

Table 11: Descriptive statistics and Wilcoxon Signed-Rank Test results for KGTB about T&L sorted by highest mean (N=90)

Survey Item	***Mean***	***SD***	***z***	***p***
Math is a worthwhile and necessary subject for KG students.	5.20	1.09	7.604	.000
KG students learn a great deal about math through their everyday math activities.	5.20	0.72	8.201	.000
**Mathematical activities are an inappropriate use of time for KG students because they aren't ready for them.*	4.93	1.56	-7.180	.000
**KG students do not have the cognitive abilities to learn math.*	4.91	1.24	-7.068	.000
KG students are very interested to learn math.	4.81	1.10	7.098	.000
**Math should not be taught with other subjects, as it will confuse young students.*	4.80	1.63	-6.923	.000
**Literacy is more important for KG students than math.*	3.54	1.62	-0.301	.763

*Reverse coded

According to the survey findings, a substantial majority of teacher participants (92.2%) agreed that students learned a great deal about mathematics through everyday activities, and 86.7% teachers acknowledged that mathematics was an essential element of the kindergarten curriculum. Significant number of teachers, n=70 to be exact, felt that mathematical activities are appropriate use of time for kindergarten students. Wilcoxon signed rank test results reported that these beliefs were all statistically significant at 0.05 level. Over 74% of teachers disagreed with the statements that kindergarten students lacked the cognitive abilities to learn mathematics and that mathematics should be taught in isolation. Figure 3 depicts the percent agreement on KGTB about T&L questionnaire items systematized by teachers experience and credentials.

Through interviews the teachers reported that numerous contextual dynamics influenced student's cognitive development, and that as a teacher their responsibility was to ensure that all their children's needs were addressed. The teachers remarked that because of their qualification and engagement with young children (years of teaching experience), they sensed a shift in their beliefs towards how children learn and their role as a teacher in their students learning. These beliefs were endorsed by survey respondents, with 100% of teacher participants with at least a master's degree acknowledging that everyday activities support young children mathematics learning. Figure 3 presents the percent agreement on KGTB about T&L questionnaire items organized by teachers experience and credentials.

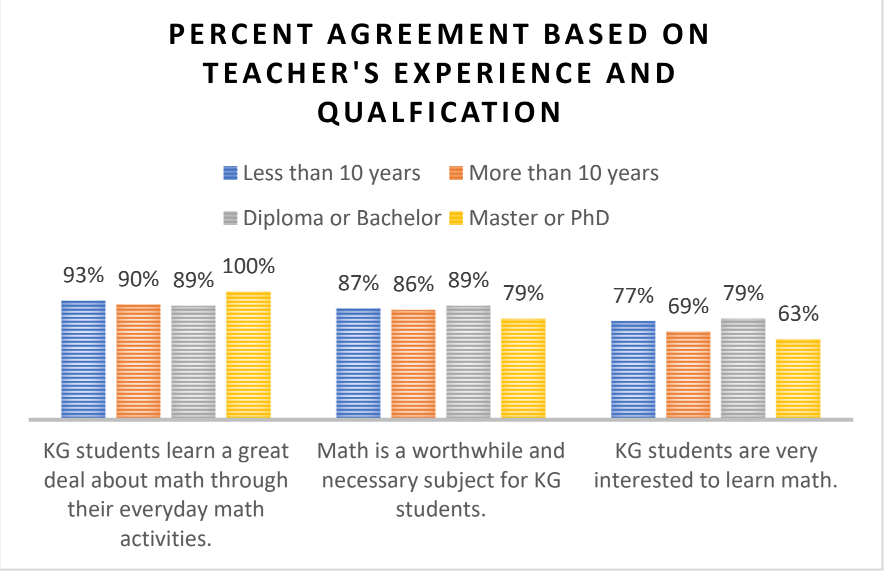


Figure 3: Percent agreement on KGTB about T&L questionnaire items organized by teachers experience and credentials

According to 83 percent of teachers with at least a master's degree stated that mathematics should not be taught in isolation, and 79 percent of the same category teachers believed that young children have the cognitive abilities necessary for learning mathematics and that mathematical activities are an appropriate use of class time. Similarly, 79% of teachers with more than ten years' experience also agreed that mathematics should be integrated with other subjects and mathematical activities were deemed suitable use of class time by 83% of the same category teachers. Figure 4 depicts the percent disagreement on KGTB about T&L questionnaire items organized by teachers experience and credentials.

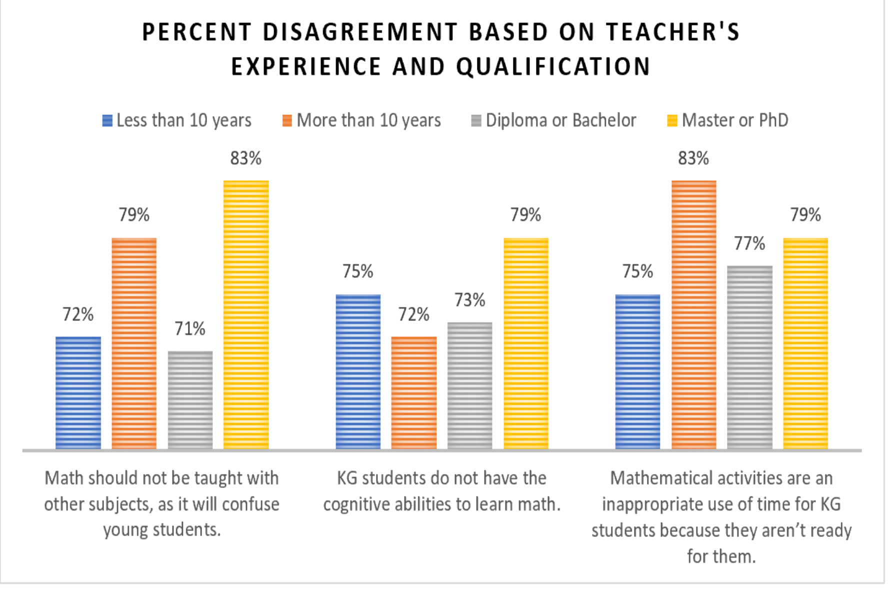


Figure 4: Percent disagreement on KGTB about T&L questionnaire items organized by teachers experience and credentials

To see if there were any differences in the means of KGTB about T&L as alleged by teachers based on their qualifications or years of experience, a Mann-Whitney U test was used. The findings of the test revealed no significant differences in the means of teachers KGTB about

T&L based on their certification (see Table 12) or experience (see Table 13). In other words, the teachers' level of experience or certification had no effect on their beliefs about teaching and learning mathematics.

Table 12*:* Mann-Whitney U-test results of KGTB about T&L by qualification

Scale	***Education***	***N***	***Mean Rank***	***Sum of Ranks***	***U***	***p***
KGTB about T&L	H. Diploma or Bachelor	66	44.57	2941.50	730.50	0.573
	Master of PhD	24	48.06	1153.50		

Table 13: Mann-Whitney U-test results of KGTB about T&L by experience

Scale	***Experience***	***N***	***Mean Rank***	***Sum of Ranks***	***U***	***p***
KGTB about T&L	10 years or less	61	45.73	2789.50	870.50	0.903
	More than 10 years	29	45.02	1305.50		

3.5 Research Question 2

What are UAE kindergarten teachers' beliefs about the nature of developmentally appropriate mathematics practices?

KGTB about DAMP were explored using sixteen survey items (see Table 14). The questions in this section were also rated on a 6-point Likert scale ranging from 1 – strongly disagree to 6 – strongly agree. Cronbach alpha reliability coefficient for this subscale was α = 0.822. A higher mean for the item indicated that teachers considered the activity developmentally appropriate and that they used it more frequently in the classroom. The survey results identified two dimensions for beliefs about teaching the

Table 14: Descriptive statistics for KGTB about DAMP sorted by highest mean (N=90)

Survey Item	***Mean***	***SD***	***z***	***p***
Teachers should encourage students to memorize counting (from 1 to 10 etc).	4.61	1.25	6.225	.000
KG students should practice mathematics as they best learn through repetition.	4.53	1.82	6.260	.000
KG students need structured math instruction.	4.48	1.09	6.410	.000
Teachers should show KG students the correct way of doing mathematics.	4.44	1.17	5.933	.000
Math flashcards are appropriate for KG students to teach math facts.	4.30	1.29	5.000	.000
The teacher should play a central role in mathematics activities.	4.17	1.23	4.586	.000
KG students learn mathematics best through direct teaching of basic skills.	4.13	1.34	4.100	.000
KG teachers are responsible for making sure that KG students learn the right answer.	3.81	1.32	2.428	.015
Math worksheets/workbooks are appropriate for pre-schoolers.	3.79	1.47	1.959	.050
KG students should learn specific procedures for solving math problems (i.e., 2 + 4).	3.74	1.46	1.556	.120
Math should always be taught to whole class and made sure that all students participate in the same activity.	3.57	1.59	0.339	.734

Table 14 (continued)

Survey Item	***Mean***	***SD***	***z***	***p***
**Children should not be allowed to opt out of activities.*	3.69	1.39	-1.255	.209
Teachers should help their students memorize number facts (for instance, 2+3).	3.26	1.46	-1.602	.109
**Children learn math only by interacting with concrete objects (ex: counting cars or counting sticks etc.)*	2.90	1.37	3.762	.000
Games, puzzles and block play (e.g., Lego, Duplo) take time away from actual mathematical teaching tasks.	2.39	1.49	-5.495	.000
If teachers spend time doing math activities in the classroom, then other subjects will be neglected.	2.30	1.20	-6.589	.000

direct transmission perspective and the constructivist view (see Appendix G). For the sixteen DAMP items, the highest frequency of occurrence was for item, *"Teachers should encourage students to memorize counting (from 1 to 10 etc.)"* with 88.9% of participants strongly agreeing or agreeing with the statement. As per the one-sample Wilcoxon signed rank test results, the teacher's beliefs were statistically significantly positive ($p < 0.05$) with regard to encouraging students to memorize counting, use of flashcards to teach, drill and practice, towards showing students the correct way of doing mathematics and towards emphasizing their authority and role. The results also showed that teachers were unsure ($p > 0.05$) about allowing students to opt out of activities, teaching whole class at a time, asking students to memorize number facts and procedures and asking them to complete worksheets. Findings indicated that teachers believed in both child-centered (or constructivist beliefs) and teacher-directed practices (or direct transmission beliefs). Figure 5 lists the questionnaire items from which the two aspects for teachers' beliefs about developmentally appropriate mathematical practices were constructed.

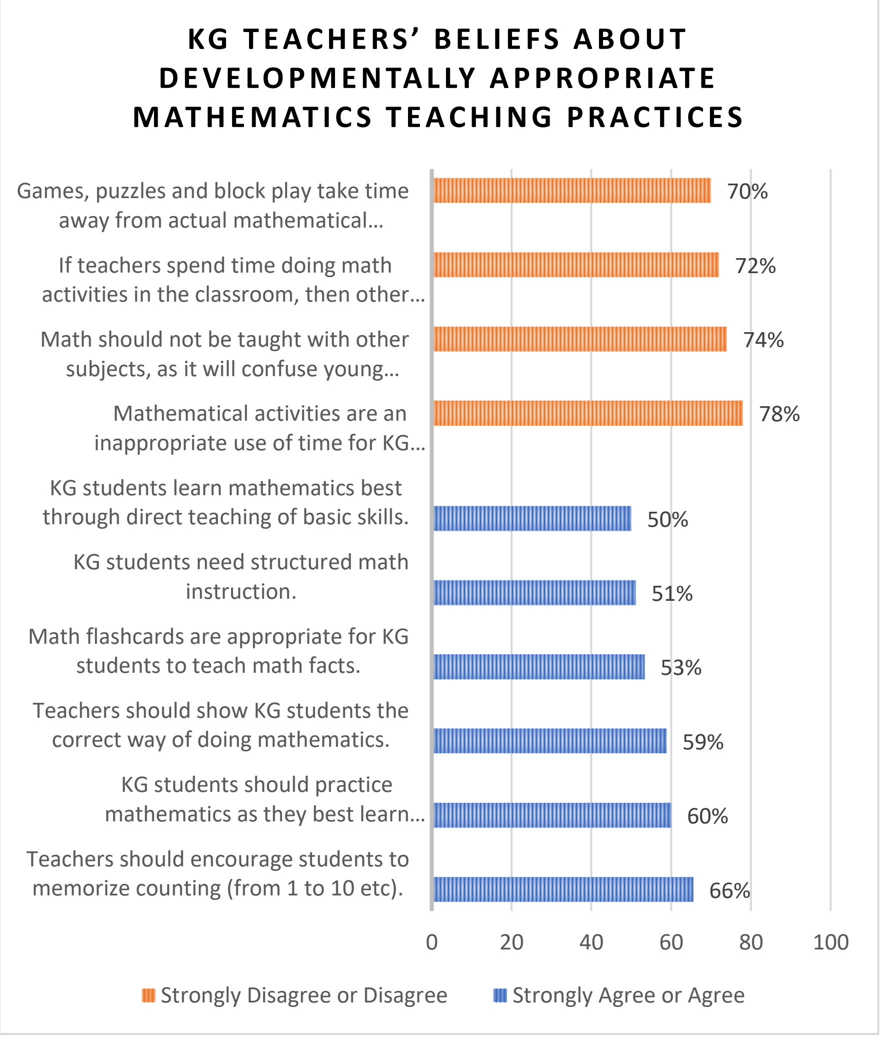


Figure 5: List of selected items according to percent agreement regarding teachers' beliefs about developmentally appropriate mathematics teaching practices

