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# Teacher beliefs about mathematics instruction and teaching practices in Croatian primary schools

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**ABSTRACT**

This study explores the relationship between primary school teachers' beliefs about mathematics instruction and their actual teaching practices in Croatian classrooms. Specifically, it examines whether teachers' instructional approaches align with their beliefs, particularly in the context of traditional versus non-traditional pedagogical models. A total of 246 primary school teachers across Croatia participated in an online survey consisting of four sections: demographic data, beliefs about mathematics instruction, their teaching practices, and preferred teaching scenarios for selected mathematics topics. Beliefs and practices were classified using a five-level scale from traditional to non-traditional, based on Raymond's (1997) framework. Quantitative data were analyzed using factor analysis, Spearman's rank correlation, and Kruskal-Wallis tests. By categorizing teacher beliefs and teaching practices from traditional to non-traditional models, this study offers insight into the complexities of instructional implementation. Notably, it highlights that although teachers have non-traditional, student-centered beliefs and problem-based learning, their actual teaching is often grounded in traditional approaches–revealing a persistent belief-practice gap. The finding that more experienced teachers are more likely to adopt non-traditional practices challenges common assumptions and adds to our understanding of instructional change. Additionally, experienced teachers were more likely to implement non-traditional practices than their less experienced peers. External factors, such as class size and school location, adds depth to the belief-practice discourse by emphasizing that external factors can moderate instructional change. This research not only reinforces the significance of teacher cognition in educational reform but also underscores the need for targeted professional development and systemic support to bridge the belief-practice divide in mathematics teaching.

**Keywords:** teacher beliefs about mathematics instruction, teacher beliefs about teaching practices, traditional and non-traditional beliefs, traditional and non-traditional teaching practices, correlation between beliefs and teaching practice

## INTRODUCTION

For many years, the Croatian school system adhered to a traditional model of teaching and learning, with a curriculum focused on content having constrained teachers in their approach to the teaching process and directing them toward knowledge transmission rather than achieving learning outcomes. This approach is known as the traditional model of instruction. In contrast, the constructivist approach to learning emphasizes students' active participation in the teaching process, based on the premise that knowledge cannot simply be transferred from teacher to student; rather, students construct knowledge independently through interaction with their environment. In this model, the teacher serves as a facilitator, guiding students toward discovery and inquiry-based learning. The educational reform in the Republic of Croatia (MZO, 2019) introduced a shift toward learning outcomes, granting teachers greater autonomy in designing the teaching process. Such freedom in content selection and outcome-oriented instruction enables the development of teaching activities grounded in the constructivist paradigm, where problem-solving situations occupy a central position in students' learning experiences. By engaging in problem-solving that is facilitated through the selection of models that best suit their needs, students develop personal learning strategies which foster conceptual understanding. The strategies that students use depend on their prior experiences and previously acquired knowledge, which they build upon and elevate to higher levels once they achieve a sense of security. Through the process of seeking solutions and acquiring conceptual knowledge, they also begin to establish the initial steps toward developing procedural knowledge. However, do teachers actually make use of the freedom granted to them in designing the teaching process? Do they even want to use it? If they do, do they know how? Teacher beliefs play a crucial role in selecting the teaching process. Beliefs, in general, are facts that people consider to be true, and teacher beliefs refer to the views teachers hold about learning, teaching, and instructional practice itself–specifically, their opinions on how best to structure the teaching process so that it provides students with an optimal learning environment when it comes to improving their knowledge. One of the goals of this research is to determine what beliefs teachers possess regarding mathematics education and instructional practice, and whether these beliefs correlate with their actual teaching practices.

## LITERATURE REVIEW

The contemporary approach to education in general, and particularly to mathematics education, emphasizes the importance of students' active participation in constructing their own knowledge, following the principles of the constructivist paradigm. On the other hand, the traditional approach to education is often described as transmissive in terms of teaching and absorptive in terms of learning. Cohen (1988) characterizes the traditional teacher as a narrator of truth whose role is to implant knowledge into their students.

Teacher beliefs about their own approach to mathematics education in Croatian primary schools are generally positively oriented toward non-traditional teaching methods (Mišurac et al., 2013). However, the question emerges regarding benefits to this trend that is frequently popularized at the theoretical level, and, at best, illustrated through a few examples, i.e., what does it actually offer to practitioners in the teaching process? The interpretation of students' active engagement can range from participation through discussion, repetitive activities, and practicing learned material, particularly when it comes to those attending the lower grades of primary school.

Many educational researchers consider teacher beliefs to be a key factor that must be addressed in the context of educational reform (Hoy et al., 2006; Li et al., 2024; Radišić et al., 2024), with a number of authors providing evidence of a strong relationship between what teachers believe and how they approach their classroom practice (Angel-Cuervo et al., 2024; Archer, 1999; Haney et al., 1996; Kasa et al., 2024; Little, 2001; Richardson & Anders, 1994). Teacher beliefs are among the most widely researched aspects of teacher cognition. Teacher beliefs, attitudes, and values have long been of interest to educational researchers as a means of understanding the motivations that underline teachers' behavior and teaching practices (Metzger & Wu, 2011).

Several research articles and review papers have contributed to the development of the concept of belief, including discussions from the perspectives of psychological and cognitive sciences, such as those by Abelson (1979) and Nespor (1987), or research reviews by Kagan (1992) and Pajares (1992). In this context, the chapter on teacher thought processes by Clark and Peterson (1986), and Richardson's (1996) chapter on the role of attitudes and beliefs in learning to teach, are particularly relevant. The literature agrees on the interpretation of beliefs as something that constitutes a part of a set of constructs that describe the structure and content of human thought, which are assumed to drive an individual's actions (Muhtarom et al., 2017; Philipp, 2007) Several works provide definitions of beliefs, including the characterization of beliefs as psychologically maintained understandings, premises, or propositions about the world that are felt to be true (Richardson, 1996, p. 103).

