TEACHERS' PERCEIVED BARRIERS TO PROMOTING CREATIVITY IN MATHEMATICS CLASSROOMS

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Although promoting creativity in mathematics education has been widely recognized as an important educational goal, creativity still plays a subordinate role in classroom practice. This suggests the presence of barriers to promoting creativity in mathematics classrooms. The present study investigates such barriers using a qualitative content analysis of 20 semi-structured interviews with in-practice mathematics teachers. The results reveal a wide range of barriers operating across multiple contexts, including the educational system, institutional, instructional, teacher, and student contexts. Within each context, specific barriers were identified that teachers perceived as hindering the promotion of creativity in mathematics classrooms.

INTRODUCTION

Creativity is widely regarded as a key competence for addressing the demands of the 21st century (Donovan et al., 2014; OECD, 2024). In mathematics education, creativity is considered particularly important, as mathematical activity involves problem solving, reasoning, and the generation of novel ideas. Consequently, promoting creativity has become an educational goal in many mathematics curricula. Despite this recognition, creativity continues to play a subordinate role in mathematics classroom practice. This discrepancy between educational goals and classroom practice points to the existence of barriers that hinder the promotion of creativity in mathematics instruction. Previous research has identified such barriers mainly from the perspective of pre-service teachers, highlighting narrow conceptions of creativity, insufficient preparation in teacher education, and challenges related to assessment practices (Bolden et al., 2010; Chamberlin & Moon, 2005). However, research has paid much less attention to how in-practice mathematics teachers experience these barriers in classroom practice, as their perspectives remain underexplored. In the present study, we investigated the barriers that in-practice teachers perceive as hindering the promotion of creativity in their classroom practice in order to gain a better understanding of why creativity-supportive approaches remain difficult to implement in mathematics instruction.

THEORETICAL BACKGROUND

Creativity in Mathematics Classrooms

Creativity in mathematics classrooms is often promoted through the use of specific tasks, including problem solving, problem posing, proving and multiple-solution tasks

2026. In H. Krzywacki, M. Hähkiöniemi, E. Haataja, M.S. Hannula & P. Hästö (Eds.). *Proceedings of the 49th Conference of the International Group for the Psychology of Mathematics Education: Research Reports*, pp. 619-626. PME.

(Elgrably & Leikin, 2021; Leikin & Elgrably, 2020; Leikin & Guberman, 2023). Within this line of research, mathematical creativity is understood as the ability to generate flexible, original, and useful solutions, to think critically, and to reason effectively, thereby promoting key components of creativity (Leikin, 2013). Open-ended and real-world problems, such as modelling problems or Fermi problems, have also been shown to enable students' creative thinking and problem solving (Lu & Kaiser, 2022; Okamoto, 2022; Schoenherr & Schukajlow, 2023). However, task characteristics alone do not determine the promotion of creativity in classroom practice. Instead, teachers and their beliefs shape students' opportunities for creative engagement through the ways they implement, scaffold, and discuss tasks (Li & Ma, 2025).

The Role of the Teacher

Teachers play a central role in fostering creativity in mathematics classrooms through their instructional practices and interactions with students. Drawing on Cropley's (1995) work, teachers who support creativity in the classroom actively foster students' autonomy and create a learning climate characterized by collaboration and social inclusion. They emphasize the development of a strong knowledge base as a prerequisite for creative thought, allow students time to elaborate their ideas before evaluating them, and encourage reflective and flexible ways of thinking. In addition, such teachers value students' contributions, offer diverse opportunities for exploration across varying materials and learning conditions, and help students develop resilience in the face of challenges, thereby supporting their willingness to explore unfamiliar and unconventional approaches.

Despite the strong potential of these instructional approaches, research indicates that creativity is seldom encouraged in mathematics classrooms (Sriraman, 2005), even though many teachers acknowledge its importance. Their implementation largely depends on teachers' beliefs, knowledge, and instructional decisions, which shape how tasks are selected, adapted, and facilitated in the classroom (Lev-Zamir & Leikin, 2011). Consequently, understanding what prevents teachers from promoting creativity is essential for identifying both barriers and opportunities related to its promotion in mathematics classrooms.