Fifty percent or more of the ninety teachers surveyed believed in teacher-directed instructional practices. Survey results revealed that more than half of the teachers believed mathematics should be taught in a highly structured classroom, that teachers should play a central role in the classroom, demonstrate the correct way to do mathematics and that students should learn through repetition. These views were also reported statistically significantly positive at 0.05 level of significance according to the one-sample Wilcoxon signed rank test results. In spite of these findings, over 70% of teachers also agreed that children should be encouraged to explore mathematics through games, play and social interactions and almost the same percent of teachers stated that students learn mathematics through meaningful activities. The one-sample Wilcoxon signed rank test results reported these views as statistically significantly at 0.05 level of significance. In comparison, a little over 43% of teachers approved to afford students with considerable workbook practice and 34.4% favored immersing students in whole-class activities for most of the day.

When the data was split by teachers' years of teaching experience and qualifications, more than half of teachers with less than ten years of experience or those with at least a higher diploma in teaching supported to a greater extent teacher-directed practice. For example, approximately 50% of teachers with fewer than ten years of teaching experience or those with higher diploma or bachelor's degree in teaching felt that they played a central role in students learning, around 52% felt that students needed a structured classroom to learn, over 60% of teachers supported that students should learn mathematics through repetition, and approximately 69% of the teachers from the same category encouraged students to memorize counting. In comparison, only 42% of teachers with at least a master's degree

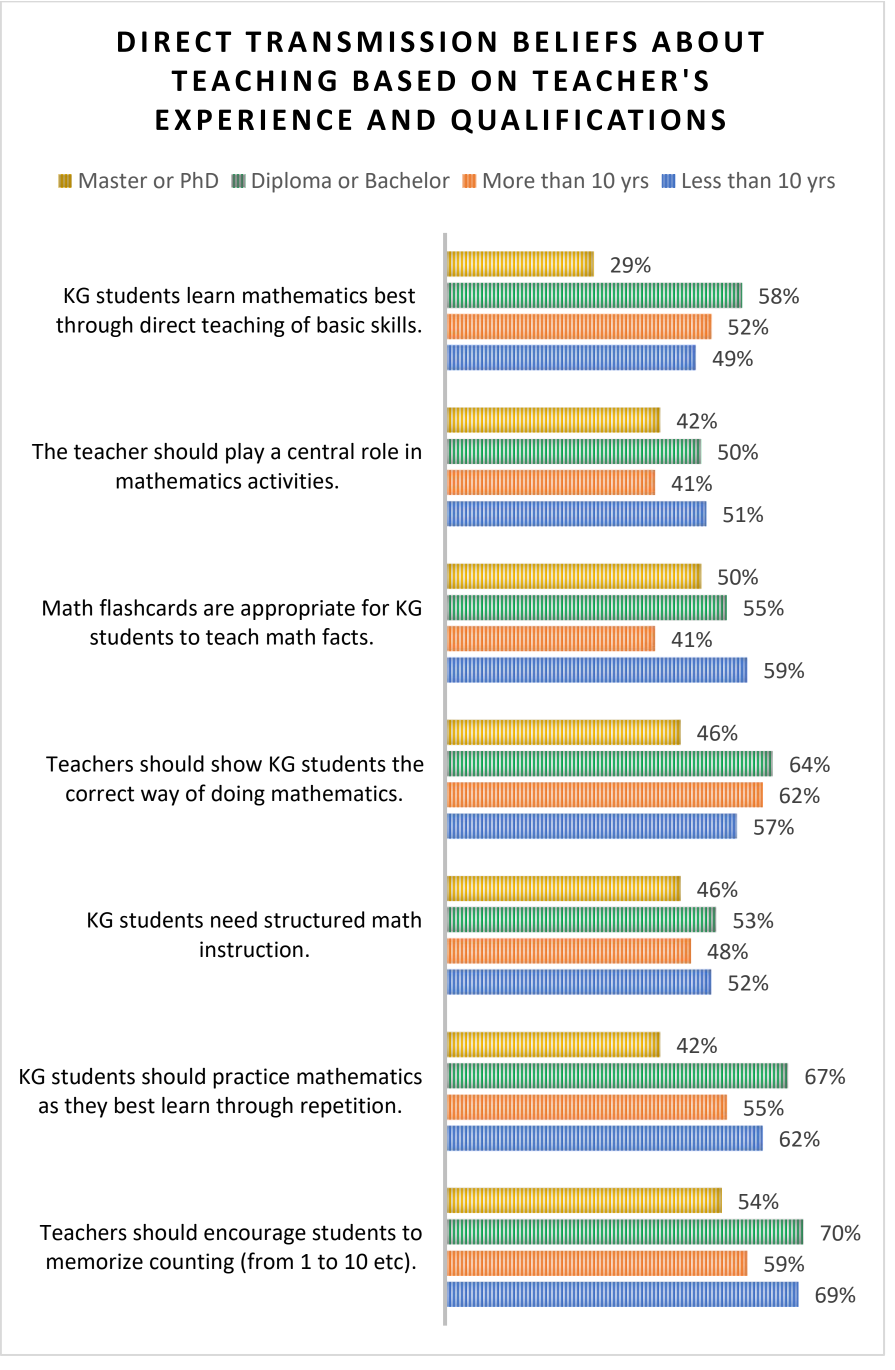
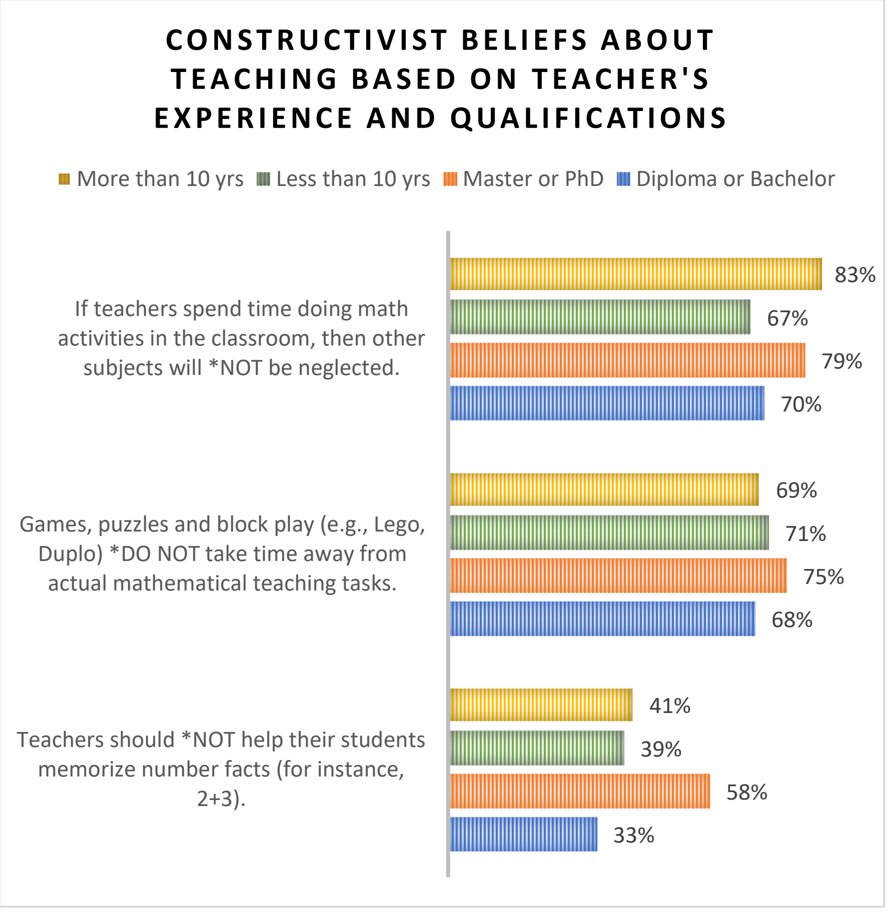


Figure 6: Percent agreement regarding direct transmission beliefs about teaching mathematics based on experience and qualifications

accepted that they played a key role in students learning and that students should learn through repetition, 46% supported the idea of structured classes and 54% encouraged the idea of rote counting. Remarkably, 55% of teachers with more than ten years of experience were undecided about their role is students learning and 45% from the same category were unsure if math flashcards are appropriate.

Similarly, 54% of teachers with at least a master's degree were uncertain about allowing children to opt out of activities and 50% of the teachers from the same group were unsure if students need structured mathematics lessons. Figure 6 lists percent agreement on selected items from the survey regarding teacher's direct transmission beliefs about teaching split by years of experience and credentials.

Majority of teachers (83%) with more than ten years of experience argued that spending time on mathematics activities will have detrimental impact on other subjects, however 67% of teachers with less than ten years of experience disagree. Notably, 58% of teachers with a master's degree or above thought that students should recall number facts, compared to just 33% of teachers with a higher diploma or bachelor's degree. Figure 7 illustrates percent agreement on selected, reverse coded survey items regarding teacher's constructivist beliefs about teaching separated by years of experience and credentials.



*Reverse coded

Figure 7: Percent agreement regarding constructivist beliefs about teaching mathematics based on experience and qualifications

A Mann-Whitney U test was conducted to determine if there were any differences in the means of KGTB about DAMP as perceived by teachers depending on their qualifications or years of experience. The findings of the test revealed no significant differences in the means of teachers KGTB perceptions of DAMP based on their certification (see Table 15) or experience (see Table 16).

Table 15*:* Mann-Whitney U-test results of KGTB about DAMP by qualification

Scale	*Education*	*N*	*Mean Rank*	*Sum of Ranks*	*U*	*p*
KGTB about DAMP	H. Diploma or Bachelor	66	48.74	3217.00	578.00	0.051
	Master of PhD	24	36.58	878.00		

Table 16*:* Mann-Whitney U-test results of KGTB about DAMP by experience

Scale	*Experience*	*N*	*Mean Rank*	*Sum of Ranks*	*U*	*p*
KGTB about DAMP	10 years or less	61	47.32	2886.50	773.50	0.338
	More than 10 years	29	41.67	1208.50		

3.6 Research Question 3

How confident are UAE KG teachers in their mathematics abilities and in helping kindergartners learn math?

The descriptive statistics for the nine items relating to KGTC about TM to kindergarten students are presented in Table 17. Cronbach alpha reliability coefficient for this subscale was α = 0.781. Seventy-seven teacher participants or 88.5% of the sample felt that they *"can create `effective math activities"* (M = 5.16, z = 8.124, p = 0.000) to "*support math learning in KG"* (M = 5.16, z = 8.153, p = 0.000). These views were also statistically significantly positive ($p < 0.05$) when analyzed using one-sample Wilcoxon signed rank test. However, only thirty-six teachers asserted that "*they can easily convert fractions to percentages and decimal numbers*" (M = 4.1, z = 4.168, p=0.000). The overall composite scale level of KGTC about TM was statistically significantly positive at (z = 7.291, p = 000 < 0.05).