Nespor (1987) argued that beliefs reside in episodic memory, with their content stemming from personal experiences or cultural sources of knowledge transmission, such as folklore (Buchmann & Schwille, 1983) or cultural myths (Tobin & McRobbie, 1996). The implications of these characteristics are particularly significant in view of education, considering that critical episodes or experiences tend to influence and shape both how individuals learn and how they apply what they have learned.

Other researchers have also observed the episodic nature of beliefs, with studies having shown that students' educational beliefs significantly influence their perceptions and judgments on their own and others' teaching, as well as their interpretation and development of professional knowledge (e.g., Calderhead, 1988; Calderhead & Robson, 1991; Clark, 1988; Feiman-Nemser & Remillard, 1996; Goodman, 1988). Abelson (1979) stated that a belief system is held more firmly than individual beliefs. Moreover, changing beliefs within a system often requires considerable mental effort, as beliefs tend to be relatively static. Nespor (1987) concluded that beliefs are far more influential than knowledge in shaping how individuals frame problems and organize tasks, making them stronger predictors of behavior.

Finally, beliefs have been characterized as mental constructs that are subjectively true for the individual, i.e., values held with a certain degree of commitment and relative stability, expected to significantly influence individuals' perceptions and interpretations of experiential encounters, but also contribute to the practices in which said individuals remain engaged (Skott, 2015).

The distinction between teachers' beliefs and their knowledge has prompted extensive research. Furinghetti and Pehkonen (2002) describe two types of knowledge: objective knowledge, which is accepted by the community (e.g., formal subject knowledge), and subjective knowledge. Turner et al. (2009) argue that beliefs represent individuals' subjective knowledge and thus differ from objective knowledge. A teacher's knowledge is activated based on their beliefs. The interconnection of different beliefs, or beliefs of varying degrees (Calderhead, 1996), establishes a solid foundation for the application of knowledge. When a teacher understands constructivist principles in teaching, they must have a well-established belief system in the positive outcomes of these principles in order to activate and apply them in their work with students.

Beliefs play a significant role in the differences among teachers, i.e., if two teachers possess the same knowledge but hold different beliefs, their teaching processes will differ substantially. Teacher beliefs about learning and teaching mathematics serve as mental models of the nature of mathematics instruction and learning. These beliefs shape a teacher's conception of the type and range of instructional actions and activities in the classroom that contribute to their personal approach to mathematics teaching (Ernst, 1989). This includes mental representations of prototypical teaching and learning activities, as well as the principles underlying instructional orientations. Beliefs pertaining to learning and teaching which are narrow and instrumental, and where knowledge is based on facts and skills, are characteristic of traditional beliefs in mathematics instruction. On the other hand, broader and more creative beliefs that adopt an investigative approach to teaching mathematics–where knowledge is constructed through meaning and understanding–form the basis of non-traditional beliefs.

The term "teaching practice" refers to instructional methods and strategies, classroom assessment, lesson planning, and curriculum implementation. It can be influenced by teachers' beliefs and attitudes concerning the nature of teaching and learning. Research on teacher thought processes (Clark, 1988; Eisenhart et al., 1988; Nespor, 1987; Pajares, 1992; Richardson, 1996) has shown that teacher beliefs about the teaching and learning process play a significant role in shaping their purpose in the classroom and directly impact a number of different aspects of their professional work, including lesson planning, assessment, and evaluation. Furthermore, teacher beliefs influence their decision-making during interactions with students in the classroom (Pajares, 1992; Taylor, 1990). Some of these beliefs are explicit, while others are implicit, relating to students, classrooms, and learning. In some cases, teachers may lack the language to articulate their beliefs; in others, they may be unwilling to express unpopular opinions. Additionally, many of their beliefs appear to be highly contextualized (Leinhardt, 1990).

Over the years, extensive research has been conducted on teacher beliefs about mathematics instruction and teaching practices. Some studies (Kaplan, 1991) have demonstrated a connection between teacher beliefs and teaching practices, while others have identified inconsistencies between them (Brown, 1986; Sun & Zhang, 2024; Thompson, 1984). Kaplan (1991) has argued that teacher beliefs and teaching practices are always intertwined, whether through deep-seated beliefs or surface-level beliefs. Deep beliefs pertain to a teacher's perception of the most effective way to teach, whereas surface-level beliefs relate to what a teacher feels they "have to" believe.

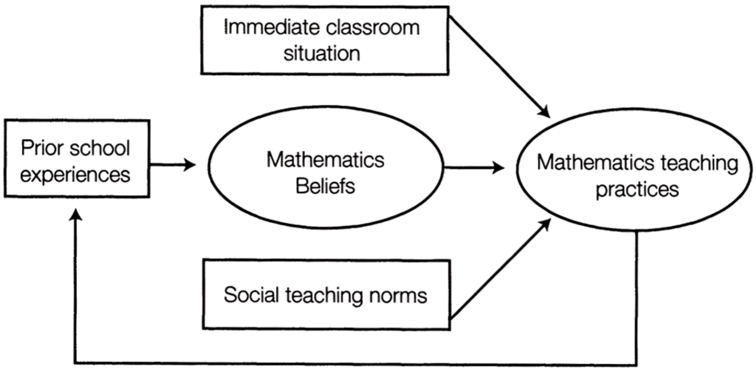


**Figure 1.** A model of the relationships between mathematics beliefs and teaching practices (adopted from Raymond, 1997, p. 551)

The relationship between mathematical beliefs and mathematics teaching practices has been explored by numerous mathematics educators, as well as psychologists and sociologists (Fazio, 1986; Fishbein & Ajzen, 1975; Hart, 1989). Scholars have long asserted that teachers' knowledge and beliefs influence their teaching practices (Ball et al., 2008; Bandura, 1986; Campbell & Malkus, 2014; Dewey, 1933; Ernst, 1989; Fennema & Franke, 1992; Nisbett & Ross, 1980; Pajares, 1992; Pintrich, 1990; Rokeach, 1968; Shulman, 1986; Wilkins, 2008). A review of these studies has led to the development of a model illustrating the connections between mathematical beliefs and teaching practices, as shown in **Figure 1**.

