Teachers' Learning Orientation Scale Development and Validation

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Abstract

Every teacher possesses a dynamic system of beliefs about students and teaching (Fives & Buehl, 2012; Pajares, 1992; Richardson, 1996). While teacher beliefs may not necessarily determine classroom practices (e.g., Lee et al., 2006; McCarty et al., 2001; Simmons et al., 1999; Stipek et al., 2001; Stipek & Byler, 1997; Wilcox-Herzog, 2002), they are the lens through which teachers interpret classroom experiences and make decisions that shape the content and quality of students' education (Nespor, 1987). The current literature on teacher beliefs development is almost exclusively based in the context of conventional pedagogy and must expand to include alternative pedagogies, such as Montessori education, if it is to reflect the current educational landscape in the United States. For this dissertation, I developed a new teacher beliefs measure, the Teachers' Learning Orientation Scale, to accurately and reliably assess student- and teacher-oriented beliefs across conventional and Montessori contexts. I followed a five-stage validation model: (1) construct definition, (2) measurement design, (3) pilot testing, (4) factor analysis and reliability, and (5) criterion validity (Messick, 1989; Schraw & Olafson, 2014). During validation testing, the TLOS demonstrated strong internal and test-retest reliability, achieved full scalar measurement invariance across pedagogy (i.e., conventional and Montessori), and detected significant differences between teachers based on pedagogy, student age range (i.e., early childhood and elementary), school funding (i.e., public and private), and Montessori teacher certification organization. Overall, the Teachers' Learning Orientation Scale contributes to the literature by providing a pedagogy-neutral measure of teacher- and student-oriented beliefs, expanding the study of teacher beliefs beyond the context of conventional education.

Keywords: teacher beliefs, Montessori, student-oriented, structural equation model, measure validation

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Introduction

Every teacher possesses a dynamic system of beliefs about students and teaching (Fives & Buehl, 2012; Pajares, 1992; Richardson, 1996). Initially based on formative experiences in primary and secondary school (Kagan, 1992; Mansfield & Volet, 2010; Richardson, 2003a), teacher beliefs continue to develop through teacher training (Hamre et al., 2012; La Paro et al., 2009; Mansfield & Volet, 2010; Richardson, 2003a) and first-hand teaching experience (Gooya, 2007; Meirink et al., 2009; Turner et al., 2009; Voss & Kunter, 2020). This literature exploring teacher beliefs development is almost exclusively based in the context of conventional pedagogy. Therefore, little is known about how alternative pedagogies, such as Montessori education, shape teacher beliefs.

Teacher beliefs research must expand to include Montessori education if it is to reflect the current educational landscape. Over the past two decades, an increased emphasis on school choice in the United States and the consequent proliferation of charter and magnet schools expanded access to Montessori education in the public sector (Bulkley & Fisler, 2003; Hoxby, 2003; Mathis & Trujillo, 2016; National Center for Montessori in the Public Sector, 2014). Considered globally, the United States has the highest estimated number of Montessori schools at 3,025 and is among the highest countries for publicly funded Montessori programs (Debs et al., 2022). Montessori teachers may develop distinctly different teacher beliefs relative to their conventional counterparts given experiences in specialized teacher training (Cossentino, 2009) and an alternative school environment (Lillard & McHugh, 2019a, 2019b). However, we cannot fairly and accurately consider teacher beliefs across Montessori and conventional pedagogies without a validated measure designed to take both pedagogies into account.

For this dissertation, I developed a new teacher beliefs measure, the Teachers' Learning Orientation Scale, to accurately and reliably assess teacher beliefs across conventional and Montessori contexts. I followed a five-stage validation model: (1) construct definition, (2) measurement design, (3) pilot testing, (4) factor analysis and reliability, and (5) criterion validity (Messick, 1989; Schraw & Olafson, 2014). Here, I share a literature review and the work completed at each stage of validation.

In the following literature review, I provide context for the development of this new teacher beliefs measure by broadly defining teacher beliefs and exploring existing measures of dichotomous learning orientations. Next, I discuss Montessori education, focusing on how specialized teacher training and first-hand teaching experience in an alternative pedagogy may influence teacher beliefs. Finally, I review the existing literature on Montessori teacher beliefs.

Teacher Beliefs

The literature exploring teacher beliefs extends over 70 years, with development of the earliest Likert-scale teacher beliefs measure, the Minnesota Teacher Attitudes Inventory, beginning in the late-1940s (Cook et al., 1951; Cook & Leeds, 1947). Across this literature, authors refer to teacher beliefs as attitudes, perceptions, conceptions, perspectives, orientations, practical knowledge, personal pedagogy, or personal epistemologies (Kagan, 1992; Pajares, 1992). Researchers have also debated teacher beliefs' defining characteristics. Are teacher beliefs stable or malleable? Are they held consciously or unconsciously, and collectively or individually? After years of debate over terminology and defining characteristics, Fives and Buehl (2012) arrived at a definition of teacher beliefs as a dynamic system of conceptions about students and teaching, consciously or unconsciously held by individual teachers.

From the first day of school in early childhood to the retirement of a veteran teacher, beliefs about students and teaching develop and shift over the course of teachers' school experiences. Preservice teachers enter training with well-established beliefs based on formative experiences as students in primary and secondary school (Kagan, 1992; Mansfield & Volet, 2010; Richardson, 2003b). Once established, teacher beliefs are tenacious, resisting change even when explicitly challenged (Kagan, 1992; Pajares, 1992; Richardson, 1996). However, teacher training (Hamre et al., 2012; La Paro et al., 2009; Mansfield & Volet, 2010; Richardson, 2003b), career transitions (Gooya, 2007; Voss & Kunter, 2020), and first-hand classroom experience (Meirink et al., 2009; Turner et al., 2009) may each prompt modification of established teacher beliefs. Put simply, school experiences shape teacher beliefs, such as dichotomous perspectives on how to best support student learning (hereafter termed learning orientations).

Learning Orientations

While the literature shows increased consensus on teacher beliefs' defining characteristics and development, the construct is still relatively broad. Teachers hold beliefs about many topics relative to students and teaching, such as classroom management, the nature of knowledge, technology use, how students learn, instruction, student motivation, the purpose(s) of education, and so on. One line of research explores how well teacher beliefs align with contemporary views of effective teaching and emerging psychological theories about motivation and learning. In this literature, teacher beliefs are often labeled according to dichotomous categories or learning orientations (LOs), such as progressivism and traditionalism, teacher control and student autonomy, and teacher- and student-oriented beliefs.

A review of the LO literature revealed 15 Likert-scale measures representing five chronologically ordered domains.[1] Based on the earliest LO measures developed toward the end of the United States' progressive education movement (i.e., late 1800s to mid-1900s; Cremin, 1961), the first domain assessed teachers' progressive and traditional beliefs (Cook et al., 1951; Kerlinger & Kaya, 1959; Schaefer & Edgerton, 1985). The second domain, based on three psychological frameworks that successively dominated psychological theory across the 1900s, assessed beliefs about teacher control and student autonomy: control ideology (Willower et al., 1967), locus of control (Wehling & Charters, 1969), and self-determination theory (Deci et al., 1981). The third domain used centered and oriented terms (e.g., teacher-centered, student-oriented) to describe LO (Bunting, 1985; de Vries et al., 2013; McCombs & Whisler, 1997; Meirink et al., 2009). This domain chronologically cuts across all other domains; centered and oriented terms have been used to describe education for nearly a century (Rugg & Shumaker, 1928) and the most recent LO measures fall within this domain. The fourth domain emerged as education organizations in the late 1980s pushed against the downward pressure to prepare young children early for rigorous academic learning; this led to a focus on beliefs about developmentally appropriate and inappropriate practices (Charlesworth et al., 1991, 1993; Hermans et al., 2008; Smith, 1993). Finally, the fifth domain assessed LO relative to constructivist theories of learning (Chan & Elliott, 2004; Woolley et al., 2004), inspired by the constructivism-based educational reform of the 1990s (Danielson, 1996; Fosnot, 1996; Prawat, 1992; Richardson, 1997). See Table 1 for a chronological list of Likert-scale LO measures.

[1] Domains ordered based on the earliest published measure in each domain.

Table 1

Learning Orientation Measures by Year Published

Domain	Citation	Measure Name	Likert -scale	Learning Orientation Factors	Items
Progressivism	Cook et al., 1951	Minnesota Teachers' Attitude Inventory	5	No explicit terms	150
	Kerlinger & Kaya, 1959	Attitudes Towards Education Scale	7	Progressivism Traditionalism	10 10
Teacher control and student autonomy	Willower et al., 1976	Pupil Control Ideology Scale	5	Humanistic v. custodial	20
	Wehling & Charters, 1969	Teacher Conceptions of the Educative Process	6	Student autonomy v. teacher direction	20
	Deci et al., 1981	Problems in Schools	7	Highly controlling Moderately controlling Moderately autonomous Highly autonomous	8 8 8 8
Centered and Oriented	Bunting, 1981, 1984, 1985	Educational Attitudes Inventory	5	Student-centered Directive	19 15
Progressivism	Schaefer & Edgerton, 1985	Modernity Scale	5	Progressive v. traditional	30
Developmental	Charlesworth et al., 1991, 1993	Teacher Beliefs Scale	5	Developmentally appropriate Social Individualization Literacy activities Integrated curriculum Developmentally inappropriate Activities and materials Structure	 4 3 2 4 11 2
	Smith, 1993	Primary Teacher Questionnaire	4	Developmentally-based Traditionally-based	18 24
Centered and Oriented	McCombs & Whisler, 1997	Teacher Beliefs Survey	4	Learner-centered: Learners, learning and teaching	14

				Non-learner-centered: Learners	9
				Non-learner-centered: Learning and teaching	12
Constructivism	Woolley et al., 2004	Teacher Beliefs Survey	6	Constructivist teaching	10
				Traditional teaching	7
				Traditional management	4
	Chan & Elliot, 2004	Teaching and Learning Conceptions Questionnaire	5	Constructivist	12
				Traditional	17
Developmental	Hermans et al., 2008	Beliefs about Primary Education Scale	4	Developmental	9
				Transmissive	9
Centered and Oriented	Meirink et al., 2009	Beliefs about Teaching and Learning Questionnaire	5	Student-oriented:	
				Cognitive regulation	10
				Affective regulation	10
				Knowledge construction	9
				Collaborative learning	7
				Subject-matter-oriented:	
				Cognitive regulation	7
				Affective regulation	8
				Knowledge reproduction	8
				Individual learning	10
	deVries, 2013	Beliefs about Learning and Teaching	4	Student-oriented	5
				Subject-matter-oriented	7

An item-level analysis of LO measures identified multiple themes underlying the five domains. Subscales aligned with traditional beliefs (i.e., teacher control, developmentally inappropriate, directive, subject-matter-oriented, and non-learner oriented) consistently included belief statements about teacher control, subject-matter/curriculum, learning via transmission or acquisition, behavior management, and obedience/discipline. These items reference aspects of the learning experience that the teacher designs, implements, or manages, such as a curriculum, instruction, rules, and expectations. While the end goal may be to facilitate student learning, these beliefs prioritize the teacher's role, responsibilities, or importance over the role students play in their own learning. From a locus of control perspective, these beliefs align with Rotter's (1966) definition of external control orientation in which individuals believe that outcomes are determined by factors outside of the individual's control. Here, teachers are an external influence on student learning. Thus, these beliefs can be seen as teacher-oriented. See Table A1 for teacher-oriented topics and example items across LO measure domains.

Alternatively, subscales aligned with progressive beliefs (i.e., student autonomy, student-centered, learner-centered, developmentally appropriate, and constructivist) consistently referenced student autonomy, interest, choice, individualized education, intrinsic motivation, a constructivist view of learning, and cooperative learning. These belief statements prioritize students' role in shaping the learning experience, viewing the teacher as one of many resources students leverage to support their learning. Considering Rotter's (1966) definition of internal control orientation (i.e., individuals believe that outcomes are determined by their efforts, abilities, and choices) this LO can be seen as student-oriented. See Table A2 for student-oriented topics and example items across LO measure domains.

Existing LO measures took the contemporary education landscape into account during development. For example, during the progressive era, the Attitudes Towards Education Scale assessed progressive and traditional LOs using salient beliefs extracted through preliminary Q-sort studies (Kerlinger, 1956, 1958; Kerlinger & Kaya, 1959). Given the expansion of Montessori education into United States public schools (National Center for Montessori in the Public Sector, 2014), I developed a new LO measure assessing teacher- and student-oriented beliefs: the Teachers' Learning Orientation Scale (TLOS). The TLOS takes the current education landscape into account by considering beliefs across conventional and Montessori pedagogy. In the following section, I explore Montessori education and how experience as a Montessori teacher may have a unique impact on one's teacher beliefs.

Montessori Education

Today's global Montessori movement began over 100 years ago (De Stefano, 2022; Kramer, 1988; Standing, 1998). In 1897, Maria Montessori (1870-1952) began working with and observing atypically developing children institutionalized at the University of Rome's psychiatric clinic. From 1899 to 1901, she continued supporting the needs of atypically developing children as co-director of the Orthophrenic School (Montessori, 2017). During this time, Montessori explored the methods of Jean Marc Gaspard Itard, best known for his work with Victor, the wild boy of Aveyron, and considered one of the founders of special education, and Edouard Seguin, who further developed Itard's sensory training techniques (Humphrey, 1962). Based on their work, Montessori developed a distinctive pedagogical philosophy and series of didactic materials. Many of the institutionalized children flourished in Montessori's care; some became so adept at reading and writing that they passed public school exams. In 1906, the Director General of the Roman Association for Good Buildings invited Montessori to

establish a school for children ages two to six years in the poverty-stricken San Lorenzo tenements; the first Casa dei Bambini–Children's House–opened in January 1907. Here, Montessori refined her methods further and again observed progress with the children. Given this early success, it was not long before the Montessori method gained international attention.

By 1911, news of the Montessori method spread to the United States (Whitescarver & Cossentino, 2008). *McClure's Magazine* published an article series lauding Montessori's accomplishments. The first Montessori school in the United States opened that same year in Tarrytown, NY. The Montessori movement expanded in a frenzy as schools opened across the nation, American trainees dominated Montessori's first international teacher training course, and prominent figures supported the movement (e.g., Alexander Graham Bell and wife, Mabel; Woodrow Wilson's daughter, Margaret; the editor of National Geographic; and the U.S. Commissioner of Education). The early Montessori movement even found its way to the University of Virginia, as seen in Figure 1, a 1912 photograph by Holsinger of a Montessori classroom on the Lawn (Clover et al., 1995). This initial frenzy, however, quickly met with critique, the most notable of which was published in 1914 by a Dewey protégé, William Heard Kilpatrick of Teachers College. Among other disparaging claims, he held that Montessori's methods hindered children's learning, development, and self-expression. Thus, the first wave of the American Montessori movement stalled as the Progressive Era came to a close.

Figure 1

Outdoor Montessori Classroom at the University of Virginia, 1912

Catalyzed by the efforts of Mario Montessori, Maria's son, and Nancy McCormick Rambusch, the founder of the American Montessori Society, the American Montessori movement was re-established in 1958 (Whitescarver & Cossentino, 2008). Today, compared to other countries across the globe, the United States has the highest estimated number of private Montessori schools at 3025 (Debs et al., 2022). With the proliferation of charter and magnet schools, Montessori education is expanding into the public sector, with at least 621 programs serving an estimated 150,000 to 200,000 students (Ayer, 2021; National Center for Montessori in the Public Sector, 2014). This ranks the United States among the highest countries for publicly

funded Montessori programs (Debs et al., 2022). Thus, after over 100 years, Montessori education is clearly part of the United States' educational landscape.

Returning to the discussion of teacher beliefs, the current literature and existing measures are based in conventional pedagogy and, therefore, only tell part of the story. To understand teacher beliefs in light of the current educational landscape, we must also consider Montessori pedagogy. In the following sections, I will two discuss key elements of the Montessori teacher experience that may influence teacher beliefs: teacher training and first-hand classroom experience. I will also examine the literature on Montessori teacher beliefs before proposing a new teacher beliefs measure that takes conventional and Montessori pedagogy into account.

Pre-service Teacher Training

Maria Montessori delivered her first teacher training course in 1909, hosted by Leopoldo and Alice Franchetti at Villa Montesca in Italy (De Stefano, 2022). In 1929, Montessori and her son, Mario Montessori, founded Association Montessori Internationale (AMI) in part to oversee teacher training courses and prepare teacher trainers. Currently, there are 91 AMI training centers across six continents (*Training Centres*, n.d.). In the following discussion I focus on AMI training because of its direct link to Maria Montessori and fidelity to Montessori's original practices. It is important to note, however, that other organizations also offer Montessori teacher training (e.g., American Montessori Society, Christian Montessori Fellowship, International Montessori Council, Montessori Institute of America, and Pan American Montessori Society; *Accredited Programs*, n.d.). Even within AMI courses, prospective teachers may also choose from multiple training lengths (e.g., academic year or multiple summers), formats (i.e., in-person, virtual, and hybrid), and student age ranges (i.e., prebirth to 3 years, three to six years, six to twelve years, and twelve to eighteen years).

Montessori designed teacher training to shift teacher beliefs. Based on working with and observing children, Montessori noted a shift in her own beliefs about student motivation and the teacher's role:

> Like others I had believed that it was necessary to encourage a child by means of some exterior reward that would flatter his baser sentiments... in order to foster in him a spirit of work and of peace. And I was astonished when I learned that a child who is permitted to educate himself really gives up these lower instincts. I then urged the teachers to cease handing out the ordinary prizes and punishments, which were no longer suited to our children, and to confine themselves to directing them gently in their work. (Montessori, 2017, p.61)

The belief that intrinsic rewards are necessary to motivate child learning is only one example of a commonly held belief that must change to become a Montessori teacher. Montessori recognized that preparing prospective teachers to work within an alternative pedagogy requires transformation, not just of beliefs and practices, but possibly of motivations and personal philosophies, as well. This transformation initiates a career-long practice of self-reflection referred to in the Montessori literature as the inner or spiritual preparation of the adult (Cossentino, 2009; Montessori, 1966; Whitescarver & Cossentino, 2007). According to A. M. Joosten, a former AMI teacher trainer, Montessori teacher training and the associated spiritual preparation "…is not merely a question of learning something. It is a question of achieving a revolution within ourselves and of our whole outlook, of our whole attitude, of everything we are" (Joosten, 1971). Cossentino (2009) discussed Montessori teacher training from an anthropological perspective of culture and craft. Prospective teachers learn the practical aspects of teaching–the craft–while also learning how to engage in Montessori culture–a group identity

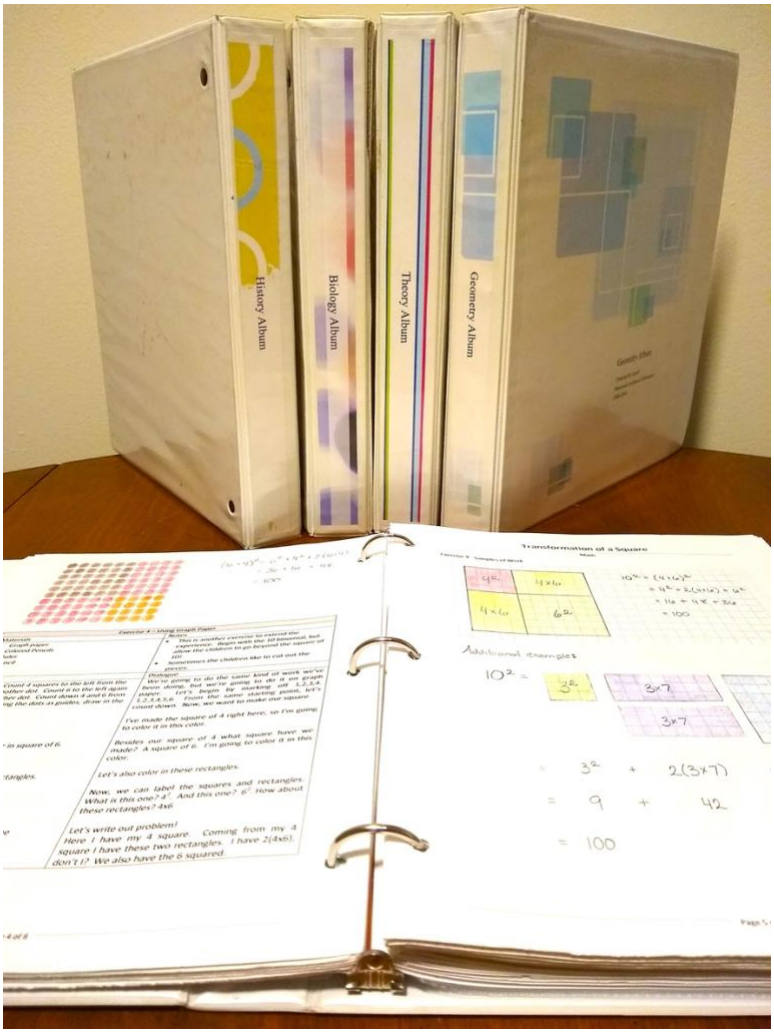
characterized by distinct terminology, beliefs, and practices. Therefore, Montessori teacher training explicitly aims to shift prospective teachers' beliefs through immersion in the culture and craft of Montessori pedagogy.

This immersion occurs as prospective Montessori teachers (PMTs) engage in a rigorous regimen of training activities (Lillard & McHugh, 2019b). PMTs attend theory lectures, lesson demonstrations, and Montessori literature discussions. They write up each theory lecture and lesson demonstration; for the latter, PMTs carefully record lessons' verbal script, precise physical movements, materials layout, and notes on topics such as child readiness, follow-up work suggestions, and extensions for more advanced students. These writings are submitted for review, edited, and organized into a series of personalized albums that serve as a foundational subject-specific curriculum and theory reference. For example, AMI elementary teachers have albums for Montessori theory, history, language, math, geometry, geography, biology, music, and art, often cumulatively containing over 1000 pages of writing.[2] Figure 2 shows a selection of my AMI elementary albums. Additionally, PMTs handmake lesson materials during training, including impressionistic charts, timelines, and nomenclature cards. Thus, during training, PMTs gain an intimate knowledge of the lessons, materials, and theory underpinning Montessori pedagogy.

[2] Albums are typically organized within binders. However, some more recent AMI trainings support PMTs creation of digital albums.

Figure 2

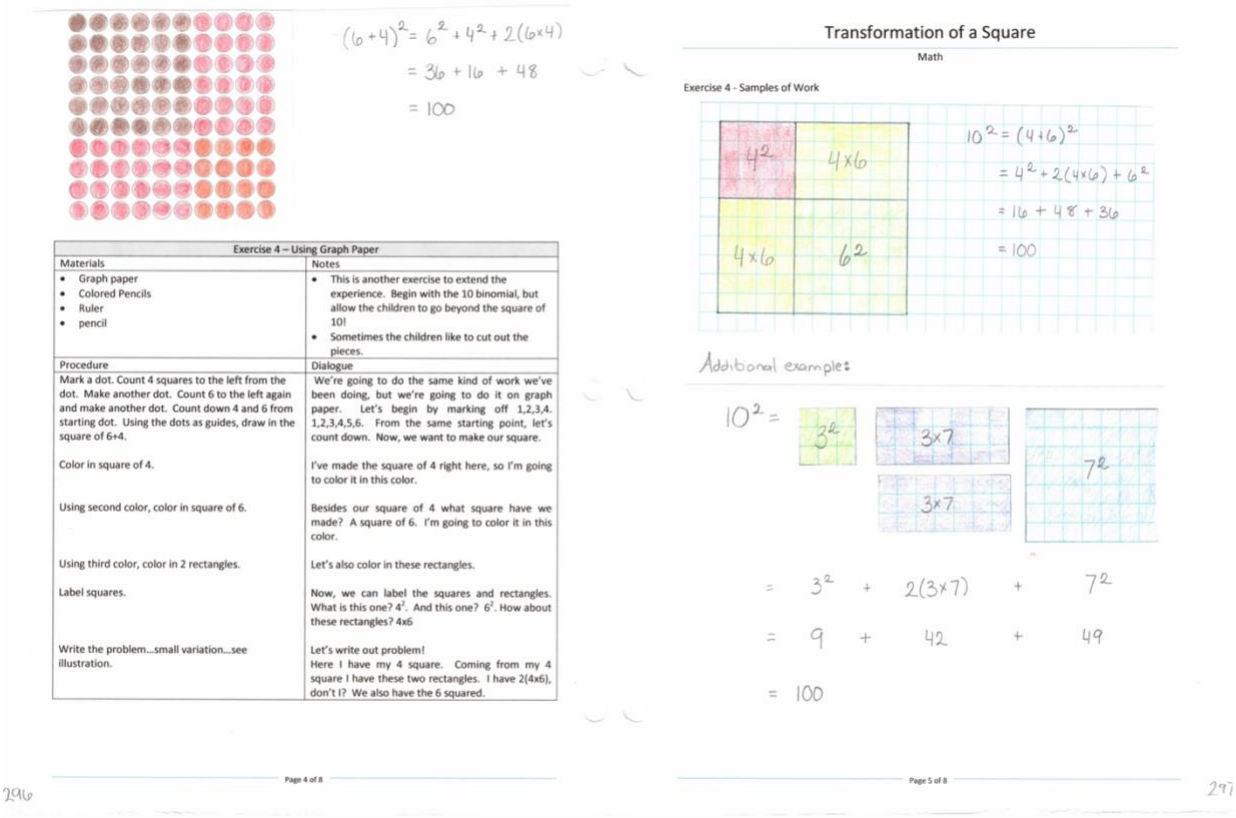
A Selection of AMI Elementary Albums



Note. PMTs write, organize, and hand-illustrate their Montessori albums during teacher certification training.

Figure 3

Illustration of an early squaring lesson, Transformation of a Square



$(6+4)^2 = 6^2 + 4^2 + 2(6\times4)$
$= 36 + 16 + 48$
$= 100$

Exercise 4 – Using Graph Paper	
Materials	Notes
• Graph paper • Colored Pencils • Ruler • pencil	• This is another exercise to extend the experience. Begin with the 10 binomial, but allow the children to go beyond the square of 10! • Sometimes the children like to cut out the pieces.
Procedure	Dialogue
Mark a dot. Count 4 squares to the left from the dot. Make another dot. Count 6 to the left again and make another dot. Count down 4 and 6 from starting dot. Using the dots as guides, draw in the square of 6+4.	We're going to do the same kind of work we've been doing, but we're going to do it on graph paper. Let's begin by marking off 1,2,3,4. 1,2,3,4,5,6. From the same starting point, let's count down. Now, we want to make our square.
Color in square of 4.	I've made the square of 4 right here, so I'm going to color it in this color.
Using second color, color in square of 6.	Besides our square of 4 what square have we made? A square of 6. I'm going to color it in this color.
Using third color, color in 2 rectangles.	Let's also color in these rectangles.
Label squares.	Now, we can label the squares and rectangles. What is this one? 4^2. And this one? 6^2. How about these rectangles? 4x6
Write the problem...small variation...see illustration.	Let's write out problem! Here I have my 4 square. Coming from my 4 square I have these two rectangles. I have 2(4x6), don't I? We also have the 6 squared.