Table 17: Descriptive statistics for KGTC about TM to kindergarteners sorted by highest mean (N=90)

Survey Item	***Mean***	***SD***	***z***	***p***
I can support math learning.	5.16	0.83	8.124	.000
I can create effective math activities for my students.	5.16	0.86	8.153	.000
**I am not comfortable teaching mathematics to KG students.*	5.07	0.91	-8.034	.000
I am knowledgeable enough to teach math to KG students.	5.00	1.11	7.416	.000
I can likely come up with creative ways to solve math problems.	4.92	0.99	7.660	.000
**I am not a "math person".*	4.51	1.34	-5.793	.000
I am good at estimating how tall something is.	4.50	1.06	6.517	.000
**I am unsure how to support math development for young children.*	4.39	1.42	-4.973	.000
I can easily convert fractions into percentages and decimal numbers.	4.10	1.25	4.168	.000

*Reverse coded

The majority of teachers endorsed they felt comfortable teaching math to kindergarten students (83%) and believed they can enhance math learning (87%) by designing effective math activities (84%). However, only 40% of teachers agreed with the assertion when asked if they could readily convert fractions to decimals and vice versa. Figure 8 shows the percent agreement and disagreement of selected confidence subscale items.

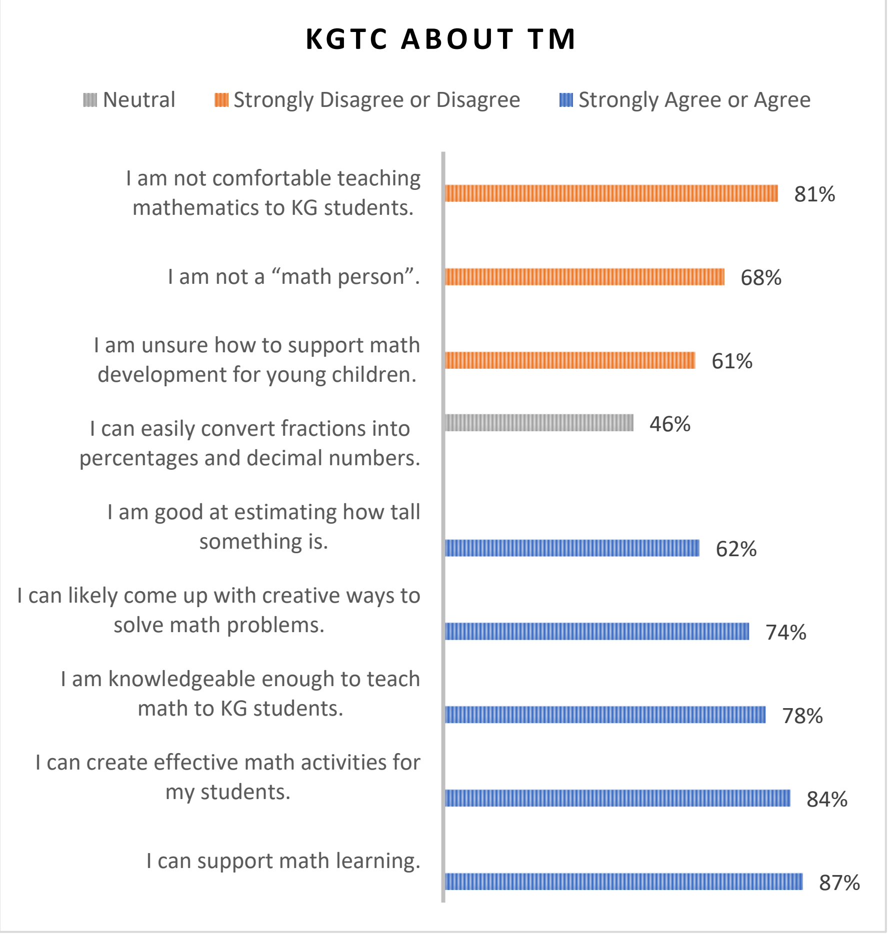
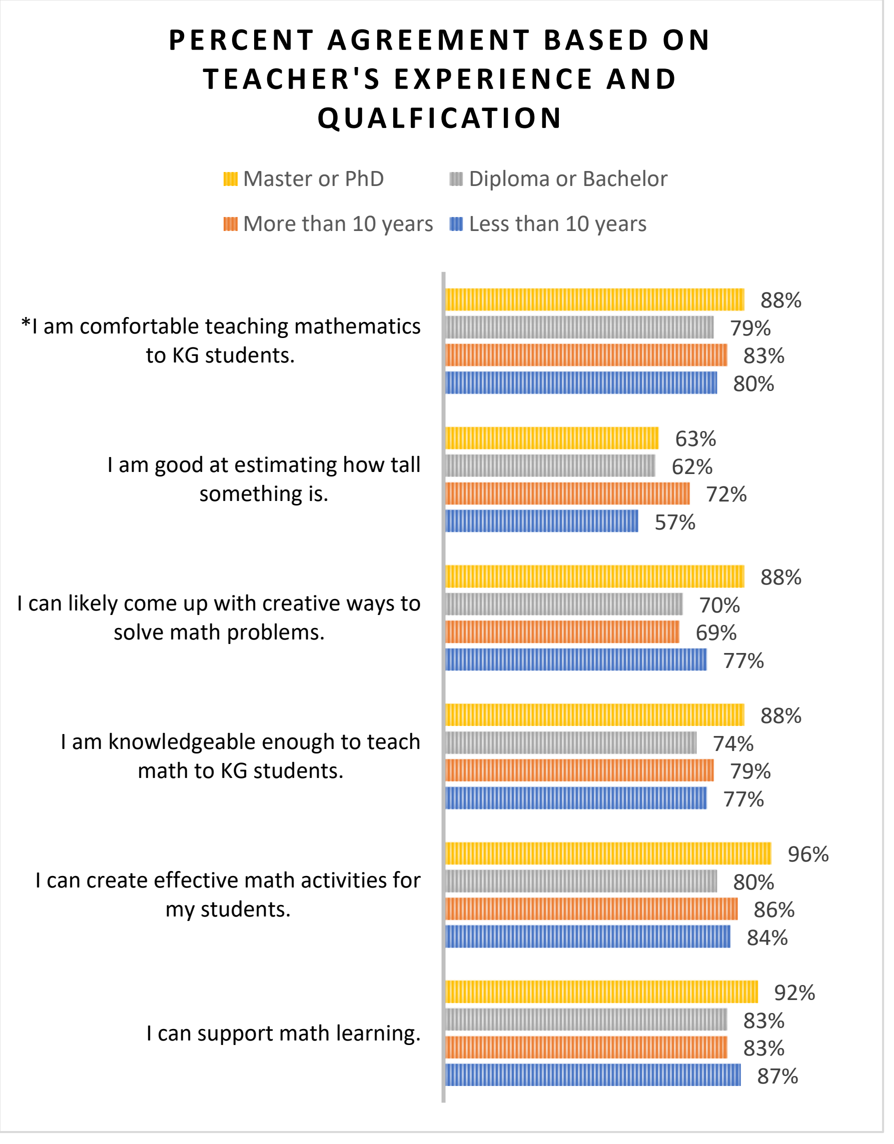


Figure 8: Percent agreement and disagreement on KGTC about TM

According to the survey results, teachers with a master's degree or higher expressed higher confidence and less mathematical anxiety. Specifically, over 88% of these teachers validated that they are confident and competent enough to teach mathematics and that they can come up with creative ways to do so. Approximately 96% of teachers from the same group affirmed that they could develop engaging and effective mathematics activities. However, when asked if they could convert fractions, decimals, and percentages easily, half of these teachers showed skepticism.

Other categories, notably those with more than 10 years of experience, also exhibited high confidence trends. Particularly, 83% of teachers in this group expressed confidence in their ability to facilitate mathematics teaching and learning in their classes, 86% expressed confidence to produce captivating mathematics lessons, and 79% felt they were knowledgeable enough to teach mathematics to kindergarten students. A similar pattern was observed in this category, when asked if they could convert fractions, decimals, and percentages effortlessly, 55 percent of these teachers expressed their reservations. Figure 9 represents percent agreement on selected, reverse coded KGTC about TM survey items split by experience and qualifications.



*Reverse coded

Figure 9: Percent agreement on selected KGTC about TM items based on experience and qualifications

To test the null hypothesis, a Mann-Whitney U test was completed to determine if there are differences in the means of KGTC about TM perceived by teachers based on either their qualification or their years of experience. The results of the test did not show a significant difference in the means of KGTC about TM to kindergarten students perceived by either their qualification (see Table 18) or their years of experience (see Table 19).

Table 18: Mann-Whitney U-test results of KGTC about TM by qualification

Scale	***Education***	***N***	***Mean Rank***	***Sum of Ranks***	***U***	***p***
KGTC about TM	H. Diploma or Bachelor	66	43.35	2861.00	650.00	0.194
	Master of PhD	24	51.42	1234.00		

Table 19: Mann-Whitney U-test results of KGTC about TM by experience

Scale	***Experience***	***N***	***Mean Rank***	***Sum of Ranks***	***U***	***p***
KGTC about TM	10 years or less	61	46.89	2860.50	799.50	0.460
	More than 10 years	29	42.57	1234.50		

3.7 Research Question 4

Is there a correlation between teachers' mathematical beliefs, developmentally appropriate teaching practices and teachers' confidence?

Spearman's correlation coefficient was utilized to measure the degree of association between the variables. The three variables were pertaining to the teachers' beliefs subscale and were (1) KGTB about T&L, (2) KGTB about DAMP and (3) KGTC about TM to kindergarten children. The value of Spearman's correlation coefficient (r) varies between +1 and -1, with a value of ± 1 indicating a perfect degree of association between the two variables and the sign indicating the direction of this association; a + sign indicates a positive relationship, while a - sign indicates a negative relationship (Muijs, 2004).

Table 20: Correlations among subscales for teachers' beliefs subscales (N=90)

Subscale		***KGTB***	***KGTB about DAMP***	***KGTC about TM***
KGTB about T&L	Correlation Coefficient	1.000	0.518**	0.189*
	Sig. (1-tailed)		0.000	0.037
KGTB about DAMP	Correlation Coefficient		-	0.309**
	Sig. (1-tailed)		-	0.002
KGTC about TM	Correlation Coefficient		-	-
	Sig. (1-tailed)		-	-

**Correlation is significant at the 0.01 level (1-tailed).
*Correlation is significant at the 0.05 level (1-tailed).

The significant Spearman correlation coefficient value of .518 (see Table 20) confirms that there appears to be a statistically significant, strong positive correlation between kindergarten teachers' beliefs and their instructional practices which is upheld by a significance level of 99%. The sample data supports the notion that the relationship between KGTB about T&L and KGTB about DAMP exists in the population of UAE kindergarten teachers.

The r value of 0.309 confirms that there appears to be a moderately positive correlation between teachers' instructional practices and their confidence. Thus, we can conclude that the relationship between KGTB about DAMP and KGTC about TM is statistically significant at p-value 0.002.

Finally, with a Spearman correlation coefficient of 0.189 and a *p*-value of 0.037, there appears to be a statistically significant but negligible association between teacher beliefs and confidence.

3.8 Discussion on Teachers promoting Higher Order Thinking

To measure teachers’ knowledge for teaching mathematics and to determine the extent to which teachers’ can support higher order thinking among their students, part of the Preschool Mathematics PCK Interview designed by McCray and Chen (2012) was adapted. The values ranged from 0 to 7 for 'noticing a mathematical situation,' 0-28 for ‘interpreting a mathematical situation’ and 0 to 3 for 'encouraging higher-order thinking.' The maximum possible score was 38 across the three subscales.

Analysis of the scores revealed that the most often recognized mathematical situations were number sense (100%) and operations (100%), followed by measurements at 75%. Half of the teachers recognised classification context and a quarter identified patterns. None of the teachers could identify shapes and spatial relationships (0% each). According to the results, more than 75% of the teachers could construe mathematical concepts associated with number sense, operations and measurements which could be regarded sufficient knowledge in those mathematical areas alone.

3.9 Summary

In this chapter, the sample was outlined, and the study questions were addressed. Tables and graphs were used to present the findings. Kindergarten teachers' perspectives on young children's cognitive development, the nature of mathematics, and how they feel kindergarten students should be taught were revealed using descriptive statistics.

According to the KGTB regarding T&L subscale outcomes, teachers thought mathematics education for kindergarten students was age appropriate. The results of the KGTB about DAMP subscale suggested that mathematics instruction was more teacher-centred than student-centred. And the teachers indicated confidence in teaching mathematics to young children, according to the KGTC about TM subscale.