In the early years of primary education, students not only acquired the requisite subject knowledge but also learned how to learn, i.e., the ways in which one acquires knowledge. Primary school teachers serve as students' first point of contact with formal education, meaning that their beliefs about teaching, as well as their teaching practices, play a significant role in shaping students' own beliefs, as illustrated by this model. The majority of today's teachers have encountered traditional teaching methods during their own education. One of the objectives of this study is to determine whether their previous schooling experiences influence the formation of their beliefs about teaching and instructional practice.

This model also demonstrates that, while teacher beliefs influence their teaching practices, they are not the sole determining factor. Teaching practices are also shaped by social norms surrounding education, which include curriculum requirements, parental expectations, and the school's infrastructure, as well as situational factors within the classroom, such as student dynamics, mathematical content, and time constraints. This raises the question of whether teacher beliefs alone are sufficient to shape teaching practices, or whether these external factors play a decisive role in shaping the teaching process despite teachers' personal beliefs.

Teacher beliefs about mathematics instruction and their approaches to implementing mathematics lessons can be categorized along a continuum ranging from traditional, primarily traditional, even mix of traditional and non-traditional, to primarily non-traditional and (fully) non-traditional models (Raymond, 1997). Non-traditional models emphasize the problem-oriented mathematics instruction and the integration of problem-solving tasks at various stages of the lesson itself. In this context, our study aims to address the following research questions:

1. What are the beliefs of primary school teachers in Croatia regarding mathematics instruction?
2. What are their beliefs when it comes to teaching practices?
3. Which instructional model do they actually implement in the classroom?
4. Is there a correlation between teacher beliefs and their teaching practices?

# METHODOLOGY

## Sample and Data Collection

The participants in this study were primary school teachers from across Croatia. In order to reach participants, we contacted the coordinators of the county-level teacher associations in Croatia and requested that they distribute the online survey to their members. The survey was anonymous and voluntary, ensuring

**Table 1.** Criteria for the categorization of teacher beliefs about teaching mathematics

| Criterion | Explanation |
|---|---|
| Traditional | • The teacher's role is to lecture and to dispense mathematical knowledge.<br>• The teacher's role is to assign individual seatwork.<br>• The teacher seeks "right answers" and is not concerned with explanations.<br>• The teacher emphasizes mastery and memorization of skills and facts.<br>• The teacher instructs solely from the textbook.<br>• Lessons are planned and implemented explicitly without deviation.<br>• The teacher assesses students solely through standard quizzes and exams. |
| Primarily traditional | • The teacher primarily dispenses knowledge.<br>• The teacher primarily values right answers over process.<br>• The teacher emphasizes memorization over understanding.<br>• The teacher primarily (but not exclusively) teaches from the textbook.<br>• The teacher includes a limited number of opportunities for problem-solving. |
| Even mix of traditional and non-traditional | • The teacher equally values product and process.<br>• The teacher equally emphasizes memorization and understanding.<br>• The teacher spends equal time as a dispenser of knowledge and as a facilitator.<br>• Lesson plans are followed explicitly at times and flexibly at others.<br>• The teacher has students work in groups and individually in equal amounts.<br>• The teacher uses textbook and problem-solving activities equally.<br>• The teacher helps students both enjoy mathematics and see it as useful. |
| Primarily non-traditional | • The teacher primarily facilitates and guides, with little lecturing.<br>• The teacher values the process somewhat more than the product.<br>• The teachers emphasize understanding over memorization.<br>• The teacher makes problem-solving an integral part of class.<br>• The teacher uses the textbook in a limited way. |
| Non-traditional | • The teacher's role is to guide learning and pose challenging questions.<br>• The teacher clearly values process over product.<br>• The teacher does not follow the textbook when teaching.<br>• The teacher provides only problem-solving, manipulative-driven activities.<br>• The teacher has students work in cooperative groups at all times.<br>• The teacher promotes students' autonomy.<br>• The teacher helps students to like and value mathematics. |

that all reports based on this study present findings in a generalized manner, without referencing individual participants' results. The questionnaire consisted of four sections in total.

## Research Design

The first section focused on general and socio-demographic characteristics, such as age, years of teaching experience in primary education, the number of students in the class they teach, and the population size of the area in which they work.

The second section consisted of a series of statements where teachers stated their beliefs concerning mathematics instruction, where 1 indicated "strongly disagree" and 5 indicated "strongly agree" answer on a five-point Likert scale. All statements were aligned with the criteria used to categorize teacher beliefs about mathematics instruction, as outlined in **Table 1**. **Table 1**, adopted by Raymond (1997, pp. 558–559), illustrates how teacher beliefs about mathematics instruction can be characterized in terms of their perception of their own role in teaching mathematics and the role of students in learning mathematics.

The third section of the questionnaire consisted of a series of statements regarding teachers' mathematics teaching practices, where 1 indicated "strongly disagree" and 5 indicated "strongly agree" answer measured on a five-point Likert scale. All statements were aligned with the criteria used to categorize mathematics teaching practices, as outlined in **Table 2**, which is also adopted from Raymond (1997, pp. 559–560). By examining the criteria for categorizing teacher beliefs about mathematics instruction alongside those for teaching practices, we can compare them to determine the relationship between the two.