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Transformation of a Square

Math

Exercise 4 - Samples of Work

4^2 | 4×6 | 4×6 | 6^2

$10^2 = (4+6)^2$
$= 4^2 + 2(4\times6) + 6^2$
$= 16 + 48 + 36$
$= 100$

Additional example:

$10^2 =$ 3^2 | 3×7 | 3×7 | 7^2

$= 3^2 + 2(3\times7) + 7^2$
$= 9 + 42 + 49$
$= 100$

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Unlike conventional teacher training which presents various pedagogical perspectives, developmental theories, and instruction strategies, Montessori teacher training provides lectures and lesson with a singular focus on Montessori pedagogy. Consistently interacting with a single pedagogical approach throughout training may have a unique influence on teacher beliefs, in that PMTs who complete training may be more similar in their beliefs relative to PTs who complete a survey-style teacher certification training. Teacher belief variation among PMTs may be further reduced by PMTs' self-selection in entering and persisting through training. PMTs that experience friction between existing beliefs and Montessori pedagogy may be less likely to persist through training, relative to PMTs whose beliefs increasingly align with Montessori pedagogy throughout training. In sum, the singular focus on Montessori pedagogy during teacher

training may have a unifying effect on Montessori teacher beliefs, especially as PMTs immediately put what they have learned into practice.

Once PMTs receive a lesson presentation, they practice giving and receiving the lesson in a model classroom environment with trainer supervision. This intimate experience of giving and receiving individual and small group lessons with fellow trainees helps PMTs become familiar with the Montessori curriculum, gaining the flexibility to offer any lesson upon request. The model classroom provides an interactive exemplar of a prepared Montessori environment (Lillard & McHugh, 2019a). It contains a full range of beautifully maintained Montessori materials ordered by subject area and progressive difficulty on child-accessible shelves. All furniture is child-sized. Wall decoration is relatively sparse, deliberately chosen to represent the culture and heritage of the school community, and hung at child-eye-level. Open floor areas provide space for students to work on small rugs or spread out large projects. Live plants and cut flowers bring a touch of nature into the classroom. These experiences help PMTs get a feel for what it will be like to teach and learn in their future classrooms while receiving support from teacher trainers.

This daily experience interacting with trainers, peers, and a model classroom environment while practicing lessons mimics the child's experience in a Montessori classroom. PMTs choose work partners, where they will work, and what lesson they will practice while trainers observe and engage with PMTs ono-on-one or in small groups to guide practice. These embodied experiences may shape PMTs' beliefs about student choice and autonomy, the role of the child and adult in the classroom, assessment through observation, and individualized instruction. Thus, Montessori training shapes PMTs' beliefs from the student perspective before inviting PMTs to experience the Montessori classroom from a teacher's perspective.

Finally, PMTs are immersed in active Montessori classrooms through observation and student teaching. Montessori training emphasizes the practice of objective observation and requires PMTs to complete observation hours within Montessori classrooms of the appropriate student age range, with the exception of Assistants to Infancy training which also allows PMTs to observe children outside of the Montessori environment (*Training*, 2020). PMTs take copious notes on the life of the classroom (e.g., interactions, lessons, learning environment) which are reviewed by the teacher trainer. Additionally, towards the end of training, PMTs complete multiple weeks of student teaching. Scaffolded by the lead teachers, PMTs have the chance to prepare the classroom environment, give lessons, interact with children, manage the classroom, organize lesson preparation, and keep lesson and observation records. Once PMTs complete course work, observations, and student teaching, they finish training after passing comprehensive written (e.g., essays on content knowledge, classroom practices, and Montessori theory) and oral exams (e.g., giving and discussing randomly selected lessons from each subject area), given by AMI trainers from other centers. Overall, classroom observation, student teaching, and exams offer PMTs multiple opportunities to experience Montessori education from the teacher's perspective and weigh their teacher beliefs against first-hand teaching experience.

First-hand Teaching Experience

Evidence suggests that first-hand teaching experience also informs teacher beliefs (Gooya, 2007; Meirink et al., 2009; Turner et al., 2009; Voss & Kunter, 2020). Teaching typically occurs within a classroom context and classroom characteristics differ based on pedagogy. For example, conventional and Montessori classrooms differ in class composition, daily schedule, instruction groupings, and assessment strategies. See Table 2 for classroom characteristics by pedagogy. These classroom characteristics shape teachers' daily experiences

and may have a unique influence on teacher beliefs based on pedagogy. I will discuss each of these alternative classroom characteristics in turn.

Table 2

Classroom Characteristics by Pedagogy

Pedagogy	Conventional	Montessori
Class composition	Age-graded	Multi-age
Daily schedule	Subject-specific periods	2.5-3 hour uninterrupted work periods
Instruction groupings	Whole class	Individual or small group
Assessment	Graded assessments (e.g., assignments and exams)	Observation and direct engagement with the child

One classroom characteristic that may foster unique beliefs among Montessori teachers is class composition. Most conventional classes are age-graded (e.g., 1st grade through 12th grade), whereas Montessori classrooms are multi-age. Nido and toddler classrooms span 1.5 years, at ages 6-weeks to 1.5 years and 1.5 to three years, respectively. Classrooms for older students (i.e., primary, lower elementary, upper elementary, adolescent) span a 3-year age range (i.e., 3-6 years, 6-9 years, 9-12 years, 12-15 years, respectively). Given this organization, new students comprise only a fraction of the class each year. While teachers are ultimately responsible for establishing behavioral expectations and giving lessons, older students often choose to mentor younger students (and sometimes the other way around!) in academic activities and classroom culture. For example, a 9-year-old elementary child may observe that a 6-year-old friend is struggling to solve a difficult subtraction problem and choose to offer assistance. Additionally, students have the opportunity to observe a wide range of lessons in terms of content and challenge, and often ask the teacher or other students for lessons that piqued their interest. Consistently observing these types of spontaneous interactions may lead Montessori teachers to view children as intrinsically motivated (i.e., naturally tending to engage in interesting,

enjoyable, and, often, challenging endeavors; Ryan & Deci, 2016) and shape beliefs about student choice, interest, and learning. Beliefs about the teacher's role may shift as the teacher is considered a guide and resource to support child development, rather than the chief source of knowledge and discipline. Thus, multi-age class composition could contribute to the development of Montessori teacher beliefs.

A flexible daily schedule might also foster distinctive beliefs among Montessori teachers. The schedule centers around 2.5-3 hour uninterrupted work periods rather than shorter subject-specific periods. During this time, students choose their work (e.g., practice lessons, work on projects, read) and teachers give lessons, observe, and manage the classroom. The uninterrupted work periods enable children to concentrate for extended durations. They also offer the teacher flexibility. For example, the Montessori teacher can sit with an individual or group of students to provide additional academic support or work through conflict resolution when necessary. The teacher can also make time for daily classroom observations. Through observation, teachers assess student progress and classroom culture, informing decisions about instruction and classroom management. This flexible daily schedule may lead Montessori teachers to believe that children learn best given choice, opportunities for concentration and self-regulation, individualized instruction, and informal assessment. Similar to class composition, the daily schedule would seem to promote beliefs that balance students' and teachers' contribution to learning and classroom culture.

Instruction format may also effect Montessori teacher beliefs. Conventional teachers predominantly deliver whole class instruction, whereas Montessori teachers give individual or small group (i.e., fewer than 6 students) lessons. Younger children (i.e., toddler and primary age) typically receive individual lessons, whereas group lessons and work are emphasized for

elementary and adolescent students. Again, this instruction format offers the Montessori teacher flexibility. Teachers can individualize lessons based on interest and readiness, allowing students to move through the curriculum at their own pace and receive supplementary lessons for further academic support or extensions. When offering small group lessons, the Montessori teacher strategically selects students, often avoiding consistently grouping students based on a single characteristic, such as age. While the teacher gives lessons, the other students work on their chosen activities, essentially managing their own work time. Given this instruction format, Montessori teachers may have different beliefs about student autonomy and classroom management compared to conventional teachers who regularly lead whole-class activities. Consistent with the previous classroom characteristics, individual and small-group instruction may encourage a balance of student- (e.g., individualized instruction based on interest and readiness, self-regulation, autonomy) and teacher-oriented beliefs (e.g., curriculum delivery and instruction group selection) among Montessori educators.

Finally, assessment strategies may play a role in shaping Montessori teacher beliefs. In a Montessori environment, teachers assess students via observation and direct engagement, rather than designing and grading assessments such as assignments and exams.[3] To illustrate, a teacher may observe that a student consistently forgets to borrow appropriately while working through subtraction problems and decide to give a that student follow-up lesson on borrowing. Teacher and student may edit a report paragraph together through discussion rather than the teacher marking the student's writing and returning it to the student for revision. Furthermore, the Montessori environment and materials often prompt students to assess their own progress. For example, when a group of elementary students work through a square root problem, they use a

[3] One notable exception is that public Montessori schools, like all other publicly funded schools, must implement mandated high-stakes testing (Block, 2015; Culclasure et al., 2018; Scott, 2017).

material called the pegboard with a series of hierarchically colored pegs (i.e., red for hundreds, blue for tens, and green for units) while also working through the problem on paper. If the peg distribution doesn't align with the paper calculations, students recognize that an error has been made without feedback from an adult. Self-assessment helps the Montessori student become friendly with mistakes and comfortable with performance monitoring (Denervaud et al., 2020). Thus, the responsibility of assessment is shared between teacher and student in the Montessori environment. Again, this classroom characteristic encourages a balance of teacher- and student-oriented beliefs that may distinguish Montessori teachers from their conventional counterparts.

To be sure, these are general characterizations of conventional and Montessori pedagogy; exceptions can be found in each case. However, these characteristics underly the pedagogical structure for most conventional and Montessori classrooms. Coupling specialized, immersive teacher training with first-hand teaching experience in an alternative classroom structure, teacher belief development among Montessori teachers may not mirror that of their conventional counterparts and is worth investigating.

Montessori Teacher Beliefs

There is a dearth of research investigating Montessori teachers' beliefs; the published literature currently consists of two studies. Rubin and Hansen (1976) assessed teacher beliefs among conventional (i.e., daycare and traditional preschool) and Montessori early childhood teachers (N=14). They used the Teacher Beliefs Rating Scale (TBRS), a 24-item Likert-scale measure, to assess five belief variables: active versus passive learning, children's similarity to adults, intrinsic versus extrinsic motivation, learning via general experience versus explicit training, and process versus product orientation (Verma & Peters, 1975). To assess teacher belief alignment among teachers within each school and pedagogy, the researchers calculated Pearson

product-moment correlations between all teachers within the same school and within the same pedagogy. To assess teacher belief alignment between teachers of different pedagogies, they created a correlation matrix comparing a subsample of four conventional and two Montessori teachers. Results showed that while teacher beliefs were highly correlated within pedagogy, correlations were lower between pedagogies (i.e., conventional and Montessori). While the authors reported correlations within and between teacher sub-groups, they did not report teachers' scores on the five variables assessed by the TBRS. Thus, Rubin and Hansen (1976) shed light on the relation between teacher beliefs among a small sample of conventional and Montessori teachers, but what these teachers believed is still an open question.

Caldwell et al. (1981) were interested in comparing conventional and Montessori preschool teacher beliefs about children's role in the classroom and how children should use classroom materials (N=37). They developed a teacher beliefs questionnaire, but only assessed validity by gathering feedback from a Montessori teacher and three education students. Results showed that Montessori teachers demonstrated greater flexibility in their beliefs about children's role in the classroom than conventional teachers. Conversely, Montessori teachers indicated more structured beliefs about how children should interact with classroom materials than conventional teachers. In sum, Caldwell et al. (1981) identified some belief differences between conventional and Montessori teachers, but the study was limited by small sample size and using a beliefs measure that lacked strong validity evidence. Overall, this literature is limited and would benefit from the application of contemporary methods.

For my predissertation, I extended this literature by studying openness and teacher beliefs among conventional and Montessori teachers (N=360). The in-service teachers were balanced across pedagogy, student age range (i.e., early childhood and elementary), and school funding

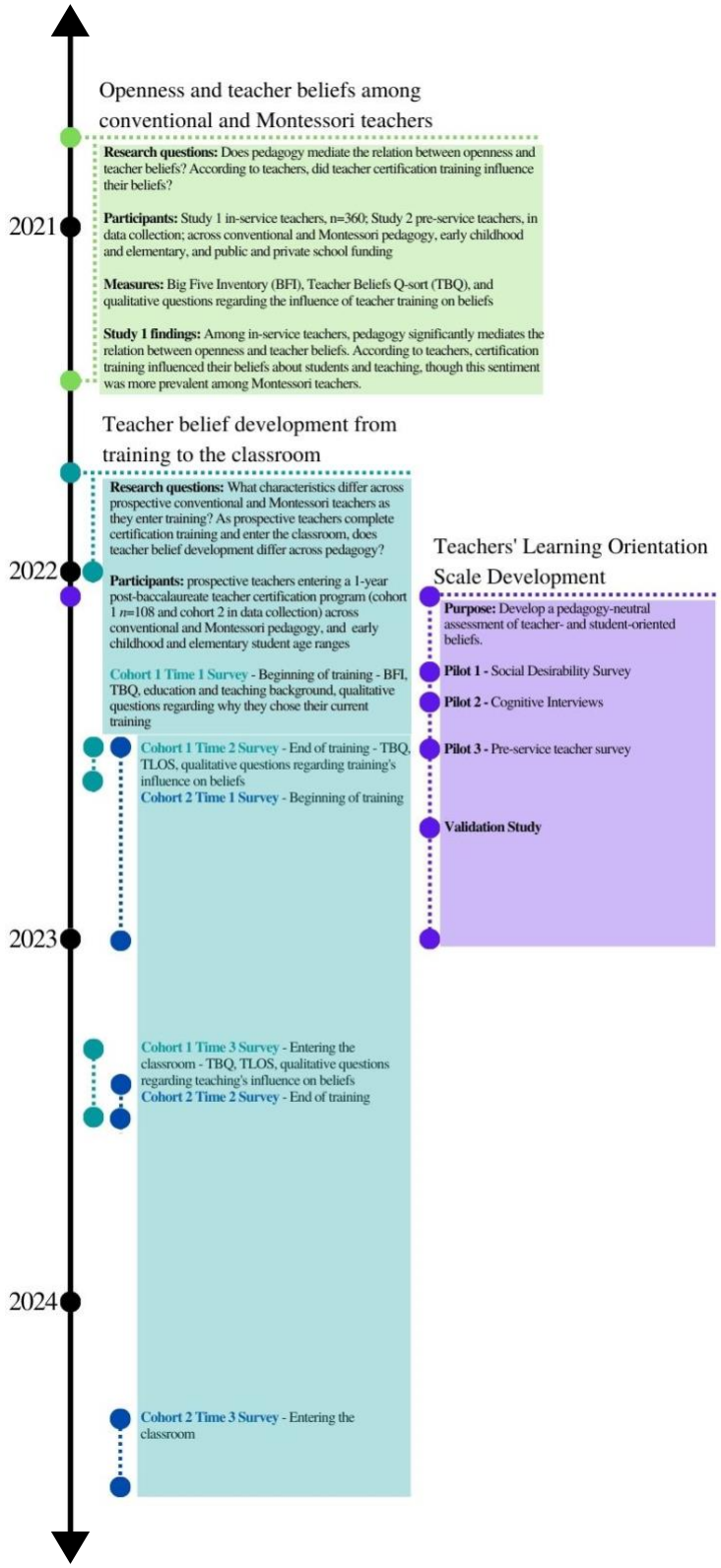
(i.e., public and private). I identified salient teacher beliefs using the Teacher Beliefs Q-sort (Rimm-Kaufman et al., 2006). Principal components and confirmatory factor analysis identified one salient teacher beliefs variable ranging from teacher-oriented beliefs (i.e., positive factor loadings; e.g., *Using whole group instruction*) to student-oriented beliefs (i.e., negative factor loadings; e.g., *Permitting students to choose from a variety of activities*). I also assessed openness with the Big Five Inventory (John et al., 1991). I hypothesized that teachers' pedagogy (i.e., conventional or Montessori) would mediate the relation between openness and teachers' beliefs.

Using structural equation modeling, I explored the relations between openness, pedagogy, and teacher beliefs. Results showed that openness predicted pedagogy, such that Montessori teachers indicated significantly higher levels of openness. Additionally, pedagogy significantly predicted teacher beliefs, such that Montessori teachers gave significantly higher priority to student-oriented teacher beliefs relative to conventional teachers. Thus, based on this model, pedagogy significantly mediated the relation between openness and teacher beliefs. In response to open-ended questions, the majority of teachers agreed that teacher training shifted their beliefs about students and teaching. However. this endorsement was significantly higher among Montessori teachers. I am currently supplementing this sample with data from prospective teachers entering conventional and Montessori pre-service training at the early childhood and elementary levels. I intend to survey these pre-service teachers again upon completion of teacher training and one year later to assess teacher belief development across training and transition into the classroom. See Figure 4 for a timeline of the teacher belief studies I am currently conducting.

Teacher beliefs measurement is an issue across this literature. Caldwell et al. (1981) consulted a Montessori teacher during measure design, but provided little additional validity evidence. Neither the Teacher Beliefs Rating Scale nor the Teacher Beliefs Q-sort were designed to consider Montessori pedagogy (Rimm-Kaufman et al., 2006; Verma & Peters, 1975). One benefit of using Q-sort is the identification of salient beliefs among a sample sub-groups. However, the Q-sort procedure is time-consuming and taxing for participants, especially when administered on an online platform. Additionally, item interdependence introduced through the sorting procedure violates assumptions underlying most hypothesis testing strategies. Thus, further study of Montessori teacher beliefs would benefit from an easy-to-use measure designed to take both conventional and Montessori pedagogy into account, supported by multiple sources of validity evidence.

Figure 4

Timeline of My Teacher Beliefs Research



TLOS Development and Validation

To support the study of teacher beliefs across pedagogies, I designed the Teachers' Learning Orientation Scale. Aligning with the learning orientations discussed above and results from my predissertation study, the TLOS assesses teacher- and student-oriented beliefs with items that apply across conventional and Montessori pedagogy. In the following sections, I outline the development and initial validation of the TLOS following a five-stage validity model that involves (1) construct definition, (2) measurement design, (3) pilot testing, (4) confirmatory factor analysis and reliability assessment, and (5) criterion validity assessment. (Messick, 1989; Schraw & Olafson, 2014).

Stage 1: Construct Definition

The first stage of validation is construct definition (DeVellis, 2003). Based on the reasoning stated in the teacher beliefs literature review above, the TLOS aims to assess teacher- and student-oriented teacher beliefs in a way that is neutral with regard to pedagogy. Teacher-oriented beliefs prioritize the teacher's role, responsibilities, or importance in shaping students' learning experience. Student-oriented beliefs prioritize students' role in shaping their own learning.

As operationalized in the TLOS, I view teacher- and student-oriented beliefs as orthogonal and sometimes complementary constructs rather than opposing ends of a single continuum. For example, a teacher might believe that students learn best when lesson content and pacing are based on a thoughtfully-designed curriculum. This would be considered a teacher-oriented belief because teachers implement the curriculum, which was not initially designed based on his or her students' individual characteristics. The same teacher might also believe that lesson content and pacing should be based on each student's prior knowledge, experience, and

interest. This would be considered a student-oriented belief because individual student characteristics shape their learning experience. This pair of teacher- and student-oriented beliefs complement one another; it is reasonable for a teacher to believe that a thoughtfully designed curriculum that offers the flexibility to accommodate students' prior knowledge, experience, and interests supports student learning. This conceptualization aligns with 10 of the 15 Likert-scale LO measures mentioned above (Bunting, 1985; Chan & Elliott, 2004; Charlesworth et al., 1993; de Vries et al., 2013; Hermans et al., 2008; Kerlinger & Kaya, 1959; McCombs & Whisler, 1997; Meirink et al., 2009; Smith, 1993; Woolley et al., 2004). The remaining five LO measures (Cook et al., 1951; Deci et al., 1981; Schaefer & Edgerton, 1985; Wehling & Charters, 1969; Willower et al., 1967) view teacher- and student-oriented beliefs as opposite ends of a continuum.

Stage 2: Measurement Design

Following construct definition, the validity model's next stage is measurement design; this consists of choosing an assessment format and generating items aligned with construct definitions (Fowler, 2014). The TLOS consists of a series of teacher belief statements, the development of which is described below. Participant responses indicate level of agreement on a 7-point Likert scale (i.e., 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree). For the studies that follow, I created online Qualtrics surveys containing the TLOS. Participants were instructed: "*Please take a moment to think about what you believe is the ideal way to support learning. Respond to the following statements as truthfully and accurately as you can. Remember that these are very subjective questions and that there are no right or wrong answers. Thank you!*"[4]

[4] These instructions were developed across pilot testing (see cognitive interview discussion) with input from the education experts discussed later in this section.

Next, items were presented at random to mitigate priming effects. Each page presented a single teacher belief statement with a vertical response list from strongly agree at the top to strongly disagree at the bottom, avoiding confusion associated with horizontal response spacing (Choi & Pak, 2005) and to optimize survey navigation on mobile devices. Aiming to assess item difficulty and potential sources of measurement error, such low engagement responses (Curran, 2016; Huang et al., 2012; Meade & Craig, 2012; Soland et al., 2019) and response modification due to socially desirability bias (Krumpal, 2013; Nederhof, 1985), I collected timing and click data per item: time to initial response, time to last response time, total time on each page, and total clicks per item. While randomization, timing data, and click data are not inherent to the measure itself, they are readily available on the Qualtrics platform and provide insight into measurement quality.

During item generation, I identified elements of the teaching and learning experience that are common across conventional and Montessori pedagogy (e.g., instruction, lesson content and pacing, assessment). I consulted literature discussing contemporary learning and pedagogical theory in conventional and Montessori contexts (e.g., Bransford et al., 2000; Darling-Hammond et al., 2020; Lillard, 2017; Lucariello et al., 2016; Montessori, 1995, 2017). For each element, I generated a pair of teacher- and student-oriented belief statements. I chose neutral or slightly positive wording aiming to generate statements that were equally socially desirable across constructs. I aim to assess teacher- and student-oriented beliefs relative to what teachers think is the ideal way to support learning in general, rather than beliefs particular to their specific students. Instructions prompt teachers to consider "*the ideal way to support learning"* generally, rather than prompting teachers to think about their students. I also worded items referring to

students in general (e.g., students should…) rather than referencing the teacher's students (e.g., my students should…).

The initial item pool contained 52 belief statements. Five experts in learning and pedagogical theory (three conventional and two Montessori), three graduate students (one with training and teaching experience in both conventional and Montessori contexts, one with training and teaching experience in the conventional context, and one with no teacher training or experience), and four undergraduate research assistants reviewed and provided feedback on the proposed items and measure instructions. We articulated item-level measurement objectives to clarify the intended meaning and interpretation of each item. During this process, we identified unclear or redundant items for modification or removal. We retained 28 items for pilot testing; shown in Table 3.

Table 3

TLOS Items Retained for Pilot Testing

Teacher-oriented	Student-oriented
1. Effective teachers assess student learning (e.g., formal, informal, formative, summative).	2. Students benefit from assessing their own learning, drawing on feedback from learning materials, peers, and the classroom environment.
3. Students thrive when the teacher provides developmentally appropriate activities and expectations.	4. Students naturally seek out the right activities to support their own development.
5. A well-planned class schedule should inform how long students work on each and every activity.	6. Students know best how long they need to work on each and every activity.
7. A carefully designed seating chart helps establish a positive learning environment.	8. It should be up to the students to decide where they work in the classroom.
9. Teachers should organize individual, partner, or group work activities.	10. Students should generally be able to choose whom they work with, if anyone.
11. A highly-structured, teacher-led learning experience fosters student learning.	12. Optimal learning occurs when students have control over their learning experience.
13. Whole-class instruction is the most effective form of teaching.	14. The most effective form of teaching is small group or individual instruction.
15. Teachers impart knowledge and skills to students.	16. Students build their own knowledge and skills through experience.
17. Lesson content and pacing should be informed by a thoughtfully-designed curriculum.	18. Students' prior knowledge, experience, and interest should inform lesson content and pacing.
19. Students learn the most from teacher-generated activities and assignments.	20. Students who get to choose and generate their own work tend to learn more.
21. Teachers should decide when to incorporate or allow purposeful student movement in the classroom.	22. Students should generally be free to move purposefully about the classroom.
23. Student behavior is best managed when the teacher sets clear, consistent rules and expectations.	24. Students learn to manage their behavior best when free to make choices about their learning.
25. Teacher feedback and grades are important motivators of student learning.	26. Students are mainly motivated by an internal love for learning.
27. Student learning is independent of the way teachers think about intelligence and ability.	28. How students think about intelligence and ability influences how they learn.

Note. Items 27 and 28 were excluded after pilot study 2.

Stage 3: Pilot Testing

During the third stage of validation, I refined the initial measure based on pilot testing. Here, data from small samples provided an assessment of item difficulty, participant comprehension, factor structure, internal reliability, and timing. I conducted three pilot studies: a social desirability survey, cognitive interviews, and a pilot survey among pre-service teachers. I will discuss each in turn.

Pilot Study 1: Social Desirability Survey

Social desirability bias contributes to measurement error when participants modify self-report responses hoping to appear more acceptable or desirable to others (Krumpal, 2013; Nederhof, 1985). Item wording can unintentionally trigger social desirability bias. For example, the statement, *Students should be confined to their desk during instruction*, would likely trigger social desirability bias given the negative connotation associated with *confined*. I suspect most teachers would be less likely to agree with this statement even if they believe that students should remain seated during lessons. In this case, responses would result in an inaccurate representation of teachers' beliefs. Thus, I designed a pilot survey study to assess social desirability across TLOS constructs.

I had two aims for this survey study. First, I sought to examine teachers' perceived social desirability across student- and teacher-oriented beliefs. If teachers perceived an equal degree of social desirability across constructs, I could be confident that item wording does not introduce bias toward either construct. Alternatively, if teachers found one construct more socially desirable than the other, I would reconsider item wording across both constructs. Second, I sought a preliminary understanding of measure completion time and item difficulty. Items with

noticeably higher response times or modifications were subsequently considered for cognitive interview probing, rewording, or removal.

Method

Sampling Procedure

I recruited currently employed conventional and Montessori lead teachers in the United States to take an anonymous online survey by collecting teacher emails from publicly available school websites and sending a recruitment email containing the survey link. Of the 89 individuals who clicked on the survey link, 56 (63%) completed the survey. Of the 33 participants with incomplete data, nine did not start the TLOS evaluation. The remaining 24 noncompleting participants evaluated seven of 28 TLOS items (*SD* = 6) and clicked 13 times (*SD* = 19.55), on average. None of the participants with incomplete data answered the concluding personal demographic questions. Given the relatively short measure completion time (6 minutes, discussed below), lack of personal demographic information, and minimal contribution to TLOS item evaluation, I excluded the 33 participants with incomplete data. Seven of the 56 completing participants indicated pedagogies other than conventional and Montessori (five Waldorf and two unspecified other), and were excluded from analysis. Our final dataset consisted of 49 teachers.