Chapter 4: Discussion

4.1 Overview

Teacher’s beliefs play a significant role in how students learn (Leder, Pehkonen, & Torner, 2002; Stipek, Givvin, Salmon, & MacGyvers, 2001; Thompson A. G., 1992). However, only a few studies have attempted to ascertain preschool teachers' beliefs about the nature of teaching and learning mathematics and their understanding of children's mathematical development in a preschool setting (Brown, 2005; Platas, 2015; Beswick, 2012). This study hopes to contribute to the literature by examining the mathematical beliefs and practices of UAE kindergarten teachers’ by exploring three critical elements – teachers’ mathematics beliefs and teachers’ confidence in the subject, and how it might influence a kindergarten teacher's mathematical teaching practice. Additionally, the relationship between beliefs and effective ways to promote higher order cognition in the light of these beliefs were explored through qualitative study. For this purpose, the study considered the following four questions:

1. What are UAE kindergarten teachers’ beliefs about the nature of teaching and learning of mathematics to kindergarteners (4 to 6 years)?
2. What are UAE kindergarten teachers’ beliefs about the nature of developmentally appropriate mathematics practices?
3. How confident are UAE kindergarten teachers in helping kindergarteners learn math?
4. Is there a correlation between teachers’ mathematical beliefs, teaching practices and teachers’ confidence?

The data for this study was collected using mixed approach from two sources: survey and interviews. In this chapter, the results of careful data analysis are discussed, with references to relevant literature and research.

4.2 Summary of the Key Findings

In response to the study's four research question, the main findings are summarized below:

- Teachers in this study held beliefs about the nature of mathematics, mathematics learning, and mathematics teaching that reflected a combination of traditional and constructivist perspectives to varying degrees. These revelations are in line with some of the earlier study findings (e.g. Cross, 2009; Thompson, 1992, OECD, 2009).
- A majority of teachers believed that teaching mathematics to kindergarteners was necessary, developmentally appropriate, and that young children improve mathematics readiness skills as a result of developmentally appropriate mathematics practices.
- Teachers placed greater emphasis on well-structured learning and were more inclined to perceive their main role as the transmitters of knowledge and demonstrators of "correct solutions". These findings were consistent with some of the prior research findings (e.g., OECD, 2009)
- Teachers were more likely to recognize mathematical concepts linked to number sense, operations, and measures, while shapes and spatial connections were least observed and interpreted. The findings were coherent with earlier empirical research (e.g., Lee, 2010, 2014, 2017).

4.3 Main Findings

4.3.1 Research Question 1

The first research question examined kindergarten teachers' perspectives on young children's cognitive development, on how they learn and about the nature of teaching and learning of mathematics to kindergarteners. The survey questions specifically examined the appropriateness of how young children should be taught, while the interview questions probed into kindergarten teachers' perceptions on how children learn.

According to the survey findings of this study, a significant number of teachers acknowledged that mathematics was an essential element of the kindergarten curriculum. Furthermore, a large majority of the teachers believed that students learned a great deal about mathematics through everyday activities and they felt that mathematical activities were appropriate use of class time. Three-quarter teachers disagreed that kindergarten students lacked the cognitive abilities to learn mathematics and that mathematics should be taught in isolation. These findings are in line with recommendations stated by Institute of Education Sciences (IES) in their practice guide on *Teaching Math to Young Children* that kindergarten programs should "dedicate time each day to teaching math and integrate math instruction throughout the school day" (Frye et al., 2013 p.47). Research indicates that knowing if young children can acquire mathematics at such a young age is vital; especially from birth through the age of five, children are receptive to mathematical information and can develop sufficient mathematical abilities for everyday use (Baroody, Lai, & Mix, 2006; Clements & Sarama, 2007).

Teachers agreed that intentional teaching and meaningful interactions embedded in play routines and other activities were essential, however they related them to the development of children's social emotional abilities when asked. They couldn't, however, justify its significance in the development of cognitive abilities. In contrast, while play has an obvious social flavor, studies have proven that intentionally engaging students in mathematics conversations appears to foster distinct cognitive skills, and hence may serve as a bridge between the social and more individualistic realms of cognitive skills (Lilliard, 2002; Piaget, 1952; Saracho & Spodek, 2003; Sutton-Smith, 1997).

Although not surprising, the study discovered that some kindergarten teachers applied the notion of cognition or cognitive development differently, while some did not fully comprehend it. The teachers' interview responses revealed that teachers were well informed about the contextual dynamics that might influence the way children think and learn, and the teacher's role in fostering this development. However, the area of cognitive development as a whole was somewhat vague. Since the extent to which kindergarten teachers need to have a comprehensive awareness of this subject is debatable, this study did not probe further into the matter. Again, this is not to suggest that kindergarten teachers needed understanding in the area of cognitive development, instead, the researcher would like to initiate a discussion on the nature of how cognitive development in its many forms is imparted in the early childhood programs.

4.3.2 Research Question 2

The second research question delved into UAE kindergarten teachers' beliefs about teaching mathematics to kindergarten children and developmentally appropriate mathematics practices.

Findings indicated that teachers believed in both child-centered (or constructivist beliefs) and teacher-directed practices (or direct transmission beliefs). These findings are consistent with earlier studies that teachers' beliefs tend to correspond with what researchers perceive to be essentially child-centered approaches for early children (Brown, 2005; Nespor, 1985; OECD, 2009). Figure 10 lists the kindergarten teachers' beliefs about developmentally appropriate teaching practices according to the constructs.

Direct transmission beliefs about teaching

- Effective/good teachers demonstrate the correct way of doing mathematics.
- Mathematics instruction should be built around problems with clear, correct answers, and around procedures that students should memorize and be able to repeat.
- Students' ability to learn mathematics is determined by their previous knowledge, which is why imparting facts is so important and necessary.
- Teachers believed in transmission of knowledge and that they should play a prominent role in teaching and learning.

Constructivist beliefs about teaching

- Students learn through social interactions and collaboration.
- In order to construct knowledge, children should spend time playing with blocks, games etc.
- Mathematics is an integrated subject and should not be taught in isolation.

Figure 10: Kindergarten teachers' beliefs about developmentally appropriate teaching practices

Survey results further revealed that more than half of the teachers believed mathematics should be taught in a highly structured classroom, that teachers play an important role in the classroom, that teachers should demonstrate the correct way to do mathematics and that students should learn through repetition and memorization. These findings are at odds with studies on how children learn, including evidence from neuroscience, cognitive scientists and mathematics education, all of which reject traditional teaching approaches for learning foundational mathematics (Boaler, 2014). Researchers regard the traditional approach as a cognitive process of "passive storage" that frequently relies on flashcards, repetition, and standardized assessments (Baroody A. J., 2006; Baroody, Bajwa, & Eiland, 2009) and does harm to children (Boaler, 2014; Henry & Brown, 2008; Seeley, 2009)

During interviews, when asked if teachers should teach mathematics skills to mastery before exposing students to knowledge and skills that are more complex, all the teachers unanimously agreed that students should master skills before new content was introduced. In contrast, research has time and again proven that classroom mathematics that focuses on the replication of others' mathematical activity and consists predominantly of repetitive computing activities might discourage students from doing genuine mathematics for themselves and authoring their own mathematical ideas (NCTM, 2018, 2020). Research suggests that procedures and answer-getting exercises should not be part of a child's mathematical education. Research has further divulged that when children are not given the opportunity to question "Why?" or voice their opinions, their interest in and engagement with mathematics is compromised. However, when school children are encouraged to ask questions and solve their own mathematical problems, their perceptions of what mathematics is and how it should be addressed can be profoundly influenced (Bonotto and Dal Santo, 2015; Silver, 1994, 1997).

A substantial percent of teachers participating in the survey also agreed that children should be encouraged to explore mathematics through games, play and social interactions which is in line with the kindergarten education research. Francis Su (2019, 2021) has argued that play is essentially doing mathematics, and joy is intertwined with mathematical insights and discoveries through problem solving, communication and collaboration (Parks, 2015; Stipek, 2017; Small, 2018; Weisberg, Hirsh-Pasek, Golinkoff, Kittredge, & Klahr, 2016). The interview participants also endorsed the importance of play-based activities and interactions and signaled that they were aware of the current trends in mathematics teaching and learning advocated by Ministry of Education in the UAE (MoE, 2021), such as learning through play, using concrete manipulatives, stressing problem-solving, discussion and logical thinking.

Despite their constructive perspective - the conviction that learning mathematics requires active participation from students, use of manipulative materials, collaborative group work, exploration and active problem solving, majority of teachers who participated in the survey also supported a static view of mathematics as a set of procedures and rules that must be memorized and applied. Even though curiosity is connected to academic performance (Shah, Weeks, Blair, & Kaciroti, 2018), teachers appeared to seldom encourage students to formulate their own inquiries concerning mathematical observations and curiosity. As a result, the teachers did not reject the transmissive view that learning mathematics is not about recalling formulas, repeating exact procedures, and getting the correct answer. These findings suggest that there is a misalignment between teachers' professed beliefs and their classroom practices.

Further investigation through interviews revealed that teachers indicated their lack of understanding of constructivist use of teaching strategies such as through group work and child-centered approaches. Moreover, teachers did not feel a strong sense of responsibility to deal with more complex mathematics knowledge such as developing children’s problem-solving skills or encouraging higher order thinking skills. This is in complete conflict to the NAEYC's suggestion that a stimulating, engaging, and developmentally age-appropriate curriculum be provided (Bredekamp & Copple, 1997). The caveat is that the curriculum should not be overly limited, focusing primarily on fundamental abilities, or a curriculum that requires mastery of fundamental skills. The NAEYC and the NCTM (2002, 2010) conjointly advocate for deep, persistent and sustained interactions with key mathematical ideas by “actively introducing mathematical concepts, methods and language” (p. 9).

This study established that the kindergarten teacher's professed constructivist beliefs were not always reflected in their teaching practices, and that the teachers implemented them in varying degrees and depths. These discrepancies were attributed to the fact that teachers in the UAE hail from different countries and have had established beliefs throughout their own schooling that served as filters through which they processed continuing educational and teaching experiences (Lortie, 2002). To address these challenges, researchers must determine what causes teachers to change their practices in contravention to their beliefs, and the time it takes for them to be "consumed by the system." These are important issues for future research.

4.3.3 Research Question 3

The third question researched UAE kindergarten teacher's confidence in their mathematics abilities and in assisting students in learning mathematics.

According to past studies, preschool teachers are often stereotyped as disapproving mathematics, lacking the confidence and the expertise to teach it, being apprehensive about teaching it, and attempting to steer clear from teaching it (Ginsburg, Lee, & Boyd, 2008; NAEYC & NCTM, 2010). The results of this study, on the other hand, depict a strikingly different portrait and are comparable to Chen and McCray (2013) research findings. Survey outcomes of this study reveal that kindergarten teachers believe that kindergarten mathematics is necessary and developmentally appropriate for the students. The teachers also consider themselves to be able to effectively support kindergarten mathematics teaching and learning. According to the results, an overwhelming majority of teachers felt confident in their knowledge of teaching mathematics and their ability to teach it to kindergarteners.

In contrast to the above, a closer examination of the survey results revealed that teachers exhibited more overall confidence in their abilities to teach kindergarteners mathematics than in their own mathematics ability. This disparity revealed that while kindergarten teachers may not consider themselves math experts, they believed they can teach kindergarten mathematics well. The likelihood that teachers consider early mathematics to be straightforward, simple, and involving little mathematical understanding to teach is concerning. And thus, the plausibility of kindergarten teachers' increased confidence in assisting kindergarteners learn mathematics may stem from a long-standing strength of theirs:

namely, a strong understanding of their students and feeling at ease engaging with them (Chen & McCray, 2013).

The variability in the findings also imply that teachers have relative strengths and weaknesses, which offer both a challenge and an opportunity, especially in relevance with designing effective continuous development. As such, school administrators should consult with teachers when planning professional development to ensure that the experiences accommodate to a wide range of teacher differences.

Although, survey results revealed that teachers exhibited more overall confidence in their abilities to teach kindergarteners mathematics, the interview findings exposed that teachers lacked the skills to make a considerable impact in their student’s development of mathematical concepts and goals. The issue is that many teachers believed teaching kindergarten mathematics was simple and straightforward because it just involved the most fundamental principles. Early mathematics is basic but not easy; rather it is complex, highly abstract, and foundational (McCray & Chen, 2012; NRC, 2009). Additionally, they underestimated children’s ability to do complex mathematics (NRC, 2009). Despite evidence indicating that early mathematical experiences improves readiness skills and potentially impacts mathematical success later in life, (Brenneman, Stevenson-Boyd, & Fred, 2009; Clements, Sarama, & DiBiase, 2004; Ginsburg, Lee, & Boyd, 2008; NRC, 2009; Platas, 2015), the absence or relative lack of high-quality mathematics experiences in kindergarten settings indicated a want of attention to mathematics teaching and learning across the early childhood education setting, and it once again highlighted the need for in-service teachers to receive continuous and relevant professional training (Clements et al., 2004; Copley, 2004; Ginsburg et al., 2008; NRC, 2009; Sarama, DiBiase, Clements, & Spitler, 2004).

