

Pre-service Teachers' Conceptions of Mathematical Promise: A Systematic Review

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Received: March 2026 || Accepted: September 2026

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Pre-service teachers' (PSTs) conceptions of mathematics teaching are reflected in their instructional practices. Understanding what PSTs consider to be mathematical promise can help teacher educators design courses that address these conceptions. This systematic literature review examines PSTs' conceptions of mathematically promising students (MPS) and the factors that influence these conceptions. The review follows a structured process consisting of literature search, selection, data extraction, analysis, and synthesis. The findings revealed that PSTs hold diverse conceptions about the characteristics of MPS and educational provisions for them. PSTs describe mathematical promise as both innate and developmental, encompassing cognitive, affective, and social dimensions. They emphasise the need for challenge and a supportive learning environment to foster the development of students' mathematical potential and stress the importance of teachers having a facilitative role. The review also underscores the influence of teacher education on shaping PSTs' conceptions, although personal school experiences and media portrayals of mathematical promise can also have an impact.

Keywords • mathematics teacher education • mathematical promise • conceptions • pre-service teachers • mathematical creativity

Introduction

Mathematics teacher education is designed to prepare pre-service mathematics teachers (PSTs) for the profession, covering a variety of aspects. The practice of mathematics teaching involves responding to each student's level of mathematical development and understanding, including students demonstrating promise in mathematics (Tomlinson et al., 2003). Mathematical promise is closely related to mathematical creativity, as the latter can be a prerequisite for, a component of, or a consequence of, the former (Assmus & Fritzlar, 2018). Supporting the learning of mathematically promising students (MPS) requires specialised knowledge about mathematical learning and teaching in comparison to other students. In a systematic review, Uysal's (2025) found that PST training generally enhanced the future teachers' knowledge and skills for supporting promising students, although challenges remained regarding practical application, assessment, and contextual relevance. PSTs' experiences, for example from their studies, practicum, and interactions with peers, shape their perspectives of diverse types of students. PSTs' views on teaching, learning, and thinking processes are reflected in their mathematics teaching practices, where they commonly employ a problem-solving approach (Senawongsa et al., 2023). Diverse experiences lead to diverse views, highlighting the importance of teacher education programs providing opportunities for PSTs to develop conceptions about teaching MPS that enhance further learning. In this review, the term *conception* is used as defined by Thompson (1984), encompassing concepts such as views, perceptions, beliefs, awareness, opinions, expressions, and attitudes in references to PSTs' professed beliefs, views, and preferences. There is an



identified lack of research on how to best prepare PSTs for their future profession (Hine & Herbert, 2022). Hine and Herbert (2022) showed that mathematics methods courses with practicum can shift PSTs' conceptions of teaching and learning, underscoring the need to challenge preconceived conceptions. Similarly, research on PSTs' conceptions of what constitutes MPS and how to teach them can guide teacher educators in designing courses and teaching methods for PSTs (e.g., Bolden et al., 2010).

Against the present background, a comprehensive review of research findings on PSTs' varying conceptions of MPS and how to teach them, including factors influencing these conceptions can contribute to a nuanced understanding of mathematics teacher education in relation to the inclusion of all students and design of relevant courses. It can also shed light on the diverse terminology and definitions used for mathematical promise and related concepts. The study is directed by the following research questions.

According to existing research:

- (1) *What conceptions do pre-service teachers have of mathematically promising students' characteristics?*
- (2) *What conceptions do pre-service teachers have regarding educational provisions for mathematically promising students? and*
- (3) *What factors influence pre-service teachers' conceptions of mathematically promising students?*

Background

This section presents previous research on the characteristics of mathematical promise and creativity. A discussion on how these concepts overlap and relate to each other follows, along with a problematisation of educational provisions for MPS. Lastly, the theoretical underpinnings of the concept of conceptions are outlined.

Mathematical Promise

An issue that complicates the conceptualisation of mathematical promise is the lack of a shared definition and the varied interpretations across research and educational contexts (Leikin, 2018; Singer et al., 2017). As a culturally situated concept, its meaning depends on context (Dai & Chen, 2013), resulting in overlapping terms such as mathematical giftedness, talent, potential, and promise (Sheffield, 2017). While these terms are sometimes used synonymously, they are also described as hierarchically related (Leikin, 2018; Sheffield, 2003, 2017). Talent, promise, and potential are often framed as dynamic and developable, whereas giftedness is more commonly viewed as inherent (Leikin, 2018).