The fourth section of the survey consisted of four mathematics lesson topics for lower primary school grades (*addition of numbers up to 1,000*, *drawing parallel lines*, *multiplication of a two-digit number by a one-digit number*, and *drawing a circle*). For each topic, three different instructional practice scenarios were provided (traditional, non-traditional, and even mixed model). Respondents selected the scenario that best aligned with

**Table 2.** Criteria for the categorization of teachers' mathematics teaching practice

| Criterion | Explanation |
|---|---|
| Traditional | • The teacher instructs solely from the textbook.<br>• The teacher follows lesson plans rigidly.<br>• The teacher has students engage only in individual paper-and-pencil tasks.<br>• The teacher creates an environment in which students are passive learners.<br>• The teacher poses questions in search of specific, predetermined responses.<br>• The teacher allows no student-to-student interactions.<br>• The teacher evaluates students solely via exams seeking "right answers." |
| Primarily traditional | • The teacher instructs primarily from the textbook with occasional diversions from the text.<br>• The teacher creates an environment in which students are passive learners, occasionally calling on them to play a more active role.<br>• The teacher primarily evaluates students through standard quizzes and exams, only occasionally using other means.<br>• The teacher primarily encourages teacher-directed discourse, only occasionally allowing for student-directed interactions. |
| Even mix of traditional and non-traditional | • The teacher teaches equally from textbook and problem-solving activities.<br>• The teacher creates a learning environment that at times allows students to be passive learners and at times active explorers.<br>• The teacher evaluates students' learning equally through standard quizzes and exams and alternative means, such as observations and writing.<br>• The teacher encourages teacher-directed and student-directed discourse. |
| Primarily non-traditional | • The teacher primarily engages students in problem-solving tasks.<br>• The teacher primarily presents an environment in which students are to be active learners, occasionally having them play a more passive role.<br>• The teacher primarily evaluates students using means beyond standard exams.<br>• The teacher encourages mostly student-directed discourse. |
| Non-traditional | • The teacher solely provides problem-solving tasks.<br>• The teacher selects tasks based on students' interests and experiences.<br>• The teacher selects tasks that stimulate students to make connections.<br>• The teacher poses questions that engage and challenge students' thinking.<br>• The teacher has students clarify and justify their ideas orally and in writing.<br>• The teacher has students work cooperatively, encouraging communication. |

their teaching approach. For example, for the instructional topic "drawing a circle," the following scenarios were presented:

- **Traditional:** The teacher assigns the task: "Draw a circle with a radius of 4 cm." The teacher explains to the students how to draw a circle. The students practice the procedure. The teacher then assigns another task: "Copy the ball from the image into your notebook."
- **Even mix:** The teacher assigns the task: "Copy the ball from the image into your notebook." The teacher discusses the task with the students. The teacher explains that students need to set the compass to the length of the radius and demonstrates how to complete the task. The students then practice the procedure.
- **Non-traditional:** The teacher assigns the task: "Copy the ball from the image into your notebook." The students independently attempt to copy the ball into their notebooks. The teacher guides them through divergent questioning. The students recognize that they need to determine the length of the radius.

## Analyzing Data

To analyze data collected in this research we used Statistica software. We did a descriptive analysis of socio demographic data, correlation between variables using Spearman rank test to determine correlation between teacher beliefs about mathematics instruction and teaching practice, as well as Kruskal-Wallis test to determine statistically significant differences between socio demographic data and teaching practice.

**Table 3.** Results of factor analysis for statements indicating teachers' beliefs about mathematics instruction in early primary education

| Variables | Principal factors (marked loadings are > 0.3) | |
|---|---|---|
| | Factor 1 | Factor 2 |
| A good teacher values the process of solving problems (pk1). | **0.31875** | −0.04492 |
| A good teacher emphasizes rote memorization of facts (pt1). | −0.13351 | **0.46206** |
| The role of the teacher is to be a mentor to students (pk2). | **0.31399** | 0.10989 |
| A good teacher strictly follows lesson plans (pt2). | −0.01649 | **0.61400** |
| A good teacher encourages students to work in groups (pk3). | **0.49491** | 0.15404 |
| A good teacher exclusively relies on the textbook (pt3). | −0.08457 | **0.60617** |
| A good teacher encourages students to perceive mathematics as useful (pk4). | **0.57896** | −0.06813 |
| A good teacher encourages students to use manipulatives (pk5). | **0.50201** | 0.01180 |
| A good teacher promotes understanding of the material (pk6). | **0.66732** | −0.06289 |
| A good teacher values the final solution to problems (pt4). | 0.19132 | 0.26987 |
| The teacher's role is to impart knowledge (pt5). | **0.36774** | 0.10449 |
| A good teacher does not strictly adhere to lesson plans and is flexible in their approach (pk7). | **0.37347** | −0.22334 |
| A good teacher encourages students to work individually (pt6). | **0.40783** | 0.15498 |
| A good teacher assigns only problem-solving tasks (pk8). | 0.24009 | **0.34013** |
| A good teacher encourages students to enjoy mathematics (pt7). | **0.78158** | −0.12423 |
| A good teacher encourages students to share knowledge with one another (pk9). | **0.73978** | −0.06524 |

**Table 4.** Results of the validity and reliability test for statements indicating teachers' beliefs about mathematics instruction in early primary education with loading on the first factor

| Variables | Mean if deleted | Variance if deleted | SD if deleted | Item-total correlation | Alpha if deleted |
|---|---|---|---|---|---|
| pk1 | 44.23171 | 16.89347 | 4.110166 | 0.314886 | 0.741282 |
| pk2 | 44.52439 | 16.22501 | 4.028028 | 0.278537 | 0.747583 |
| pk3 | 44.97155 | 15.31220 | 3.913080 | 0.435174 | 0.726185 |
| pk4 | 44.17073 | 16.11719 | 4.014622 | 0.482514 | 0.724799 |
| pk5 | 44.56097 | 15.23815 | 3.903608 | 0.425056 | 0.727658 |
| pk6 | 44.11789 | 16.16903 | 4.021073 | 0.533984 | 0.722191 |
| pk7 | 44.96748 | 15.47049 | 3.933254 | 0.306046 | 0.748532 |
| pk9 | 44.13415 | 15.86412 | 3.982979 | 0.624627 | 0.714300 |
| pt5 | 44.72358 | 15.11058 | 3.887233 | 0.306521 | **0.752538** |
| pt6 | 44.75610 | 15.54214 | 3.942352 | 0.356892 | 0.737865 |
| pt7 | 44.27236 | 15.05997 | 3.880718 | 0.64677 | 0.703401 |

Note. SD: Standard deviation; M = 48.9431; SD = 4.3176; N = 246; Cronbach alpha = 0.749868; Standard alpha = 0.785123; Average inter-item correlation = 0.255070.