Shifting teachers' belief of foundational mathematics and strengthening their awareness of foundational math, including big ideas - that connect mathematical understandings into a coherent whole, is absolutely essential to professional development effectiveness. Teachers must be trained with relevant skills and collaborative experiences, which should include modeling, classroom observations, mentoring to name a few (Copley, 2004). Exposure to such kind of professional development and training will assist teachers to build adaptive teaching skills, allowing them to capitalize on 'teachable moments' and anchor their instruction on the concepts that are most essential to the development of mathematical thinking (Sarama et al., 2004). As well, from the standpoint of educational policy, it is even more critical to analyze the influence on teachers' beliefs, practices and confidence of professional background characteristics such as kind of training, certification, and professional development.

4.3.4 Research Question 4

The study's last research question investigated the relationships between teachers' mathematical beliefs, developmentally appropriate teaching approaches, and teachers' confidence in teaching mathematics to kindergarten children.

A Spearman's correlation coefficient was utilized to measure the degree of association between the variables. According to the results there is enough evidence to suggest that there is strong positive monotonic correlation between teachers' beliefs and teachers' developmentally appropriate mathematical practices ($r_s = 0.518$, $n = 90$, $p < 0.001$). The relationship between these variables is positive, which indicates that as KGTB about T&L increases, KGTB about DAMP rises. Secondly, there is moderately positive monotonic correlation between teachers' developmentally appropriate mathematical practices and teachers' confidence ($r_s = 0.309$, $n = 90$, $p < 0.001$). Again, the relationship between these variables is positive, which indicates that as KGTB about T&L increases, KGTC about TM increases. And finally, there exists a weak or negligible relationship between teachers' beliefs and teachers' confidence ($r_s = 0.189$, $n = 90$, $p < 0.005$). Other variables such as qualifications and years of experience were not significant determinants of kindergarten teachers' beliefs, practices and confidence. Thus, this study concluded that there is a positive relationship between in-service KGTB about T&L, KGTB about DAMP and KGTC about TM.

4.3.5 Encouraging Higher Order Thinking through Teacher Questioning

The interviews aimed to explore teachers' knowledge about their student's abilities to learn mathematics, teachers' knowledge about teaching mathematics and to determine to what extent teachers' can support higher order thinking among their students. This section will specifically discuss the findings on teachers' knowledge about teaching mathematics and the extent to which teachers' can support higher order thinking among their students.

The low MPCK scores suggests that teachers' ability to comprehend and improve children's mathematical processes is limited. The findings of this study corroborate with those of Lee's (2010, 2014, 2017) earlier empirical research. The study established that teachers were more likely to identify mathematical situations linked to number sense, operations, and measurements.

When presented with the scenario, in which the students place babies in boxes (beds) of varying sizes, teachers were quick to relate it to measurements, but rarely noticed that the beds can be associated to shapes and spatial relationships. If teachers lacked the knowledge about certain mathematical contexts, such as spatial relations and shapes, children will have less opportunities to explore, think deeply and connect.

When asked, "what can you ask the students that would encourage them to think further about math in their play?". Teachers had to think long and hard, whereas two of them couldn't think of any question. These two teachers believed that the activity in itself was appropriate for children's ability, and no intervention was necessary. The other two participants answered: (a) *"how many dolls did you put to bed?"* (b) *"how many dolls had long hair?"* (c) *"how many beds did you arrange?"*. All these questions were classified as low-level questions that required basic knowledge recall. Research has informed us that the kinds of questions teachers ask have an impact on the quality of student mathematical thinking.

Problem-solving in kindergarten settings should mainly arise from social interactions, and not through traditional symbolic problems such as "how many dolls did you put to bed?' or '1+1+1'. Problems which arise within familiar contexts with some mathematical complexity, help students make meaningful connections (Copley, 2010). Asking open-ended questions like 'In how many different ways can you share three beds between five dolls?' requires more mathematical thinking, as well as real world discussion about fair share. When analyzing young children's mathematical problem-solving strategies, teachers should take into account that it's crucial to evaluate what socio-cultural factors the child is considering, rather than assuming they don't comprehend the mathematics if they don't answer the question as expected.

Children in kindergarten are developing their own conceptions of what mathematics is, what it means to know math, how to think mathematically and to learn math through play (Copley, 2010; NAEYC &

NCTM, 2002). For children, comprehending mathematical concepts is empowering. Teaching deep conceptual knowledge, on the other hand, is challenging and complex (Eisenhart et al., 1993; Richland, Stigler, & Holyoak, 2012). Researchers have advocated for a conceptual approach to teaching mathematics, as opposed to a calculation-based approach (Thompson, Philipp, & Boyd, 1994). When teachers or curriculum documents specify a computation orientation, students are more inclined to pursue a procedure for finding the "correct" recommended solution. Instead, student’s must be afforded with learning opportunities to develop profound understanding of mathematics through higher-order tasks, given enough time to discover the mathematics of the task, and to deliberate the mathematics with other children.

In general, the interview findings complement with Lee's (2014, 2017) research, which concluded that early childhood teachers' skill to discern mathematical contexts was not always related with their ability to augment children’s mathematical thinking. The relevance of preschool teachers' knowledge about implementing high-quality mathematics instruction has been highlighted in several research (Ginsburg & Ertle, 2016; NCTM, 2020). However, this study’s findings highlight teacher’s lack of focus on going deep with mathematics and inform us that school administrators should provide kindergarten teachers with opportunities to improve their mathematical pedagogical content knowledge which can support them to extend their student’s mathematical understanding.

4.4 Summary

The basis of this study was grounded in cognitive constructivism (Piaget, 1952) which states that learners actively construct knowledge based on their existing cognitive structures. Both constructivism and neuroconstructivism theories propose that genes, brain, cognition, behavior, and the environment all impact one another in a process of reciprocal determinism. This study employed a design in which beliefs, practices, and confidence were all equally weighted. In addition, teachers were also asked to express their opinions on the importance of higher order thinking and how they would foster it in their students' play.

On the whole, the statistical analyses suggests that the teachers' beliefs, practices, and confidence survey is highly reliable. Results of correlational analyses indicated that teachers’ beliefs about the nature of mathematics teaching and learning is related to beliefs about classroom mathematical instructional practices and to teachers’ confidence in teaching mathematics to kindergarten students. Many researchers have suggested that higher qualifications affect teachers' beliefs regarding mathematics teaching and learning (Copley & Padron, 1998; Ginsburg, Lee, & Boyd, 2008). Although a substantial percent of teachers in this study with at least a masters or higher supported beliefs that kindergarten mathematics curriculum was necessary and age-appropriate and that they were increasingly comfortable in supporting mathematical learning in the classroom, the findings were not statistically significant when compared to teachers with a higher diploma or bachelor’s degree.

This study uncovered that teachers' mathematical beliefs were inconsistent with their teaching practices. Teaching practices were, for the most part, more conventional than their beliefs. The degree of discrepancy between beliefs and practices varied from teacher to teacher. Several aspects, such as the teacher's personal experiences, teaching experience, professional development experiences, and qualifications, were identified to influence teachers' adoption of teaching strategies during the interviews. The interviews also brought to light the breadth of UAE kindergarten teachers' knowledge of mathematics and their limited ability to expand children’s mathematical thinking.

Chapter 5: Conclusion

5.1 Summary of the Study

Early childhood education in the UAE has undergone considerable revisions as a result of the UAE Ministry of Education's new guidelines (2021). The new guidelines suggest that high-quality, complex mathematics in early childhood is a critical foundation for children's future mathematics learning. As such, examining who is capable of practicing and comprehending mathematics, as well as disrupting inequitable policies and practices, is a crucial element for high-quality early childhood programs. The literature reviewed argues that every child is capable of learning mathematics with depth (Adams, 2018; NCTM, Catalyzing Change in Early Childhood and Elementary Mathematics: Initiating Critical Conversations, 2020) and rich, meaningful, and purposeful instruction are required to improve children's cognitive development and mathematical reasoning (NCTM, Catalyzing Change in Early Childhood and Elementary Mathematics: Initiating Critical Conversations, 2020). As a response, addressing our beliefs is the first step towards more balanced and inclusive mathematics learning opportunities. The NCTM (2014) report stresses that, "The question is not whether all children can succeed in mathematics but whether the adults organizing mathematics learning opportunities can alter traditional beliefs and practices to promote success to all" (p. 61).

Thus, the purpose of this study was to explore the beliefs, practices and confidence of kindergarten teachers working in a public and private sector in UAE. The objectives of the study were (a) to explore UAE kindergarten teachers' beliefs about the nature of teaching and learning of mathematics to kindergarteners (4 to 6 years), (b) to examine UAE kindergarten teachers' beliefs about the nature of developmentally appropriate mathematics practices, (c) to investigate the level of confidence that UAE kindergarten teachers have in their mathematical abilities and in their ability to support children learn mathematics, and (d) to examine if teachers' mathematical beliefs, developmentally appropriate teaching practices and teachers' confidence are corelated.

The study employed a mixed method approach and after a comprehensive data analysis and establishing associations from various sources (such as surveys and interviews), uncovered that, teachers' beliefs towards the nature of teaching and learning mathematics were associated with their instructional practices and confidence in teaching mathematics. However, teachers teaching practices and instructional interactions with students varied from their professed beliefs. Although the teacher's had constructivist beliefs, their practice did not always reflect those beliefs. This finding contradicts Torff and Warbourton's (2005) research conclusion, which claimed that teacher's beliefs are a predictor of classroom practices. The most revealing information was unearthed from the interviews, which indicated that teachers lacked the potential to immerse children in rich mathematical discourse. Nevertheless, this inference is not meant to represent the practices of all UAE kindergarten teachers. The findings, on the other hand, have significant implications for children's learning, and the information gained from this study can be beneficial to teachers, teacher educators, and policymakers.

5.2 Recommendations

Teachers and their teaching approaches have a significant impact on children's mathematics learning, often considerably bigger than one assumes. As such, viewing all children as capable of learning complex mathematics must begin with conversations about beliefs, practices and policies.

Stakeholders must collaborate to assess and challenge current practices and to chart a course ahead. It is the adult stakeholders' collective responsibility to question their beliefs and practices in order to bring about changes that benefits all children (NCTM, 2014, 2020).

Policy makers and school administrators should put an end to explicit and tacit practices that promote the belief that mathematics is about recalling, rather than reasoning and making sense of the world. Such practices can have unanticipated and long-term repercussions on children.

If policymakers choose to promote constructivist viewpoints, teachers' preparatory education should include a systematic construction of knowledge about teaching and instruction. In-service teachers should receive ongoing training and support to deepen their knowledge of mathematics content, related content-specific pedagogical practices and children's mathematical thinking and development (NCTM, 2020). Such trainings should focus on how the content should be taught and support kindergarten teachers in planning developmentally appropriate activities. The sort of training a teacher pursues is more crucial than the amount of time spent doing it.

Teachers and leaders should also have access to ongoing professional development opportunities to critically examine, learn, and reflect on mathematics curriculum, pedagogies, beliefs, and prejudices. Moreover, professional development courses should be of high-quality and systematically designed for all stakeholders to develop specialized mathematical knowledge. Such opportunities will help teachers to expand

and develop their own understanding of mathematics, children’s thinking about mathematics and about mathematics teaching.

5.3 Limitations of the Study

The findings of this study have to be seen in the light of some possible limitations. Fundamentally, the study relied largely on self-reporting. Although some studies have found a positive correlation between teachers' anonymous self-reported surveys on their teaching and classroom observations (Desimone, Smith, & Frisvold, 2010), a distinction must be made between what teachers' claim to practice and what they actually practice (Bretscher, 2014). Thus, results from a self-reported data may be skewed, considering participants may exaggerate or misreport. To help strengthen the validity of the study, classroom observations with instructional checklists are recommended for future research.

Next, the lack of expertise to extemporize during the interview sessions in order to elicit crucial information from the participants posed as a setback to the analysis portion of the study.

The principals' support in forwarding an email with the research information to the teachers was crucial in recruiting teachers for the study. As such, teachers received research information based on the priorities and schedule of the principal, which could be another factor limiting the study. Furthermore, since the principals contacted the teachers to complete the survey, there was no way of knowing if the principal offered it to all kindergarten teachers or only to a selected few. Then there were several principals who refused to allow their teachers to participate in the research. This reduced the number of teachers who could participate in the study.