The term *mathematical promise* was introduced by the National Council of Teachers of Mathematics as a broader alternative to giftedness, extending beyond the traditionally identified top 3–5% performers (Singer et al., 2016). It is defined as a function of ability, motivation, beliefs, and opportunities, capacities that can and should be nurtured in all students (Sheffield, 2003). From this perspective, mathematical giftedness or talent may be seen as subcategories of mathematical promise (Leikin, 2018).

A commonly referenced framework for understanding mathematical promise stems from Krutetskii's (1976) analysis of mathematical abilities in problem-solving. He identified abilities related to obtaining, processing, and retaining mathematical information, as well as a general "mathematical cast of mind." Additional characteristics, such as pace of work, computational skills, memory for symbols, and spatial visualisation, may be present but are not unique to giftedness. In this review, mathematical promise is used as an overarching term encompassing related concepts (e.g., giftedness), emphasising its dynamic, domain-specific, and context-dependent nature (Krutetskii, 1976; Sheffield, 2003). MPS do not form a homogeneous group; their strengths may manifest in diverse ways, such as flexible reasoning or creative problem-solving (Singer et al., 2016), and they may also encounter social and educational challenges (Coleman & Cross, 2014).



Mathematical Creativity

Mathematical creativity is closely related to mathematical promise. Both constructs lack a commonly agreed-upon definition, and descriptions of creativity are often vague, reflecting the difficulty of capturing its nature (Singer et al., 2017; Sriraman, 2005). Researchers such as Lev-Zamir and Leikin (2011), drawing on Torrance (1974), described mathematical creativity in terms of fluency, flexibility, originality, and elaboration. Fluency refers to generating multiple ideas or solutions; flexibility to approaching problems in varied ways; originality to producing novel responses; and elaboration to developing ideas in depth (Lev-Zamir & Leikin, 2011; Mann et al., 2017). Together, these components are commonly understood as forms of divergent thinking (Nadjafikhah & Yaftian, 2013). Being able to think divergently is considered essential to creativity and contrasts with convergent thinking. Divergent thinking is open-ended in nature (Aiken, 1973) and can increase opportunities for original thoughts (Kwon et al., 2006), hence open-ended mathematical problems with several possible solutions enable students to think divergently.

Sriraman (2005) defined mathematical creativity at the K–12 level as “the process that results in unusual (novel) and/or insightful solution(s) to a given problem or analogous problems, and/or the formulation of new questions and/or possibilities that allow an old problem to be regarded from a new angle requiring imagination” (p. 24). This definition encompasses both the process through which new mathematical ideas emerge and the outcomes of that process. A similar distinction is evident in Haylock’s (1997) account of how creative thinking can be recognised in students. One approach establishes criteria for judging a product as creative, whereas another approach focuses on students’ responses to problem-solving activities designed to elicit cognitive processes associated with creativity.

Mathematical Promise in Relation to Mathematical Creativity

The relationship between mathematical promise and mathematical creativity is complex (Sriraman, 2005). The constructs have sometimes been treated as closely aligned or even synonymous, whereas others position mathematical creativity as a component or precondition of mathematical promise (Assmus & Fritzlar, 2018). More recently, Chamberlin et al. (2026) similarly emphasised that mathematical creativity and mathematical promise are closely related but distinct constructs and caution against treating them as conceptually interchangeable. Creativity nevertheless occupies a central position in broader models of promise. In Renzulli’s (2005) three-ring conception, for example, gifted behaviour emerges through the interaction of above-average ability, creativity, and task commitment, in interaction with social and environmental factors. Similarly, Schindler and Rott’s (2017) synthesis of Krutetskii’s (1976) framework and Renzulli’s conception demonstrates substantial correspondence between mathematical abilities associated with promise and characteristics of creativity. Krutetskii’s flexibility of mental processes, broad generalisation of mathematical objects and relations, striving for simple and effective solutions, and mathematical cast of mind, correspond closely to characteristics commonly associated with mathematical creativity, including flexibility, fluency, and originality (e.g., Lev-Zamir & Leikin, 2011).