## RESULTS

The survey questionnaire was completed by 246 primary school teachers. Among the respondents, 4% were aged 20–29, 24% were aged 30–39, 35% were aged 40–49, 28% were aged 50–59, and 9% were over 60 years old. Since teachers typically begin working in schools immediately after completing their studies (either on a fixed-term or permanent contract), age is highly positively correlated with years of teaching experience. Accordingly, 19% of respondents had less than 10 years of teaching experience in primary education, 33% had 10–19 years, 25% had 20–29 years, and 22% had 30 or more years of experience. The majority of respondents worked in communities with fewer than 5,000 inhabitants (42%), while 16% worked in small towns with populations between 5,000 and 20,000, 12% in cities with populations between 20,000 and 50,000, and 30% in large cities with over 50,000 inhabitants. Interestingly, although most teachers worked in smaller communities, their classrooms tended to have a higher number of students. Only 16% of teachers taught in classes with fewer than 10 students, 17% in classes with 10–14 students, one-third (32%) in classes with 15–19 students, 28% in classes with 20–24 students, and just 7% taught in classes with more than 25 students.

We conducted validity and reliability tests for the responses from the second and third sections of the questionnaire (**Table 3**, **Table 4**, and **Table 5**). Factor analysis of teachers' beliefs about teaching mathematics in lower primary education revealed that statements associated with the non-traditional teaching model had saturation on the first factor, with a Cronbach's alpha of α = 0.75, while statements reflecting the traditional model displayed saturation on the second factor, with a Cronbach's alpha of α = 0.60.

**Table 5.** Results of the validity and reliability test for statements indicating teachers' beliefs about mathematics instruction in early primary education with loadings on the second factor

| Variables | Mean if deleted | Variance if deleted | SD if deleted | Item-total correlation | Alpha if deleted |
|---|---|---|---|---|---|
| pt1 | 6.865854 | 4.295013 | 2.072441 | 0.357067 | 0.518981 |
| pt2 | 6.723577 | 3.793509 | 1.947693 | 0.418576 | 0.467352 |
| pt3 | 6.967480 | 4.104634 | 2.025990 | 0.454258 | 0.446420 |
| pk8 | 5.760163 | 4.629470 | 2.151620 | 0.245315 | **0.603176** |

Note. SD: Standard deviation; M = 8.77236; SD = 2.56766; N = 246; Cronbach alpha = 0.583926; Standard alpha = 0.585572; Average inter-item correlation = 0.263496.

The test results indicate that primary school teachers categorized three traditionally framed statements as non-traditional: *A good teacher encourages students to enjoy mathematics, The teacher's role is to impart knowledge,* and *a good teacher encourages students to work individually.* While teachers aim to foster students' independence in learning, reasoning, and acquiring knowledge, they also maintain the belief that teachers must actively share their knowledge. Furthermore, the interpretation of the statement *a good teacher encourages students to work individually* depends on context. In a traditional sense, this implies that students work alone with paper and pencil, without interaction or exchange of ideas and strategies. However, from a non-traditional perspective, it can be understood as the teacher providing individualized support, acknowledging that each student progresses at their own pace. Data analysis suggests that respondents in this study perceived the statement in a non-traditional context. Conversely, respondents also classified one non-traditional statement within the traditional category: *A good teacher assigns only problem-solving tasks*.

If one refers to the example in **Figure 1**, the scenarios presented are, in order, traditional, mix between traditional and non-traditional models, and finally, non-traditional models. In the traditional model, the teacher explains the procedure for solving tasks related to the instructional topic, after which the students exercise the procedure, and finally, the teacher assigns a problem-solving task. In the mixed model, the teacher begins with a problem-solving task, explains the procedure through discussion with the students, and concludes by having students practice the problem-solving procedure. In contrast to the mixed model, where the teacher explains how to arrive at the solution, the non-traditional model entails that the students independently arrive at the solution to the problem, whereas the teacher guides them with divergent questions. From this, we can see that teachers perceive a problem-solving task as any task presented in a real-world context, rather than a task for which students already have a pre-determined solution strategy. This explains why they categorize the statement *a good teacher assigns only problem-solving tasks* within the traditional model, as they associate problem-solving tasks with word problems. Additionally, the data analysis revealed that, on average, the respondents in this study predominantly hold non-traditional beliefs when it comes to the teaching of mathematics (mean [M] = 3.545).

Factor analysis of the responses regarding mathematics teaching practices in the lower grades of elementary school revealed that statements related to the non-traditional model of teaching practice have a factor loading on the first factor with a Cronbach's alpha of α = 0.77, while traditional statements have a factor loading on the second factor with a Cronbach's alpha of α = 0.61 (**Table 6**, **Table 7**, and **Table 8**).

The results of the test show that elementary school teachers categorized two traditional statements as non-traditional: *I assign individual tasks for students to complete in their notebooks* and *during lessons, I allow students to interact with me*. As with the beliefs about teaching mathematics, the statement regarding individual work can be understood in both traditional and non-traditional contexts. Based on the data analysis, we conclude that the respondents in this study interpreted this statement from a non-traditional perspective.

On the other hand, the respondents in this study classified one non-traditional statement as traditional: *I teach exclusively through activities involving problem-solving tasks*. Again, similar to the beliefs about teaching, the statement regarding teaching through problem-solving activities was categorized under the traditional factor. Furthermore, the data analysis revealed that, on average, the respondents in this study implement a mixed traditional and non-traditional model of mathematics teaching practice (M = 3.345).

