Investigating Natural Differences in Mathematics Teacher Questioning Over Time

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Research on teacher questioning often provides snapshots of questioning practices or studies on how interventions can lead to questioning development. Still, few studies have investigated whether and how teacher questioning evolves naturally over time. This study explored such natural variation by analyzing the questioning practice of a Norwegian elementary teacher as she was teaching a Grade 5 class over two weeks in the Fall of 2022 and then as the same teacher was teaching the same class over two weeks in the Fall of 2023. Quantitative analyses showed a significant decrease in teacher questions from one year to the next, and the main change was in two sub-categories of teacher questions. Qualitative analyses indicated that these differences in teacher questioning were related to establishing classroom climate and norms. The study demonstrates the possibility for natural variation in teacher questioning over time, and these findings have implications for teacher education, professional development, and future research on teacher questioning.

Introduction

Research on teacher questioning has a long history (e.g., Gall, 1970; Stevens, 1912). Studies have investigated the types of questions teachers ask (DeJarnette et al., 2020), often in connection with some other variable. Traditionally, many studies have investigated the effects of teacher questioning on student learning (e.g., Prommaruk, 2016; Taba, 1966), but recent studies tend to focus more on how different types of questions serve to elicit students' thinking or reasoning (Stephens et al., 2023). Several studies have investigated the development of teacher questioning from teacher education or professional development (e.g., Weiland et al., 2014), and most of these studies demonstrate that teachers can develop their questioning through some intervention or education. Whereas many previous studies did not explicitly attend to context, some recent studies have explored how mathematics teachers' questioning might vary across instructional situations (e.g., Hsu et al., 2023; Mosvold, 2023). This recent development is interesting since previous studies implicitly assume that teachers' questioning is stable and independent of context. The studies by Hsu et al. (2023) and Mosvold (2023) prove that teachers' questioning can vary across instructional settings. However, to our knowledge, studies have not investigated if and how teacher questioning varies naturally over time. For instance, if a mathematics teacher teaches the same class over several years, is her questioning likely to change over time? If so, does the change in questioning follow any patterns? Does such change come naturally, or is it possible to identify influences on the questioning practice? We suggest that it is important to consider such questions. Suppose there is a pattern of natural evolution of teacher questioning over time. In that case, research on teacher questioning should attend to this, and teacher education and professional development should consider the temporal aspect of interventions. If teacher questioning evolves naturally over time, the field needs to develop more nuanced perspectives on questioning practice. The present study aims to contribute to the field by exploring the natural evolution of questioning in a mathematics classroom from one year to the next.

Literature review

In preparation for this study, we conducted a structured search in the ERIC database for peer-reviewed journal articles that included the search terms "questioning," "mathematics," and "teaching" in the abstract, and that were published between 2013 and 2023. After screening the abstracts and removing non-empirical studies, studies that were not about questioning or not in mathematics education, we ended up with 38 articles that were included. These articles were coded in terms of their location, the study context, level, and experience of the teachers involved, methodological approach, and study size. We then carefully read the articles to consider how much they emphasized the development of questioning over time.

Studies were from all parts of the world. Most studies were conducted in the context of teacher education or professional development (n=22), but ten studies included an analysis of teacher questioning in naturalistic settings. Most studies were small-scale studies (n=18) with less than ten participants (e.g., Aziza, 2018; Cayton et al., 2017; Chao et al., 2016; McCarthy et al., 2016), and most studies used qualitative methods (n=23). Only four studies applied quantitative methods or analyses, and nine used mixed methods. Most studies were conducted with practicing teachers (n=23) in primary school settings (n=14). However, twelve studies included pre-service teachers, and twelve investigated teacher questioning in secondary school settings.

Nine of the studies investigated the development of teacher questioning over time, and six were qualitative studies carried out in professional development settings. For instance, Aydogan Yenmez et al. (2018) investigated how teachers' questioning strategies changed from engagement in a professional development program focusing on mathematical modeling following a cyclic process over five months. Several studies demonstrated how teachers' questioning could evolve toward more emphasis on eliciting students' thinking through professional development (e.g., Chapman, 2015; Christman et al., 2016; Heng & Sudarshan, 2013), and Gal (2022) demonstrated similar development in a student teacher's questioning from a development effort in teacher education. In another study, Cumhur and Guven (2022) demonstrated how lesson study stimulated development in teacher questioning toward more probing questions. Three studies focusing on the development of teacher questioning applied mixed methods. Kabar and Tasdan (2020) studied the development of questioning among pre-service teachers over a semester in teacher education. Interestingly, the results indicated that some participants developed their questioning while others did not. A study by Hinojosa and Bonner (2023) also investigated the development of pre-service teachers' questioning, and their study demonstrated how a development program could support change in teacher questioning over time. Finally, a study by Roberts (2021) demonstrated a change in teacher questioning over a semester, and their study also involved a professional learning intervention. All these studies demonstrate that it is possible to change teacher questioning through various interventions in teacher education and professional development among in-service teachers. Interestingly, none of the studies in our review investigated the evolution of questioning practice in naturalistic settings without interventions.