Participant Characteristics

The sample consisted of 49 in-service teachers: 30 conventional and 19 Montessori. Average participant age was 44.2 years (*SD* = 11.1 years). The majority of participants identified as female (*n* = 42, 85.7%) and white (*n* = 41, 83.7%). Most of the teachers taught in a publicly funded school: 23 of the 30 conventional teachers (77%) and 12 of the 19 Montessori teachers (63%). As noted above, Montessori teachers often take specialized teacher certification training.

However, some Montessori schools employ teachers who lack Montessori training. In this sample, 8 of the 19 (42%) Montessori teachers were untrained. See Table 4 for participants' demographic information, and Tables 5a and 5b for conventional and Montessori teacher characteristics, respectively.

Table 4

Pilot Study 1: Participant Demographics

Characteristic	*M*	*SD*	*n*	*%*
Age	44.2	11.1		
Gender				
Female			42	85.7
Male			4	8.2
Non-binary/ Third gender/Agender			1	2.0
Prefer not to say			2	4.1
Race and Ethnicity				
White			41	83.7
Black or African American			3	6.1
Filipino			2	4.1
South Korean			1	2.0
Multiple identifications			2	4.1

Note. $N = 49$.

Table 5a

Pilot Study 1: Conventional Teacher Characteristics

	School Funding	
Student Age Range	Public (*n* = 23)	Private (*n* = 7)
Infant/toddler		2
Early childhood	3	5
Elementary	11	
Adolescent/middle school	5	
High School	4	

Note. $N = 30$

Table 5b

Pilot Study 1: Montessori Teacher Characteristics

	School Funding			
	Public (*n* = 12)		Private (*n* = 7)	
Montessori Training	Trained	Untrained	Trained	Untrained
Student Age Range				
Infant/toddler			1	1
Early childhood	2	1	3	2
Elementary	5	3		
Adolescent/middle school		1		

Note. $N = 19$

Measure

In an anonymous, online Qualtrics survey, teachers evaluated the 28 proposed TLOS items, answering the question "Do you think a teacher who agrees with the following statement would be seen as a good person or not?" Teachers responded on a 5-point Likert scale (1=extremely bad, 2=somewhat bad, 3=neither good nor bad, 4=somewhat good, 5=extremely good). Qualtrics randomly presented each item on a separate page, collecting data on participants' click number and response time (i.e., first click, last click, and total) per item.

Analysis Strategy

To gain a preliminary understanding of measure completion time, item difficulty, and careless responding, I considered the mean initial response time (i.e., time to first click on an

item), response modification time (i.e., time between first and last click on an item), navigation time (i.e., difference between last click and total page time), and mean clicks per item. Items with abnormally high response times would be considered for probing in cognitive interview, rewording, and removal. I assessed careless responding by evaluating final response (i.e., last click) time per item. Responses provided in under two seconds were considered missing data due to low engagement. A subsample of 11 participants provided a total of 39 low engagement responses out of 1568 total TLOS responses (2.5% of responses).

For hypothesis testing, I calculated mean factor scores of teachers' perceived social desirability associated with student- and teacher-oriented beliefs. The mean factor score represents the mean of all items associated with each construct for each participant. Using the factor score data, I assessed the normality and homoscedasticity assumptions using the Shapiro-Wilk test and Levene's test, respectively. Finally, I conducted an independent samples *t*-test comparing teachers' perceived social desirability across student- and teacher-oriented beliefs.

Results

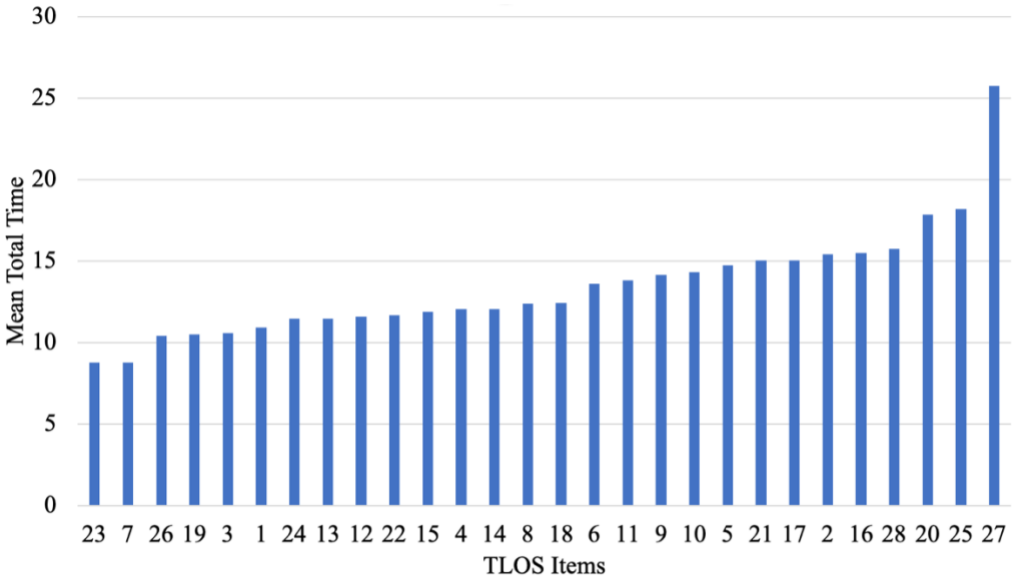
On average, participants who completed the survey spent 5 minutes and 49 seconds evaluating TLOS statements and clicked 33 times (28 initial responses and 5 modifications). Participants averaged 13.94 seconds per item (*SD* = 3.41 seconds), ranging from 8.77 seconds on item 23 (*Student behavior is best managed when the teacher sets clear, consistent rules and expectations.*) to 25.77 seconds on item 27 (*Student learning is independent of the way teachers think about intelligence and ability*.). On average, participants took 11.24 seconds (*SD* = 3.06 seconds, 84% of total time) to select an initial response, ranging from 6.76 seconds on item 7 (*A carefully designed seating chart helps establish a positive learning environment.*) to 20.81 seconds on item 27, 0.55 seconds (*SD* = 0.29, 4% of total time) for response modification,

ranging from 0.25 seconds on item 11 (*A highly-structured, teacher-led learning experience fosters student learning.*) to 1.78 seconds on item 27, and 1.65 seconds (*SD* = 0.39, 12% of total time) navigating the online platform, from 1.22 seconds on item 7 to 3.18 seconds on item 27. Participants averaged 1.19 clicks (*SD* = 0.05 clicks) per item, ranging from 1.11 clicks on item 26 (*Students are mainly motivated by an internal love for learning*.) to 1.30 clicks on item 21 (*Teachers should decide when to incorporate or allow purposeful student movement in the classroom*.). Overall, timing data indicate high engagement, low response modification, and ease in navigating the online platform.

The only negatively worded item in the set (Item 27: *Student learning is independent of the way teachers think about intelligence and ability.*) had the highest initial response time at 20.81 seconds (4.6 seconds greater than the next highest item), response modification time at 1.78 seconds (0.77 seconds greater than the next highest item), navigation time at 3.18 seconds (0.82 seconds greater than the next highest item), and total time at 25.77 seconds (7.6 seconds greater than the next highest item; see Figure 5). These high response times indicate that participants found this item particularly difficult. Therefore, I flagged this item for probing in a cognitive interview.

Figure 5

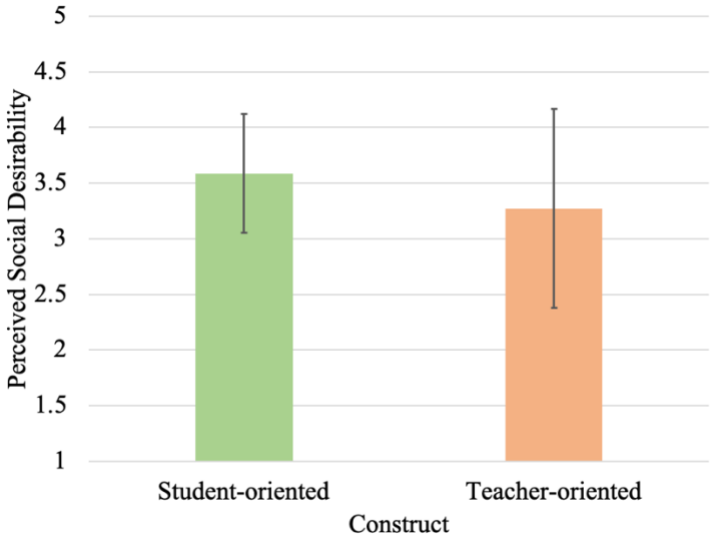
Pilot Study 1: TLOS Item Mean Total Times



During hypothesis testing, the normality assumption was met for both student- (W = .97, p = .87) and teacher-oriented beliefs (W = .91, p = .15). Levene's test indicated statistically equal variances (F = 3.42, p = .08). There was no significant difference between teachers' social desirability rating of student- (M = 3.58, SD = .53) and teacher-oriented beliefs (M = 3.27, SD = .89), $t(26)$ = 1.79, p = .25, d = .45. See Figure 6 for a bar graph of teachers' perceived social desirability by construct.

Figure 6

Pilot Study 1: Teachers' Perceived Social Desirability of TLOS Constructs



Discussion

The first aim of this study was to assess teachers' perceived social desirability across student- and teacher-oriented beliefs. I found no significant difference in perceived social desirability across constructs. Despite the small sample size, these results provide initial evidence that, while social desirability may influence participant responses, the bias is statistically equal across constructs as assessed by the TLOS. However, as the TLOS is further modified (e.g., dropping or rewording items), perceived social desirability scores across constructs may change warranting reassessment. Therefore, it may be necessary to assess perceived social desirability again after finalizing the TLOS.

Pilot Study 2: Cognitive Interviews

Cognitive interviews employ theory and techniques based in cognitive psychology (Collins, 2015). Tourangeau (1984) outlined a four-stage model of cognitive processes involved in item response: question comprehension, memory retrieval, judgment of relevant information, and response formation. Cognitive interviews explore these stages using techniques such as

think-aloud, based on Ericsson and Simon's (1980) verbal protocol, and probing questions (Belson, 1981). See Table 6 for cognitive interview aims by item processing stage.

Cognitive interviews provide a unique opportunity to observe how participants engage with the TLOS. The aim is to understand participants' thought process as they respond to each item, assessing the alignment between responses and item measurement objectives. This pretest method helped me to identify and mitigate unwanted influences that could introduce measurement error, such as confusion due to unclear wording and response modification due to social desirability bias.

Table 6

Pilot Study 2: Cognitive Interview Aims by Item Processing Stage

Item processing stage	Aim
Comprehension	• Explore participants' interpretation of key words and phrases
Retrieval	• Establish whether participants can reflect on teaching knowledge or experience when formulating item response
Judgment	• Explore what information participants consider when formulating item response • Assess participants' response strategies
Response	• Assess how well participants' decided answers map onto the provided responses (7-point Likert scale) • Assess response modifications and their causes

Method

Sampling Procedure

For this study, I used a convenience sample. The research team, consisting of myself (i.e., a former conventional and Montessori teacher) and two undergraduate research assistants, created a contact list of professional colleagues and acquaintances employed as lead teachers in

the United States. We distributed a recruitment email using to each teacher on the contact list and selected the first eight teachers, balanced across pedagogy, that replied with interest in participating.

Participant Characteristics

We interviewed a sample of eight teachers: four teaching in conventional schools and four in Montessori. Seven teachers identified as White and one as American Indian or Alaskan Native. Six identified as female and two as male (one male in each pedagogy). Average age was 40.5 years: 36.5 years (*SD* = 13.3 years) among conventional teachers and 46.5 years (*SD* = 14.1 years) among Montessori teachers. Student-age range among conventional teachers was evenly split across elementary and adolescent, whereas three Montessori teachers taught elementary and one infant/toddler. See Table 7 for more information on participants teaching background and demographics.

Table 7

Pilot Study 2: Participants' Teaching Background and Demographics

ID	Protocol	Pedagogy	Student Age Range	Age (years)	Race	Gender
1	A	Conventional	Elementary	30	White	Female
2	B	Conventional	Adolescent	46	White	Female
3	A	Conventional	Elementary	21	White	Female
4	B	Conventional	Adolescent	49	White	Male
5	A	Montessori	Infant/toddler	36	American Indian or Alaskan Native	Male
6	B	Montessori	Elementary	44	White	Female
7	A	Montessori	Elementary	67	White	Female
8	B	Montessori	Elementary	39	White	Female

Cognitive Interview Protocol

To respect participants' time and energy, I aimed to keep interviews under an hour in length. According to D'Ardenne (2015), 15-20 questions can be assessed in one hour. Therefore, I created two cognitive interview protocols, observation forms, and anonymous online surveys, A and B, each containing 14 TLOS items (i.e., seven pairs of student- and teacher-oriented beliefs) and a series of probes: comprehension (e.g., In the following statement, what does the phrase **the way teachers think about intelligence and ability** mean to you?), judgement (How did you find answering these questions? Did you feel comfortable evaluating these statements?), and response (Was it easy or difficult to select one of the provided responses? Did you feel any pressure to answer in a particular way?). Conventional and Montessori participants were balanced across protocols. See the Cognitive Interview Protocol in the Appendix.

Interviews were conducted and recorded via Zoom as participants engaged with the online Qualtrics survey, consistent with procedures planned for the upcoming studies. Two trained undergraduate research assistants conducted interviews. Given the convenience sample, I matched interviewers and participants with no prior associations. Interviewers began the Zoom session with video and audio on. Participants shared their screens as they followed an anonymous link to the appropriate Qualtrics survey. After obtaining consents and walking participants through a think-aloud training, interviewers turned their own video and audio off until participants completed the survey. Interviewers turned audio back on to prompt participants struggling to think-aloud, which occurred once in the interviews. While participants completed the survey, interviewers recorded observations. For each demographic, TLOS item think-aloud, and probe item, interviewers noted terms or phrases that elicited participant confusion or

misinterpretation, response modification and the associated reasoning, and additional notes as necessary. See Cognitive Interview Observation Form A in the Appendix.

Analysis Strategy

Data analysis for this study is qualitative (Collins, 2015; Miles & Huberman, 1994; Ritchie & Lewis, 2003; Ritchie & Spencer, 1994). First, I combined data sources (i.e., survey responses, think-aloud findings, interviewer observations, and probe findings) into a single dataset. Next, I created a descriptive analysis matrix where we considered TLOS item and probe responses based on each item processing phase and the associated aims. For comprehension aims, we noted instances when participants' item interpretation did not align with item-level measurement objectives or across conventional and Montessori participants. For response aims, we noted response modifications (i.e., modifications per item, direction, and magnitude) and preceding comments, and categorized probe responses. We also noted instances where a participant's verbal response did not match the selected response (e.g., the participant stated "I choose somewhat agree," but selected *disagree* on the Qualtrics survey).

The bulk of think-aloud responses addressed retrieval and judgement aims, warranting a more in-depth analysis. A female undergraduate research assistant and I analyzed teachers' think-aloud responses following standard qualitative content analysis strategies (Miles & Huberman, 1994). Each think-aloud response was individually coded identifying the types of information teachers' considered during response formation and response strategies. Like information types were grouped into categories. Upon comparison, the information categories and response strategies independently identified by coders were very similar. Consensus on final coding was derived through discussion. The second female undergraduate research assistant conducted inter-rater reliability coding. Cohen's Kappa was calculated to determine rater

consistency (Landis & Koch, 1977). Finally, we calculated frequencies and percentages for each information category and response strategy.

Results

In the following sections, I discuss results for each item processing stage: question comprehension, memory retrieval, judgment of relevant information, and response formation.

Item comprehension

For the majority of items, participants' interpretation aligned with item-level measurement objectives. However, results confirmed concerns identified in the social desirability survey with the item *Student learning is independent of the way teachers think about intelligence and ability*. Participant 6 reread the item four times, exclaimed, "This is hard" during think-aloud, and verbally modified the response twice. In the follow-up probe, participant 6 twice stated, "I really don't know how to answer this question." Participant 4 ended the probe response with, "I don't know. Maybe?" Participant 8 stated, "This is the one I got hung up on." Further probing indicated that rather than considering teachers' fixed or growth mindset towards intelligence and ability in general, participants considered how teachers' feelings and beliefs towards individual students or beliefs about their own intelligence and ability influenced student learning. Participant 8 asked, "Is this question saying student learning is independent of the way teachers think about individual students' intelligence and that student's ability?" Participants displayed similar confusion with the paired student-oriented belief statement, *How students think about intelligence and ability influences how they learn*. Thus, due to item difficulty and inconsistent interpretation, I decided to drop these two items from the TLOS.

Memory Retrieval and Judgement

We achieved acceptable inter-rater reliability ($\kappa = .95$) during judgement coding. We analyzed the types of information teachers recalled and considered, judgement strategies, and teachers' comfort level. In the following sections, I discuss each in turn.

Information Recalled and Considered. Teachers recalled and considered teaching knowledge when formulating responses (92% of responses). For 42% of responses, teachers made general statements about teaching, such as "Children should be able to move at their own pace," "Metacognition is huge," and "Structured choice is always a good thing." They referred to factors that influence learning in 25% of responses. For example, participant 3 noted, "We all learn best from self-reflection and from getting feedback from not just the teacher but from our peers as well." Teachers also referenced classroom context (e.g., subject matter, grade level, specific programs like Responsive Classroom; 19% of responses), child characteristics (e.g., age, ability, interest; 18% of responses), and behavior management (15% of responses). Of the 94 total responses, 62 (67%) referenced teaching knowledge alone, making no explicit reference to first-hand teaching experience. In sum, teachers relied heavily on teaching knowledge, often independent of teaching experience examples, when judging TLOS items.

Teachers also referenced first-hand teaching experience when formulating responses by recalling their own classroom, individual students, or colleagues (28% of responses). For example, when responding to item 24 (*Students learn to manage their behavior best when free to make choices about their learning.*), participant 4 spoke specifically about his students, "Well, the kids I see during the day with behavioral modification plans, behavioral support plans…" Participant 3, when answering item 6 (*Students know best how long they need to work on each and every activity.*), stated "Maybe as they get older that would be true, but I don't think that is

true for my first graders. So, I am going to answer this for my own students." However, teachers rarely considered their teaching experience in isolation, as shown in the previous example. Of the 26 teaching experience references across interviews, 24 references (92%) were coupled with teaching knowledge statements. Thus, while teachers mainly relied on teaching knowledge to judge TLOS items, they also considered first-hand teaching experience in just over a quarter of responses.

Judgement Strategies. Teachers mainly used four strategies when judging TLOS items. The first three strategies were similar; teachers considered alternatives to the TLOS statement (33% of responses), extreme cases (7% of responses), and exceptions (3% of responses). When judging a student-oriented statement, teachers often considered the alternative by referencing teacher-oriented knowledge and experiences, and vice versa. For example, when answering item 10 (*Students should generally be able to choose whom they work with, if anyone.),* participant 1 responded, "My mind automatically goes to like instances when I've paired up students." For this same item, participant 7 thought about an extreme case, "I think that sometimes they need to know you can't always work with the same person all day long in every single lesson on every single subject that you're not doing." Participant 3 responded to this item after thinking about exceptions, "I always think about those students who maybe don't have the social skills to form friendships as well as others and then you feel bad for those kids or it might make them feel anxiety to try and find their own partner." Thus, thinking through a TLOS statement by considering multiple perspectives and situations helped teachers formulate their responses.

Additionally, teachers considered how often the statement was true or not, using terms that indicated frequency or quantity (50% of responses). For example, participant 7 noted, "We are assessing children all the time," when responding to item 1 (*Effective teachers assess student*

learning (e.g., formal, informal, formative, summative).). When responding to item 13 (*Whole-class instruction is the most effective form of teaching.*), participant 5 stated, "In some cases, yes, but most cases, no." Teachers relied on this strategy alone in 24% of responses and coupled it with one of the first three strategies in 26% of responses. Overall, when judging TLOS items, teachers pulled from their own teaching knowledge and experience to consider alternative perspectives, extreme cases, exceptions, and how often the statements hold true.

Comfort Level During Judgement. Upon further probing, all teachers said they felt comfortable evaluating the TLOS items. Teachers attributed this comfort to feeling confident about teaching. Participant 1 explained, "I did feel comfortable evaluating the statements I think because I feel confident that what's happening in my classroom is with the children's best interests in mind always." Teachers also referenced years of teaching experience. Participant 3 wondered, "One may think that there were right ways to answer the questions, but I wonder if I might have felt that way if I had been teaching for less years. Like the fact that I have been teaching for 24 years… I felt really comfortable talking about the way things go in my room." Participant 3 also reflected on the TLOS items, "I did not think that any of them were threatening types of questions." Thus, participants felt comfortable relying on teaching knowledge and experience when evaluating TLOS items.

However, six participants found it challenging to consider multiple factors during the judgement process. Participant 7 explained, "Sometimes it was hard to select the right response because it depends upon the situation. It depends upon the child. It depends upon the circumstance. It depends upon the lesson I am giving. It depends upon the ability of the children." Participant 8 noted that this challenge was partially due to fatigue, "I do have to admit at the end of a long day of teaching I am quite fatigued. So, it did take me a while to think

through the process of what I did actually want to say." In sum, participants expressed ease with calling upon teaching knowledge and experience during the retrieval and judgement phases, but challenge in weighing multiple factors and managing fatigue.

Response Formation

Of the eight teachers, seven explicitly stated that it was easy to select a response on the 7-point Likert scale. However, in five instances across interviews, teachers selected a response on the Qualtrics survey that did not align with their verbal response. For example, participant 5 selected *neither agree nor disagr*ee just after stating "I agree with that." It was unclear whether these instances were a result of typical measurement error, or the increased cognitive demand of the think-aloud procedure.

Teachers modified responses 15 times across all interviews (M=1.9, SD=2.3). Of the 15 total modifications, six indicated greater disagreement, seven indicated greater agreement, and two decided on their original response after considering another option. Most modifications were preceded by participants considering the alternative orientation (e.g., considering student-oriented beliefs while judging a teacher-oriented item; 9 modifications), child characteristics (e.g., student at different ages; 1 modification), and exceptions (1 modification). There was one instance of modification possibly due to social desirability. When modifying one response from disagree to somewhat disagree, participant 6 stated, "I'll keep it reasonable with somewhat." Thus, in most cases, there is little evidence that response modification was prompted by social desirability bias.

Upon further probing, participants indicated that they did not feel pressured to answer in a particular way while completing the TLOS. Participant 2 stated, "I did not feel pressure in this scenario but, sometimes when I am filling out surveys for school, I do feel like I have to answer

in a certain way because my school will be viewed in a certain way." Instead, participant 8 mentioned an internal pressure to accurately represent her beliefs, "I just wanted to make sure I hit all of the points that I am most passionate about…" Overall, teachers found it easy to select a response and provided little evidence of modifying responses due to social desirability bias.

Discussion

Despite the small sample size, the cognitive interviews yielded rich insight into how participants interact with the TLOS. Participants generally comprehended items as intended. However, teachers consistently misinterpreted and struggled to answer items 27 and 28, prompting us to drop these two items (leaving 26 items) before administering the TLOS in an online pilot survey. Outside of these items, teachers expressed ease in completing the TLOS with little evidence of modification due to social desirability bias.

While teachers relied mostly on general teaching knowledge during the judgement phase, they explicitly referenced teaching experience and their students in about a quarter of responses. This response pattern indicates that teachers may sometimes conflate beliefs about what is ideal for learners in general and beliefs about what is best for their students in particular when responding to the TLOS. It is possible that ideal and student-specific beliefs align well for some teachers and not for others (e.g., Hornstra et al., 2015). TLOS items are worded for learners in general. During cognitive interviews, instructions prompt participants to "*think about your beliefs about students and teaching*." In subsequent testing, I reworded instructions, prompting participants to consider general/ideal beliefs: "*think about what you believe is the ideal way to support learning*." In future work, developing a second TLOS version, wording instructions and items to reference teachers' current students, may help researchers assess alignment between ideal and student-specific beliefs.

Pilot Study 3: Pre-service Teacher Survey

For the third and final TLOS pilot study, I aimed to conduct initial assessments of timing, factor structure, internal reliability, and convergent validity. A sample of prospective conventional and Montessori teachers (N = 41) completed the TLOS and the Teacher Belief Q-Sort (TBQ; Rimm-Kaufman et al., 2006) in an online survey. Following the procedure used by Kerlinger and Kaya (1959), I used a Q-sort to identify salient teacher beliefs among the participant group.

I chose the Teacher Belief Q-sort (TBQ) because it is, to my knowledge, the only well-validated Q-sort in the teacher beliefs literature (Rimm-Kaufman et al., 2006). The TBQ was designed and validated to identify and compare salient teacher beliefs among teachers with different training backgrounds and has been used among pre- (Decker & Rimm-Kaufman, 2008; La Paro et al., 2009) and in-service teachers (Garrity et al., 2019; Rimm-Kaufman & Sawyer, 2004). For example, in terms of discipline and behavior management, Rimm-Kaufman et al. (2006) identified beliefs about teacher direction and student self-regulation and autonomy as most salient across four teacher groups (N = 197): in-service teachers trained in the Responsive Classroom Approach (RC; n = 30), in-service teachers without RC training (n = 32), pre-service teachers training at the elementary level (n = 61), and pre-service teachers training at the middle/high school levels (n = 74). Group comparisons showed that pre-service middle/high school teachers gave beliefs about teacher direction less priority relative to in-service teachers, and RC trained in-service teachers gave beliefs about student self-regulation and autonomy higher priority relative to in-service teachers that lacked RC training. Additionally, in my predissertation study (discussed earlier), the TBQ identified student- and teacher-oriented beliefs as the most salient among conventional and Montessori in-service teachers. In the current pilot

study, I provided evidence for convergent validity by assessing the relation between the salient beliefs extracted by the TBQ and the student- and teacher-oriented beliefs measured by the TLOS.

Method

Sampling Procedure

I recruited participants from a concurrent longitudinal teacher beliefs study, assessing teacher beliefs at the beginning, end, and one year after teacher certification training using the TBQ. In Fall 2021, I distributed a recruitment email to prospective teachers (PTs) entering 1-year post-baccalaureate teacher certification programs for the early childhood or elementary level. I recruited conventional PTs from nine universities ranked among the top 100 education schools in the United States (*Find the Best Education Schools*, n.d.) and Montessori PTs from training programs accredited by the Montessori Accreditation Council for Teacher Education. Of the 108 PTs that took the beginning-of-training survey, 74 agreed to be contacted about taking an end-of-training survey.