**Table 6.** Results of factor analysis for statements on mathematics teaching practice by teachers in lower elementary school grades

| Variables | Principal factors (marked loadings are > 0.3) | |
|---|---|---|
| | Factor 1 | Factor 2 |
| I teach exclusively using the textbook (npt1). | –0.14542 | **0.57176** |
| I assign individual tasks for students to complete in their notebooks (npt2). | **0.36111** | 0.15305 |
| During lessons, I allow students to interact with me (npt3). | **0.60452** | –0.04583 |
| Students frequently work in groups (npk1). | **0.51724** | –0.00764 |
| I ask students questions that require a specific, predetermined answer (npt4). | 0.04378 | **0.51108** |
| I assign tasks to students based on their interests (npk2). | **0.42787** | 0.15768 |
| In my teaching practice, I create an environment where students are active participants (npk3). | **0.65982** | –0.10431 |
| I teach exclusively through activities involving problem-solving tasks (npk4). | 0.23649 | **0.43348** |
| I assess students solely through written knowledge tests and short quizzes (npt5). | –0.15532 | **0.57566** |
| I take student records into account when assessing them (npk5). | **0.46268** | 0.05251 |
| During lessons, I allow students to interact with each other (npk6). | **0.54760** | –0.05837 |
| When teaching, I follow my lesson plan (npt6). | 0.10836 | 0.29276 |
| Students explain their ideas both orally and in writing (npk7). | **0.64166** | 0.14306 |
| I ask students questions that encourage critical thinking (npk8). | **0.70978** | –0.02728 |

**Table 7.** Results of validity and reliability test for statements on mathematics teaching practice by teachers in lower elementary school grades with loadings on the first factor

| Variables | Mean if deleted | Variance if deleted | SD if deleted | Item-total correlation | Alpha if deleted |
|---|---|---|---|---|---|
| npt2 | 33.43903 | 14.47392 | 3.804461 | 0.315137 | **0.772466** |
| npt3 | 32.50813 | 15.35562 | 3.918625 | 0.502288 | 0.748817 |
| npk1 | 33.72764 | 13.73476 | 3.706044 | 0.448076 | 0.749358 |
| npk2 | 33.83333 | 14.30962 | 3.782806 | 0.380013 | 0.759871 |
| npk3 | 32.74390 | 14.66206 | 3.829107 | 0.560027 | 0.738318 |
| npk5 | 33.18699 | 13.94877 | 3.734806 | 0.403932 | 0.757189 |
| npk6 | 33.29268 | 13.88995 | 3.726922 | 0.471805 | 0.744787 |
| npk7 | 33.06911 | 13.31636 | 3.649159 | 0.570399 | 0.728502 |
| npk8 | 32.70325 | 14.45259 | 3.801656 | 0.610168 | 0.732523 |

Note. SD: Standard deviation; M = 37.3130; SD = 4.19373; N = 246; Cronbach alpha = 0.769646; Standard alpha = 0.793047; Average inter-item correlation = 0.302167.

**Table 8.** Results of validity and reliability test for statements on mathematics teaching practice by teachers in lower elementary school grades with loadings on the second factor

| Variables | Mean if deleted | Variance if deleted | SD if deleted | Item-total correlation | Alpha if deleted |
|---|---|---|---|---|---|
| npt1 | 8.634147 | 4.215745 | 2.053228 | 0.427108 | 0.514099 |
| npt4 | 8.439024 | 4.945468 | 2.223841 | 0.354703 | 0.568214 |
| npt5 | 8.792683 | 3.831003 | 1.957295 | 0.483916 | 0.464486 |
| npk4 | 8.121951 | 5.294071 | 2.300885 | 0.311855 | 0.595466 |

Note. SD: Standard deviation; M = 11.3293; SD = 2.68809; N = 246; Cronbach alpha = 0.611985; Standard alpha = 0.607013; Average inter-item correlation = 0.280556.

In the data analysis, we defined four new variables: pk, pt, npk, and npt. Each of these variables was derived as the arithmetic mean of the variables that are saturated on one of the factors:

$$pk = \frac{pk1 + pk2 + pk3 + pk4 + pk5 + pk6 + pk7 + pk9 + pt6 + pt7}{10},$$

$$pt = \frac{pt1 + pt2 + pt3}{3},$$

$$npk = \frac{npk1 + npk2 + npk3 + npk5 + npk6 + npk7 + npk8 + npt2 + npt3}{9},$$

and

$$npt = \frac{npt1 + npt4 + npt5 + npk4}{4}.$$

**Table 9.** Results of the correlation test between teaching scenarios for the four given lesson topics and teachers' beliefs about mathematics instruction and teaching practice

| Pair of variables | Spearman rank order correlations (marked correlations are significant at p < 0.05) | | | |
|---|---|---|---|---|
| | Valid N | Spearman R | t (N–2) | p-value |
| *Addition*&pk | 246 | **0.228676** | **3.66927** | **0.000299** |
| *Addition*&pt | 246 | –0.082301 | –1.28996 | 0.198284 |
| *Addition*&npk | 246 | **0.218269** | **3.49371** | **0.000565** |
| *Addition*&pk | 246 | –0.046916 | –0.73366 | 0.463863 |
| *Parallel*&pk | 246 | 0.095118 | 1.49256 | 0.136843 |
| *Parallel*&pt | 246 | **–0.163011** | **–2.58083** | **0.010441** |
| *Parallel*&npk | 246 | **0.133521** | **2.10451** | **0.036357** |
| *Parallel*&npt | 246 | **–0.188420** | **–2.99690** | **0.003009** |
| *Multiplication*&pk | 246 | **0.181606** | **2.88475** | **0.004268** |
| *Multiplication*&pt | 246 | –0.038345 | –0.59941 | 0.549456 |
| *Multiplication*&npk | 246 | **0.206712** | **3.30022** | **0.001110** |
| *Multiplication*&npt | 246 | –0.005386 | –0.08413 | 0.933022 |
| *Circle*&pk | 246 | 0.068254 | 1.06645 | 0.287277 |
| *Circle*&pt | 246 | –0.090138 | –1.41085 | 0.159567 |
| *Circle*&npk | 246 | 0.115122 | 1.80658 | 0.072065 |
| *Circle*&npt | 246 | –0.120979 | –1.89983 | 0.058639 |

The analysis of the collected data entailed the following correlation tests:

- Correlation between socio-demographic variables (age, years of experience, number of students in the class, and the population size of the area where the school is located) and the teacher beliefs about teaching mathematics (pt, pk) and teaching practice (npk, npt) variables: The correlation test analysis, with statistical significance at $p < 0.05$, showed no significant correlations between said variables. The highest correlation was found between years of experience and npk, with a value of 0.16. Although this correlation is minimal, it suggests that teachers with more years of experience tend to implement more non-traditional teaching models. While it might be expected that "younger" teachers would be more open to non-traditional teaching models due to being more familiar with current trends in educational policies, the results show that older teachers with more years of experience actually incorporate non-traditional models more frequently in their teaching practice. A possible reason for this may be that these teachers, having used traditional methods for many years, have recognized the need for an alternative approach.
- Correlation between teaching scenarios for the four given lesson topics and teacher beliefs about mathematics instruction and teaching practice: The results of the correlation test between teaching scenarios for the four given lesson topics (*addition of numbers up to 1,000*, *drawing parallel lines*, *multiplication of a two-digit number by a one-digit number*, and *drawing a circle*) and teachers' beliefs about mathematics instruction (pk, pt) and teaching practice (npk, npt), with statistical significance at $p < 0.05$, are provided in **Table 9**.

  Analysis of the results allows us to conclude that all instructional topics–except for circles–positively correlate with pk and npk. In other words, teachers addressing the instructional topics *addition of numbers up to 1,000*, *drawing parallel lines*, and *multiplication of a two-digit number by a one-digit number*, who selected the scenario corresponding to the non-traditional teaching model, hold the belief that mathematics should be taught using a non-traditional approach, and they indeed implement it in their instructional practice. Furthermore, **Table 9** indicates that this relationship is more pronounced for arithmetic topics than for geometry topics.
- Correlation between teachers' beliefs about teaching mathematics (pk, pt) and their teaching practice (npk, npt): The results of the correlation test between primary school teachers' beliefs when it comes to teaching mathematics and their teaching practices indicate that beliefs are positively correlated with their teaching practices, with statistical significance at $p < 0.05$. npk and pk are correlated with a coefficient of 0.66, while npt and pt are correlated with a coefficient of 0.47. Teachers who believe that mathematics should be taught using a non-traditional model indeed implement a non-traditional teaching model in their practice, while teachers who believe in teaching mathematics through a traditional model carry out a traditional teaching model in their practice. Therefore, their beliefs about

**Table 10.** Results of the Kruskal-Wallis test between years of teaching experience and npk

| Dependent: npk | Multiple comparison p-values; npk; independent grouping variable: years of experience; Kruskal-Wallis test: H (3, N = 246) = 9.495770, p = 0.0234 | | | |
|---|---|---|---|---|
| | 1. R: 118.55 | 2. R:107.05 | 3. R:132.67 | 4. R:142.34 |
| 1 | | 1.000000 | 1.000000 | 0.551501 |
| 2 | 1.000000 | | 0.194684 | 0.027960 |
| 3 | 1.000000 | 0.194684 | | |
| 4 | 0.551501 | 0.027960 | 1.000000 | |

**Table 11.** Results of the Kruskal-Wallis test between the population size of the town where the teacher's school is located and npt

| Dependent: npt | Multiple comparison p-values; npt; independent grouping variable: population size; Kruskal-Wallis test: H (3, N = 246) = 11.94745, p = 0.0076 | | | |
|---|---|---|---|---|
| | 1. R: 125.04 | 2. R: 153.44 | 3. R: 98.717 | 4. R: 115.11 |
| 1 | | 0.193081 | 0.447525 | 1.000000 |
| 2 | 0.193081 | | **0.008716** | **0.037082** |
| 3 | 0.447525 | **0.008716** | | 1.000000 |
| 4 | 1.000000 | **0.037082** | 1.000000 | |

teaching mathematics are consistent with their teaching practices. On the other hand, teachers with non-traditional beliefs are more strongly correlated with their teaching practices, while traditional beliefs are less strongly correlated with traditional practices, which suggests that teachers with non-traditional beliefs may find it "easier" to change their teaching practices.

Using the collected data, we conducted a Kruskal-Wallis test to determine whether significant differences exist in the teaching model implemented by teachers depending on class size, years of teaching experience, teacher age, and the population size of the area in which they teach. The Kruskal-Wallis test revealed a statistically significant difference at the 5% significance level between teachers with 10–19 years of experience and those with more than 30 years of experience (**Table 10**).

To adjust the calculated p-values, we applied the Mann-Whitney U test at a 5% significance level, which indicated that teachers with 10–19 years of teaching experience implement non-traditional teaching practices less frequently than those with 30 or more years of experience (Z = –2.62187, p = 0.008745). Given that teachers with more years of experience have spent a significant portion of their careers employing traditional teaching methods, they have likely recognized the need for change, which explains why they are more inclined to adopt non-traditional instructional approaches.

Additionally, the Kruskal-Wallis test revealed statistically significant differences at the 5% significance level regarding the population size of the area in which teachers implement traditional teaching methods. The test results indicate significant differences in the implementation of traditional teaching between areas with 5,000–20,000 inhabitants and those with 20,000–50,000 inhabitants, as well as between areas with 20,000–50,000 inhabitants and those with more than 50,000 inhabitants (**Table 11**).

To examine the nature of these differences, a Mann-Whitney U test was conducted at a 5% significance level, with the results indicating that teachers in smaller communities with up to 20,000 inhabitants implement traditional teaching practices more frequently than those in areas with 20,000–50,000 inhabitants (Z = 3.008492, p = 0.002626). Similarly, teachers in smaller communities with up to 20,000 inhabitants use traditional teaching practices more often than those in areas with over 50,000 inhabitants (Z = 2.800905, p = 0.005096). These findings do not come as a surprise, as larger urban areas tend to be more inclined toward modernization and the adoption of new educational practices.

Furthermore, the Kruskal-Wallis test at a 5% significance level revealed statistically significant differences concerning the number of students in a class where teachers implement traditional teaching methods, with the test results indicating significant differences in the application of traditional teaching between classes with 10–14 students and those with 20–24 students (**Table 12**).