Among the studies that investigated the development of questioning through interventions, several investigated patterns in teacher questioning in naturalistic settings. However, all these studies provided snapshots, and none considered variation in questioning over time. For instance, Kaya and Ceviz (2017) conducted a quantitative study of questioning among pre-service teachers in Türkiye through observations of classroom discourse. Their study provided a snapshot of the questioning practices of the participating teachers by examining questioning in one lesson from each participant. However, these authors discussed the limitations of observing each classroom only once and reflected on how the findings might be content specific. In another study, Ni et al. (2014) investigated the relationship between teacher questioning, instructional tasks, and students' responses among 30 Chinese Grade 5 teachers. After analyzing observations of each teacher over three days, they found that lower-order questions often lead to simple responses, whereas higher-order questions lead to more involved answers from the students. Whereas both studies were quantitative, several qualitative studies also provided snapshots, often of individual teachers' questioning strategies, but none investigated teachers' questioning over time.

We do not mean to argue that a study of the natural evolution of teacher questioning is relevant only because it has not been done before. However, we argue that understanding more about the natural development of teachers' questioning might help design more effective teacher education and professional development programs, and it can also shed light on how to foster classroom environments that promote better opportunities for students' learning and development. Although a substantial body of research has explored the impact of development initiatives on teacher questioning (e.g., Chapman, 2015; Gal, 2022; Roberts, 2021), less is known about how teacher questioning evolves naturally with a teacher. Our study contributes to this by investigating a Norwegian teacher's questioning in naturalistic settings, with no intervention, from one year to the next. We ask the following research questions:

1. Does a mathematics teacher's questioning vary naturally from one year to the next, when teaching the same class?
2. What characterizes variations in a teacher's questioning over time?

To answer these questions, we conducted quantitative as well as qualitative analysis of the questioning of a mathematics teacher, as she was teaching the same class over two years.

Methods

To investigate variation in teacher questioning over time, we observed an elementary mathematics teacher in Norway, as she was teaching a Grade 5 class over two weeks in the Fall of 2022. We then returned to the same classroom and observed the same teacher, teaching the same group of students (who were then in Grade 6) one year later—in the Fall of 2023. Data were collected through audio and video recordings, which were transcribed verbatim. A total of ten mathematics lessons were observed—five in 2022 and five in 2023 (see Table 1).

The teacher had less than five years of teaching experience and taught in a school that followed a curriculum on Developmental Education in Mathematics (see Gjære & Blank, 2019). This curriculum highlights dialogue, and the teacher organized many of her lessons as whole-class discussions of mathematical tasks. This makes it a suitable context for exploring teacher questioning in whole-class settings. Our analysis only focused on questioning in whole-class settings to avoid differences due to variations in instructional settings (Hsu et al., 2023).

Table 1
Overview of data material

Lesson	Date	Duration	Whole class	Questions
2022				
Lesson 1	September 21	57:55	31:45	119
Lesson 2	September 22	66:18	32:40	79
Lesson 3	September 27	69:19	34:01	71
Lesson 4	September 28	60:29	32:25	76
Lesson 5	September 29	70:24	37:51	115
2023				
Lesson 1	September 18	65:06	40:06	59
Lesson 2	September 20	57:48	31:55	59
Lesson 3	September 25	59:31	34:40	31
Lesson 4	September 26	73:49	35:04	45
Lesson 5	September 27	57:39	34:56	43