Thus, mathematical promise and mathematical creativity are not assumed to be theoretically identical constructs in this review. Rather than treating them as conceptually synonymous, mathematical creativity is considered an important dimension or manifestation of mathematical promise for the purpose of identifying and synthesising PSTs’ conceptions. This analytical decision rests on the substantial overlap in the characteristics through which the two constructs are recognised in mathematics education: both foreground flexible and original mathematical thinking, generalisation, problem sensitivity, and the production of novel or insightful solutions. Moreover, in dynamic and contextual conceptualisations of mathematical promise (e.g., Renzulli, 2005; Sheffield, 2003), creativity constitutes one way in which mathematical potential can be expressed and recognised rather than an unrelated ability. Consequently, studies examining PSTs’ conceptions of mathematical creativity can provide insights about how PSTs recognise, interpret, and respond to an important dimension of mathematical promise, even when the studies frame their focus in terms of creativity. It is in this



analytical sense that articles of mathematical creativity are included within the broader scope of mathematical promise in the present review.

Educational Provisions for Mathematically Promising Students

Krutetskii (1976) emphasised that mathematical abilities develop through appropriate teaching methods and engagement in meaningful mathematical activity. Similarly, Renzulli (2005) argued that gifted behaviour requires varied learning opportunities, encouragement, and resources. Since students learn differently, educational provision for MPS necessitates differentiation (Reed, 2004), commonly achieved through modifications of content, process, or product (Tomlinson et al., 2003). Learning opportunities, both in school (e.g., ability grouping and special classes) and outside school (e.g., math clubs and university courses), are considered crucial for fostering mathematical promise (Leikin, 2010; Sriraman, 2003).

Challenge is a central provision for MPS. Leikin (2010) defines a mathematical challenge as a motivating difficulty that a student can overcome, emphasising its individual and contextual nature. Challenging tasks often involve multiple solution paths, inquiry, non-routine structures, or connections across topics (Applebaum & Leikin, 2007). Solving problems alone, however, is insufficient for developing mathematical creativity, an integral aspect of mathematical promise. Students also need opportunities for problem posing and teacher scaffolding that extends their thinking (Sheffield, 2006; Singer et al., 2016). Providing such challenge requires strong mathematical and pedagogical knowledge (Leikin, 2011).

Enrichment and acceleration are proposed to address the cognitive and affective needs of MPS, either as separate provisions or in combination with ability grouping (Gavin et al., 2009; Leikin, 2010; Singer et al., 2016). Whereas enrichment extends and deepens curricular content, acceleration enables faster progression without necessarily broadening students' learning experiences (Koshy & Casey, 2005). Ability-based grouping may similarly create opportunities for instruction that is more responsive to the learning needs of MPS (Dimitriadis, 2012). Importantly, the educational value of these provisions depends on how they are enacted in the classroom. Teachers therefore play a central role in creating learning environments that value alternative ideas, unconventional solutions, encourage risk-taking, reflection, and flexible thinking rather than focusing solely on correct answers (Leikin, 2010; Nadjafikhah et al., 2012).

Theoretical Underpinnings

Conceptions refer to teachers' professed beliefs, views, and preferences and are related to, although not necessarily aligned with, instructional practice (Thompson, 1984). Pratt (1992) similarly described conceptions as underlying beliefs and assumptions that guide practice and emphasised their dynamic, socially and culturally situated nature. Hence, one cannot say that certain conceptions are wrong or right as they are consistent with particular people, contexts, and purposes (Pratt, 1992).

A literature review by Mladenovici et al. (2024) highlighted that conceptions of teaching and beliefs about teaching originate from different theoretical perspectives: a phenomenological approach characterised by qualitative methods and a cognitive approach characterised by quantitative methods. They concluded that several articles explicitly acknowledge that the terms conceptions of teaching and beliefs about teaching are used interchangeably, despite being grounded in different theoretical frameworks. Based on this, we cannot separate the different terms/concepts used in the articles included in the present review, as terms often are used interchangeably. The PSTs' expressed conceptions are considered as they are presented in the articles included in the review, without extending them beyond the specific situations or contexts in which they were reported. In relation to the phenomenon of mathematical promise, we consider conceptions as underlying beliefs and assumptions that shape how PSTs interpret, characterise, and respond to MPS.