**Table 12.** Results of the Kruskal-Wallis test between the number of students in the classroom where the teacher teaches and npt

| Dependent: npt | Multiple comparison p-values; npt; independent grouping variable: number of students; Kruskal-Wallis test: H (4, N = 246) = 11.20818, p = 0.0243 | | | | |
|---|---|---|---|---|---|
| | 1. R: 133.22 | 2. R: 91.381 | 3. R: 125.13 | 4. R: 131.87 | 5. R: 138.25 |
| 1 | | 0.081950 | 1.000000 | 1.000000 | 1.000000 |
| 2 | 1.000000 | | 0.132136 | **0.036452** | 0.193868 |
| 3 | 1.000000 | 0.132136 | | 1.000000 | 1.000000 |
| 4 | 1.000000 | **0.036452** | 1.000000 | | 1.000000 |
| 5 | 1.000000 | 0.193868 | 1.000000 | 1.000000 | |

A Mann-Whitney U test was conducted to examine the nature of these differences. The results indicate that teachers with 10–14 students in a class implement traditional teaching practices less frequently than those with 20–24 students (Z = –2.72098, p = 0.006509). This finding is also understandable, given that teachers with smaller class sizes are able to dedicate more individual attention to each student, thereby facilitating the implementation of more non-traditional teaching methods.

## DISCUSSION

The findings indicate that teacher beliefs about approaches to mathematics instruction are generally positively oriented toward non-traditional teaching models at a declarative level. However, in real classroom situations, many teachers still find it challenging to detach from traditional models, which rely on teacher-led demonstrations, explanations, and modeling, followed by student repetition and practice. The freedom for students to develop their own individual strategies and reasoning–which can manifest in a wide range of approaches within a single classroom–is an aspect that many teachers find daunting, as it diminishes their sense of control over students' acquisition of knowledge. In situations where they feel uncertain about the outcomes of an open-ended approach to problem-solving, teachers tend to revert to instructional models shaped by their prior experience.

The correlation between teacher beliefs and teaching practices confirms that beliefs play a crucial role in shaping instructional decisions. Teachers with non-traditional beliefs are more likely to implement non-traditional teaching models, while those with traditional beliefs adhere more closely to traditional practices. However, the results suggest that teachers with non-traditional beliefs may find it "easier" to change their teaching practices, whereas traditional beliefs are less strongly correlated with instructional practices.

Interestingly, teachers with more years of experience were found to implement non-traditional teaching models more frequently than their younger counterparts. While it might be expected that younger teachers would be more open to non-traditional teaching models due to their familiarity with current trends in educational policies, the findings suggest that older teachers with more experience recognize the need for change and adapt their instructional approaches accordingly.

The impact of external factors, such as school location and class size, was also evident in the study. Teachers in smaller communities were more likely to employ traditional teaching methods, possibly due to limited professional development opportunities or adherence to long-established teaching norms. Additionally, larger class sizes appeared to influence instructional choices, with teachers in bigger classes relying more on traditional methods, likely due to classroom management challenges and time constraints.

Overall, these findings highlight the complexity of translating teacher beliefs into instructional practice. While beliefs are an important factor in shaping teaching approaches, they are influenced by external constraints such as class size, community expectations, and resource availability. Future research should further explore the challenges teachers face in implementing non-traditional teaching methods and identify strategies to support them in making meaningful instructional changes.

## CONCLUSION

We conclude that teacher beliefs about approaches to mathematics instruction are generally positively oriented toward non-traditional teaching models at a declarative level. However, in real classroom situations, it appears they find it challenging to detach from traditional models, which rely on teacher-led demonstrations, explanations, and modeling, followed by student repetition and practice. The freedom for students to develop their own individual strategies and reasoning–which can manifest in a wide range of approaches within a single classroom–is an aspect that many teachers find daunting, as it diminishes their sense of control over students' acquisition of knowledge. In situations where they feel uncertain about the outcomes of an open-ended approach to problem-solving, teachers tend to revert to instructional models shaped by their prior experience–models in which they feel secure in having "covered" the material. This often results in a reliance on traditional teaching methods.

In other words, while teachers express a desire to implement non-traditional instructional methods and believe such approaches enable students to reach their full potential, they often struggle with how to effectively apply them in practice, thus reverting to traditional instruction due to feelings of uncertainty in terms of learning outcomes, specific constraints mandated by the classroom environment, and a lack of confidence in executing non-traditional teaching methods. This dynamic is precisely illustrated in **Figure 1**, which presents a model of the relationship between teacher beliefs and instructional practices. While teacher beliefs influence their teaching methods–contributing to the non-traditional aspects of their practice–social norms of teaching and real-time classroom conditions tend to push them toward a traditional model. This interplay thus results in a blended instructional practice, which leads us to conclude that–while teacher beliefs do shape their approach to instruction–they are not, on their own, sufficient to determine the corresponding teaching practice.

### Recommendations

The topic explored in this study could be examined on a larger sample to provide a more comprehensive understanding of teacher beliefs about teaching, as well as the instructional models they implement. Additionally, through classroom observations, it may be possible to identify the underlying reasons why teachers do not adopt non-traditional teaching models, despite holding non-traditional beliefs about teaching. Moreover, employing a triangulation approach could yield more objective insights into teachers' instructional practices. Future research could explore these factors in greater depth and develop support strategies to assist teachers in implementing non-traditional teaching models more effectively.

### Research Limits

In this study, an analysis of the final section of the questionnaire, which presents different teaching scenarios in mathematics, revealed that teachers predominantly select those which depict non-traditional teaching models. However, the results from the third section of the questionnaire, which examines their instructional practices, indicate that teachers primarily implement a mix of traditional and non-traditional approaches. This suggests that, while teachers recognize non-traditional teaching models, they do not incorporate them as frequently into their actual practice. Applying a triangulation approach could help uncover the reasons behind this discrepancy.

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