All teacher questions were coded according to a recent typology of mathematics teacher questions by their instructional function (Enright et al., 2016). This typology presents two main categories of questions with sub-categories. The first main category is *information collection* (IC), which consists of questions that collect information about the students' mathematical thinking. Sub-categories are: 1) *call-for-participation*, where the teacher invites the students to participate; 2) *check-in*, where the teacher asks if students are done with a task; 3) *orienting*, where the teacher asks questions to clarify what students are working; and 4) *survey*, where the teacher asks questions to learn what other students did. The second main category of the typology consists of questions that aim at *accessing mathematical content* (AMC). Here, Enright et al. (2016) distinguish between seven sub-categories: 1) *clarification*, where the teacher asks questions to extend or clarify a student's idea; 2) *confirmation*, where the teacher asks a question to confirm that she has the correct understanding of the student's mathematical idea; 3) *direct answer*, where the teacher asks students to answer a specific problem or task; 4) *eliciting mathematical explanation*, where the teacher asks for justification or explanation; 5) *eliciting mathematical process*, where the teacher asks students to describe how they have solved a problem; 6) *eliciting mathematical thinking*, where the teacher invites students to describe their ideas or thinking, but not by giving an explanation or elaborating on process; and 7) *eliciting stance on a mathematical claim*, where the teacher asks the students if they agree or disagree with a mathematical claim. The first part of our analysis involved coding all teacher questions in whole-class discussions according to these categories.

We then applied quantitative analyses to explore variation in teacher questioning in this study. Descriptive statistics was used to investigate tendencies in teacher questions per year, and we applied Welch's two-sample *t*-test to compare teacher questioning between the two years. We decided to use Welch's *t*-test instead of Student's *t*-test. The primary reason was that we could not guarantee equal variances since we suspected that the teacher might have developed different questioning patterns over the year. Welch's *t*-test would be more robust in situations with unequal variance (Welch, 1947).

Results

Patterns of variation in questioning over time

Our first research question prompts investigations of variation in teacher questioning from one year to the next. Variation in questioning can take many forms, but our study focuses on two: variation in the number of questions and variation in the types of questions.

First, we explore variations in the number of questions a mathematics teacher asks in ten lessons from one year to another.

Table 2
Variation in the number of teacher questions per year

Year	f	M	SD	max	min	median
2022	460	92	23.04	119	71	79
2023	238	47.6	11.78	59	31	45

The summary statistics from Table 2 already indicate that the number of questions asked has decreased considerably from one year to the next. The mean number of questions per year decreased from 460 to 238, a decrease of 48.3%. Overall, the results suggest that the teacher posed fewer questions in 2023 than in 2022, and a *t*-test confirms that these differences are significant ($p=.0087$).

Next, we set out to explore variation across types of questions. First, we consider the main categories of questions: accessing mathematical content (AMC) and information collection (IC).

Table 3
Comparison of questioning in main categories across two years

Category	f_{22}	M_{22}	SD_{22}	f_{23}	M_{23}	SD_{23}	df	t	p
IC	214	42.8	14.27	86	17.2	6.14	5.43	3.68	.012
AMC	246	49.2	12.87	152	30.0	10.37	7.65	2.60	.033

To check for statistical significance, we then conducted *t*-tests to explore variation in questioning in the two main categories (IC and AMC) across two years. As shown in Table 3, the results show that the teacher asked significantly more IC questions in 2022 ($M = 42.8$ per lesson) than in 2023 ($M = 17.2$ per lesson). The *p*-value of .012 shows that this difference was significant. Conversely, the teacher also asked significantly more AMC questions in 2022 ($M = 49.2$ per lesson) than in 2023 ($M = 30.0$ per lesson), and the p-value of .033 shows that the difference was significant (95% level). In other words, the teacher not only asked significantly fewer questions in general in whole-class discussions in 2023 as compared with 2022 but also a significant decrease in teacher questions in both main categories studied. To get even more nuanced, we also conducted *t*-tests for each sub-category of teacher questions (Table 4).

Table 4
T-tests for sub-categories across two years

Categories of teacher questions	df	t	p
Information collection			
Call for participation	6.05	3.28	.017
Check-in	.2	5.27	.85
Orienting	1.95	4.50	.12
Surveying	1.28	4.91	.26
Accessing mathematical content			
Clarifying	.72	5.88	.50
Confirmation	-1.42	6.58	.20
Direct answer	-.23	7.16	.82
Eliciting mathematical explanation	-1.29	7.62	.24
Eliciting mathematical process	.37	5.96	.72
Eliciting mathematical thinking	2.08	6.53	.078
Eliciting stance on a mathematical claim	20.01	4.00	< .0001

Interestingly, although the differences across years were significant for both main questioning categories, we could only find significant differences for two of the individual sub-categories. Significant differences occurred in the teacher's use of questions to *call-for-participation* between the two years. This category's mean number of questions was 32.8 in 2022 (SD=11.97) and 13 in 2022 (SD=6.28). For *eliciting stance on a mathematical claim*, the mean number of questions was 20.6 in 2022 (SD=2.30), whereas no questions were coded in this category in any of the lessons observed in 2023. In the next section, we will use two example excerpts from the data (one from each year) to further qualitatively explore the differences in questioning across years.