For this pilot study, we included the TLOS in the end-of-training survey. As survey-completion incentives, we provided $5 Starbucks gift cards and participants' teacher- and student-oriented beliefs mean scores at the end of the survey. Of the 44 participants that took the survey, three were removed for careless responding (i.e., responding in under 2 seconds to 20% or more of TLOS items, $N = 41$). Most participants completed the survey with no missing data (i.e., 36 of 41 participants, 88%). The remaining 5 participants completed the survey but had at least one missing datapoint. Therefore, we used data from all 41 participants in analysis.

Participant Characteristics

The sample consisted of 41 prospective teachers (PTs): 18 (44% of sample) conventional and 23 (56% of sample) Montessori. Average participant age was 30.5 years (*SD* = 8.51 years). The majority of participants identified as female (*n* = 40, 97.6%) and white (*n* = 28, 68.3%). For most PTs (*n* = 31, 76%), the current teacher certification training was the first teacher certification. However, of the 10 PTs with prior certification training, nine were attending Montessori training. A majority of conventional PTs were training at the elementary level (*n* = 15; 83%), whereas Montessori teachers were roughly split across elementary (*n* = 10; 43%) and early childhood (*n* = 13; 57%). Finally, most conventional PTs attended in-person training (*n* = 11; 61%), whereas most Montessori PTs attended virtual or hybrid training (*n* = 20; 87%).[5] See Table 8 for demographic information, and Tables 9a and 9b for conventional and Montessori teacher characteristics, respectively.

Table 8

Pilot Study 3: Participant Demographics

Characteristic	*M*	*SD*	*n*	*%*
Age	30.50	8.51		
Gender				
Female			40	97.6
Male			1	2.4
Race and Ethnicity				
White			28	68.3
Asian/Pacific Islander			7	17.1
Multiple identifications			3	7.3
Hispanic/Latinx			2	4.9
Unspecified			1	2.4

Note. *N* = 41.

[5] Many Montessori training programs began offering hybrid or virtual options in response to the Covid pandemic.

Table 9a

Pilot Study 3: Conventional Teacher Characteristics

	Student Age Range	
Training Format	Elementary (*n* = 15)	Early Childhood (*n* = 3)
In-person	9	2
Virtual		1
Hybrid	6	
First Certification		
Yes	15	2
No		1

Note. $N = 18$, 44% of sample.

Table 9b

Pilot Study 3: Montessori Teacher Characteristics

	Student Age Range	
Training Format	Elementary (*n* = 10)	Early Childhood (*n* = 13)
In-person		3
Virtual	5	5
Hybrid	5	5
First Certification		
Yes	5	9
No	5	4

Note. $N = 23$, 56% of sample.

Measures

As mentioned above, I assessed teacher beliefs using two measures. Participants first completed the Teachers' Learning Orientation Scale followed by the Teacher Belief Q-sort (Rimm-Kaufman et al., 2006). I will discuss each in turn.

Teachers' Learning Orientation Scale (TLOS). Here, the TLOS consisted of 26 teacher belief statements, omitting items 27 and 28 based on prior pilot testing. Participants indicated agreement level using a 7-point Likert scale ranging from (1) strongly disagree to (7) strongly agree. Items were presented at random on individual pages. We also collected timing

data (i.e., first and last click time, total page time, and total clicks per page). See the preceding Measurement Design section for further detail.

Teacher Beliefs Q-Sort (TBQ). The Teacher Belief Q-Sort consists of three 20-item Q-sorts assessing teachers' prioritization of teacher beliefs about: discipline and behavior management (TBQ1; e.g., *If I anticipate problems before they happen and discuss them with students, I have fewer discipline problems.*), teaching practices (TBQ2; e.g., *Permitting students to choose from a variety of activities.*), and students (TBQ3; e.g., *Students are more motivated by grades than they are by the acquisition of competence*; Rimm-Kaufman et al., 2006). For each Q-Sort, participants were presented with a collection of 20 teacher belief statements. Participants sorted each statement into one of five anchor categories: "very characteristic of my approach or beliefs," "characteristic of my approach or beliefs," "somewhat characteristic of my approach or beliefs," "less characteristic of my approach or beliefs," and "least characteristic of my approach or beliefs." This measure specifies a forced choice distribution wherein participants could only assign four belief statements to each anchor category, requiring them to prioritize certain belief statements over others.

Analysis Strategy

As in Pilot Study 1, I began with an analysis of TLOS timing data to assess measure length, item difficulty, and response modification rates. Next, I conducted factor analysis on the TBQ and TLOS data. The resulting TBQ and TLOS variables were then included in a structural equation model (SEM). This model estimated the relation between teacher belief variables and predicted teacher beliefs by pedagogy. While some SEM heuristics recommend a larger sample (Wolf et al., 2013), this sample size (N = 41) provided enough data (i.e., degrees of freedom) for this relatively simple model. Analyses were conducted using R (Dinno, 2018; Fox & Weisberg,

2019; R Core Team, 2020; Revelle, 2018; RStudio Team, 2019). In the following sections, I discuss each analysis step in detail.

TLOS Timing. I collected timing data for each TLOS item to assess measure length, item difficulty, and response modification rates. I calculated the mean initial response time (i.e., time to first click on an item), response modification time (i.e., time between first and last click on an item), navigation time (i.e., difference between last click and total page time on an item), and mean clicks per item.

TLOS Factor Analysis. I began by conducting a confirmatory factor analysis (CFA) based on my theoretical two-factor TLOS model. I compared this model to a one-factor CFA using a likelihood ratio test. Model fit was evaluated based on goodness-of-fit indices: Root Mean Square Error of Approximation (RMSEA < .05; Steiger, 1990), Comparative Fit Index (CFI > .90; Hu & Bentler, 1999), and Standardized Root Mean Square Residual (SRMR < .08; Hu & Bentler, 1999). Next, I conducted exploratory factor analysis (EFA) aiming to identify low- and cross-loading items. In subsequent CFA, I excluded items that loaded below 0.4 on both factors or did not discriminate well between factors as indicated by a complexity score of 1.6 or greater in the EFA. I enhanced model fit by consulting modification indices and applying theoretically appropriate adaptations. Based on the CFA, I calculated factor scores for use in data visualization. Finally, I assessed internal reliability for each factor by calculating Cronbach's α.

TBQ Factor Analysis. I identified salient teacher belief factors emerging from the Q-Sort data by following the analytic method adopted by Rimm-Kaufman and Sawyer (2004) and Rimm-Kaufman et al. (2006a) during measure design and validation, and all subsequent studies using the TBQ (Decker & Rimm-Kaufman, 2008; Garrity et al., 2019; La Paro et al., 2009). I began with a parallel analysis, with probability set at .05, to get an idea of how many factors we

should extract (Horn, 1965; O'Connor, 2000). Next, I performed a principal components analysis (PCA) with varimax rotation to increase the likelihood of identifying unique, orthogonal components from each Q-sort (Watts & Stenner, 2012). I started by extracting the number of factors suggested by the parallel analyses. I assessed the PCA results seeking a mean item complexity nearest to one and conceptual coherence. For each component, I retained items with a loading of 0.40 or higher.

Here, I diverged from the factor analytic method adopted by Rimm-Kaufman et al. (2006) to prepare data for use in the subsequent structural equation model. Rather than calculating mean factor scores for each component, I conducted a CFA containing all TBQ components using the maximum likelihood estimator. I retained items with standardized loadings greater than 0.4. I also enhanced model fit by consulting modification indices and applying adaptations that were conceptually coherent and did not substantively alter factor structure. Based on the CFA, I calculated factor scores for use in data visualization.

Structural Equation Model. TBQ and TLOS CFA provided the measurement models for the three teacher belief variables (i.e., TBQ, TLOS student, and TLOS teacher). I assessed convergent validity by correlating the TBQ and TLOS variables. Based on my predissertation study (see the preceding discussion of Montessori teacher beliefs), I hypothesized that pre-service teacher beliefs would differ significantly by the end of certification training based on pedagogy. Thus, I included pedagogy as an exogenous predictor (coded 0 = conventional and 1 = Montessori). I assessed the efficacy of including additional covariates: training format (i.e., in-person, virtual, hybrid), first teaching certification (coded 0 = yes and 1= no), student age range (coded 0 = elementary and 1= early childhood), and years of teaching experience. I added each covariate to the model one at a time and compared model fit with the one predictor model.

Covariates that decreased model fit or did not significantly predict the three teacher belief variables were dropped from the model. See Figure 5 for the SEM path diagram with standardized estimates.

Results

In this pilot study, I conducted a preliminary assessment of TLOS timing, factor structure, internal reliability, and convergent validity. In the following sections, I first present timing results to get a feel for how participants engaged with the TLOS. Next, I discuss results of the TBQ and TLOS factor analysis. The factor analysis results supplied the teacher belief variables estimated in the subsequent structural equation model. The model estimated the correlation between teacher belief variables and predicted teacher beliefs by pedagogy providing evidence for convergent validity between the TBQ and TLOS.

TLOS Timing

On average, participants who completed the TLOS spent 4 minutes and 49 seconds evaluating TLOS statements and clicked 34 times (i.e. 26 initial responses and 8 modifications). Participants averaged 11.10 seconds per item, ranging from 7.06 seconds on item 12 (*Optimal learning occurs when students have control over their learning experience.*) to 21.10 seconds on item 11 (*A highly-structured, teacher-led learning experience fosters student learning*; *SD* = 3.12 seconds). On average, participants took 8.75 seconds to select an initial response, ranging from 5.51 seconds on item 12 to 18.38 seconds on item 11 (*SD* = 2.93 seconds, 79% of total time). Participants took an average of 0.72 seconds for response modification, ranging from 0.14 seconds on item 6 (*Students know best how long they need to work on each and every activity.*) to 1.84 seconds on item 1 (*Effective teachers assess student learning (e.g., formal, informal, formative, summative)*; *SD* = 0.41, 6% of total time). Participants took an average of 1.63

seconds navigating the online platform, ranging from 1.18 seconds on item 12 to 2.27 seconds on item 6 (*SD* = 0.27, 15% of total time). Finally, Participants averaged 1.31 clicks per item, ranging from 1.12 clicks on item 6 to 1.51 clicks on item 25 (*Teacher feedback and grades are important motivators of student learning*; *SD* = 0.11 clicks). Overall, timing data indicate high engagement, low response modification, and ease in navigating the online platform.

TLOS Factor Analysis

The two-factor model demonstrated significantly stronger model fit relative to a one factor model, χ^2 (299) = 42.48, $p < 0.001$, supporting my theory that teacher- and student-oriented beliefs, as assessed by the TLOS, are orthogonal rather than unidimensional. I excluded eight items for low loading and five for high complexity scores. The final TLOS CFA model retained 13 items and demonstrated acceptable fit (RMSEA = .049, CFI = .97, SRMR = .078). Internal reliability for teacher- (α = .87) and student-oriented (α = .79) factors were considered sufficient (Schraw & Olafson, 2014). See Table 10 for TLOS CFA results.

Table 10

Pilot Study 3:TLOS Confirmatory Factor Analysis Results

Item	β	*B*	*SE*
Factor 1: Teacher-oriented beliefs (α = .87)			
1. Effective teachers assess student learning using various techniques (e.g., formal, informal, formative, summative, etc).	.55	1.00	
5. A well-planned class schedule should inform how long students work on each and every activity.	.58	2.06	.71
7. A carefully designed seating chart helps establish a positive learning environment.	.77	2.82	.82
9. Teachers should organize individual, partner, or group work activities.	.69	1.61	.50
11. A highly-structured, teacher-led learning experience fosters student learning.	.80	2.42	.69
17. Lesson content and pacing should be informed by a thoughtfully-designed curriculum.	.54	1.35	.49
21. Teachers should decide when to incorporate or allow purposeful student movement in the classroom.	.76	2.44	.72
25. Teacher feedback and grades are important motivators of student learning.	.75	2.14	.63
Factor 2: Student-oriented beliefs (α = .79)			
6. Students know best how long they need to work on each and every activity.	.66	1.00	
12. Optimal learning occurs when students have control over their learning experience.	.65	0.49	.15
24. Students learn to manage their behavior best when free to make choices about their learning.	.85	0.99	.26
26. Students are mainly motivated by an internal love for learning.	.54	0.71	.18
20. Students who get to choose and generate their own work tend to learn more.	.48	0.43	.16

Note. N = 41. Standardized coefficients (β), unstandardized coefficients (*B*), and standard error (*SE*) reported. Results obtained using maximum likelihood estimation.

TBQ Factor Analysis. The parallel analysis for TBQ1 (i.e., beliefs about discipline and behavior management) suggested extracting two components, TBQ2 (i.e., beliefs about classroom practices) one component, and TBQ3 (i.e., beliefs about students) zero components. See Figures A1 and A2 for TBQ1 and TBQ2 parallel analyses results. After extracting the suggested number of components through principal components analysis, we retained two

components from TBQ1 and one from TBQ2 based on conceptual coherence. See Tables 11 and 12 for TBQ1 and TBQ2 PCA results, respectively.

Table 11

Pilot Study 3: Teacher Beliefs Q-Sort 1 Principal Component Analysis Results

Statements	Loadings
TBQ1 Component 1: Teacher-directed classroom (Teacher)	
19. If I anticipate problems before they happen and discuss them with students, I have fewer discipline problems.	.55
17. If I treat students with respect, kindness, and concern, there are less behavior problems.	.53
16. Students learn best in primarily teacher-directed classrooms.	.51
15. Praise from me is an effective way to change students' behavior.	.47
9. A classroom runs smoothly when there are clear expectations for behavior.	.43
18. Verbal punishment is an unacceptable means of controlling students' behavior; I believe it is more important to use only positive management techniques.	-.44
20. Extrinsic rewards for desirable behaviors (e.g. stickers, candy bars, etc.) undermine students' motivation; it is better not to give such rewards at all.	-.60
13. Students should try to solve conflicts on their own before going to the teacher.	-.60
5. Proper control of a class is apparent when the students work productively while I am out of the room (either briefly or when a substitute is present).	-.66
TBQ1 Component 2: Discipline Structures (Structure)	
10. Classroom rules should be discussed and posted.	.73
14. Rules for the students' classroom behavior need to be reinforced consistently.	.56
8. The curriculum and class schedule need to be prioritized over students' specific interests.	.56
1. The primary goal in dealing with students' behavior is to establish and maintain control.	.53
4. When students are engaged in interesting problems and challenging activities, they tend to have very few discipline problems.	-.63
2. A noisy classroom is okay as long as all the students are being productive.	-.68

Note. Mean item complexity of 1.4. Accounted for 31% of variance (i.e., Teacher 16%, Structure 15%). All loadings are standardized.

Table 12

Pilot Study 3: Teacher Beliefs Q-Sort 2 Principal Component Analysis Results

Statements	Loadings
TBQ2 Component 1: Classroom Practices (Practices)	
18. Using whole group instruction.	.79
15. Using work sheets.	.68
12. Using drill and recitation for factual information (math facts, etc.).	.65
8. Discussing a written announcement or message created by the teacher.	.63
4. Doing an activity to create a sense of community.	-.54
7. Having at least a few students share something that has happened to them.	-.49
16. Permitting students to choose from a variety of activities.	-.42

Note. Accounted for 17% of variance. All loadings are standardized.

The confirmatory factor analysis containing all three teacher belief components revealed that the first components extracted from TBQ1 and TBQ2 (i.e., Teacher and Practices) were significantly correlated (r = -.81, p < .001). Thus, I collapsed Teacher and Practices into one factor. Negative loadings on this latent variable indicated beliefs about teacher-oriented education, endorsing the use of whole group instruction and worksheets. Alternatively, positive loadings indicated beliefs about student-oriented education, endorsing student choice and self-regulation. The second factor pertained to beliefs about classroom rules. We excluded this factor from further analysis as it did not directly relate to the TLOS. The final TBQ CFA model demonstrated acceptable fit (RMSEA = .048, CFI = .98, SRMR = .068). See Table 13 for TBQ CFA results.

Table 13

Pilot Study 3: Teacher Beliefs Q-sort Confirmatory Factor Analysis Results

Q-Sort	Statement	β	*B*	*SE*
Factor 1: Student- and Teacher-oriented Beliefs				
1	13. Students should try to solve conflicts on their own before going to the teacher.	.71	1.00	
2	16. Permitting students to choose from a variety of activities.	.54	1.02	.35
1	18. Verbal punishment is an unacceptable means of controlling students' behavior; I believe it is more important to use only positive management techniques.	.47	0.87	.34
2	8. Discussing a written announcement or message created by the teacher.	-.43	-0.62	.26
2	18. Using whole group instruction.	-.56	-1.04	.35
2	15. Using work sheets.	-.86	-1.03	.25
Factor 2: Discipline Structures				
1	10. Classroom rules should be discussed and posted.	.51	1.00	
1	14. Rules for the students' classroom behavior need to be reinforced consistently.	.62	1.29	.60
1	2. A noisy classroom is okay as long as all the students are being productive.	-.56	-1.08	.52

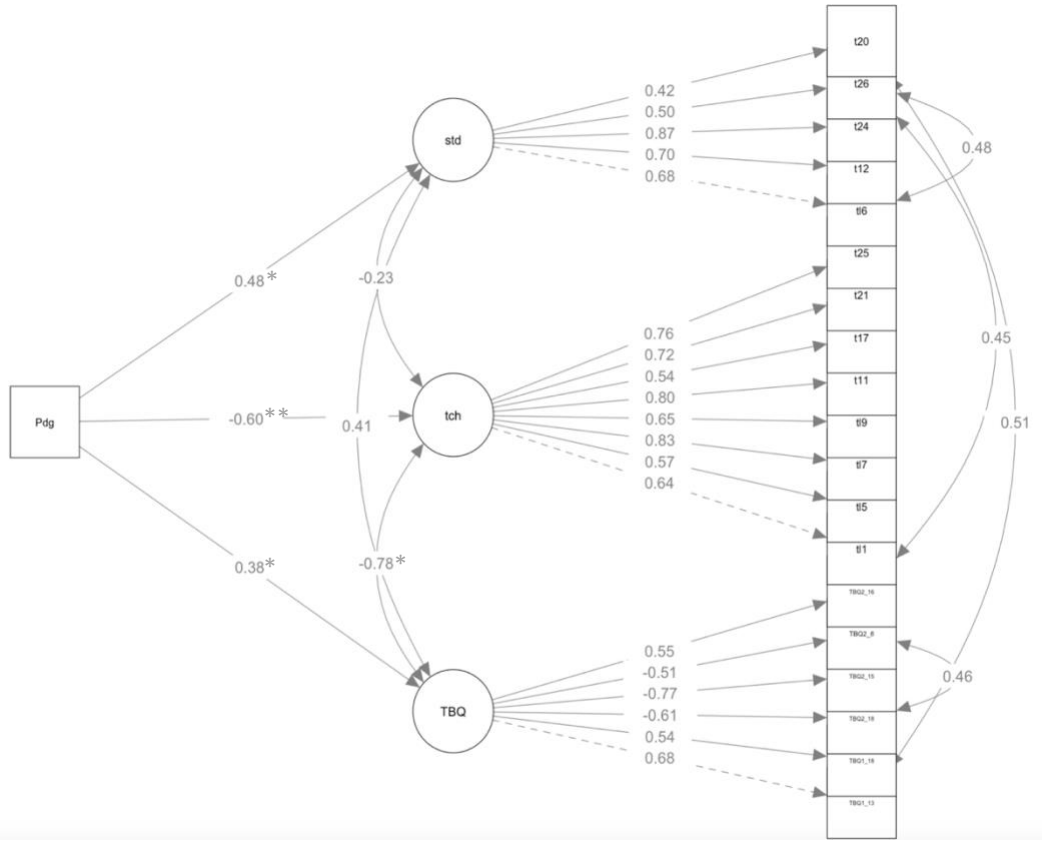
Note. $N = 36$. Standardized coefficients (β), unstandardized coefficients (*B*), and standard error (*SE*) indicated. Results obtained using maximum likelihood estimation.

Structural Equation Model

A model predicting three teacher beliefs variables (i.e., TBQ, TLOS student, and TLOS teacher) by pedagogy (i.e., conventional and Montessori) demonstrated good model fit (RMSEA = .022, CFI = .99, SRMR = .085; see Figure 7 for the SEM path diagram with standardized estimates). Inclusion of additional covariates (i.e., training format, first certification, student age range, and years of teaching experience) resulted in decreased model fit and, in the case of training format and first certification, did not significantly predict any of the teacher belief variables. Thus, I retained the more parsimonious, one-predictor model. See Table 14 for model fit comparisons by covariate.

Figure 7

Pilot Study 3: Structural Equation Model Predicting Teacher Beliefs by Pedagogy



Note. * $p < .05$, ** $p < .01$.

Table 14

Pilot Study 3: Model Fit Indices by Covariate

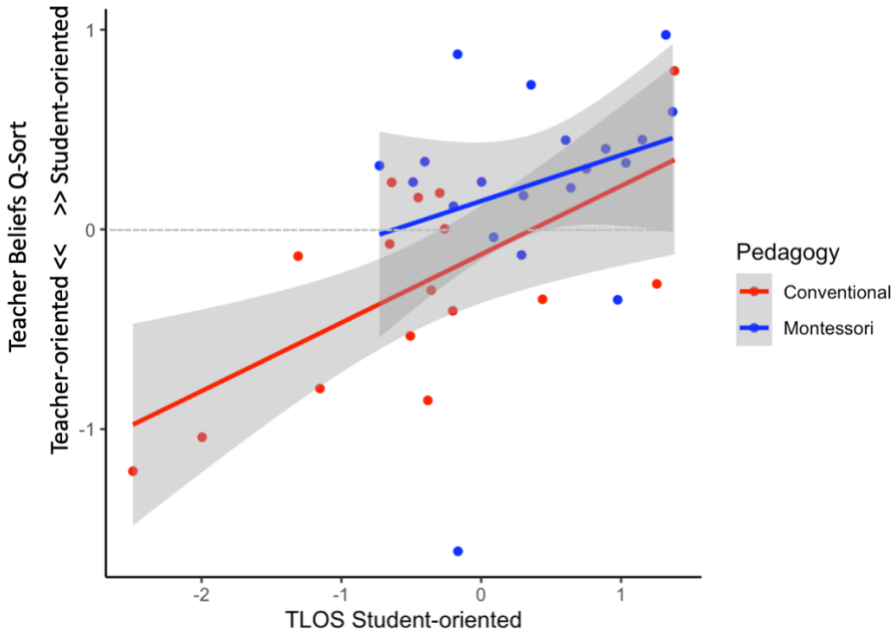
	Model Fit Indices		
Predictor(s)	RMSEA [90% CI]	CFI	SRMR
Pedagogy	.022 [.000 - .080]	.99	.085
Pedagogy and			
First certification	.053 [.000 - .094]	.94	.086
Training format	.060 [.000 - .099]	.92	.088
Student age range	.077 [.029 - .112]	.89	.088
Years of teaching experience	.094 [.050 - .129]	.84	.094

I assessed convergent validity by estimating the correlation between the TBQ variable (i.e. the unidimensional factor representing student-oriented beliefs as positive loadings and

teacher-oriented beliefs as negative loadings) with the orthogonal student- and teacher-oriented belief TLOS variables. The TLOS student-oriented variable showed a trend towards positively correlating with the TBQ variable (β = .41, *SE* = .12, *p* = .10). These results indicate that while a higher score on the TLOS student-oriented variable (std) is associated with a more positive-loading, student-oriented score on the TBQ variable, the TLOS captures aspects of student-oriented beliefs unrelated to the TBQ variable. Figure 8 shows a scatterplot of TLOS student-oriented beliefs and TBQ factor scores. The TLOS teacher-oriented variable (tch) negatively correlated with the TBQ variable (β = -.78, *SE* = .09, *p* = .01), indicating that a higher score on the TLOS teacher-oriented variable is significantly associated with a more negative-loading, teacher-oriented score on the TBQ, shown in Figure 9. These results provide supportive evidence for convergent validity, in that teacher- and student-oriented belief variables captured by the TLOS are similar but not redundant to the teacher belief variable captured by the TBQ.

Figure 8

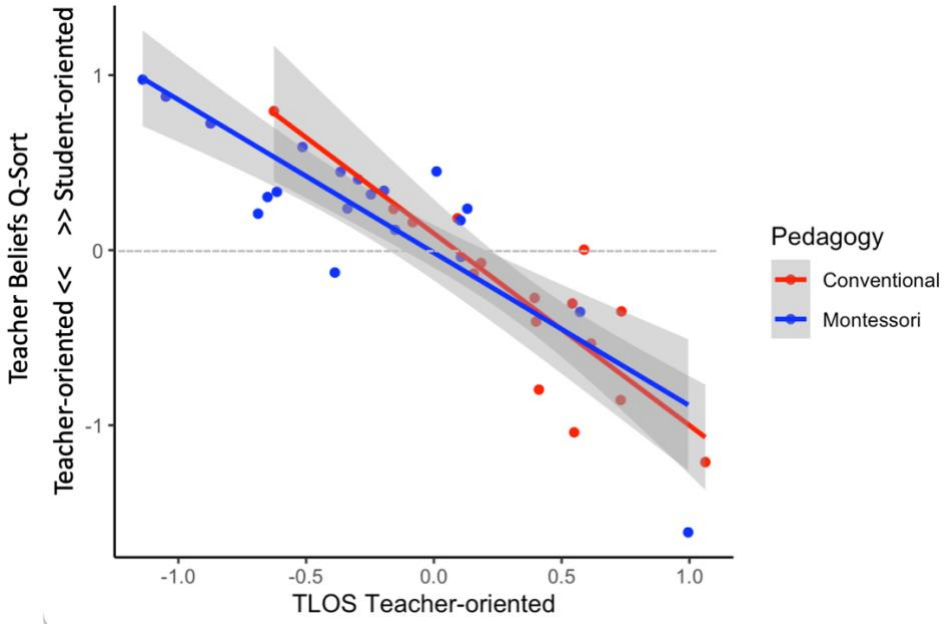
Pilot Study 3: TLOS Student-Oriented Beliefs and Teacher Beliefs Q-Sort Factor Score Scatterplot



Note. Correlation between TBQ and TLOS student-oriented was positive, but not significant (β = .41, *SE* = .12, *p* = .10).