Perceived Barriers to Promoting Creativity

Previous research has addressed barriers to promoting creativity in mathematics education from pre-service teachers' perspectives. According to Bolden et al. (2010), one barrier lies in (pre-service) teachers' narrow conceptions of creativity, which are often associated primarily with the arts and rarely with mathematics. Mathematics is frequently perceived as a closed, rule-based domain focused on fixed procedures and correct answers, leaving little room for imaginative or independent thinking (Shriki, 2010). Bolden et al. (2010) describe that teachers emphasize "teaching creatively" – for example, by using engaging materials or technologies – rather than "teaching for

creativity", which focuses on promoting students' creative thinking. Teachers' own negative experiences with mathematics and a lack of preparation in teacher education programs further constrain the integration of creative practices, as educators often replicate traditional, teacher-centered approaches they experienced themselves (Bolden et al., 2010). In addition, creative processes and products are difficult to measure, making them poorly compatible with the assessment systems that prioritize accuracy and standardized testing (Chamberlin & Moon, 2005).

Despite growing interest in barriers and opportunities to promote creativity in mathematics education, existing research has largely centered on pre-service teachers, leaving the perspective of in-practice mathematics teachers underexplored. Barriers to promoting creativity perceived by in-practice teachers are particularly important because they reflect the challenges that arise in authentic classroom settings, where curricular demands, institutional constraints, and everyday instructional decisions directly shape students' opportunities for creative engagement.

Research Question

In this study, we investigated the following research question: Which barriers do in-practice mathematics teachers perceive as hindering for promoting creativity in mathematics classrooms?

METHODOLOGY

Participants and Procedure

This study employed semi-structured interviews with 20 in-practice mathematics teachers (10 female, 10 male) with heterogeneous years of teaching experience (M = 12.88 years; SD = 9.44 years). The first author and trained pre-service teachers conducted the interviews. The interview protocol began with general questions about teachers' understandings of creativity, followed by questions focusing on the promotion of creativity and creative thinking in mathematics classrooms. In particular, teachers were asked to reflect on the extent to which they perceive themselves as successful in promoting creativity, on the barriers or difficulties they encounter in doing so, and on how frequently they promote creativity in their mathematics teaching.