The breadth of generalizations to a larger population was also constrained by this form of convenience sampling. To make the generalizations more meaningful, administering the survey to a larger participant pool is recommended.

In the light of this, readers should consider these limitations while interpreting the study's conclusions. These limitations, however, do not obscure the study's contributions; rather, addressing these limitations raises new concerns and leads to future research directions.

5.4 Need for Further Research

For this study, the selection of instruments to measure teachers' beliefs, practices and confidence in regard to teaching mathematics in an early childhood setting was limited to a few options. The limited options reflect that not many studies have focused on exploring teachers' beliefs, practices and confidence teaching mathematics in an early childhood setting. As such, there is a need to conduct further studies with larger samples to strengthen the reliability of these findings. Another suggestion is to undertake longitudinal research with training interventions to examine the beliefs and practices of UAE kindergarten teachers over time.

The findings of this study must be followed up on. In order to extend this study, in-field classroom observations should be carried, which would provide a more thorough insight into the face of kindergarten in today's classrooms. Survey method and interviews might lead to teachers reporting beliefs and practices that are factual. Thus, observations will help to validate the study findings which may further aide to enhance educational implications.

Teacher's beliefs are shaped by their personal and professional experiences. Thus, potential future research in this area of study should include the factors influencing teachers' beliefs to further confirm and explore the ways they influence teachers' practice or limit implementation of curriculum.

Another probable area of research could be to conduct a cross-national comparative study that looks at how curriculum affects the quality of mathematics instruction and explores the differences in mathematics instruction provided by different set of teachers.

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Appendices

Appendix A: Teachers' Belief, Practices and Confidence Survey

Section A: Demographics

Please honestly indicate the correct response to each question in the space provided:

يرجى اختيار الإجابة الصحيحة لكل سؤال في الفراغ المعطى:

1. Do you currently work for a private or public school/institute?

هل تعمل حاليا في مدرسة حكومية أم خاصة؟

☐ Public ☐ Private ☐ Other (please specify)

2. In which emirate do you currently teach?

في أي إمارة تقوم بالتدريس حاليا؟

☐ Abu Dhabi ☐ Abu Dhabi (Al Ain) ☐ Dubai ☐ RAK ☐ UAQ ☐ Ajman ☐ Fujairah ☐ Sharjah ☐ Other (please specify)

3. Please indicate which age group do you belong to.

يرجى اختيار الفئة العمرية التي تنتمي إليها.

21 – 25 26 – 30 31 – 35 36 – 40 Other (please specify)

4. Provide your highest qualification attained?

ما هو أعلى مؤهل علمي لديك؟

☐ Bachelor of Education (other please specify)
☐ Master of Education (other please specify)
☐ Ph.D (please specify)
☐Others (please specify)

5. Which grade(s) do you teach?

ما هو الصف (أو الصفوف) الذي تقوم بتدريسه؟

☐ KG1/FS2 ☐ KG2/Y1 ☐ Both ☐ Other (please specify)

6. Please indicate your teaching experience as a KG teacher.
كم هي عدد سنوات خبرتك التدريسية كمعلم لمرحلة رياض الأطفال؟

0 – 5 | 6 -10 | 10 – 15 | 15-20 | 20+

7. How many students on average you have per class?
كم هو متوسط عدد الطلاب لديك في كل فصل دراسي؟

☐ Less than 10 students ☐ 11 – 15 students ☐ 16 – 20 students
☐ 21 – 25 students ☐ 25 and above students

8. Would you like to participate in an online research interview?
هل تود المشاركة في مقابلة بحثية (عن بعد)؟

☐ Yes ☐ No

If you selected YES, please provide us with your personal email address to contact you and discuss the interview process.
إذا اخترت نعم، يرجى تزويدنا بعنوان بريدك الإلكتروني الشخصي للتواصل معك ومناقشة إجراءات المقابلة.

____

Instructions: Please indicate the response that BEST describes your opinion about the following statements.
تعليمات: يرجى اختيار الإجابة الأقرب لرأيك حول العبارات التالية.

1=Strongly Disagree 2=Disagree 3=Somewhat Disagree
1=لا أوافق بشدة 2=لا أوافق 3=لا أوافق إلى حد ما

4=Somewhat Agree 5=Agree 6=Strongly Agree
4=أوافق إلى حد ما 5=أوافق 6=أوافق بشدة

Section 1: *Teacher Beliefs about Teaching Mathematics to kindergarteners*

معتقدات المعلم حول تدريس الرياضيات لطلاب رياض الأطفال

	Statement	**Options**					
1.	KG students are very interested to learn math. طلاب رياض الأطفال مهتمون جدًا بتعلم الرياضيات.	1	2	3	4	5	6
2.	Literacy is more important for KG students than math. القراءة والكتابة أكثر أهمية لطلاب رياض الأطفال من الرياضيات.	1	2	3	4	5	6
3.	KG students do not have the cognitive abilities to learn math. لا يتمتع طلاب رياض الأطفال بالقدرات الإدراكية لتعلم الرياضيات.	1	2	3	4	5	6
4.	Math is a worthwhile and necessary subject for pre-schoolers. الرياضيات مادة جديرة بالاهتمام وضرورية لطلاب رياض الأطفال.	1	2	3	4	5	6
5.	Math should *not* be taught with other subjects, as it will confuse young students. لا ينبغي تدريس الرياضيات مع مواد أخرى، لأنها ستربك الطلاب الصغار.	1	2	3	4	5	6
6.	KG students learn a great deal about math through their everyday math activities. يتعلم طلاب رياض الأطفال الكثير عن الرياضيات من خلال أنشطتهم اليومية في الرياضيات.	1	2	3	4	5	6
7.	Mathematical activities are an *inappropriate* use of time for KG students, because they aren't ready for them. استغلال الوقت لممارسة أنشطة الرياضيات يعتبر خاطئاً لطلاب مرحلة رياض الأطفال، لأنهم ليسوا مستعدين لها.	1	2	3	4	5	6

Section 2: *Teacher Beliefs about Developmentally Appropriate Mathematics Practices*

معتقدات المعلم حول ممارسات الرياضيات الملائمة تنموياً

	Statement	**Options**					
1.	The teacher should play a central role in mathematics activities. يجب أن يقوم المعلم بدور مركزي أثناء أنشطة الرياضيات.	1	2	3	4	5	6
2.	Math flashcards are appropriate for KG students to teach math facts. البطاقات التعليمية الخاصة بالرياضيات مناسبة لطلاب رياض الأطفال لتعليمهم حقائق الرياضيات.	1	2	3	4	5	6
3.	KG students need structured math instruction. يحتاج طلاب رياض الأطفال إلى تعليمات منظمة في الرياضيات.	1	2	3	4	5	6
4.	If teachers spend time doing math activities in the classroom, then other subjects will be neglected. إذا قضى المعلمون وقتهم بالقيام بأنشطة الرياضيات في الفصل الدراسي، فسيتم إهمال المواد الأخرى.	1	2	3	4	5	6
5.	Math worksheets/workbooks are appropriate for pre-schoolers. أوراق العمل / كتب التمارين الخاصة بالرياضيات مناسبة لأطفال رياض الأطفال.	1	2	3	4	5	6
6.	Games, puzzles and block play (e.g., Lego, Duplo) take time *away* from actual mathematical teaching tasks. الألعاب والألغاز واللعب بالمكعبات (على سبيل المثال مكعبات التركيب) تأخذ من الوقت الفعلي لمهام تدريس الرياضيات.	1	2	3	4	5	6
7.	Teachers should help their students memorize number facts (for instance, 2+3). يجب على المدرسين مساعدة طلابهم في حفظ الحقائق العددية (على سبيل المثال 2 + 3).	1	2	3	4	5	6

8.	Children learn math only by interacting with concrete objects (ex: counting cars or counting sticks etc). يتعلم الأطفال الرياضيات فقط من خلال التفاعل مع الأشياء المحسوسة (على سبيل المثال: عد السيارات أو عد العصي، إلخ).	1 2 3 4 5 6
9.	KG students learn mathematics *best* through direct teaching of basic skills. يتعلم طلاب رياض الأطفال الرياضيات بشكل أفضل من خلال التدريس المباشر للمهارات الأساسية.	1 2 3 4 5 6
10.	Teachers should show KG students the correct way of doing mathematics. يجب على المعلمين أن يوضحوا لطلاب رياض الأطفال الطريقة الصحيحة لممارسة الرياضيات.	1 2 3 4 5 6
11.	Math should always be taught to whole class and made sure all students participate in the same activity. يجب تدريس الرياضيات للفصل بأكمله والتأكد من مشاركة جميع الطلاب في نفس النشاط.	1 2 3 4 5 6
12.	KG students should learn *specific* procedures for solving math problems (i.e., 2 + 4). يجب على طلاب رياض الأطفال تعلم خطوات معينة لحل مسائل الرياضيات (أي 2 + 4).	1 2 3 4 5 6
13.	KG students should practice mathematics as they best learn through repetition. يجب أن يمارس طلاب رياض الأطفال الرياضيات لأنهم يتعلمون بشكل أفضل من خلال التكرار.	1 2 3 4 5 6
14.	Teachers should encourage students to memorize counting (from 1 to 10 etc) يجب على المعلمين حث الطلاب على حفظ العد (من 1 إلى 10 إلخ).	1 2 3 4 5 6

15.	KG teachers are responsible for making sure that KG students learn or get the right answers in mathematics. مدرسو رياض الأطفال مسؤولون عن التأكد من حصول طلاب رياض الأطفال على الإجابات الصحيحة في الرياضيات أو تعلمها.	1 2 3 4 5 6
16.	Children should *not* be allowed to opt out of activities. لا ينبغي السماح للأطفال بالانسحاب من الأنشطة.	1 2 3 4 5 6

Section 3: *Teachers Confidence about Teaching Mathematics to kindergartens*

ثقة المعلمين في تدريس الرياضيات لطلبة رياض الأطفال

	Statement
1.	I am knowledgeable enough to teach math to KG students. لدي المعرفة الكافية لتدريس الرياضيات لمرحلة رياض الأطفال.
2.	I am *unsure* how to support math development for young children. لست متأكدًا من كيفية دعم تنمية الرياضيات للأطفال الصغار.
3.	I am not a “math person.” أنا لا أفهم في الرياضيات كثيرا.
5.	I can likely come up with creative ways to solve math problems. يمكنني على الأرجح التوصل إلى طرق مبتكرة لحل مسائل الرياضيات.
6.	I am *not* comfortable teaching mathematics to KG students. لست مرتاحًا لتعليم الرياضيات لطلاب رياض الأطفال.
7.	I can create effective math activities for my students. يمكنني إنشاء أنشطة رياضيات فعالة لطلابي.
8.	I can easily convert fractions into percentages and decimal numbers. يمكنني بسهولة تحويل الكسور إلى نسب مئوية وأرقام عشرية.
9.	I can support math learning in KG. يمكنني دعم تعلم الرياضيات في مرحلة رياض الأطفال.

Thank you for your participation!

Appendix B: Interview Protocol

Interviewee Pseudonym: ____________

Pre-Interview Background

Hello, my name is Mausmi. I want to thank you for agreeing to participate in this study. The following questions are to help me to learn more about you before we begin this interview.

How many hours of professional development have you attended related to mathematics teaching? This academic year: (app.) _______________

Previous academic year: (app.) _______________

Section I: Context

a. Appreciation and Introduction
   Again, I would like to thank you for participating in this study. I realize that your time is valuable and so I appreciate your help. I am a graduate student at United Arab Emirates University and the information collected from this interview will be used for my research study.
b. Overview and Purpose
   The purpose of this study is to better understand in-service kindergarten teachers' beliefs about mathematics and educational practices. My goal for this interview is to investigate your beliefs toward mathematics and how these beliefs were formed and also understand how you apply these beliefs and knowledge to your everyday teaching practice. I will begin this interview by asking you questions about your educational and professional background so that I can understand who you are and then I will ask you questions regarding your beliefs and knowledge of pre-school student's mathematical development. I am not looking for any "right answers." Instead, I am interested in your perspective in regards to this topic. I will also be interviewing other in-service teachers from different school in the UAE. This interview should take no more than forty-five minutes.

c. Confidentiality and Recording

I would like to assure you that your identity will be kept confidential and while I may quote things that you say, your name will not be used on any published documents. You may choose to skip questions or ask me to clarify a question. All information collected will be stored on a password-protected computer. I will record this interview using the app recording option and may take some hand-written notes. May I have permission to record this interview? Do you have any questions before I begin? At any time, please let me know if you have any questions.