Figure 9

Pilot Study 3: TLOS Teacher-Oriented Beliefs and Teacher Beliefs Q-Sort Factor Score Scatterplot

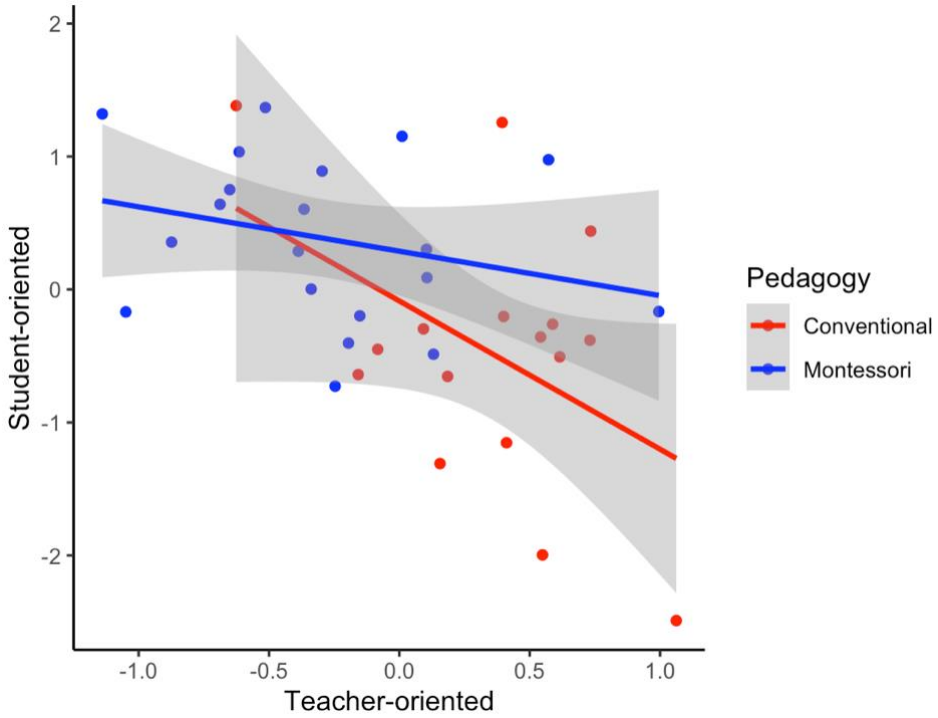


Note. Correlation between TBQ and TLOS teacher-oriented was negative and significant (β = -.78, *SE* = .09, *p* = .01).

The TLOS teacher- and student-oriented belief factors negatively correlated (β = -.23, *SE* = .09, *p* = .28). However, this association was not significant, supporting my assertion that teacher- and student-oriented beliefs are orthogonal factors. See Figure 10 for a scatterplot of TLOS teacher- and student- oriented beliefs. Interestingly, the negative relation between student- and teacher-oriented beliefs appears weaker among Montessori PTs than among conventional PTs. This result indicates that Montessori PTs may be more likely to balance high teacher- and student-oriented beliefs relative to conventional PTs.

Figure 10

Pilot Study 3: TLOS Student- and Teacher-Oriented Beliefs Scatterplot



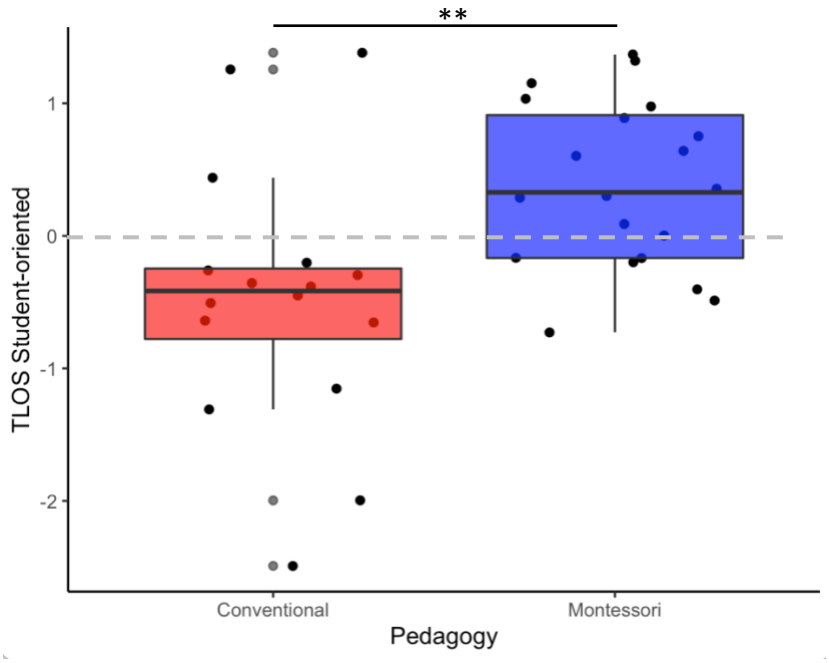
Note. Correlation between TLOS student- and teacher-oriented beliefs was negative, but not significant (β = -.23, *SE* = .09, *p* = .28).

I hypothesized that by the end of teacher certification training, PTs would differ significantly in teacher- and student-oriented beliefs based on pedagogy (i.e., conventional and Montessori). As hypothesized, PTs differed significantly on student-oriented beliefs as measured by the TLOS (β = .49, *SE* = .37, *p* = .01), such that Montessori PTs scored 0.49 standard deviations higher than conventional PTs. See Figure 11 for a box plot of student-oriented beliefs by pedagogy. Similarly, PTs differed significantly on teacher-oriented beliefs as measured by the TLOS (β = -.60, *SE* = .23, *p* = .001), such that Montessori PTs scored 0.60 standard deviations lower than conventional PSTs, shown in Figure 12. As further evidence of convergent validity, pedagogy significantly predicted teacher beliefs on the TBQ factor (β = .38, *SE* = .23, *p* = .04),

such that Montessori PTs scored 0.38 standard deviations higher than conventional PTs, indicating that Montessori PTs were more likely to prioritize student-oriented beliefs relative to conventional PTs. See Figure 13 for a box plot of TBQ factor scores by pedagogy.

Figure 11

Pilot Study 3: Student-oriented Beliefs by Pedagogy Boxplot

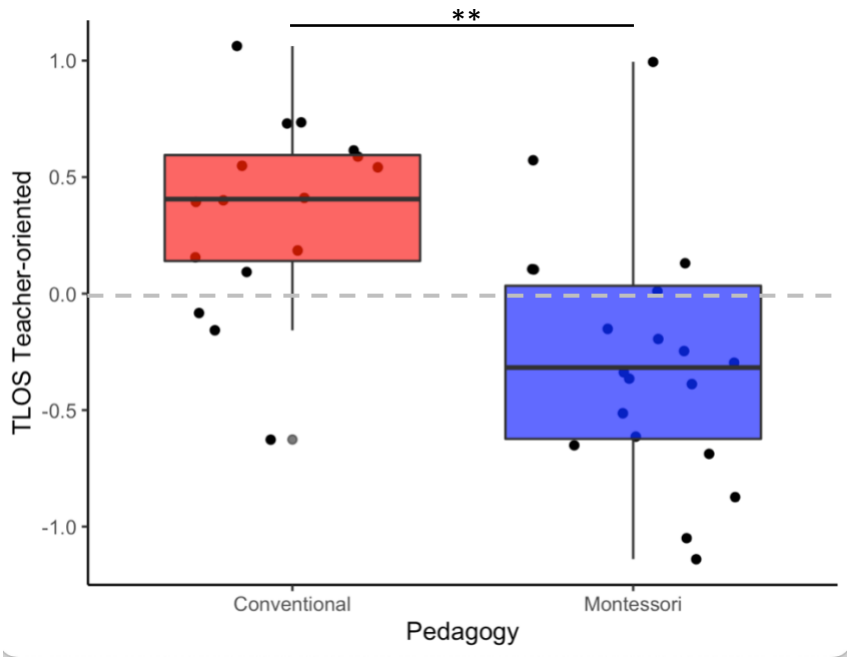


Note. PTs differed significantly on student-oriented beliefs (β = .49, *SE* = .37, *p* = .01). Gray dots indicate outliers. Gray dashed line indicates the mean.

** $p \leq .01$.

Figure 12

Pilot Study 3: Teacher-oriented Beliefs by Pedagogy Boxplot

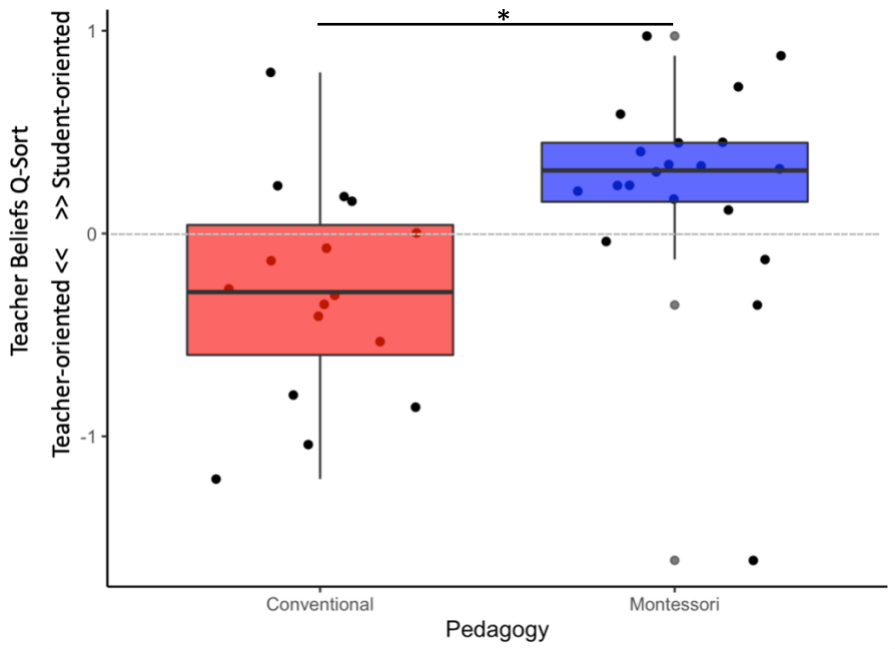


Note. PTs differed significantly teacher-oriented beliefs (β = -.60, *SE* = .23, *p* = .001). Gray dots indicate outliers. Gray dashed line indicates the mean.

** $p \leq .01$.

Figure 13

Pilot Study 3: TBQ Factor Scores by Pedagogy Boxplot



Note. Pedagogy significantly predicted the TBQ factor (β = .38, *SE* = .23, p = .04). Gray dots indicate outliers. Gray dashed line indicates the mean.

* $p \leq .05$.

Discussion

This pilot survey provided evidence that the TLOS captured student- and teacher-oriented beliefs among a small sample of pre-service teachers. TLOS results were similar to, but not exactly the same as, salient teacher beliefs captured by the more established TBQ, providing evidence for convergent validity. Given the effort required for participant completion and statistical analysis of the TBQ, the TLOS provides a relatively quick and easy alternative for capturing teacher- and student-oriented beliefs. The TLOS captured belief differences across pedagogies, as expected. However, measurement invariance across pedagogies was not assessed. Differences in intercepts and slope across pedagogy, as shown in Figure 8, may indicate that

future measurement invariance testing will not immediately achieve metric and scalar invariance. A TLOS validation study among a larger sample is necessary to assess measurement invariance across pedagogies.

Stages 4 and 5: Validation Study

For the last two stages of validation testing, I collected TLOS data from a larger sample of in-service teachers. Stage four involves factor analysis, another assessment of internal reliability, and an assessment of test-retest reliability (Schraw & Olafson, 2014; Tabachnick & Fidell, 2001). Stage five involves assessing predictive relations to related constructs (i.e., criterion validity), such as teachers' pedagogy, student age range, years of teaching experience, and, among Montessori teachers, certification organization. For this final stage, I asked, do conventional and Montessori teacher beliefs differ based on student age range (i.e., early childhood and elementary), school funding (i.e., public and private) and years of teaching experience? Furthermore, do Montessori teacher beliefs differ based on certification organization (AMI, AMS, other, or none)?

As discussed in the literature review, Montessori teachers may have different beliefs about students and teaching relative to their conventional counterparts based on pedagogy-specific pre- and in-service experiences. Based on results from my predissertation study and pilot study 3 provide, I hypothesize that teacher- and student-oriented belief mean scores will differ based on pedagogy, such that Montessori teachers score higher on student-oriented and lower on teacher-oriented beliefs relative to conventional teachers. Additionally, I hypothesize that variance in student-oriented beliefs will be less among Montessori teachers relative to conventional teachers.

Teacher beliefs may also differ depending on student age range given that teaching practices may differ based on what is developmentally appropriate at each age range. For example, in a position statement on developmentally appropriate practices, NAEYC suggests that while rigorous academic learning is often emphasized at the elementary level, early childhood programs should foster opportunities for purposeful movement, social engagement, integrated learning across disciplines, and play (National Association for the Education of Young Children, 2020). Thus, I hypothesize that early childhood teachers, across both pedagogies, will score lower on teacher-oriented beliefs and higher on student-oriented beliefs relative to elementary teachers.

Montessori public schools often modify practices in response to public policy. For example, assessment in the Montessori classroom is typically based on observation, direct interactions with students, and student self-assessment. However, public Montessori schools, like all other publicly funded schools, implement mandated high-stakes testing (Block, 2015; Culclasure et al., 2018; Scott, 2017). While private Montessori programs may choose to adopt some conventional practices, they are not required to do so. Given that publicly mandated practices, such as high-stakes testing, tend to be more teacher-oriented, I hypothesize that Montessori private school teachers will score lower on teacher-oriented beliefs and higher on student-oriented beliefs relative to Montessori public school teachers.

Teacher beliefs may also be associated with years of teaching experience. Evidence suggests when teachers maintain commitment and motivation into their mid- and late-career years, they often hone their teaching practice to support student learning and exude a sense of serenity in the classroom, respectively (Day, 2013; Hargreaves, 2005; Huberman et al., 1993). This increased serenity and openness to exploring practices that support student learning may be

associated with a shift in teacher beliefs. Therefore, I hypothesize that teachers, across pedagogy, become more student-oriented and less teacher-oriented as years of teaching experience increase.

Finally, as an exploratory analysis, I investigated the relations between Montessori teacher certification organization and teacher beliefs as assessed by the TLOS. Multiple organizations offer Montessori teacher certification training. Maria Montessori established Association Montessori Internationale (AMI) in part to oversee teacher training and maintain fidelity to her original teachings (Kramer, 1988). Nancy McCormick Rambusch established the American Montessori Society (AMS), with an interest in adapting Montessori pedagogy to modern, American teaching practices (Whitescarver & Cossentino, 2008). Various other organizations offer Montessori teacher certification training (e.g., International Montessori Council, Center for Guided Montessori Studies, and Pan American Montessori Society). Finally, some Montessori programs employ teachers with no Montessori teacher certification. Being exploratory, I did not propose formal hypotheses regrading teacher belief differences based on Montessori teacher certification organization.

Method

In the following section, I outline the method for stages four and five of the validation study. I discussion the sampling procedure, participant characteristics, and analysis strategy in turn.

Sampling Procedure

I recruited individuals currently employed as teachers in the United States to take an anonymous online Qualtrics survey. Recruitment efforts aimed for relatively balanced teacher ratios across three school contexts: pedagogy type (i.e., conventional and Montessori), school funding (i.e., public and private), and student age range (i.e., early childhood and elementary). I

used snowballing recruitment techniques by sharing a survey link on teacher-relevant Facebook pages, placing a Facebook ad, and inviting teacher associations to share the survey link in newsletters. Additionally, I emailed school administrators and teachers asking that they share and take the survey, respectively. I procured school administrator and teacher emails through school websites and professional association directories. At the end of the survey, I invited participants to provide their email if they are willing to take the same survey again, two to four weeks after the completion date. As incentive for survey completion, participants were shown their teacher- and student-oriented belief scores.

Participant Characteristics

The sample consisted of 451 American in-service teachers: 225 (50% of sample) conventional and 226 (50% of sample) Montessori. Average participant age was 45.6 years (*SD* = 11.8 years). The majority of participants identified as female (*n* = 368, 92.7%) and white (*n* = 329, 82.7%). Not all participants responded to the demographics questions, either dropping from the online survey before the demographics questions or choosing not to answer despite "prefer not to say" option (i.e., 54 participants did not specify gender identity, 52 did not specify race, and 53 did not specify Hispanic, Latinx, or Spanish origin). Despite not providing demographic information, these teacher provided teaching background information and enough TLOS data to for analysis. Four participants expressed that race and gender are social constructs that they refuse to acknowledge or specified "Human" for race. See Table 15 for demographic information.

Table 15

TLOS Validation Study: Participant Demographics

Characteristic	Conventional (*n* = 225, 50%)			Montessori (*n* = 226, 50%)		
	M	*SD*	*n*	*M*	*SD*	*n*
Age	46.2	11.7		45.0	11.8	
Years of teaching experience	14.8	10.2		11.3	9.49	
Gender Identification						
Female			177 (93%)			191 (92%)
Male			10 (5%)			10 (5%)
Prefer not to say			3 (1%)			3 (1%)
Non-binary or Agender			1 (<1%)			1 (>1%)
Transgender						1 (>1%)
Race						
White			160 (83%)			169 (82%)
Multiple identifications			16 (7%)			11 (5%)
Black or African American			10 (5%)			6 (3%)
Chinese			2 (1%)			2 (1%)
Indigenous American			2 (1%)			1 (>1%)
Filipino			1 (>1%)			3 (1%)
Unspecified			1 (>1%)			2 (1%)
Specified: Human			1 (>1%)			1 (>1%)
Asian Indian						8 (4%)
Asian						2 (1%)
Japanese						1 (>1%)
Hispanic, Latinx, or Spanish Origin						
No			183 (95%)			194 (94%)
Yes			9 (5%)			12 (6%)

Note. *N* = 451.

Teachers averaged 13.0 years of teaching experience (*SD* = 10.0 years). While teachers' pedagogy (i.e., conventional and Montessori) and student age range (i.e., early childhood and elementary) were relatively balanced, more teachers taught at private (*n* = 277; 61%) than public schools (*n* = 174; 39%). As noted in the literature review, Montessori teachers often take specialized teacher certification training. However, some Montessori schools employ teachers who lack Montessori training. Of the 226 Montessori teachers, 214 (95%) held a Montessori teacher certification, 10 were untrained (4%; 5 public and 5 private school teachers), and 2 (1%) did not specify. Most Montessori teachers acquired Montessori teacher certification through the

Association Montessori Internationale (*n* = 101; 46%) or American Montessori Society (*n* = 83; 38%). See Table 16 and Figure 14 for further information on teachers' school context, and Table 17 for Montessori teachers' school context by certification organization.

Table 16

TLOS Validation Study: Teachers' School Context

Pedagogy	Conventional (*n* = 225, 50%)		Montessori (*n* = 226, 50%)	
Student age range	Early Childhood	Elementary	Early Childhood	Elementary
n	129 (57%)	96 (43%)	134 (59%)	92 (41%)
School funding				
Public	49 (22%)	61 (27%)	28 (12%)	36 (16%)
Private	80 (36%)	35 (15%)	106 (47%)	56 (25%)

Note. *N* = 451.

Figure 14

TLOS Validation Study: Teachers' School Context Pie Graph

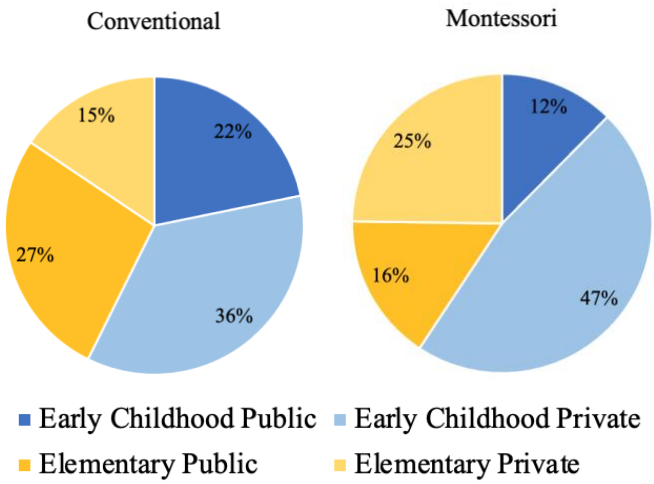


Table 17

TLOS Validation Study: Montessori Teachers' School Context by Certification Organization

	Montessori Certification Organization			
	AMI *n* = 100 (45%)	AMS *n* = 81 (36%)	Other *n* = 32 (14%)	None *n* = 10 (5%)
Student age range				
Early childhood	56 (42%)	48 (36%)	23 (17%)	7 (5%)
Elementary	44 (50%)	33 (37%)	9 (10%)	3 (3%)
School funding				
Public	15 (24%)	34 (55%)	8 (13%)	5 (8%)
Private	86 (53%)	47 (29%)	24 (15%)	5 (3%)
Years of teaching experience				
M (SD)	10.3 (8.8)	13.0 (9.6)	11.8 (11.0)	6.1 (8.1)

Note. Largest disparity in Montessori certification organization by school funding highlighted in yellow.

A subset of this sample volunteered to retake the survey two to four weeks after the initial assessment to assess test-retest reliability. Of the initial sample, 233 volunteered their email to receive a retest survey invitation. Of these volunteers, 102 clicked on the retest survey link and 92 provided enough data to calculate TLOS factor scores. Given that the aim is to assess test-retest reliability, seven participants excluded from the original dataset (e.g., student age range infant/toddler or middle school) were included in this dataset. The retest sample average age was 44.5 years (*SD* = 12.3 years), and most participants identified as female (*n* = 87, 94.5%) and white (*n* = 82, 89.1%). See Table 17 for demographic information.

Table 18

TLOS Validation Retest Survey: Participant Demographics

Characteristic	Conventional (*n* = 40, 44%)			Montessori (*n* = 52, 56%)		
	M	*SD*	*n*	*M*	*SD*	*n*
Age	44.6	14.3		44.4	10.7	
Years of teaching experience	17.9	12.8		11.3	9.61	
Gender Identification						
Female			39 (97.5%)			48 (92%)
Male						2 (4%)
Non-binary or Agender			1 (2.5%)			1 (2%)
Specified: She/They pronouns						1 (2%)
Race						
White			35 (88%)			47 (90%)
Multiple identifications			1 (2%)			2 (4%)
Black or African American			4 (10%)			1 (2%)
Asian Indian						1 (2%)
Some other: Unspecified						1 (2%)
Hispanic, Latinx, or Spanish Origin						
No			39 (98%)			46 (88%)
Dominican			1 (2%)			
Mexican, Chicano						4 (8%)
Brazilian						1 (2%)
Spanish						1 (2%)

Note. *N* = 92.

Retest participants averaged 14.1 years of teaching experience (*SD* = 11.5). Similar to the original sample, most retest teachers taught in private (*n* = 61, 66%) rather than public (*n* = 31, 33%) schools. Of the 52 Montessori teachers, 47 held a Montessori teacher certification. Most Montessori teachers acquired Montessori teacher certification through the Association Montessori Internationale (*n* = 21; 40%) or American Montessori Society (*n* = 21; 40%). See Table 18 for more information on retest teachers' school context.

Table 19

TLOS Validation Retest Survey: Teachers' School Context

Pedagogy	Conventional (*n* = 40, 44%)		Montessori (*n* = 52, 56%)	
School funding	Public	Private	Public	Private
n	19 (47.5%)	21 (52.5%)	12 (23%)	40 (77%)
Student age range				
Infant/toddler		1 (2.5%)		4 (8.0%)
Early childhood	10 (25.0%)	11 (27.5%)	6 (11.5%)	23 (44.0%)
Elementary	8 (20.0%)	8 (20%)	6 (11.5%)	13 (25.0%)
Middle school	1 (2.5%)	1 (2.5%)		

Note. $N = 92$.

Measure

After pilot testing, I retained all 26 TLOS items for further testing. See the preceding Measurement Design section for further detail.

Analysis Strategy

I began with an analysis of TLOS timing data to assess measure length, item difficulty, and response modification rates. Next, I chose a strategy for addressing missing data in subsequent analyses. I then conducted factor analysis on the TLOS data, assessed measurement invariance between conventional and Montessori teachers, and calculated internal and test-retest reliability. The resulting TLOS variables were included in a multigroup structural equation model (MSEM). Timing and reliability analysis were conducted using R (v4.1.2; R Core Team, 2020; Revelle, 2018; RStudio Team, 2019). All factor analyses, measurement invariance assessment, and structural equation modeling was conducted in MPlus (Muthén & Muthén, 1998). In the following sections, I discuss each analysis step in detail.

TLOS Timing. I collected timing data for each TLOS item to assess measure length, item difficulty, and response modification rates. I calculated the mean initial response time (i.e., time to first click), response modification time (i.e., time between first and last click), navigation time (i.e., difference between last click and total page time), and mean clicks per item.

Participant responses entered in less than two seconds total were considered missing data due to low engagement. A subsample of 71 participants offered at least one low engagement response for a total of 183 low engagement responses out of 11,726 total TLOS responses (1.6% of responses).

Missing Data. I addressed missing data using full information maximum likelihood estimation (McCartney et al., 2006). Missing data comprised 7% (816 data points) of the dataset (11,726 data points based on 451 participants and 26 survey items). Of the 451 participants, 400 (89%) completed the TLOS. TLOS items averaged 30.56 (*SD* = 4.49) missing datapoints, ranging from 11 missing datapoints on item 16 (*Students build their own knowledge and skills through experience*.) to 36 missing datapoints on items 19 (*Students learn the most from teacher-generated activities and assignments.*) and 13 (*Whole-class instruction is the most effective form of teaching.*). Missingness did not differ greatly between student- (*M* = 30.08, *SD* = 6.54) and teacher-oriented beliefs (*M* = 31.08, *SD* = 2.75). These patterns indicate that missingness was unrelated to variables in the dataset. Therefore, I treated data as missing completely at random.

Factor Analysis. I conducted an overall CFA based on the theoretical two-factor TLOS model using the maximum likelihood estimator. Model fit was evaluated based on goodness-of-fit indices: Root Mean Square Error of Approximation (RMSEA < .05; Steiger, 1990), Comparative Fit Index (CFI > .90; Hu & Bentler, 1999), and Standardized Root Mean Square Residual (SRMR < .08; Hu & Bentler, 1999). Items loading below 0.4 on both factors were excluded from the model. Results from this analysis provided the initial model for subsequent measurement invariance testing.

Measurement Invariance. I tested measurement invariance across pedagogies using multigroup confirmatory factor analysis (MGCFA; Jöreskog, 1971). This analysis indicated the

extent to which conventional and Montessori teachers differ in how they conceptualize teacher- and student-oriented beliefs, based on the TLOS. The level of measurement invariance achieved (i.e., configural, metric, or scalar) determines the extent to which I can fairly compare structural parameters and latent variable means across groups. I fit a series of MGCFA models sequentially: unconstrained, constraining factor loadings as equal, and constraining intercepts as equal, thereby testing configural, metric, and scalar measurement invariance, respectively. I compared each model to the previous one using a chi-squared difference test and model fit indices (ΔCFI < 0.01, ΔRMSEA < 0.015, ΔSRMR < .015; Chen, 2007). As necessary, I achieved measurement invariance by sequentially removing items with the largest discrepancy in loadings and intercepts across pedagogies. If model fit improved upon removal, the item was permanently excluded from the model. If model fit did not improve upon removal, the item was retained. I chose not to evaluate strict measurement invariance (i.e., item residuals equal across groups) because it is unnecessary for structural parameter and latent variable mean comparisons across groups (Leitgöb et al., 2023).

Once measure invariance testing was complete, I compared model fit between one- and two- factor models. Results from the MGCFA analysis provided the measurement model for the subsequent multigroup SEM. I also compared latent variable means and variances between pedagogies by comparing model fit between freely estimated and constrained models (i.e., Montessori group variance constrained as equal to the conventional group). Based on the MGCFA, I calculated standardized factor scores for use in data visualization. Finally, I simulated a sum score CFA (i.e., constraining loadings and residuals as equal across pedagogies) to assess the efficacy of relying on sum scores for future analysis rather than estimating factor scores using a statistical method that takes measurement error into account, such as SEM.