Characteristics of variation in questioning over time

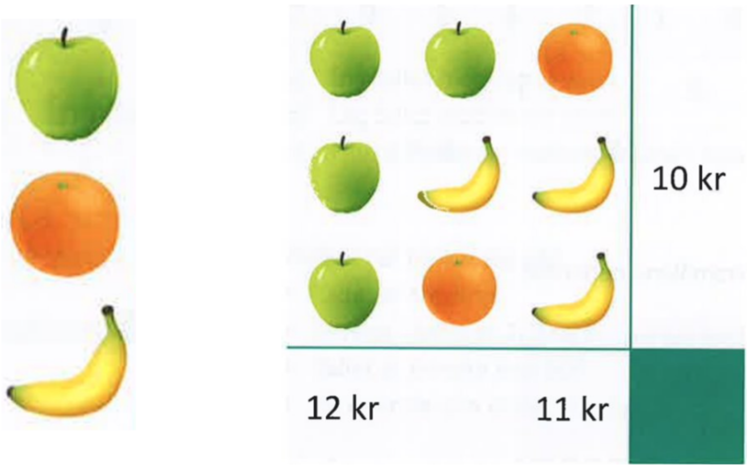

Figure 1. Warm-up task from lesson 2, 2022

To illustrate the patterns of teacher questioning, we first consider an episode from the second lesson from 2022. At the beginning of the lesson, students are always given a warm-up task. On this day, they were given a task that challenged them to use addition and subtraction to find the missing prices (see Figure 1). One student suggested that the price of the apples must be 4kr (*kr* is the abbreviation for the Norwegian currency, *kroner*). Another student then suggested that bananas must cost 3kr. In such instances, the teacher often challenged them to explain their reasoning. Instead of confirming the answer herself, the teacher would typically ask the students what they thought as eliciting stance, and the students typically responded by showing an agreement sign. A third student approached the board and explained why the oranges must be 5kr. After completing the task and saying good morning to the class, the teacher realized that some students had not understood it. One of the students, Anna, was brave enough to say aloud that she had not understood anything, and the teacher then decided to revisit the task.

The teacher explained that they must calculate both horizontally and vertically in this task. Then she invited the students to explain their thinking, prompting the following discussion.

Johannes: Because you see that it says 10 kroner on that side, we know that an apple costs four, and bananas cost three, so two bananas will be 6, and an apple costs 4, and 4 plus 6 is 10.

Teacher: 4 plus 6 makes 10. What do you think, does it become 10? So, it's one apple and two bananas. Can we try to figure out the rest then? Can we do that? There's something we haven't written what will be. (4s) Can we figure out the price? Gustav.

Gustav: (writes 12kr on the board)

Teacher: Gustav writes 12 kroner. Can you write the price of the fruit that's there in that column, so we can see what you think then? Apple 4, banana 3 and orange 5, and that becomes 12 kroner, says Gustav.

(Students show agreement sign)

Teacher: Oh, there were many who agreed with that. Then we have two more that we must fill in. What will the price be? (3s) Would you like to try, Anna? That's brave.

Anna: So, I should write the price of these?

Teacher: Yes.

Anna: (writes on the board)

Teacher: Anna writes 12 kroner. One apple, one orange, one banana, 12 kroner. What do you think?