Section II: Interview Questions

Start Time of Interview: ____________________________________

Date: ____

Location: ____

I would like to thank you for answering the pre-interview questions. It helped me to
better understand you and your professional background.

Qualitative Survey Questions

Q1. In your opinion, is preschool mathematics knowledge (prompt: counting, comparing, pattern recognition) a strong predictor of subsequent high school mathematics achievement?

Prompts for Yes:

- Do you suggest, children as young as those in your class should be screened for early mathematics deficit?
- In your opinion, do teachers play an important role in influencing and being a role model for children by providing opportunities for children to learn and develop new skills?

Prompts for No:

- In your opinion, are literacy skills more important than math? Why?
- In your opinion, only when children can read and write, they can do math?
- Do you see math as less useful than literacy / other subjects?

Q2. In your opinion, can a low performing student (for example a student in KG1 student), through structured instruction and interaction, be “pulled” to a higher level (KG2 or even G1)?

Prompts for Yes:

- So in your opinion if learning deficit occurs, remediation is **possible**?
- So in your opinion, should math lessons be highly structured?

Prompts for No:

- So, you are suggesting that learning differences/deficits **cannot** be reduced over time?

Q3. In your opinion, can learning to recite numbers (from 1 to 10) meaningful and guarantees that a child is able to count, understand quantity and teaches students number sense?

Prompts for Yes and No:

- So, in your opinion does learning to recite numbers lay a foundation for more complicated mathematical concepts to be built on?

Q4. In your opinion, are KG students capable of learning complex mathematics?

(For example, children understand that the order of counting a group of objects does not matter, so long as you count each object only once and know about ‘largest number’)

Prompts for Yes:

- Do you think it is because children possess informal math knowledge? (students have mathematical knowledge before they begin KG)
- In your opinion, are children born ready to learn mathematics?
- Do you suggest that to build students math abilities teachers should help students count in contexts that are more meaningful to them? Ex: staring with 3 cars and then adding another car and say ‘four’ cars; thus helping students connect number names to increasing objects.

Prompts for No:

- Do you think that, “some” children are born with math genes and therefore excel at math?

Scenario

Mariam and Amna are playing with five dolls in the corner of the class. They want to put their five dolls to bed. There are no doll beds, so they make three beds from the boxes they find in the play area. Mariam says, “we don’t have enough beds.” Amna responds, “these dolls are younger,” picking up three small dolls and setting them near the beds. She picks up the remaining two long hair dolls and says, “these two don’t need to nap anymore,” and sets them aside. Mariam then picks up the biggest doll from the three and sets her in the largest bed and says, “OK, this baby needs big bed.” Amna watches her and then puts the medium size doll in the medium sized bed and the smallest doll in the smallest bed. They both seemed satisfied with the outcomes.

Questions:

Q1. Do you think any math is in play here?

If positive reply, then what are the kids doing that makes you think math is in play?

Q2. What can you ask the students that would encourage them to think further about math in their play?

Q3. Do you see the use of Number Sense in this play?

☐ Yes ☐ No ☐ Not Sure

If yes, where you see Number Sense in this play?

If not sure, where you think you might see Number Sense in this play?

Q4. Do you see the use of Patterns in this play?

☐ Yes ☐ No ☐ Not Sure

If yes, where you see Patterns in this play?

If not sure, where you think you might see Patterns in this play?

Q5. Do you see the use of Operations in this play?

☐ Yes ☐ No ☐ Not Sure

If yes, where you see Operations in this play?

If not sure, where you think you might see Operations in this play?

Q6. Do you see the use of Measurement in this play?

☐ Yes ☐ No ☐ Not Sure

If yes, where you see Measurement in this play?

If not sure, where you think you might see Measurement in this play?

Q7. Do you see the use of Shape in this play?

☐ Yes ☐ No ☐ Not Sure

If yes, where you see Shape in this play?

If not sure, where you think you might see Shape in this play?

Q8. Do you see the use of Spatial Relationships in this play?

☐ Yes ☐ No ☐ Not Sure

If yes, where you see Spatial Relationships in this play?

If not sure, where you think you might see Spatial Relationships in this play?

Q9. Do you see the use of Classification in this play?

☐ Yes ☐ No ☐ Not Sure

If yes, where you see Classification in this play?

If not sure, where you think you might see Classification in this play?

Appendix C: Consent Form

نموذج الموافقة

INFORMED CONSENT DOCUMENT
نموذج الموافقة المسبقة

Research Title
UAE Kindergarten Teachers' Mathematical Beliefs and Self-Reported Practices

عنوان البحث

المعتقدات والممارسات الذاتية في مادة الرياضيات لمعلمي رياض الأطفال في دولة الإمارات العربية المتحدة

Introduction
The purpose of this form is to give you information that may affect your decision whether to say YES or NO to participate in this research, and to record the consent of those who say YES.

مقدمة
الغرض من هذا النموذج هو إعطائك معلومات قد تؤثر على قرارك فيما إذا كنت ستقول نعم أو لا للمشاركة في هذا البحث، وتسجيل موافقة أولئك الذين يقولون نعم.

Description of Research Study
The study aims to explore the beliefs and practices of UAE kindergarten teachers within a mathematical context relating particularly to the teaching and learning of mathematics. If you decide to participate, then you will join a study involving research of pre-school mathematics. If you say YES, then your participation will include: an online interview session.

وصف الدراسة البحثية
تهدف الدراسة إلى استكشاف معتقدات وممارسات معلمي رياض الأطفال في دولة الإمارات العربية المتحدة في سياق الرياضيات والتي تتعلق بشكل خاص بتدريس وتعلم الرياضيات. إذا قررت المشاركة، فسوف تنضم إلى دراسة تتضمن بحثا عن الرياضيات في رياض الأطفال. إذا قلت نعم، فستشمل مشاركتك: جلسة مقابلة عبر الإنترنت.

Exclusionary Criteria
You should be a Kindergarten teacher in a UAE based school who works with students between the ages of three and half and six and half years old.

معايير الاستثناء
يجب أن تكون معلم رياض أطفال في مدرسة مقرها الإمارات العربية المتحدة وتعمل مع طلاب تتراوح أعمارهم مابين ثلاث سنوات ونصف وستة سنوات ونصف.

Risks and Benefits
RISKS: There are no foreseeable risks associated with participating in this study
BENEFITS: The main benefit to you for participating in this study is: understanding your participation may advance the field of kindergarten mathematics.

المخاطر والفوائد
المخاطر: لا توجد مخاطر متوقعة مرتبطة بالمشاركة في هذه الدراسة.
الفوائد: الفائدة الرئيسية التي تعود عليك من المشاركة في هذه الدراسة هي: معرفة أن مشاركتك قد تؤدي إلى تطوير مجال الرياضيات في رياض الأطفال.

Costs and Payments
The researcher wants your decision about participating in this study to be absolutely voluntary. Yet they recognize that your participation may pose some inconvenience of time if the interview runs over the projected 30 - 40 minutes it is estimated. The researcher is unable to give you any payment for participating in this study.

التكاليف والمدفوعات
يريد الباحث أن يكون قرارك بشأن المشاركة في هذه الدراسة طوعيًا تمامًا.
الباحث غير قادر على منحك أي مدفوعات مالية مقابلالمشاركة في هذه الدراسة .

New Information
If the researchers find new information during this study that would reasonably change your decision about participating, then they will inform you.

معلومات جديدة
إذا وجد الباحثون معلومات جديدة خلال هذه الدراسة من شأنها أن تغير بشكل معقول قرارك بشأن المشاركة، فسيبلغونك بذلك.

Confidentiality
All information obtained about you in this study is strictly confidential unless disclosure is required by law. The results of this study may be used in reports, presentations and publications, but the researcher will not identify you.

السرية
جميع المعلومات التي تم الحصول عليها عنك في هذه الدراسة سرية للغاية ما لم يكن الكشف عنها مطلوبًا بموجب القانون. يمكن استخدام نتائج هذه الدراسة في التقارير والعروض التقديمية والمنشورات، لكن الباحث لن يحدد هويتك.

Withdrawal Privilege
It is OK for you to say NO. Even if you say YES now, you are free to say NO later, and walk away or withdraw from the study -- at any time.

ميزة الانسحاب
لا بأس أن تقول لا. حتى لو قلت "نعم" الآن، لك الحرية في قول "لا" لاحقًا، والابتعاد أو الانسحاب من الدراسة - في أي وقت.

Voluntary Consent
By signing this form, you are saying several things.

- You are saying that you have read this form or have had it read to you, that you are satisfied that you understand this form, the research study, and its risks and benefits.

- The researcher should have answered any questions you may have had about the research. If you have any questions later, then the researchers should be able to answer them:

الموافقة الطوعية

بتوقيعك على هذا النموذج، فإنك تقول عدة أشياء.

-أنت تقول إنك قرأت هذا النموذج أو قرأته لك ، وأنك راضٍ عن فهمك لهذا النموذج ، والدراسة البحثية ، ومخاطرها وفوائدها.

-يجب أن يكون الباحث قد أجاب على أي أسئلة قد تكون لديك حول البحث. إذا كانت لديك أي أسئلة لاحقًا، فيجب أن يتمكن الباحثون من الإجابة عليها:

Researcher: Mausmi Jadhav
050 – 4689464
202070102@uaeu.ac.ae

By signing below, you are telling the researcher YES, that you agree to participate in this study.

بالتوقيع أدناه, فأنت موافق على المشاركة في هذه الدراسة.

Participant's Printed Name الإسم المشارك في البحث	Signature التوقيع	Date التاريخ

Investigator's Statement

I certify that I have explained to this participant the nature and purpose of this research, including benefits, risks, costs, and any experimental procedures. I have described the rights and protections afforded to human subjects and have done nothing to pressure, coerce, or falsely entice this subject into participating. I am aware of my obligations under state and federal laws and promise compliance. I have answered the participant's questions and have encouraged him/her to ask additional questions at any time while this study. I have witnessed the above signature(s) on this consent form.

Mausmi Jadhav Investigator's Printed Name	Signature	Date

Appendix D: Human Subjects Approval

Ethical Approval Application Approved

RO **Research Office <research.office@uaeu.ac.ae>**
15/12/2021 4:16 PM

To: Mausmi Jadhav

Dear Mausmi Jadhav,

Your application entitled **ERS_2021_8403 : UAE Kindergarten Teachers' Mathematical Beliefs and Self-Reported Practices** has been approved. Kindly logon to https://odvcrgs.uaeu.ac.ae/easp to view the status.