Reliability. I assessed internal reliability for each factor identified in the overall CFA and MGCFA by calculating Cronbach's α ($\alpha > 0.70$; Schraw & Olafson, 2014). For test-retest reliability, I calculated the intra-class correlation (ICC; i.e., single-rater, absolute agreement, two-way mixed effects model) between time one and two factor scores for each factor identified in the overall CFA and MGCFA (ICC > .75; Koo & Li, 2016).

Multigroup Structural Equation Model. Addressing stage five of the validation model, I used multigroup structural equation modeling (MSEM) to compare differences between conventional (reference group) and Montessori teacher beliefs based on student age range (i.e., early childhood coded 1 and elementary coded 0), school funding (i.e., private coded 1 and private coded 0) and years of teaching experience. I chose the multigroup modeling approach rather than including pedagogy as a covariate because I wanted to assess the interaction between pedagogy the exogenous predictors (i.e., student age range, school funding, and teaching experience). See Figures 15a and 15b for the multigroup SEM path diagrams by pedagogy.

Exploratory Montessori Certification SEM. To explore the relation between Montessori teacher certification organization and teacher beliefs, I fit a SEM using data from Montessori teachers only (*N*=223). I used the 20-item TLOS measurement model for this within-pedagogy comparison.[6] The model estimated relations between teacher- and student-oriented beliefs and six independent variables. I coded Montessori certification variables for AMS (AMS = 1, all other training options = 0), trainings other than AMI and AMS (other = 1, all other training options = 0), and no Montessori training (none = 1, all other training options = 0), with AMI as the reference group. I also retained predictors used in the MSEM (i.e., student age range, school funding, and years of teaching experience) to see if accounting for Montessori training

[6] The 12-item TLOS yielded similar, but slightly different fit statistics and results for this analysis. See Figure A3. Results from the 20-item TLOS reported here to demonstrate criterion validity for within-pedagogy analysis.

impacted other structural parameters. See Figure 23 for the Montessori certification SEM path diagram.

Results

In this validation study, I assessed TLOS timing, factor structure, measurement invariance across pedagogy, internal and test-retest reliability, and criterion validity. In the following sections, I first present timing results to get a feel for how in-service teachers engaged with the TLOS. Next, I discuss the results of the overall CFA and measurement invariance testing across pedagogy. For Stage 5, I discuss criterion validity evidence by reviewing the MSEM results assessing differences in teacher- and student-oriented beliefs among conventional and Montessori teachers by student age range, school funding, and years of teaching experience. Finally, I explore Montessori teacher beliefs in relation to certification organization.

TLOS Timing

On average, participants who completed the TLOS spent 6 minutes and 2 seconds evaluating TLOS statements and clicked 33 times (i.e. 26 initial responses and 7 modifications). Participants averaged 13.91 seconds per item, ranging from 9.08 seconds (*SD* = 3.21 seconds) on item 16 (*Students build their own knowledge and skills through experience.*) to 22.64 seconds on item 2 (*Students benefit from assessing their own learning, drawing on feedback from learning materials, peers, and the classroom environment*.). On average, participants took 11.20 seconds (*SD* = 2.70 seconds, 81% of total time) to select an initial response, ranging from 6.98 seconds on item 16 to 17.20 seconds on item 3 (*Students thrive when the teacher provides developmentally appropriate activities and expectations*.). Participants took an average of 1.05 seconds (*SD* = 0.64, 7% of total time per item) for response modification, ranging from 0.52 seconds on item 14 (*The most effective form of teaching is small group or individual instruction.*)

to 3.68 seconds on item 2. Participants took an average of 1.65 seconds (*SD* = 0.13, 12% of total time) navigating the online platform, ranging from 1.45 seconds on item 18 (*Students' prior knowledge, experience, and interest should inform lesson content and pacing.*) to 2.08 seconds on item 17 (*Lesson content and pacing should be informed by a thoughtfully-designed curriculum*.). Finally, participants averaged 1.29 clicks (*SD* = 0.05 clicks) per item, ranging from 1.20 clicks on item 16 to 1.45 clicks on item 21 (*Teachers should decide when to incorporate or allow purposeful student movement in the classroom*.). Overall, timing data indicate high engagement, low response modification, and ease in navigating the online platform.

Factor Analysis

For the overall CFA, a two-factor model demonstrated acceptable fit (RMSEA = .052 [.045-.059], CFI = .95, SRMR = .041). I excluded six items with standardized loadings less than 0.40, resulting in a 20-item measure. Internal reliability for teacher- (α = .90) and student-oriented (α = .91) factors were considered sufficient (Schraw & Olafson, 2014). Test-retest reliability for teacher- (ICC = .88 [.83-.91], $F(91,92) = 16$, $p < .001$) and student-oriented (ICC = .87 [.83-.91], $F(91,92) = 15$, $p < .001$) factors were also considered sufficient (Koo & Li, 2016). See Table 19 for the overall CFA results.

Table 20

TLOS Validation Study: Overall Confirmatory Factor Analysis Results

Item	β	*B*	*SE*
Factor 1: Teacher-oriented beliefs (α = .90, ICC = .88)			
5. A well-planned class schedule should inform how long students work on each and every activity.	.77	1.00	.00
7. A carefully designed seating chart helps establish a positive learning environment.	.78	1.05	.06
9. Teachers should organize individual, partner, or group work activities.	.63	0.69	.05
11. A highly-structured, teacher-led learning experience fosters student learning.	.78	0.94	.06
13. Whole-class instruction is the most effective form of teaching.	.69	0.69	.05
15. Teachers impart knowledge and skills to students.	.57	0.61	.05
19. Students learn the most from teacher-generated activities and assignments.	.76	0.78	.05
21. Teachers should decide when to incorporate or allow purposeful student movement in the classroom.	.72	0.95	.06
25. Teacher feedback and grades are important motivators of student learning.	.72	0.87	.06
Factor 2: Student-oriented beliefs (α = .91, ICC = .87)			
2. Students benefit from assessing their own learning, drawing on feedback from learning materials, peers, and the classroom environment.	.51	1.00	.00
4. Students naturally seek out the right activities to support their own development.	.73	2.29	.23
6. Students know best how long they need to work on each and every activity.	.64	2.17	.23
8. It should be up to the students to decide where they work in the classroom.	.79	2.50	.24
10. Students should generally be able to choose whom they work with, if anyone.	.77	2.45	.24
12. Optimal learning occurs when students have control over their learning experience.	.71	1.61	.17
16. Students build their own knowledge and skills through experience.	.45	0.68	.09
20. Students who get to choose and generate their own work tend to learn more.	.78	2.20	.21
22. Students should generally be free to move purposefully about the classroom.	.74	2.04	.20
24. Students learn to manage their behavior best when free to make choices about their learning.	.76	2.19	.21
26. Students are mainly motivated by an internal love for learning.	.60	1.90	.21

Note. N = 450. Standardized coefficients (β), unstandardized coefficients (*B*), and standard error (*SE*) reported.

Measurement Invariance

When considered in a MGCFA based on pedagogy groups (i.e., conventional and Montessori), the overall model failed to achieve metric and scalar invariance. Excluding two items with the greatest loading discrepancies across pedagogies resulted in a model close to achieving full metric invariance. Excluding an additional five items with the greatest intercept discrepancies across pedagogies resulted in a 12-item, two factor model that achieved full scalar

invariance across pedagogies (RMSEA = .048 [.034-.062], CFI = .95, SRMR = .072). After achieving scalar measurement invariance, item 16 was also excluded for a standardized loading less than .04. Internal reliability for teacher- (α = .85) and student-oriented (α = .84) factors were considered sufficient (Schraw & Olafson, 2014). Test-retest reliability for teacher- (ICC = .82 [.75-.87], $F(91,92) = 10$, $p < .001$) and student-oriented (ICC = .81 [.75-.86], $F(91,92) = 9.7$, $p < .001$) factors were also considered sufficient (Koo & Li, 2016). Running this model as a single learning orientation latent variable, rather than separate teacher- and student-oriented belief variables, resulted in poor model fit (RMSEA = .113 [.102-.123], CFI = .74, SRMR = .132). Additionally, a CFA model simulating sum scores also resulted in poor model fit (RMSEA = .091 [.082-.101], CFI = .87, SRMR = .194). See Table 20 for measurement invariance testing fit statistics by model and Table 21 for the MGCFA results.

Table 21

TLOS Validation Study: Measurement Variance Testing Fit Statistics by Model

					Δ	
		Measurement Invariance			Configural	Metric to
Model description	Fit Statistic	Configural	Metric	Scalar	to Metric	Scalar
[A] Overall CFA	Chi-square	489.20***	541.71***	651.67***	52.51***	109.96***
	CFI	.926	.912	.876	.014	.036
	RMSEA	.053	.056	.065	.003	.009
	SRMR	.056	.092	.143	.036	.051
[B] Excluded highest loading discrepancy items (22, 8)	Chi-square (*p*)	377.66***	404.50***	485.33***	26.84 (.03)*	80.83***
	CFI	.935	.929	.900	.006	.029
	RMSEA	.052	.053	.061	.001	.008
	SRMR	.055	.07	.084	.015	.014
[C] Excluded highest intercept discrepancy items (7, 5, 21, 10, 26)	Chi-square (*p*)	157.31***	173.12***	188.25***	15.82 (.11)	15.12 (.13)
	CFI	.961	.957	.953	0.004	0.004
	RMSEA	.048	.048	.048	0	0
	SRMR	.051	.067	.072	0.016	0.005

Note. N=[A] 449, [B] 446, [C]444. For model C, the chi-square difference test between the configural and scalar model was also not significant, $\chi^2(20, N = 444) = 30.94$, $p = .06$.

$p \leq .05$*, $p \leq .001$***.

Table 22

TLOS Validation Study: Multigroup Confirmatory Factor Analysis Results

Item	β_{conv}	β_{Mont}	*B*	*SE*	Intercepts
Factor 1: Teacher-oriented beliefs (α = .85, ICC = .82)					
9. Teachers should organize individual, partner, or group work activities.	.61	.50	1.00	.00	5.57
11. A highly-structured, teacher-led learning experience fosters student learning.	.72	.78	1.45	.12	4.18
13. Whole-class instruction is the most effective form of teaching.	.59	.68	1.06	.09	3.18
15. Teachers impart knowledge and skills to students.	.53	.50	0.93	.09	5.61
19. Students learn the most from teacher-generated activities and assignments.	.68	.78	1.20	.10	3.97
25. Teacher feedback and grades are important motivators of student learning.	.62	.65	1.27	.11	4.49
Factor 2: Student-oriented beliefs (α = .84, ICC = .81)					
2. Students benefit from assessing their own learning, drawing on feedback from learning materials, peers, and the classroom environment.	.44	.42	1.00	.00	5.96
4. Students naturally seek out the right activities to support their own development.	.68	.58	2.28	.24	4.08
6. Students know best how long they need to work on each and every activity.	.59	.46	2.12	.25	3.85
12. Optimal learning occurs when students have control over their learning experience.	.66	.65	1.67	.18	5.44
20. Students who get to choose and generate their own work tend to learn more.	.75	.69	2.25	.23	5.09
24. Students learn to manage their behavior best when free to make choices about their learning.	.67	.67	2.15	.22	4.93

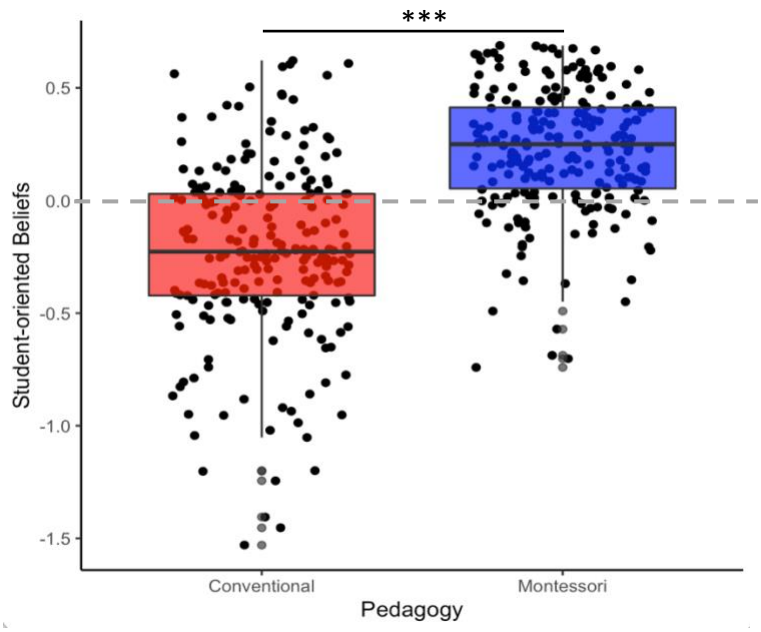
Note. N = 444. Standardized coefficients for conventional teachers (β_{conv}), standardized coefficients for Montessori teachers (β_{Mont}), unstandardized coefficients (*B*, equal across pedagogy), standard error (*SE*, equal across pedagogy), and unstandardized intercepts (equal across pedagogy) reported.

Full scalar measurement invariance supports comparison of latent variable means between pedagogy groups. As hypothesized, on average, Montessori teachers rated themselves as significantly lower on teacher-oriented beliefs (β = -1.212, *SE* = .13, $p < .001$) and higher on student-oriented beliefs (β = -1.88, *SE* = .19, $p < .001$), relative to conventional teacher self-ratings. Fixing variance in teacher-oriented beliefs as equal across pedagogy had little impact on model fit (RMSEA = .048 [.033-.062], CFI = .95, SRMR = .075). However, fixing variance in

student-oriented beliefs as equal across pedagogies resulted in a decrease in model fit (RMSEA= .056 [.043-.069], CFI = .94, SRMR = .160). This suggests that variance in student-oriented beliefs is significantly lower among Montessori teachers (*B* = .08, *SE* = .02) relative to conventional teachers (*B* = .19, *SE* = .04), as hypothesized. See Figures 15 and 16 for box plots of student- and teacher-oriented belief scores by pedagogy, respectively.

Figure 15

TLOS Validation Study: Student-oriented Beliefs by Pedagogy



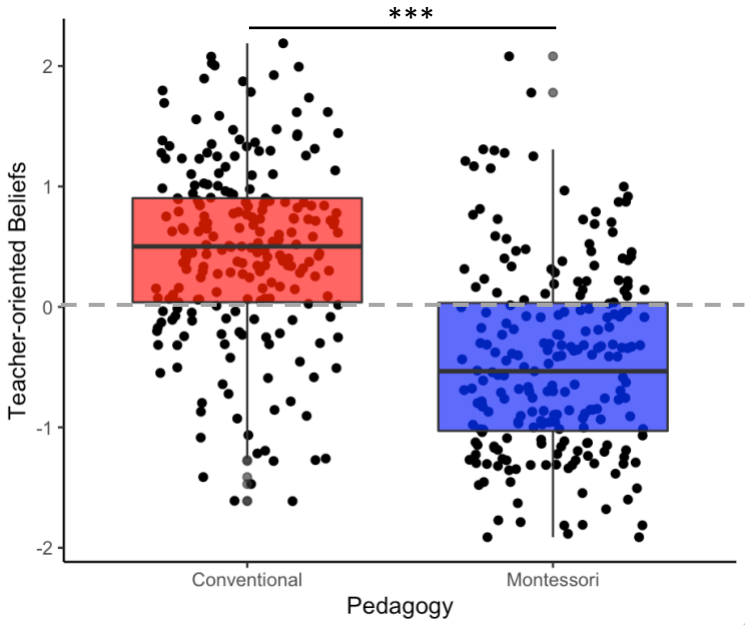
Note. Data are standardized factor scores. Gray datapoints indicate outliers.

Gray dashed line indicates the mean.

$p \leq .001$***.

Figure 16

TLOS Validation Study: Teacher-oriented Beliefs by Pedagogy



Note. Data are standardized factor scores. Gray datapoints indicate outliers. Gray dashed line indicates the mean.

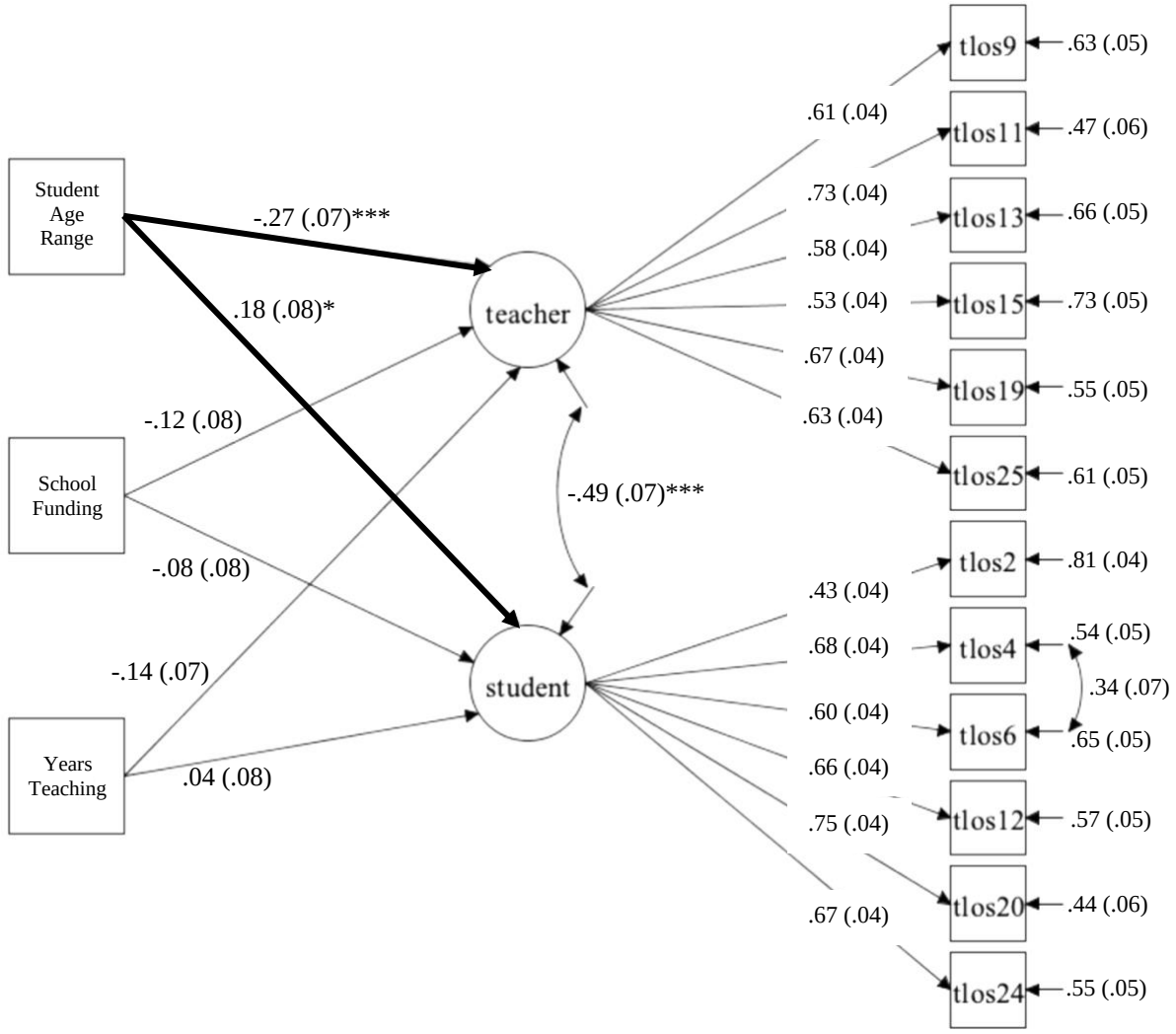
$p \leq .001$***.

Multigroup Structural Equation Model

The MSEM comparing differences in teacher- and student-oriented beliefs based on student age range (i.e., early childhood and elementary), school funding (i.e., private and private), and years of teaching experience by pedagogy (i.e., conventional and Montessori) demonstrated sufficient model fit (RMSEA = .048 [.036-.059], CFI = .93, SRMR = .070). See Figures 17a and 17b for the MSEM path diagrams for conventional and Montessori teachers, respectively.

Figure 17a

TLOS Validation Study: Multigroup Structural Equation Model Predicting Teacher Beliefs - Conventional Teachers

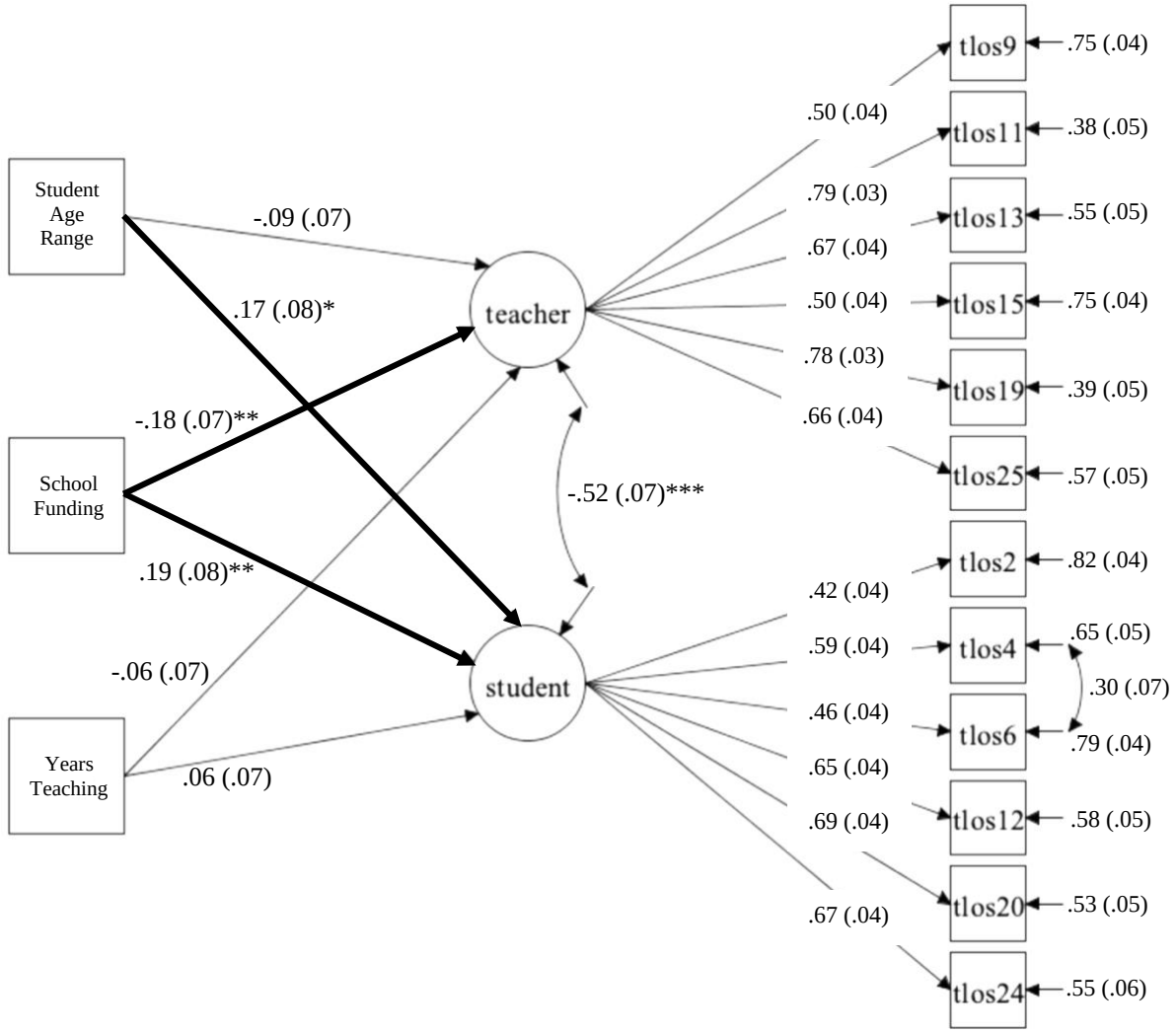


Note. Standardized estimates (standard error) reported. Significant pathways indicated in bold.

$p \leq .05$*, $p \leq .001$***.

Figure 17b

TLOS Validation Study: Multigroup Structural Equation Model Predicting Teacher Beliefs - Montessori Teachers



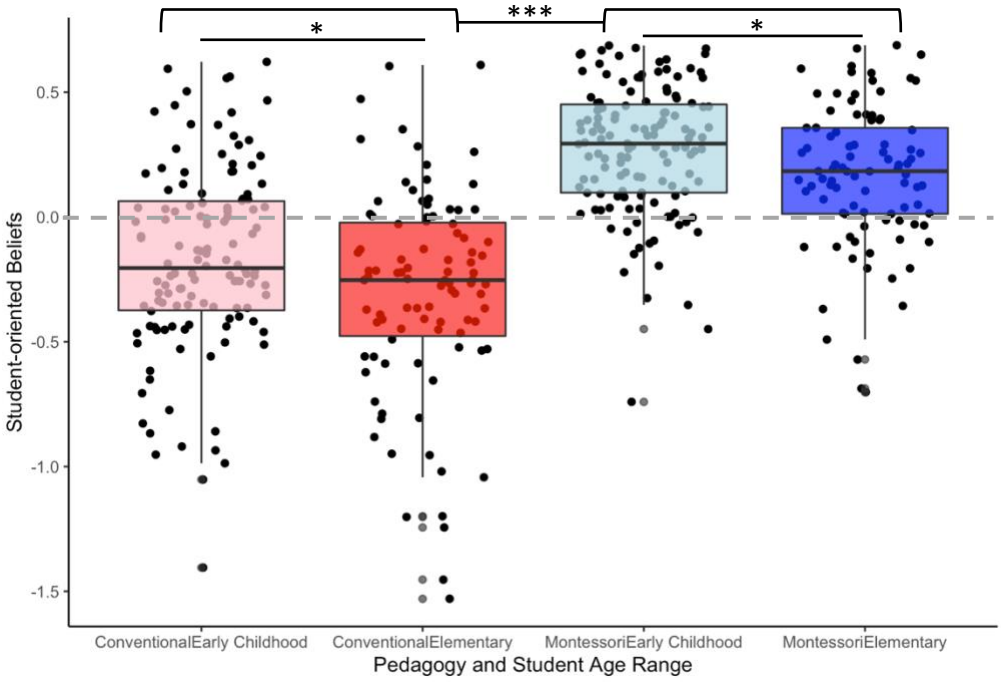
Note. Standardized estimates (standard error) reported. Significant pathways indicated in bold.

$p \leq .05$*, $p \leq .01$**, $p \leq .001$***.