(Students show agreement sign)

When Johannes explained, we noticed how the teacher asked several questions. We coded the first question as a question to elicit their stance (“What do you think, does it become 10?”). Usually, the students would then show signs of agreement or disagreement. Since no one responded, the teacher shifted and asked some questions, inviting students to participate. After the first set of invitation questions, the teacher paused to give students time to think. She then asked, “Can we figure out the price?” Even though this is technically a question about the content, we see it functioned as a call for students (here, Gustav) to participate. When Gustav had written down 12kr on the board, the teacher repeated and asked another question, which also served as a *call-for-participation*. No one responded immediately, but when the teacher revoiced Gustav’s suggestion, many students responded by showing signs of agreement. After commenting that many students agreed, the teacher then asked a *direct answer* question: “What will the price be?” This type of question was rare in this class. After a pause, the teacher asked a question that called for Anna to participate. Anna then came up, wrote on the board, and the teacher revoiced what Anna had written. The teacher then asked, “What do you think?” The students responded by showing agreement signs, so we coded this question as *eliciting stance* on a mathematical claim. This teacher often asked the students what they were thinking, and it could be tempting to code such questions as *eliciting mathematical thinking*. However, when considering the questions about their function in the classroom, we notice that the students often interpreted them as prompts to show their agreement.

The two questions most prominent in the episode above, *call-for-participation* and *eliciting stance on a mathematical claim*, were often used in 2022. The following year, however, the teacher used these types of questions much less frequently. The teacher still asked some questions that served to call students to participate in 2023, but significantly less frequently. Interestingly, we did not observe any questions to elicit students’ stances on a mathematical claim in 2023. The students still showed signs of agreement or disagreement in 2023, but the teacher did not have to prompt them for this. The following episode from the second lesson in 2023 illustrates some of the shifts in questioning between the two years.

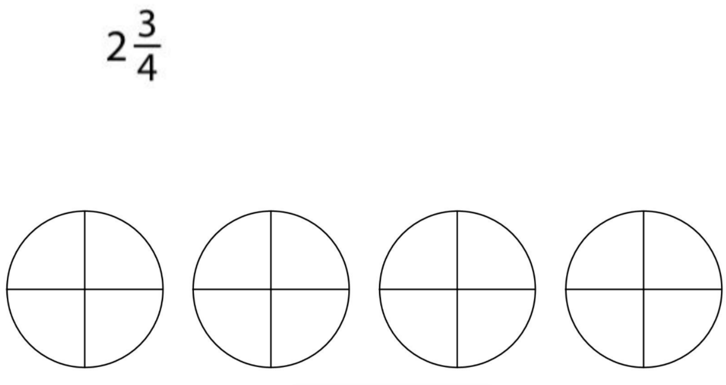

Figure 2. Task on converting to improper fraction

In the second lesson from 2023, the students discussed a task on how to convert $2\frac{3}{4}$ to an improper fraction (see Figure 2). One student immediately came up with $4 \times 2 + 3$, which is the standard algorithm for doing this. The teacher challenged him and the other students about why they should multiply the denominator by the whole number and then add the numerator, not any other combination. Another student responded that one whole has four parts, and since there are two wholes, there must be eight parts. One of the other students wondered if there was a "because" in the explanation—the teacher had frequently asked them to explain their reasoning—and the teacher commented on that before she invited Gustav, who had raised his hand, to respond.

Teacher: Okay then, Gustav.

Gustav: Can I come up and write how I would have done it?

Teacher: You can. Then we will get to Teodor afterwards.

(Gustav writes $\frac{4}{4} + \frac{4}{4}$)

Teacher: Can you explain what you are doing?

Gustav: It's two whole [numbers] like this (circles around the whole number "2")

Teacher: Why is it two whole [numbers]? It says four fourths.

Gustav: Because when the numerator and the denominator are the same, that's a whole [number], and then we have got the two (pointing at the whole number), two whole [numbers] to become two fractions.

Teacher: Okay.

(Gustav finishes writing out his suggestion, $\frac{4}{4} + \frac{4}{4} + \frac{3}{4} = \frac{11}{4}$)

Teacher: So, Gustav says four fourths, when the numerator and the denominator are completely equal, then it is the same as one whole. So, he has replaced the two wholes with four fourths twice.

(5s)

Teacher: And if I understand you correctly, this is another argument for that one? (pointing at $2 \times 4 + 3$)

Gustav: Eh... yes

We notice that the teacher did not ask a question to *call-for-participation* at the beginning of this episode, but she invited Gustav to take the floor by saying his name. The teacher asked significantly fewer *call-for-participation* questions in 2023 than in 2022, and several possible explanations exist. One explanation could be that the teacher had now worked with this class for a year, and they had established routines. In 2023, the teacher would often wait and look at the class in instances like this, and they would interpret it as an invitation to participate. Another possible reason is that the students might have become more engaged in class in the second year of data collection. Finally, it could be that the students were more conscious about the presence of observers and cameras in the first year and that they had become more accustomed to this in the second year.