Regards,
Research Office

UAEU
جامعة الإمارات العربية المتحدة
United Arab Emirates University

Division of Research and Graduate Studies Ethics Approval System

You are Logged in as: Mausmi Jadhav

Ref No	Subject	Request Type	Request Status	Submit Date
ERS_2021_8403	UAE Kindergarten Teachers' Mathematical Beliefs and Self-Reported Practices	Social Sciences Ethics Committee - Research	Approved	30/10/21

Appendix E: Research Support for Survey Items

Section 1: *Teacher Beliefs about the Nature of Teaching and Learning Mathematics*

	Statement
1.	KG students are very interested to learn math. adapted from (Chen & McCray, 2013) Original statement: *Most children in my class are very interested in learning math.*
2.	Literacy is more important for KG students than math.
3.	KG students do not have the cognitive abilities to learn math. adapted from (Chen & McCray, 2013) Original statement: (Clements & Sarama, Myths of Early Math, 2018) *Most children in my class have the cognitive abilities to learn math.*
4.	Math is a worthwhile and necessary subject for KG students. adapted from (Platas, 2015) Original statement: *Math is a worthwhile and necessary subject for preschoolers.*
5.	Math should *not* be taught with other subjects, as it will confuse young students. adapted with negation from (Burts, Buchanan, Charlesowrth, & Jambunathan, 2000) Original statement: *Children in your class do activities that integrate multiple subjects (reading, math, science, social studies, etc.)*
6.	KG students learn a great deal about math through their everyday math activities. (Ginsburg, Inoue, & Seo, 1999) adapted from (Chen & McCray, 2013) Original statement: *Most children in my class learn a great deal about math through their everyday activities.*
7.	Mathematical activities are an *inappropriate* use of time for KG students, because they aren't ready for them. adapted from (Platas, 2015) Original statement: *Mathematics activities are an inappropriate use of time for preschoolers; because they aren"t ready for them.*

Section 2: *Teacher Beliefs about Developmentally Appropriate Mathematics Practices*

	Statement
1.	The teacher should play a central role in mathematics activities. adapted from (Platas, 2015) Original statement: *The teacher should play a central role in preschool mathematics activities.*
2.	Math flashcards are appropriate for KG students to teach math facts. adapted from (Platas, 2015) Original statement: *Math flashcards are appropriate for preschoolers.* Also in (Burts, Buchanan, Charlesowrth, & Jambunathan, 2000)
3.	KG students need structured math instruction. adapted from (Chen & McCray, 2013) Original statement: *Most children in my class need structured preschool math instruction.*
4.	If teachers spend time doing math activities in the classroom, then other subjects will be neglected. adapted from (Clements & Sarama, Myths of Early Math, 2018)
5.	Math worksheets/workbooks are appropriate for pre-schoolers. adapted from (Platas, 2015) Original statement: *Math worksheets are appropriate for preschoolers.* *Math workbooks are appropriate for preschoolers.* Also in (Burts, Buchanan, Charlesowrth, & Jambunathan, 2000)
6.	Games, puzzles and block play (e.g., Lego, Duplo) take time *away* from actual mathematical teaching tasks. adapted with negation from (Burts, Buchanan, Charlesowrth, & Jambunathan, 2000) Original statement: *Children in your class participate play with games, puzzles, and construction materials (e.g., Thinker Toys, Bristle Blocks)*

7.	Teachers should help their students memorize number facts (for instance, 2+3). adapted from (Platas, 2015) Original statement: *Helping preschoolers memorize number facts (for instance, 2+3) is important.*
8.	Children learn math only by interacting with concrete objects (ex: counting cars or counting sticks etc). adapted from (Clements & Sarama, Myths of Early Math, 2018)
9.	KG students learn mathematics *best* through direct teaching of basic skills. adapted from (Platas, 2015) Original statement: *Preschoolers learn mathematics best through direct teaching of basic skills.*
10.	Teachers should show KG students the correct way of doing mathematics. adapted from (Platas, 2015) Original statement: *Teachers should show preschoolers the correct way of doing mathematics.*
11.	Math should be taught to whole class and make sure all students participate in the same activity. adapted from (Burts, Buchanan, Charlesowrth, & Jambunathan, 2000) Original statement: *Children in your class participate in whole-class, teacher-directed instruction*
12.	KG students should learn *specific* procedures for solving math problems (i.e., 2 + 4). adapted from (Platas, 2015) Original statement: *Preschoolers should learn specific procedures for solving math problems (i.e., 2 + 4).*
13.	KG students should practice mathematics as they best learn through repetition. adapted from (Platas, 2015) Original statement: *Preschoolers should practice mathematics.*

14.	Teachers should encourage students to memorize counting (from 1 to 10 etc) adapted from (Platas, 2015) Original statement: *Preschool teachers should make sure preschoolers memorize the counting numbers.* Also in (Burts, Buchanan, Charlesowrth, & Jambunathan, 2000)
15.	KG teachers are responsible for making sure that KG students get the right answers in mathematics. adapted from (Platas, 2015) Original statement: *Preschool teachers are responsible for making sure that preschoolers can learn the right answer.*
16.	Children should *not* be allowed to opt out of activities.

Section 3: *Teachers Confidence about Teaching Mathematics to Kindergarteners*

	Statement
1.	I am knowledgeable enough to teach math to KG students. adapted from (Platas, 2015) Original statement: *I am knowledgeable enough to teach math in preschool.*
2.	I am *unsure* how to support math development for young children. adapted from (Platas, 2015) Original statement: *I am unsure about how to support math development for young children.*
3.	I am not a "math person." adopted from (Chen & McCray, 2013) Also in (Clements & Sarama, Myths of Early Math, 2018)
4.	I can likely come up with creative ways to solve math problems. adapted from (Chen & McCray, 2013) Original statement: I like coming up with creative ways to solve math problems.
5.	I am *not* comfortable teaching mathematics to KG students. adapted from (Platas, 2015) Original statement: *Teaching mathematics to preschoolers would be uncomfortable for me.*

6.	I am good at estimating how tall something is. adopted from (Chen & McCray, 2013)
7.	I can create effective math activities for my students. adapted from (Platas, 2015) Original statement: *I can create effective math activities for preschoolers.* Also in (Chen & McCray, 2013)
8.	I can easily convert fractions into percentages and decimal numbers. adopted from (Chen & McCray, 2013)
9.	I can support math learning in KG. adapted from (Platas, 2015) Original statement: *I know how to support math learning in preschool.*

Appendix F: Summary of Studies Used to Design the Instruments

1	Start with a child's informal math knowledge
2	Use developmental progression
3	Link informal knowledge to formal representation
4	Involved regular math lessons
5	Incorporate math into daily routine
6	Reinforces math skills through play
7	Teach Number and Operations
8	Teach Geometry
9	Teach Patterns
10	Teach Measurements
11	Teach Data Analysis
RCT	Randomized controlled trial. Children, classrooms, or schools were randomly assigned to intervention conditions.
QED	Quasi-experimental design. Children, classrooms, or schools were non-randomly assigned to intervention conditions.
SD	Standard Deviation.

Study Characteristics		Components Tested										
Reference	Sample Information	1	2	3	4	5	6	7	8	9	10	11
Arnold et al. (2002) RCT	Head Start classes (half-day or full-day) Children: 103 total (49 intervention; 54 comparison) Age range: 3.1 to 5.3 years Average age: 4.4 years (SD 7.32 months)	x		x	x	x		x				
Barnett et al. (2008) RCT	Children attending a fullday preschool program Children: 202 total (85 intervention; 117 comparison) Age range: 3 to 4 years; slightly more 4-year-olds (54%)		x			x		x	x	x		
Clements and Sarama (2007b) RCT	Preschool classrooms in state-funded or Head Start programs Children: 68 total (30 intervention; 38 comparison) Age range: 2.9 to 4.8 years Mean age: 4.2 years (SD 6.2 months)	x	x	x	x	x	x	x	x	x	x	x

Clements and Sarama (2008) RCT	24 teachers in Head Start or state-funded preschool programs and 20 teachers in programs serving low- and middle-income students Children: 201 total (101 intervention; 100 comparison) Age range: Children had to be within kindergarten entry range for the following year.	x	x	x	x	x	x	x	x	x	x	x
Clements et al. (2011) RCT	Prekindergarten classrooms in two urban public school districts Children: 1,305 total (927 intervention; 378 comparison)	x	x	x	x	x	x	x	x	x	x	x
Dyson, Jordan, and Glutting (2013) RCT	Kindergarten students attending full-day kindergarten in one of five schools in one district in the Mid-Atlantic region of the United States Children: 121 total (56 intervention; 65 comparison) Mean age: 5.5 years (SD 4.0 months)		x	x	x	x	x	x				
Fantuzzo, Gadsden, and McDermott (2011) RCT	80 Head Start classrooms in Philadelphia, Pennsylvania Children: 778 total (397 intervention; 381 comparison) Age range: 2.9 to 5.8 years Mean age: 4.2 years	x	x	x	x	x		x	x		x	x

Griffin, Case, and Capodilupo (1995) and related publication Griffin, Case, and Siegler (1994) QED	Kindergarten students in public schools in inner-city areas in Massachusetts Children: 47 total (23 intervention; 24 comparison)	x	x		x	x	x	x				
Jordan et al. (2012) RCT	Kindergarten students attending full-day kindergarten in one of five schools in one district in the Mid-Atlantic region of the United States Children: 86 total (42 intervention; 44 comparison) Mean age: 5.5 years (SD 4.38 months)		x	x	x		x	x				
Klein et al. (2008) RCT	40 prekindergarten classrooms in Head Start or state-funded programs in New York and California Children: 278 total (138 intervention; 140 comparison) Age range: 3.8 to 4.9 years Mean age: 4.4 years	x	x	x	x	x	x	x	x	x	x	x
Monahan (2007) RCT	Children attending Head Start centers in Philadelphia, Pennsylvania Children: 83 total (41 intervention; 42 comparison) Age range: 4 to 6 years Mean age: 5 years, 1 month				x	x		x				

Ramani and Siegler (2008) RCT	Preschoolers attending Head Start programs Children: 124 total (68 intervention; 56 comparison) Age range: 4.1 years to 5.5 years Mean age: 4 years, 9 months (SD 0.44)						x	x				
Sarama et al. (2008) RCT	Head Start or state-funded prekindergarten classrooms in New York and California Children: 200 total (104 intervention; 96 comparison) Average age: 4.3 years	x	x	x	x	x	x		x	x	x	x

Appendix G: Traditional and Constructivist Models of Education

(Kohonen, 1992; cited in Nunan 1999, p. 7)

Type of Model	Dimension	Survey Question	Percent		Teachers Beliefs
			A+SA	D+SD	
Traditional Model	View of Learning: Transmission of Knowledge	KG teachers should teach skills to mastery before exposing young children to knowledge and skills that are more complex.	58.9	12.2	Traditional
		The teacher should play a central role in mathematics activities.	47.8	13.3	Traditional
	Power Relation: Emphasis on teacher's authority	Math flashcards are appropriate for KG students to teach math facts.	51.1	13.3	Traditional
	Teacher's Role: Providing mainly frontal instruction; professionalism as individual autonomy	KG students need structured math instruction.	54.5	4.4	Traditional
		Math worksheets/workbooks are appropriate for pre-schoolers.	41.1	22.2	Traditional
	Learner's Role: Relatively passive recipient of information; mainly individual work	Children learn math only by interacting with concrete objects (ex: counting cars or counting sticks etc).	37.8	22.2	Traditional
		KG students learn mathematics *best* through direct teaching of basic skills.	48.9	15.5	Traditional
	View of Knowledge: presented as "certain" application problem-solving	Teachers should show KG students the correct way of doing mathematics.	55.5	11.1	Traditional
	View of Curriculum: Static;	Math should be taught to whole class and make sure all students participate in the same activity.	36.7	32.2	-

	hierarchical grading of subject matter, predefined content and product Learning Experiences: Knowledge of facts, concepts and skills; focus on content and product Control of Process: mainly teacher-structured learning Motivation: Mainly extrinsic	KG students should learn *specific* procedures for solving math problems (i.e., 2 + 4).	36.7	27.8	Traditional
		KG students should practice mathematics as they best learn through repetition.	56.6	8.9	Traditional
		Teachers should encourage students to memorize counting (from 1 to 10 etc.)	62.2	8.9	Traditional
		KG teachers are responsible for making sure that KG students get the right answers in mathematics.	36.6	16.7	Traditional
		Math should *not* be taught with other subjects, as it will confuse young students.	6.6	72.3	Constructive
		Games, puzzles and block play (e.g., Lego, Duplo) take time *away* from actual mathematical teaching tasks.	16.7	68.9	Constructive
		Teachers should help their students memorize number facts (for instance, 2+3).	23.4	38.9	Constructive
		If teachers spend time doing math activities in the classroom, then other subjects will be neglected.	10	71.1	Constructive
		Children should *not* be allowed to opt out of activities.	18.9	35.6	Constructive

Constructive Model	View of Learning: Transformation of knowledge Learner's Role: Active participation, largely in collaborative small groups View of Knowledge: Construction of personal knowledge; identification of problems Control of process: emphasis on learner; self-directed learning	KG students learn a great deal about math through their everyday math activities.	92.2	1.1	Constructive
		KG students learn mathematics *without* support from teachers.	5.5	52.2	Traditional

UAEU جامعة الإمارات العربية المتحدة United Arab Emirates University

UAE UNIVERSITY MASTER THESIS NO. 2022:13

A mixed-method study was conducted in order to explore the beliefs, practices and confidence of UAE kindergarten teachers in teaching mathematics. The study analyzed surveys from ninety teachers employed in public and private schools and interviewed four teachers. According to the findings, the participants believed that kindergarten mathematics was developmentally appropriate, necessary and that kindergarten students were ready for it. However, while most teachers shared similar beliefs, their practices differed. The other noteworthy finding from this study was that PCK level was higher in the participants for number sense, operations, and measures, than for patterns, shapes, classifications and spatial connections.

Mausmi Dilip Jadhav received her M.Ed. from the Department of Curriculum and Instruction, College of Education at UAE University, UAE. She has received her M.A in Digital Technologies, Communication and Education from University of Manchester, UK and Bachelor of Computer Science from Pune University, India.

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