Student Age Range. As hypothesized, on average, early childhood teachers reported significantly higher levels of student-oriented beliefs relative to elementary teachers across both pedagogies: conventional (β = .18, *SE* = .08, p = .02) and Montessori (β = .17, *SE* = .08, p = .03). Conventional early childhood teachers reported significantly lower levels of teacher-oriented beliefs relative to conventional elementary teachers (β = -.27, *SE* = .07, $p < .001$). Contrary to my hypothesis, however, Montessori early childhood and elementary teachers did not differ significantly on teacher-oriented beliefs (β = -.09, *SE* = .07, p = .21). See Figures 18 and 19 for a box plots of student- and teacher- oriented beliefs, respectively, based on pedagogy and student age range.

Figure 18

TLOS Validation Study: Student-oriented Beliefs by Teachers' Pedagogy and Student Age Range

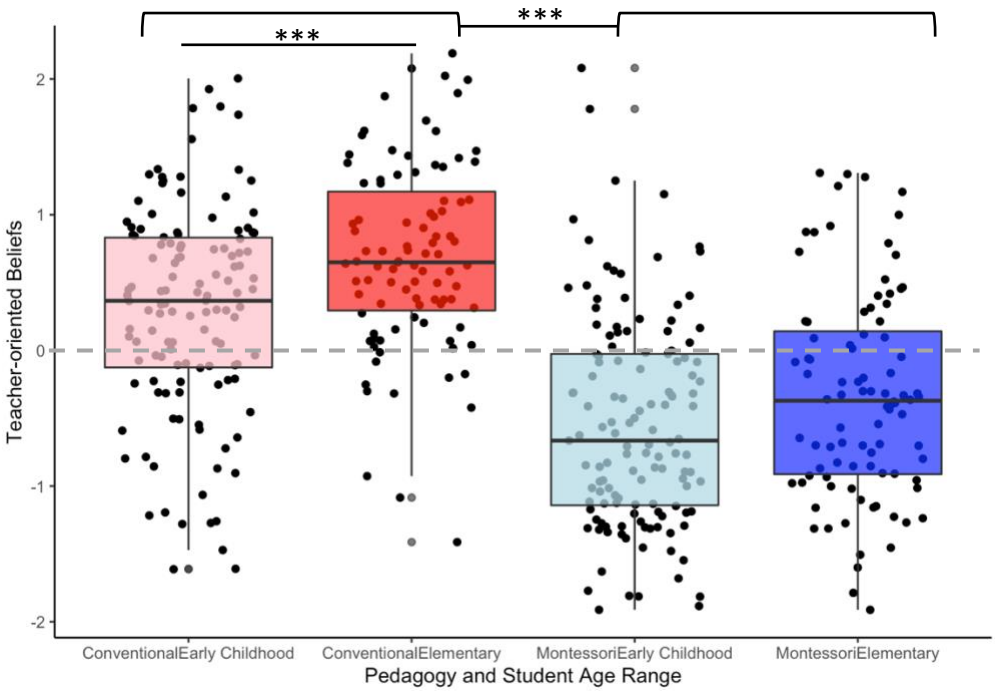


Note. Data are standardized factor scores. Gray datapoints indicate outliers. Gray dashed line indicates the mean.

$p \leq .05$*. $p \leq .001$***.

Figure 19

TLOS Validation Study: Teacher-oriented Beliefs by Teachers' Pedagogy and Student Age Range



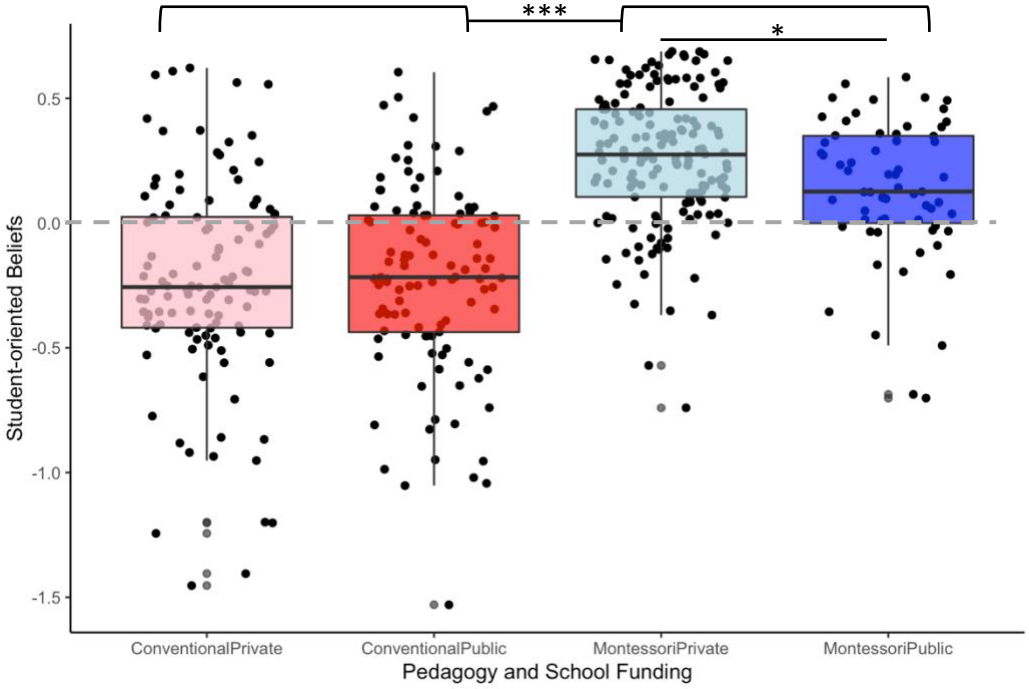
Note. Data are standardized factor scores. Gray datapoints indicate outliers. Gray dashed line indicates the mean.

$p \leq .001$***.

School Funding. As hypothesized, on average, Montessori private school teachers rated themselves as significantly more student-oriented (β = .19, *SE* = .08, p = .01) and less teacher-oriented (β = -.18, *SE* = .07, p = .01) relative to Montessori public school teachers. Teacher beliefs among conventional teachers did not differ significantly based on school funding. See Figures 20 and 21 for a box plots of student- and teacher-oriented beliefs, respectively, based on pedagogy and school funding.

Figure 20

TLOS Validation Study: Student-oriented Beliefs by Teachers' Pedagogy and School Funding

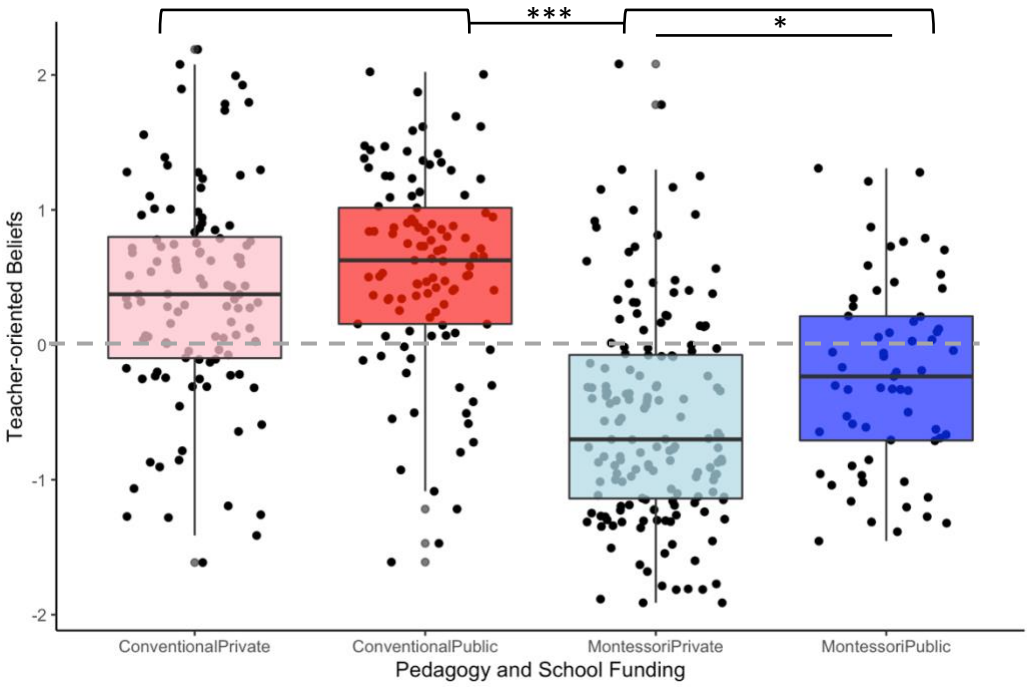


Note. Data are standardized factor scores. Gray datapoints indicate outliers. Gray dashed line indicates the mean.

$p \leq .05$*. $p \leq .001$***.

Figure 21

TLOS Validation Study: Teacher-oriented Beliefs by Teachers' Pedagogy and School Funding



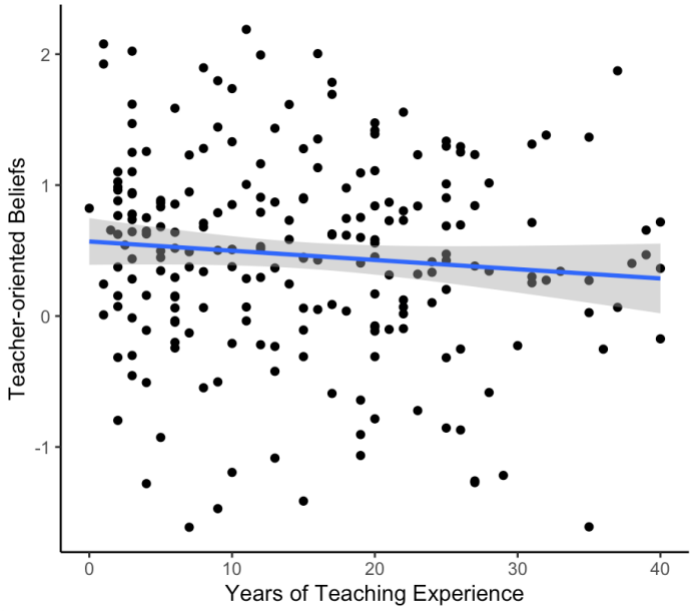
Note. Data are standardized factor scores. Gray datapoints indicate outliers. Gray dashed line indicates the mean.

$p \leq .05$*. $p \leq .001$***.

Years of Teaching Experience. Contrary to my initial hypothesis, teaching experience did not significantly predict teacher beliefs. However, conventional teachers showed a slight trend toward reporting lower teacher-oriented beliefs as years of teaching experience increased (β = -.14, *SE* = .07, *p* = .06). See Figure 22 for a scatterplot of teacher-oriented beliefs among conventional teacher by years of teaching experience.

Figure 22

TLOS Validation Study: Teacher-oriented Beliefs among Conventional Teachers by Years of Teaching Experience



Note. Data are standardized factor scores.

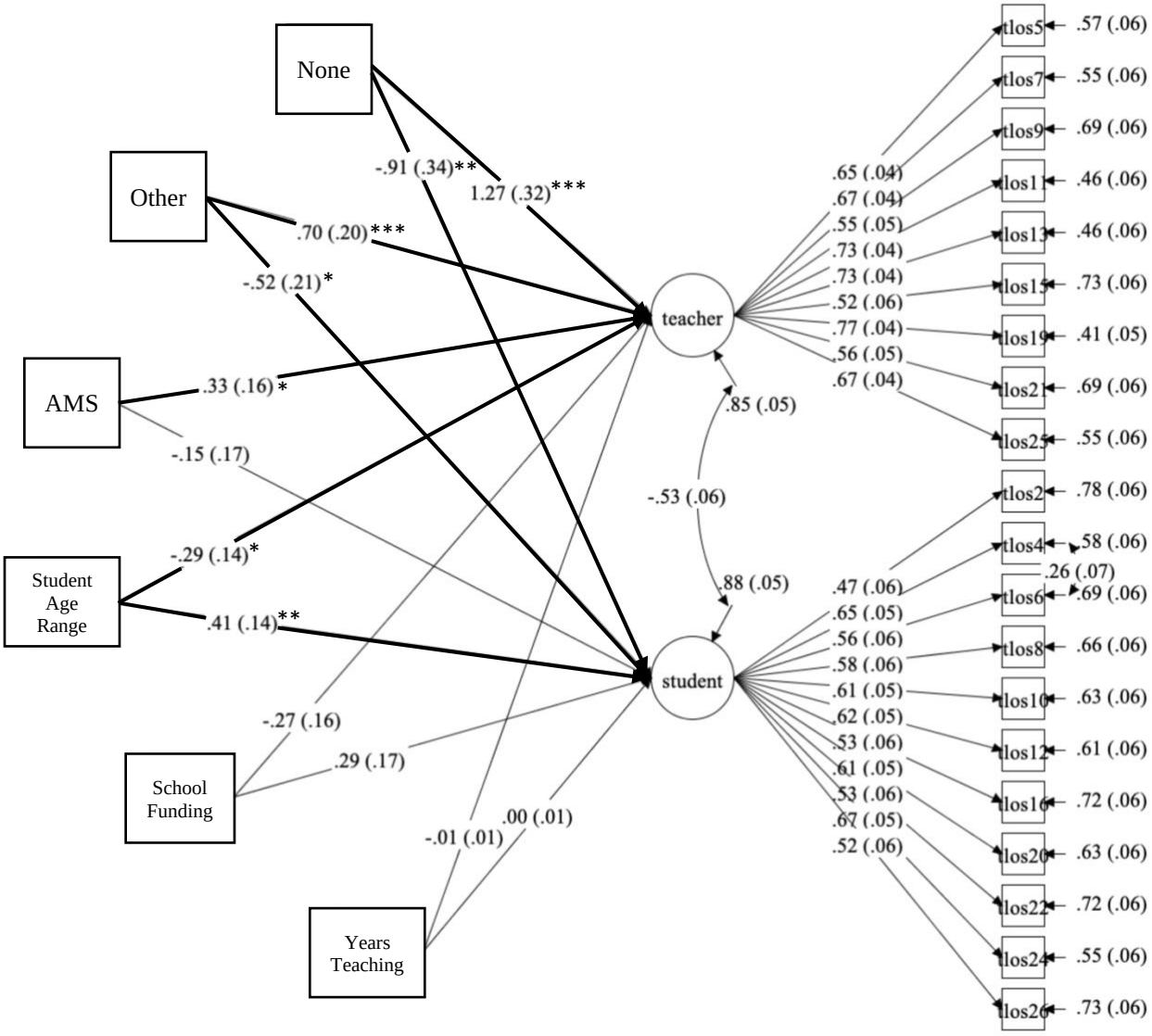
Exploratory Montessori Certification SEM

The SEM assessing the relations between Montessori certification organization and teacher beliefs demonstrated sufficient model fit (RMSEA = 0.050 [.041-.059], CFI = 0.89, SRMR = 0.059; See Figure 23). Certification organization significantly predicted teacher-oriented beliefs; teachers with AMS (β = .33, *SE* = .16, *p* = .04), other (β = .70, *SE* = .20, *p* <

.001), and no Montessori training (β = 1.28, *SE* = .32, $p < .001$) rated themselves as significantly more teacher-oriented relative to AMI trained teachers. Certification organization also predicted student-oriented beliefs, such that Montessori teachers trained by organizations other than AMI and AMS (β = -.52, *SE* = .21, $p = .02$) and those lacking Montessori training (β = -.91, *SE* = .35, $p = .01$) rated themselves as significantly lower on student-oriented beliefs relative to AMI and AMS trained teachers. There was no significant difference in student-oriented beliefs between AMS and AMI trained teachers (β = -.15, *SE* = .17, $p = .36$). See Figures 24 and 25 for box plots of student- and teacher-oriented beliefs by Montessori certification organization, respectively. When controlling for Montessori certification organization, significant structural parameters for Montessori teachers matched those for conventional teachers in the MSEM; early childhood teachers rated themselves as significantly more student-oriented (β = .41, *SE* = .15, $p = .005$) and less teacher-oriented (β = -.29, *SE* = .14, $p = .04$) relative to elementary teachers, but school funding and years of teaching experience produced no significant results.

Figure 23

TLOS Validation Study: Exploratory Montessori Certification Structural Equation Model Path Diagram

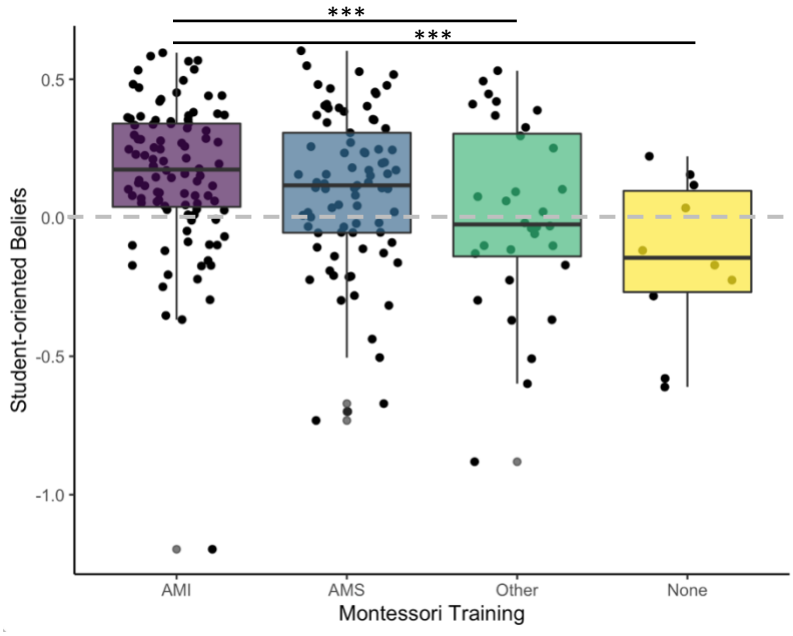


Note. Standardized estimates (standard error) reported. Significant pathways indicated in bold.

$p \leq .05$*, $p \leq .01$**, $p \leq .001$***.

Figure 24

TLOS Validation Study: Student-oriented Beliefs by Montessori Certification Organization

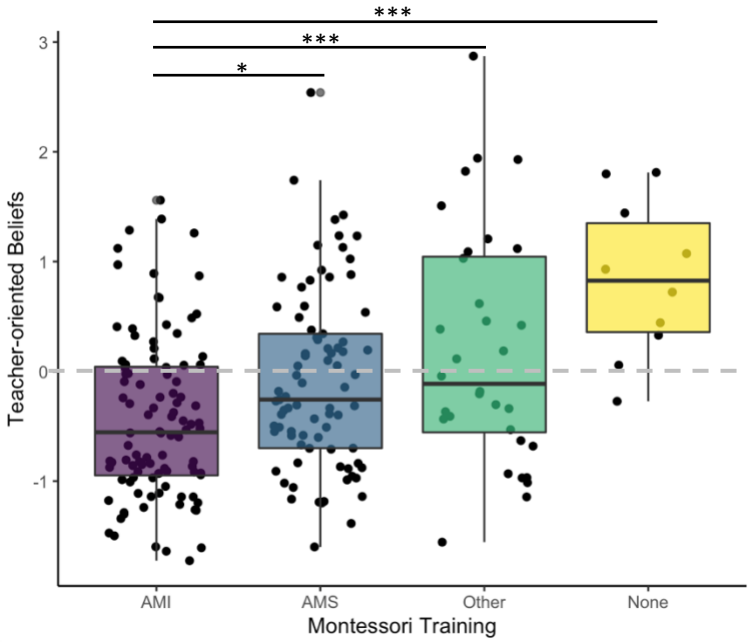


Note. Data are standardized factor scores. Gray datapoints indicate outliers. Gray dashed line indicates the mean.

$p \leq .001$***.

Figure 25

TLOS Validation Study: Teacher-oriented Beliefs by Montessori Certification Organization



Note. Data are standardized factor scores. Gray datapoints indicate outliers. Gray dashed line indicates the mean.

$p \leq .05$*, $p \leq .001$***.

Discussion

The TLOS performed well during Stages 4 and 5 of validation testing. During Stage 4, I assessed factor structure, measurement invariance across pedagogy, and reliability (i.e., internal and test-retest). The 2-factor theoretical structure (i.e., student- and teacher- oriented beliefs) was supported across CFA and MGCFA (i.e., conventional and Montessori teachers), with both factors demonstrating strong internal and test-retest reliability. A 12-item version of the TLOS achieved full scalar measurement invariance across pedagogy based on MGCFA, allowing for latent variable mean and structural parameter comparisons across pedagogy. This MGCFA model revealed significant differences in student- and teacher-oriented beliefs across pedagogy. Montessori teachers rated themselves as significantly more student-oriented and less teacher-

oriented relative to conventional teachers. Additionally, Montessori teachers showed significantly less variance in student-oriented beliefs relative to conventional teachers. These results may be due to the unique influence of pedagogical coherence in Montessori pre-service teacher certification training and first-hand teaching experiences in the Montessori environment, as discussed in the Introduction.

During Stage 5, I assessed criterion validity for the 12-item TLOS by estimating predictive relations between student- and teacher-oriented beliefs and related constructs in a MSEM. The 12-item TLOS parsed between teachers based on student-age-range. For example, conventional early childhood teachers rated themselves as significantly higher in student-oriented beliefs and lower in teacher-oriented beliefs relative to conventional elementary teachers. The 12-item TLOS also showed differences in teachers based on school funding, such that Montessori private school teachers rated themselves as significantly more student-oriented and less teacher-oriented relative to Montessori public school teachers.

However, upon further exploration using the 20-item TLOS among Montessori teachers, school funding was no longer a significant predictor of teacher beliefs after controlling for Montessori certification organization. These results indicate that the significant school funding results among Montessori teachers in the MSEM were likely driven by differences in teacher beliefs based on certification organization and disparities in certification organization sample sizes between public and private Montessori schools. One limitation of this analysis is the relatively small sample size of public Montessori teachers relative to private Montessori teachers, and relatively small certification organization subsamples (i.e., teachers trained by organizations other than AMI and AMS and those employed in Montessori programs but lacking Montessori training). Despite small subsamples, the 20-item TLOS parsed between Montessori

teachers based on certification organization. AMI and AMS trained teachers were similar in terms of student-orient beliefs, but the similarities stopped there. AMI and AMS trained teachers rated themselves as more student-oriented relative to those trained by other organizations and those with no Montessori training. Additionally, AMI trained teachers rated themselves as significantly lower on teacher-oriented beliefs relative to all other training types. In sum, Stage 5 testing provided strong evidence for criterion validity of the 12- and 20-item TLOS.

General Discussion

The study of teacher belief development spans over 70 years, with the first dichotomous learning orientation measures published in the 1950s (Cook et al., 1951; Kerlinger & Kaya, 1959). However, not one learning orientation measure, to my knowledge, considered alternative pedagogies, such as Montessori, during measure development and validation. Current understanding of teacher beliefs (e.g., development, relation to practices and student outcomes) is squarely based in the context of conventional education. Teacher beliefs should also be assessed within the context of alternative pedagogies. Therefore, a pedagogy-neutral teacher beliefs scale is needed.

TLOS development and validation took both conventional and Montessori pedagogy into account. Montessori pedagogy is expanding in the public sector at unprecedented rates (National Center for Montessori in the Public Sector, 2014), as is the literature comparing conventional and Montessori pedagogy (e.g., Ansari & Winsler, 2020; Courtier et al., 2021; Denervaud et al., 2020; Lillard, 2012; Lillard et al., 2017; Lillard & Else-Quest, 2006; Mallett & Schroeder, 2015; Rathunde & Csikszentmihalyi, 2005a, 2005b). Thus, I developed and presented validity evidence for the Teacher's Learning Orientation Scale with the aim of expanding the quantitative study of teacher beliefs to reflect the current educational landscape.

Expanding the teacher beliefs literature beyond the context of conventional education may challenge some commonly held conclusions about teacher beliefs. For example, evidence supporting the link between teacher beliefs and classroom practices in the current literature is inconsistent (e.g., Lee et al., 2006; McCarty et al., 2001; Simmons et al., 1999; Stipek et al., 2001; Stipek & Byler, 1997; Wilcox-Herzog, 2002), potentially leading to the conclusion that there is little to no meaningful relation between beliefs and practices. However, if exposure to pedagogically coherent teacher certification training and first-hand teaching experiences has a unique influence on teacher beliefs (as demonstrated among Montessori teachers in Stages 3, 4, and 5 of TLOS validation testing), pedagogically coherent experiences may also impact the relation between teacher beliefs and classroom practices. To illustrate, pre-service Montessori teachers (PMTs) first experience the Montessori classroom from a student's perspective by receiving lessons from a trainer and practicing those lessons with peers, just as children would in a Montessori classroom. These experiences may shift PMTs beliefs about student choice, interest, and self-regulation, such that PMTs become more student-oriented. As PMTs transition to teaching in Montessori classrooms, these beliefs may translate into practices given that Montessori classroom characteristics (i.e., multi-age class composition, uninterrupted work periods, individual and small group instruction, and assessment based on observation and student self-assessment) promote student choice, interest, and self-regulation (Lillard, 2017). If Montessori teacher beliefs indeed translate into practices, results from Stage 5 regarding Montessori certification organization may have practical implications as pre-service teachers, school administrators, and policy makers as they consider different routes to Montessori teacher certification. Thus, assessing teacher- and student-oriented beliefs across conventional and

Montessori pedagogy, as shown here with the TLOS, may offer unique insights that challenge conclusions based on the current teacher beliefs literature.

Intended Uses for the TLOS

My primary motivation was to design a teacher beliefs measure intended for use in empirical research. As discussed in Pilot Study 3, I am currently using the TLOS, in addition to the Teacher Beliefs Q-Sort, to assess conventional and Montessori teachers at the end and one year after teacher certification training.[7] I also intend to publish and openly share the TLOS with other researchers. One researcher from the National Center for Montessori in the Public Sector is already using the TLOS to assess shifts in pre-service teachers' student- and teacher-oriented beliefs across Montessori teacher certification training. Given the CFA and MGCFA results in Stage 4, I hope to offer two versions. A long 20-item version (see Appendix) is appropriate for studies assessing teachers from a single pedagogy (i.e., either conventional or Montessori) or researchers making cross-pedagogical comparisons after conducting measurement invariance testing across pedagogy for their sample. A short 12-item version (see Appendix) is appropriate for studies making cross-pedagogical comparisons, given the full scalar measurement invariance across pedagogy achieved here. I strongly urge researchers to estimate factor scores using a statistical method that takes measurement error into account, such as SEM, given that model fit for the MGCFA was superior to simulated sum scores. Finally, I may consider increasing TLOS accessibility by designing a webpage where researchers can estimate participant scores based on Stage 4 MGCFA parameters. This would be most convenient for researchers that do not want to rely on sum or mean factor scores, but are not able to conduct CFA or measure invariance testing in preparation for making mean comparisons across pedagogy.

[7] At the beginning of teacher certification training, pre-service teachers only completed the Teacher Beliefs Q-sort as the TLOS had yet to be developed.

Over the course of pilot testing and in discussion with members of the Montessori community, teachers expressed excitement about using the TLOS as a tool for personal reflection. Montessori trainers and coaches have shown interest in assessing teachers as they work through certification training and coaching sessions, respectively. Thus, I also intend to make the TLOS available as an informal reflection tool.