Another observation from this episode is a strong focus on explanations. The teacher also emphasized this in the first year, but we noticed that the teacher was not satisfied just by receiving an answer; she kept pressing the students to explain. After Gustav had started writing down his approach, the teacher asked him to explain what he was doing; this question was coded as *eliciting mathematical process*. After Gustav had explained his process, the teacher kept pushing for an explanation by asking why it is two wholes when it says four-fourths. This question was coded as *eliciting a mathematical explanation*, and Gustav responded by providing such an explanation.

A third observation is that this episode only included a couple of questions, and there were several instances where the teacher used alternatives to questions to elicit the students' thinking. For instance, when Gustav had finished writing down his complete suggestion, the teacher revoiced and then stopped and waited for the other students to react. The year before, she would often have asked the other students to take a stance in a situation like this, but in 2023, it was often enough for her to stop and wait. No one responded, and Gustav walked back to his desk when the teacher asked him to confirm that his approach was an argument in support of the standard algorithm that another student initially proposed. Although no students showed agreement signs in this episode, they often showed signs of agreement or disagreement in mathematical discussions in the second year, even though the teacher never asked a question to invite them to make a stance in that year. Again, an explanation for this could be that this routine had now been firmly established in the class.

Discussion

This study's findings show differences in the teacher's questioning from one year to the next. *Difference* can mean different things. The observed differences might mean there is *variation*, which might be due to contextual or temporal factors. Second, the observed differences might point toward cyclic evolution or *change* in questioning, and this might be due to developing relationships and establishing social and sociomathematical norms in the classroom. Finally, the observed differences might indicate *development* or even improvement in the teacher's questioning skills. Although the teacher did not participate in any professional development at the time, and although there was no intervention involved in our study, there is a possibility that the teacher developed her questioning practice from increased experience, her development efforts, or other influences. In the following, we discuss these three possibilities and their potential implications.

Our study provides evidence of differences in teacher questioning from one year to the next, and we first want to discuss this difference in terms of *variation*. The word variation means something deviates from what is common, and the observed differences in questioning could simply be a matter of natural deviation. Interestingly, most studies of mathematics teacher questioning appear to consider questioning practice as a static entity, and there is little discussion of variation in teacher questioning. Among the studies that have investigated teacher questioning in naturalistic settings, several studies have included observations (e.g., Kaya & Ceviz, 2017; Ni et al., 2014). Some of these studies provide snapshots of teacher questioning only based on observations of one lesson from each participating teacher (e.g., Kaya & Ceviz, 2017).

In contrast, other studies follow the teacher over several lessons (e.g., Ni et al., 2014). Although some studies indicate that teachers' questioning might vary across contexts (Hsu et al., 2023) or across groups of students (Mosvold, 2023), previous research on teacher questioning in mathematics does not emphasize natural variation in questioning over time. In our study, we had the opportunity to follow the same teacher, teaching the same class over two weeks. We returned to the same classroom a year later and followed the same teacher, teaching the same class, for another two weeks. When comparing the teacher questioning in these two time periods, we observed variation, some of which was significant.

Our study had no interventions, and the teacher did not participate in professional development during this period. Hence, the variation in teacher questioning appears natural in our study. Interestingly, some of the observed variation was statistically significant. For instance, we noticed that the number of questions per lesson decreased significantly, indicating that teacher questions might have a purpose of activating the students. Over time, there might be less need for this. We also noticed a significant decrease in two specific questioning categories related to establishing classroom routines or norms. We cannot establish from our case study that this variation will always occur. However, our results indicate that some natural variation in teacher questioning can occur. The observed variations indicate that there might be a temporal aspect to some types of teacher questions.

Second, we discuss how the evidence of difference in teacher questioning might relate to *change* in questioning practice. The research literature on mathematics teacher questioning primarily focuses on the development of questioning from interventions or on patterns of teacher questioning at a certain point in time. None of the studies in our literature review provided direct evidence of natural change in questioning practice, but our findings indicate that such change is possible. One plausible source of natural change is experience—either on the side of students, the teacher, or both. In 2022, the class was new to the teacher, and naturally, she had to spend more time and energy establishing a productive classroom climate and facilitating student participation. These efforts might have resulted in a higher number of *call-for-participation* questions, and there were indications in 2023 that the students volunteered to participate without such prompts. Again, in 2022, the teacher reminded the students to indicate if they agreed by showing an agreement sign, but the students were used to this routine in 2023, and the teacher no longer had to ask questions to prompt such student behavior.