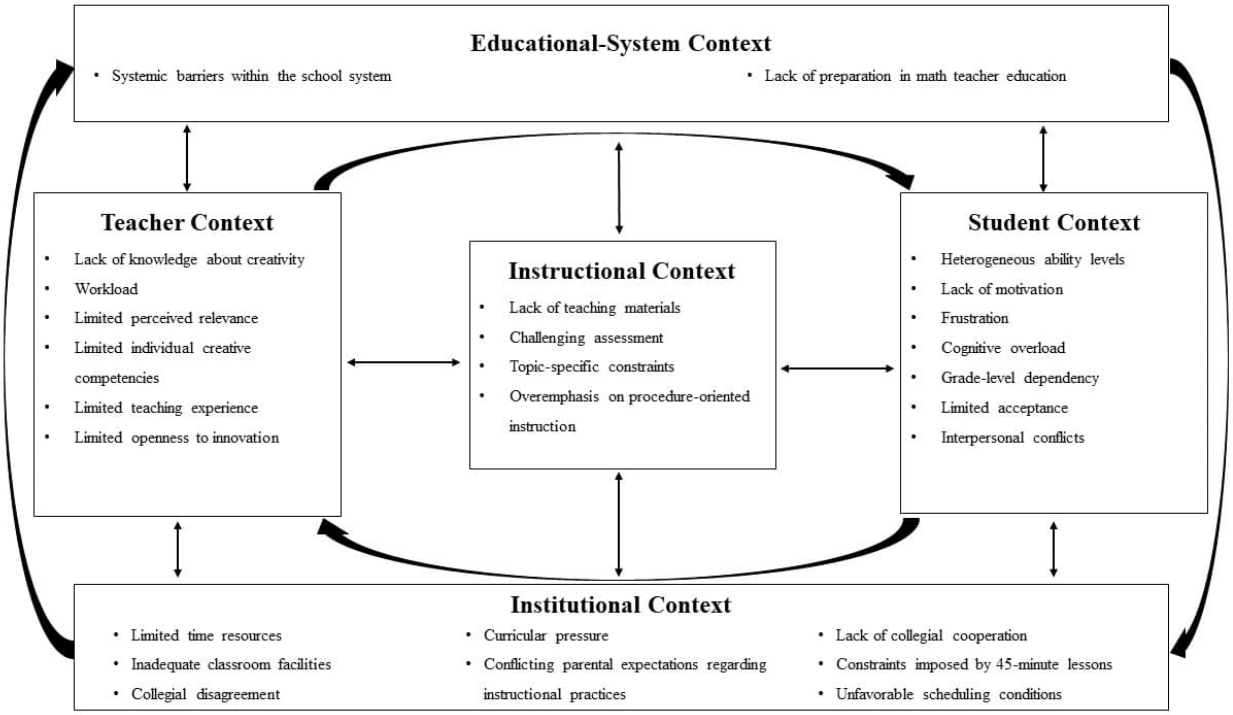
Data Analysis

We conducted a qualitative content analysis following an inductive approach. The first author coded teachers' statements regarding barriers to promoting creativity inductively, with categories derived directly from the data. We systematically grouped similar codes into categories and iteratively refined and abstracted. Throughout the coding process, the authors engaged in frequent communication and mutual validation of coding decisions. Discrepancies were discussed until consensus was reached. We present the resulting categories and subcategories in the Results section, illustrated in Figure 1.

RESULTS

The analysis of teachers' statements regarding barriers to promoting creativity resulted in a system of categories, reflecting multiple contexts of influence. The five identified contexts are the **Educational-System Context**, the **Institutional Context**, the **Instructional Context**, the **Teacher Context**, and the **Student Context**. Each context captures several barriers as described by the teachers, which are displayed in Figure 1.

Figure 1: Illustration of barriers to promoting creativity in mathematics classrooms



Educational-System Context

In terms of the educational-system context, teachers mention *systemic barriers within the school system*. For example, one teacher said:

> I would say that with the current system, creative work kind of falls by the wayside. I have to admit, though, that I don't really have a constructive suggestion for how it could be improved—just to point that out.

They also criticized a *lack of preparation in math teacher education*:

> And that means, in order to be able to foster creativity, you also have to be able yourself, have learned to solve tasks creatively, to think creatively. I think, for example, that this is completely missing in school mathematics teacher education, in the mathematics program.

Institutional Context

With regard to the institutional context, teachers reported several constraining factors, including *limited time resources* and *curricular pressure*:

> Due to the fact that one often simply does not have much time and somehow has a curriculum 'on one's neck' that one has to keep moving forward, I myself currently notice that in the longest phases of instruction there is not always necessarily room for creativity.

They also mentioned *lack of collegial cooperation*, *inadequate classroom facilities* (e.g., lack of technical equipment), *conflicting parental expectations regarding instructional practices*, *constraints imposed by 45-minute lessons*, *collegial disagreement* and *unfavorable scheduling conditions* (e.g., decreased concentration for creative engagement in late lessons).

Instructional Context

In terms of the instructional context, teachers primarily reported a *lack of teaching materials* to support the promotion of creativity:

> I think the biggest obstacle is, or sometimes simply finding suitable material. So, for example, when it comes to these proof tasks involving triangles, I don't think I would have come up with the idea of carrying out such proof methods in an open, creative way. And I think many ideas only occur to you once you see them, once you find appropriate material for them.

They also highlighted challenges related to *challenging assessment*, *topic-specific constraints* (e.g., creativity may be more easily promoted in geometry than in solving linear equation systems), and the difficulty of promoting creativity in the context of an *overemphasis on procedure-oriented instruction*.

Teacher Context

Beyond external constraints, teachers also reflected on factors to their own professional and personal context. For example, they reported *a lack of knowledge about creativity*:

> There is also the issue that the relevance of creativity may not be clear to everyone. For me, it was the same; I first had to think about what it actually means. At the beginning, I also focused on solving problems in different ways, and you realize that there are indeed several forms of creativity. So perhaps some initial awareness-raising among teachers could be helpful.

Teachers also described increased *workload* associated with integrating creativity into mathematics instruction, as well as *limited individual creative competencies*. They further questioned the *perceived relevance* of creativity in mathematics learning:

> But I don't place any particular emphasis on creativity in mathematics teaching. I know that it naturally occurs in mathematics and can be fostered there, but I wouldn't say that I actively promote it in any special way.

In addition, they referred to *limited teaching experience* promoting creativity and to challenges related to *limited openness to innovation* (e.g., continued emphasis on traditional instructional objectives).