Future TLOS Development

While I developed the TLOS taking Montessori pedagogy into account, it is intended to fairly and accurately measure student- and teacher-oriented beliefs in both the conventional and Montessori contexts. In the final validation study, I assessed early childhood and elementary teachers. Further work can be done to explore TLOS validity among secondary school teachers. Additionally, I recruited participants in the United States. However, both conventional and Montessori education have a global presence. Further study is necessary to assess TLOS measurement invariability across cultures. Other alternative pedagogies, such as Waldorf/Steiner, are present in the United States and expanding into the public sector. Further study can explore TLOS validity within the context of other alternative pedagogies. Finally, as mentioned in the cognitive interview discussion, developing a student- specific version of the TLOS may help researchers parse and assess the alignment between teachers' general and student-specific beliefs about the ideal way to support learning.

Conclusion

Five stages of measurement development and validation provided ample evidence in support of the Teachers' Learning Orientation Scale as a tool for assessing teacher- and student-oriented beliefs. The TLOS demonstrated strong internal and test-retest reliability, achieved full scalar measurement invariance across pedagogy (i.e., conventional and Montessori), and detected

differences between teachers based on pedagogy, student age range (i.e., early childhood and elementary), school funding (i.e., public and private), and Montessori teacher certification organization (i.e., AMI, AMS, other, and none). Thus, the Teachers' Learning Orientation Scale effectively expands the quantitative study of teacher beliefs beyond the context of conventional education and, with further development, could continue pressing the boundaries of teacher beliefs research for years to come.

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Appendix

Supplemental Tables, Figures, and Documents

Contents

Table A1

Teacher-oriented Topics and Example Items across Learning Orientation Domains

Teacher Control		
Domain	Citation	Example Item
Progressivism	Kerlinger & Kaya, 1959	The pupil-teacher relationship is the relationship between a child who needs direction, guidance, and control and a teacher who is an expert supplying direction, guidance, and control.
Control v. Autonomy	Wehling & Charters, 1969	The effective teacher has complete control of the learning situation at all times.
Centered/Oriented	Bunting, 1985	Possibly the most valuable understanding to emerge from open education is the importance of order and control in the classroom.
Development	Smith, 1993	The teacher's primary goal regarding children's behavior should be to establish and maintain teacher classroom control.
Constructivism	Woolley et al., 2004	It is important that I establish classroom control before I become too friendly with students.
Subject-Matter and Curriculum		
Progressivism	Kerlinger & Kaya, 1959	The backbone of the school curriculum is subject-matter; activities are useful mainly to facilitate the learning of subject matter.
Control v. Autonomy	Willower et al., 1967	It is justifiable to have pupils learn many facts about a subject even if they have no immediate application.
Centered/Oriented	McCombs & Whisler, 1997	I know best what students need to know and what's important; students should take my word that something will be relevant to them.
Development	Hermans et al., 2008	The content of a lesson has to be completely in line with the curriculum.
Constructivism	Woolley et al., 2004	I like to make curriculum choices for students because they can't know what they need to learn.
Learning via Transmission or Acquisition		
Progressivism	Kerlinger & Kaya, 1959	Learning is essentially a process of increasing one's store of information about the various fields of knowledge.
Development	Hermans et al., 2008	The main task of a teacher is to transmit knowledge and skills to learners.
Constructivism	Chan & Elliott, 2004	A teachers' major task is to give students knowledge/information, assign them drill and practice, and test their recall.

Centered/Oriented	de Vries et al., 2013	In my teaching, it is important that students acquire knowledge.
		Behavior Management
Progressivism	Cook et al., 1951	Classroom rules and regulations must be considered inviolable.
Control v. Autonomy	Wehling & Charters, 1969	Establishing the rules well in advance strengthens the teacher's hand in meeting various problems that might arise.
Centered/Oriented	McCombs & Whisler, 1997	One of the most important things I can teach students is how to follow rules and to do what is expected in the classroom.
Development	Smith, 1993	Primarily, teachers should motivate children's behavior through the careful use of rewards and punishments in the classroom.
Constructivism	Woolley et al., 2004	When there is a dispute between students in my classroom, I try to intervene immediately to resolve the problem.
		Obedience and Discipline
Progressivism	Kerlinger & Kaya, 1959	Children need and should have more supervision and discipline than they usually get.
Control v. Autonomy	Willower et al., 1967	It is more important for pupils to learn to obey rules than that they make their own decisions.
Centered/Oriented	de Vries et al., 2013	In my teaching, it is important that there is order and discipline during the lesson.
Constructivism	Woolley et al., 2004	It is more important for students to learn to obey rules than to make their own decisions.

Note. Only included topics spanning a minimum of four LO domains. Provided only one example item, even when multiple example items were available.

Table A2

Student-oriented Topics and Example Items across Learning Orientation Domains

Student Autonomy		
Domain	Citation	Example Item
Progressivism	Cook et al., 1951	Children should be allowed more freedom in their execution of learning activities.
Control v. Autonomy	Wehling & Charters, 1969	Pupils frequently learn more under their own initiative than they do under teacher direction.
Centered/Oriented	Bunting, 1985	Teachers should be quite cautious in adopting methods and procedures that give students greater control over the educative process. (Negative)
Development	Charlesworth et al., 1993	It is ____ for children to create their own learning activities.
Constructivism	Woolley et al., 2004	I make it a priority in my classroom to give students time to work together when I am not directing them.
Student Interest		
Progressivism	Kerlinger & Kaya, 1959	The goals of education should be dictated by children's interests and needs, as well as by larger demands of society.
Control v. Autonomy	Wehling & Charters, 1969	Nothing captures students' interest in school work as quickly as allowing them to wrestle with problems of their own choosing. Nothing captures students' interest in school work as quickly as allowing them to wrestle with problems of their own choosing.
Centered/Oriented	de Vries et al., 2013	In my teaching, it is important that I take into consideration the differences in aptitudes and interests between students.
Development	Charlesworth et al., 1993	It is ___ that projects and centers reflect children's individual interests and suggestions.
Constructivism	Woolley et al., 2004	I often create thematic units based on students' interests and ideas.
Individualized Education		
Progressivism	Kerlinger & Kaya, 1959	We should fit the curriculum to the child and not the child to the curriculum.
Centered/Oriented	de Vries et al., 2013	In my teaching, it is important that I take into consideration the differences in aptitudes and interests between students.
Development	Smith, 1993	Curriculum should respond primarily to individual differences in ability and interest.

Constructivism	Chan & Elliott, 2004	Every child is unique or special and deserves an education tailored to his or her particular needs.
	Student Choice	
Progressivism	Cook et al., 1951	Children are not qualified to select their own topics for themes and reports. (Negative)
Control v. Autonomy	Wehling & Charters, 1969	When given a choice of activity, pupils generally select what is best for them.
Centered/Oriented	Bunting, 1985	Gaps occur in the student's learning when he is provided opportunities to choose what he will study. (Negative)
Development	Smith, 1993	Teachers can most effectively promote children's social-emotional development by allowing peers to interact to make cooperative choices among appropriate activities.
	Intrinsic Motivation to Learn	
Progressivism	Cook et al., 1951	Most pupils are not interested in learning (Negative)
Control v. Autonomy	Wehling & Charters, 1969	A properly motivated group of mature students might learn more in a semester's time if they were left entirely to their own resources than if they had a teacher to guide them.
Centered/Oriented	McCombs & Whisler, 1997	I can help students who are uninterested in learning get in touch with their natural motivation to learn. I can help students who are uninterested in learning get in touch with their natural motivation to learn.
Development	Smith, 1993	Primarily, teachers should build on children's internal motivation.
	Constructivist View of Learning	
Progressivism	Kerlinger & Kaya, 1959	Learning is not so much imparting knowledge as it is encouraging and prompting the child to use his potentialities for learning.
Centered/Oriented	Meirink et al., 2009	It's important that the teacher allows students to relate the different aspects of the subject matter themselves.
Development	Hermans et al., 2008	Learners must get the opportunity to build up their own knowledge in a collaborative way or together with the teacher.
Constructivism	Chan & Elliott, 2004	The focus of teaching is to help students construct knowledge from their learning experiences instead of knowledge communication.
	Cooperative Learning	
Development	Charlesworth et al., 1993	It is ____ for students to learn by interacting and working cooperatively with other children.

Control v. Autonomy	Deci et al., 1981	Help the group devise ways of learning the words together (skits, games, and so on).
Constructivism	Woolley et al., 2004	I prefer to cluster students' desks or use tables so they can work together.
Centered/Oriented	Meirink et al., 2009	It's important that the teacher stimulates students to learn from each other.

Note. Only included topics spanning a minimum of four LO domains. Provided only one example item, even when multiple example items were available.

Supplemental Figures

Figure A1

Pilot Study 3: Teacher Beliefs Q-sort 1 Parallel Analysis Results

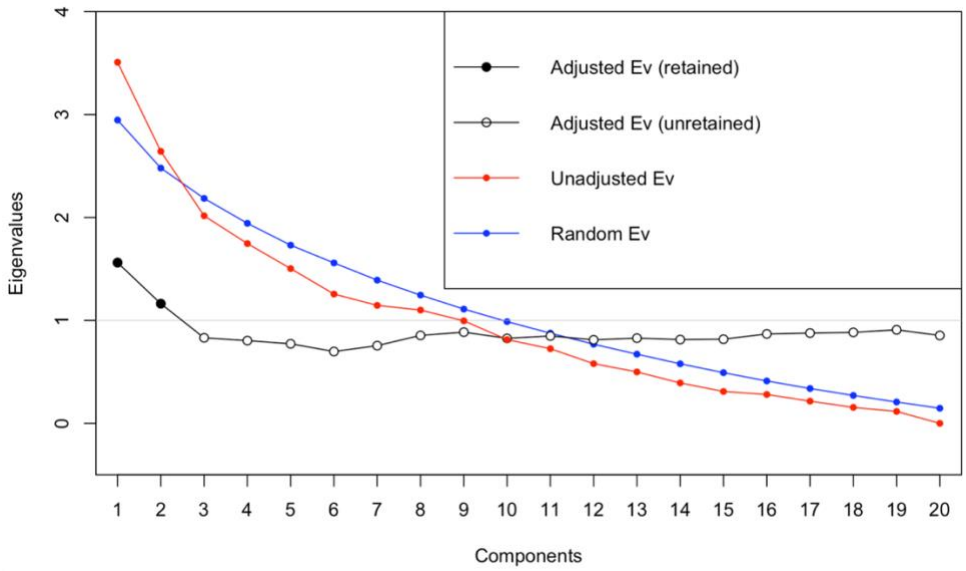


Figure A2

Pilot Study 3: Teacher Beliefs Q-sort 2 Parallel Analysis Results

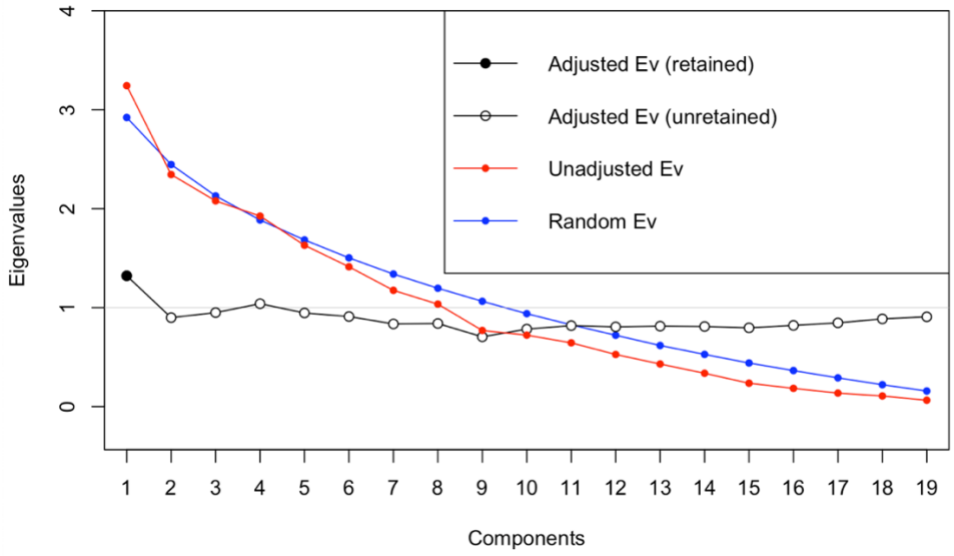
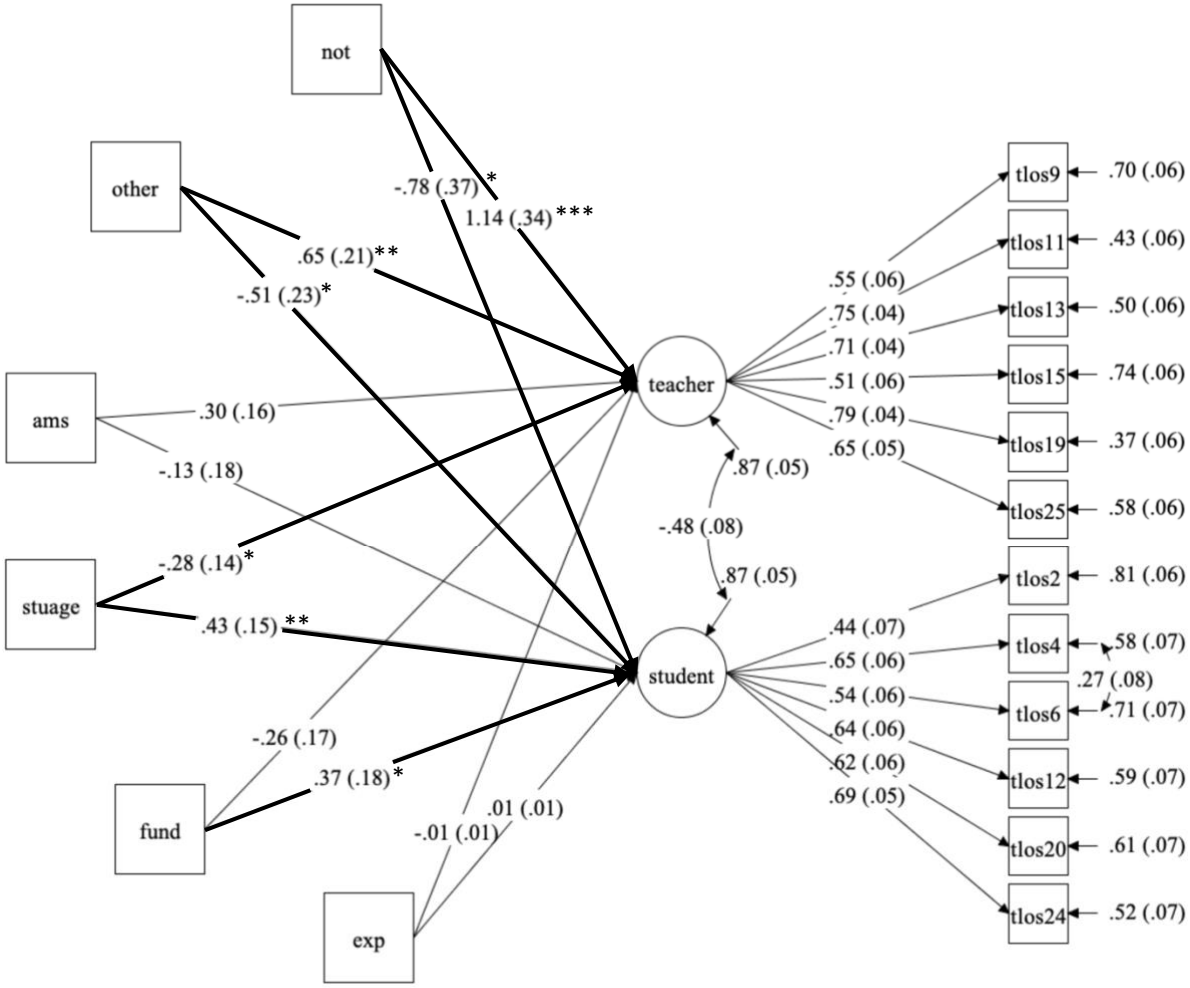


Figure A3

TLOS Validation Study: Exploratory Montessori Certification Structural Equation Model Path Diagram



Note. Standardized estimates (standard error) reported. Significant pathways indicated in bold. Model fit was sufficient, RMSEA = .048 [.032-.062], CFI = .92, SRMR = .057. *N*=221. $p \leq .05$*, $p \leq .01$**, $p \leq .001$***.

Teachers' Learning Orientation Scale:
Cognitive Interview Protocol

Interview Preparation

Interviews will take place in the West Complex EDL call room. Please, arrive at least 15 minutes before the interview and open the Zoom session 5 minutes before the interview time. This will give you time to get settled and prepare for the interview. In addition to the computer, you will need this protocol and the appropriate observation form. Observation forms can be accessed on our secure lab server: EDL Shared Folder > Active Studies > Teacher Learning Orientation Scale > 05_Cognitive Interview > 03_Observations. Be sure to to use the observation form with the appropriate participant number and survey form.

Survey Introduction

Welcome the participant to the interview. "Hello! Thank you for joining me today. We really appreciate you taking the time to participate in our research. Today, we would like to take a new survey about teacher beliefs."

"To get started, I will begin recording and you'll need to open up the survey on your computer. I just put the anonymous survey link in the chat. Go ahead and open the link." Begin the Zoom recording (directions). Be sure to save the recording to the computer rather than the cloud. Share the anonymous Qualtrics survey link: copy and paste the appropriate Qualtrics Link into the Zoom chat.

Qualtrics Links

- Protocol A - https://virginia.az1.qualtrics.com/jfe/form/SV_bQ5PUo2pOBnMXNc
- Protocol B - https://virginia.az1.qualtrics.com/jfe/form/SV_4Ida1xpf1GuP0ma

Enable participant screen share on Zoom (directions). "I just enabled screen sharing on Zoom. Do you need directions on how to share your screen?" If the participant responds yes, walk them through sharing their screen (directions). If the participant responds no, skip to the next step. "Great! I can see your screen!"

Obtain study consent. "Before we continue, please read through the study consent form, answer the question and sign below. Feel free to ask any questions." Pause. Give the participant time to read and respond. If the participant consents, continue to the next step. If not, end the interview. "Thank you for your time. I hope you have a great rest of your day!"

Obtain video consent**.** "We would like to record today's interview. Please, read through the video consent form, answer the question, and sign below. Again, feel free to ask any questions." Pause. Give the participant time to read and respond. Once the participant finishes the media release form, say "Thank you! Go ahead and click next to move to the next section."

Think-Aloud Training

"As you complete the survey, we would like you to think-aloud. This means saying out loud anything that you are thinking while you take the survey. Here's a sample prompt so you can practice thinking aloud before starting the survey. Go ahead and read the prompt to yourself. Then, say out loud anything you think about as you decide how to answer." Pause. Give the participant time to read and respond.

Training prompt: Try to visualize the place where you live, and think about how many windows there are in that place. As you count up the windows, say out loud what you are seeing and thinking about.

If the participant struggles, demonstrate how you would think through the prompt. Something like, "How many windows are in my home? Well there's a window in the front door. I'm not sure if that counts as a window, but I'm going to count it. Then, there's a window in the foyer. There's a set of windows next to each other in the living room. I'm not sure if it would be considered 1 or 2 widows. They open separately and there's a few inches gap between them. I guess I'll count them as 2…"

If the participant looks like they're thinking, but are not speaking, you may prompt them, "Be sure to say what you are thinking." or "Keep talking."

Once the participant finishes responding, wrap up the practice and transition into the survey. "That's just how you should think aloud during the rest of the survey. Voice all of your thoughts as you read instructions and answer questions. Before you start the survey, I'm going to turn off my video." Turn off your video (directions). "Go ahead and click next to start the survey." Turn off your microphone (directions).

Note: This is the one place in the interview where you may give feedback to the participant. Once this training is complete, remain as neutral as possible. However, you may prompt participants to continue thinking aloud when necessary, "Be sure to say what you are thinking." or "Keep talking."

Think-Aloud and Probing Questions

Participants will now answer a series of questions:

- Teaching background
- TLOS items
- follow-up probing questions about specific TLOS items
- demographics (Participants DO NOT need to think-aloud or answer verbally here.)

During this time you will take notes on the interview form. Once participants complete the survey, turn your video and microphone back on.

Wrap up the Interview

"That was the last question. I'll stop the recording now. Thank you for your time and effort today!" Stop recording and exit Zoom. The video will save to the computer automatically. Once the video is on the computer, transfer the video to our secure lab server: Videos > Current Studies > TLOS Cognitive Interviews. Name the video file to match the observation form: Participant number and survey form. E.g., P3_A.mp4.

Cognitive Interview Observation Form A

Participant number:

Date:

Time:

Interviewer Initials:

Educator Demographic Questions
Directions: Note any confusion participants display when selecting an answer for these questions.

I currently teach in a _____ classroom.
Any confusion? No Yes If yes, describe:

I currently teach at the _____ level.
Any confusion? No Yes If yes, describe:

Think-Aloud Observation Example

(Example Q)

Directions: Highlight terms or phrases that the participant found confusing. Note source of confusion in the space below the term/phrase.

Students are mainly motivated by an internal love for learning.

Wasn't sure how to judge: most of the time, 4 times out of 5?

Did the participant change their answer? Yes No If so, how many times? 2

Additional Notes:
Confusion over how to judge "mainly" led to answer changes.

Think-Aloud Observations

1

(Q2) Students benefit from assessing their own learning, drawing on feedback from learning materials, peers, and the classroom environment.

Did the participant change their answer? Yes No If so, how many times?
Additional Notes:

2

(Q5) A well-planned class schedule should inform how long students work on each and every activity.

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

3

(Q1) Effective teachers assess student learning (e.g., formal, informal, formative, summative).

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

4

(Q9) Teachers should organize individual, partner, or group work activities.

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

5

(Q8) It should be up to the students to decide where they work in the classroom.

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

6

(Q14) The most effective form of teaching is small group or individual instruction.

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

7

(Q4) Students naturally seek out the right activities to support their own development.

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

8

(Q11) A highly-structured, teacher-led learning experience fosters student learning.

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

9

(Q13) Whole-class instruction is the most effective form of teaching.

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

10

(Q12) Optimal learning occurs when students have control over their learning experience.

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

11

(Q6) Students know best how long they need to work on each and every activity.

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

12

(Q10) Students should generally be able to choose whom they work with, if anyone.

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

13

(Q7) A carefully designed seating chart helps establish a positive learning environment.

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

14

(Q3) Students thrive when the teacher provides developmentally appropriate activities and expectations.

Did the participant change their answer? Yes No If so, how many times?

Additional Notes:

Probing Observations

1. How did you find answering these questions?
    a. Was it easy or difficult to select one of the provided responses?
    b. Why do you say that?

2. Did you feel comfortable evaluating these statements?

    a. Did you feel any pressure to answer in a particular way?

3. In the following statement, what does the term **class schedule** mean to you?
    a. Statement: A well-planned **class schedule** should inform how long students work on each and every activity.

4. In the following statement, what does the term **highly-structured, teacher-led learning experience** mean to you?
    a. Statement: A **highly-structured, teacher-led learning experience** fosters student learning.

5. In the following statement, what does the term **control** mean to you?
    a. Statement: Optimal learning occurs when students have **control** over their learning experience.

Teachers' Learning Orientation Scale
Long-version

Directions: Take a moment to think about what you believe is the ideal way to support learning. Please, indicate how much you agree or disagree with the following statements as truthfully and accurately as you can. Remember that these are very subjective questions and that there are no right or wrong answers. Thank you!

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
1	2	3	4	5	6	7

1. _____ A well-planned class schedule should inform how long students work on each and every activity.
2. _____ Students benefit from assessing their own learning, drawing on feedback from learning materials, peers, and the classroom environment.
3. _____ A carefully designed seating chart helps establish a positive learning environment.
4. _____ Students naturally seek out the right activities to support their own development.
5. _____ Teachers should organize individual, partner, or group work activities.
6. _____ Students know best how long they need to work on each and every activity.
7. _____ A highly-structured, teacher-led learning experience fosters student learning.
8. _____ It should be up to the students to decide where they work in the classroom.
9. _____ Whole-class instruction is the most effective form of teaching.
10. _____ Students should generally be able to choose whom they work with, if anyone.
11. _____ Teachers impart knowledge and skills to students.
12. _____ Optimal learning occurs when students have control over their learning experience.
13. _____ Students learn the most from teacher-generated activities and assignments.
14. _____ Students build their own knowledge and skills through experience.
15. _____ Teachers should decide when to incorporate or allow purposeful student movement in the classroom.
16. _____ Students who get to choose and generate their own work tend to learn more.
17. _____ Teacher feedback and grades are important motivators of student learning.

18. _____ Students should generally be free to move purposefully about the classroom.

19. _____ Students learn to manage their behavior best when free to make choices about their learning.

20. _____ Students are mainly motivated by an internal love for learning.

Syntax to create teacher-oriented and student-oriented belief subscales:
Teacher-oriented beliefs = 1, 3, 5, 7, 9, 11, 13, 15, 17
Student-oriented beliefs = 2, 4, 6, 8, 10, 12, 14, 16, 18, 19, 20

Uses: Intended for empirical research making comparisons within pedagogy (i.e., all conventional or all Montessori teachers) or for researchers interested in conducting measurement invariance testing before making cross-pedagogy comparisons. May also be used for personal reflection.

Teachers' Learning Orientation Scale
Short-version

Directions: Take a moment to think about what you believe is the ideal way to support learning. Please, indicate how much you agree or disagree with the following statements as truthfully and accurately as you can. Remember that these are very subjective questions and that there are no right or wrong answers. Thank you!

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
1	2	3	4	5	6	7

1. _____ Teachers should organize individual, partner, or group work activities.
2. _____ Students benefit from assessing their own learning, drawing on feedback from learning materials, peers, and the classroom environment.
3. _____ A highly-structured, teacher-led learning experience fosters student learning.
4. _____ Students naturally seek out the right activities to support their own development.
5. _____ Whole-class instruction is the most effective form of teaching.
6. _____ Students know best how long they need to work on each and every activity.
7. _____ Teachers impart knowledge and skills to students.
8. _____ Optimal learning occurs when students have control over their learning experience.
9. _____ Students learn the most from teacher-generated activities and assignments.
10. _____ Students who get to choose and generate their own work tend to learn more.
11. _____ Teacher feedback and grades are important motivators of student learning.
12. _____ Students learn to manage their behavior best when free to make choices about their learning.

Syntax to create teacher-oriented and student-oriented belief subscales:
Teacher-oriented beliefs = 1, 3, 5, 7, 9, 11
Student-oriented beliefs = 2, 4, 6, 8, 10, 12

Uses: Intended for empirical research making comparisons within (i.e., all conventional or all Montessori teachers) or across (i.e., comparing conventional and Montessori teachers) pedagogies. May also be used for personal reflection.