By getting to know the teacher better, it is also possible that the students have learned to interpret more invisible cues. For instance, the teacher frequently paused and waited for the students to respond. Although it is beyond the scope of our analysis, we observed that the teacher used wait time in 2023, and the students often appeared to respond to this. However, further studies might be necessary to explore how such more invisible teacher moves might influence students' participation in mathematical discussions. Another plausible source of natural change is the teacher's implicit learning from interactions with students. It is plausible that the teacher might learn from her experience of interactions with the class and gradually adjust her questioning practice accordingly. The mere presence of researchers, knowing that some of the observers were interested in the questioning practices, might also support such implicit learning by the teacher. Finally, there is also a possibility that the curriculum and school culture might have influenced the teacher's questioning practices. This school used a mathematics curriculum that focused a lot on facilitating productive dialogues between teachers and students, and there is a possibility that this might influence the teachers' practices. It is challenging to single out such influences and measure their impact in a research study like this. However, our study demonstrates the possibility of natural change in teacher questioning. We suggest that future studies of teacher questioning continue to investigate different forms of natural variation or change in teacher questioning over time and explore the influences of this.

Third, we discuss differences in terms of *development*. Unlike variation or change, development indicates a direction, often in terms of improvement. Whereas only a few studies investigated the variation of teacher questioning in naturalistic settings, several studies have explored the development of teacher questioning. Many studies provide evidence that teachers' questioning can develop from teacher education or professional development (e.g., Aydogan Yenmez et al., 2018; Chapman, 2015; Christman et al., 2016; Gal, 2022; Heng & Sudarshan, 2013; Roberts, 2021), but there have also been studies showing that not all teachers develop their questioning practices from teacher education or professional development (e.g., Kabar & Tasdan, 2020). Research thus indicates that teacher questioning *can* develop from interventions, but such development is not always guaranteed.

Our study demonstrates that teacher questioning can develop naturally, without any intervention or development efforts, but a few potential caveats must be discussed. Although the teacher in our study did not participate in any professional development, and although our study did not involve any interventions, the mere presence of researchers might have influenced the teacher's practice. The first author had several informal discussions with the teacher during the project, and this teacher is continually striving to develop her practice. So, although our study did not include any interventions, there is always a possibility of influence that needs to be considered; we cannot rule out a possible Hawthorne effect. However, we argue that if a teacher's questioning practice can develop significantly with so little direct influence, it is worth attending to in future studies of teacher questioning.

Our study provides evidence of a general decrease in teacher questions—when this corresponds with increased student participation in discussions, it can be described as an improvement—and a broad shift in this teacher's questioning from one year to the next. The more nuanced analysis of sub-categories revealed a significant reduction in *call-for-participation* questions and the complete disappearance of questions *eliciting stance on a mathematical claim*. This indicates a development of questioning practices in this classroom. The qualitative analysis of the 2023 lesson indicates a slightly greater emphasis on eliciting explanations and mathematical reasoning, and this suggests a development in the teacher's pedagogical approach toward fostering deeper understanding through student-led discourse. It can also be argued that this development of questioning practice might correspond with a general development of the discussion climate in this class, where the students become increasingly more independent and active participants.

Our study has some obvious limitations. This study focused on a single teacher in a specific context, limiting the findings' generalizability. Future research should investigate the temporal dynamics of teacher questioning with a more extensive and diverse sample of teachers across different grade levels and instructional settings. The longitudinal perspective was particularly intriguing in our study, but the study was limited to only two years. Future longitudinal studies could track changes in questioning practices over an extended period, which might provide a richer understanding of how these practices evolve and adapt in response to various factors.

Conclusion

This study contributes to the growing body of research challenging the notion of teacher questioning as a static and context-independent phenomenon. By highlighting the temporal variations in questioning practices, this study offers a more nuanced understanding of how teacher questioning evolves and interacts with the complex dynamics of classroom learning. The findings have implications for teacher education, professional development, and future research on teacher questioning. For instance, the findings of this study underscore the importance of considering the temporal dimension in teacher education and professional development programs. Rather than focusing solely on isolated questioning techniques, these programs should support teachers in developing a flexible and adaptive questioning repertoire that can respond to the evolving needs of their students and classroom contexts.

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