Student Context

In addition, teachers also highlighted student-related barriers for promoting creativity in mathematics classrooms. They report challenges arising from *heterogeneous ability levels*, such as varying abilities and prior knowledge, as well as a *lack of motivation*:

> So I think that creativity tasks are tasks that you have to engage with and first find access to. If you have a learning group that is rather unmotivated—whether due to age or other reasons—they are then not really willing to take that first step to even understand a complex and, um, unfamiliar task, but immediately block and say, 'I don't know what they want from me, I'm not doing it.

Teachers reported additional barriers, including *frustration* and *cognitive overload*, which may be induced by open-ended problems and creative tasks:

> But it is already important to also support the lower-achieving students, because I think that overloading them in heterogeneous learning groups is indeed a problem with tasks that are highly open and require creativity.

They further identified *grade-level dependency* (e.g., creativity cannot be promoted equally across all grade levels), *limited acceptance* for creative tasks, and *interpersonal conflicts* (e.g., avoiding creativity-promoting activities due to potential conflicts among students) as additional barriers.

DISCUSSION

The present study extends existing research on barriers to promoting creativity in mathematics classrooms by providing insights from in-practice teachers. Findings indicate that barriers are not isolated but interrelated across multiple contexts, forming patterns that constrain teachers' promotion of creativity in mathematics classrooms.

Consistent with the findings of Bolden et al. (2010) and Shriki (2010), in-practice teachers reported a lack of knowledge about creativity, an emphasis on procedure-oriented instruction, challenges related to assessment, and a lack of preparation during mathematics teacher education. These findings suggest that these barriers persist beyond teacher education and continue into classroom practice, indicating that initial barriers are not automatically resolved through teaching experience alone.

Beyond barriers identified in previous research, our analysis of in-practice teachers' statements indicates additional barriers, operating at the institution, instruction, teachers, and student contexts. At the *institutional context*, teachers most frequently reported limited time resources and curricular pressure. These structural barriers may hinder creativity-supportive practices, which often require extended, uninterrupted learning periods and flexibility in instructional pacing. Many teachers described a tension between their intentions to promote creativity and the perceived obligation to adhere closely to curricular requirements, resulting in a prioritization of procedure-oriented instruction. Within the *teacher context*, teachers' perceived relevance of creativity, their own creative competencies, and openness to instructional innovation may constrain the promotion of creativity. These findings align with research

emphasizing teachers' professional beliefs and self-efficacy as key mediators between curricular intentions and enacted classroom practice (Li & Ma, 2025). At the *instructional context*, teachers reported a lack of teaching materials and topic-specific barriers, with uncertainty about how to promote creativity in certain topics potentially leading to a reversion to process-oriented instruction. This indicates that besides available tasks, teachers also require guidance on how they can meaningfully implement creative approaches across different mathematical topics. Teachers also reported barriers at the *student context*, such as heterogeneous ability levels and cognitive overload when working with creative and open-ended problems. These barriers reflect teachers' perceptions of student responses rather than direct assessments of students' experiences; however, such perceptions may shape instructional decisions, as perceived student frustration or disengagement can reinforce teachers' reluctance to implement creativity-supportive instruction and encourage a reliance on procedure-based learning.

Taken together, these findings point to a self-reinforcing cycle in which institutional constraints, teacher beliefs, instructional practices, and perceived student responses mutually sustain barriers to promoting creativity. Efforts to promote creativity are therefore likely to be most effective when addressing institutional, instructional, and teacher-related conditions simultaneously. Future research should examine how interventions, e.g., targeting teacher education, instructional materials, and assessment practices, interact to promote creativity in mathematics instruction.

Limitations

The present study has several limitations. First, we based our findings on a relatively small sample of mathematics teachers, which limits the generalizability of the results to broader populations or different educational and cultural contexts. Second, we analyzed qualitative interview data, which inherently involves interpretation. Although we applied systematic coding procedures, our perspectives and assumptions may have influenced how we identified and categorized factors, potentially affecting the objectivity of the results. Third, the semi-structured interview format led to variation in the depth and focus of discussions, which may have caused some factors to appear more prominent or less detailed, limiting the comprehensiveness of the data. We need more research to examine these factors in larger and more diverse samples, to explore their interactions across contexts, and to clarify the mechanisms through which they influence the promotion of creativity in mathematics education.

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