Method

To address the aim of investigating existing research on PSTs' conceptions of MPS characteristics, educational provisions for MPS and what influences these conceptions, a systematic literature review was conducted. The review was inspired by the stages described by Gough et al. (2017) and was conducted in four steps: literature search, selection of literature, data extraction, and analysis. The set of data includes entries that can be called, for example, articles, papers, and studies. To avoid confusion, they will all be called articles in this review.

Literature Search

In the initial stage, an extensive search was done to identify relevant terms for the final search string. The initial search was conducted in Kristianstad University's interdisciplinary database "Summon" using terms such as "promis*" combined with "math*", "pre-service teacher" and "conception*" as four separate search blocks. Within each block, the "OR"-operator was used between synonyms, and the "AND"-operator was used between the blocks to include all blocks in the sought text. The four blocks were identified as relevant to the aim and research questions of the review. By reading titles, keywords, and abstracts in the articles, the blocks were extended with relevant search terms acting as synonyms.

The final searches were conducted in the online databases ERIC, PsychINFO, Scopus, and Web of Science, which all contain articles performed in educational contexts. The final version of the search string is as follows:

(gifted* OR "highly able*" OR creativ* OR "high abilit*" OR promis* OR aptitude OR talent* OR "high-achieving" OR superior OR "high* achievement*" OR "gifted student*" OR "gifted child*" OR "gifted education") AND (perception* OR feeling* OR opinion* OR conception* OR emotion* OR viewpoint* OR attitude* OR experience* OR thought* OR belief* OR evaluati* OR impression* OR perspective* OR awareness OR notion* OR view* OR judgement* OR reflection* OR value*) AND (teacher* NEAR ("pre-service" OR "pre service" OR preservice OR prospective OR future OR aspiring OR student* OR graduate OR educat* OR prepar* OR training)) AND math*

Selection of Articles

Inclusion criteria are typically used to identify relevant literature for a systematic review based on the aim and research questions of the review (Xiao & Watson, 2019). The initial inclusion criteria were applied as search filters. Firstly, the criteria *peer-reviewed* and *English* were used to ensure the availability of quality articles in English. To maintain contemporaneity, articles published from the year 2000 until the search date (November 15th, 2024) were considered. Lastly, articles had to be empirical. When all limitations were applied, the final search string yielded a total of 651 articles (ERIC 157, PsychINFO 32, Scopus 313, and Web of Science 149) articles. After removing duplicates ($n = 179$), 472 unique articles remained.

Articles were included in the review based on three inclusion criteria denoted A (Setting), B (Participants) and C (Topic) listed in Table 1. First, articles had to be within the scope of K–12 mathematics teacher education to be included, leading to exclusions based on Criterion A for those that did not meet this requirement. Inclusion Criterion B stipulates that participants in studies in the articles included must be PSTs, and focus must be on their conceptions, including related concepts. Articles featuring different participants or focusing on unrelated topics were excluded. Lastly, based on Criterion C, the articles were screened to address aspects of MPS as a topic related to PSTs' conceptions. In terms of mathematical promise, articles focusing on conceptions related to MPS and teaching fostering mathematical promise were included. This led to the exclusion of articles that did not refer to mathematical promise. All titles and abstracts were screened sequentially according to Criterion A, then B and C, resulting in the exclusion of 430 articles ($A = 319$, $B = 102$, and $C = 9$) (Figure 1). A total of 42 articles required full-text screening to determine suitability, resulting in 14 articles included after the search in databases. All articles were screened independently by at least two of the authors. The first



author screened all articles, while the other two authors screened one half of the set of articles each. This collaborative approach ensured that decisions regarding inclusion and exclusion were made with the consensus of at least two authors. In instances of disagreement, the authors engaged in discussions and reached a collective resolution.

Table 1

Overview of Inclusion and Exclusion Criteria Based on Setting, Participants, and Topic

	Criteria	Inclusion	Exclusion
Setting	A	K–12 mathematics teacher education	Pre-school teacher education, professional development programs, in-service teacher development programs, higher education, special education, other subjects than mathematics
Participants	B	PSTs' conceptions (and synonyms)	PSTs' noticing, lesson planning, skills, problem/task solving, competences, knowledge
Topic	C	Mathematical promise and mathematical creativity (in K–12 education)	Diversity, disabilities/difficulties, mathematically promising or creative PSTs, creative teaching

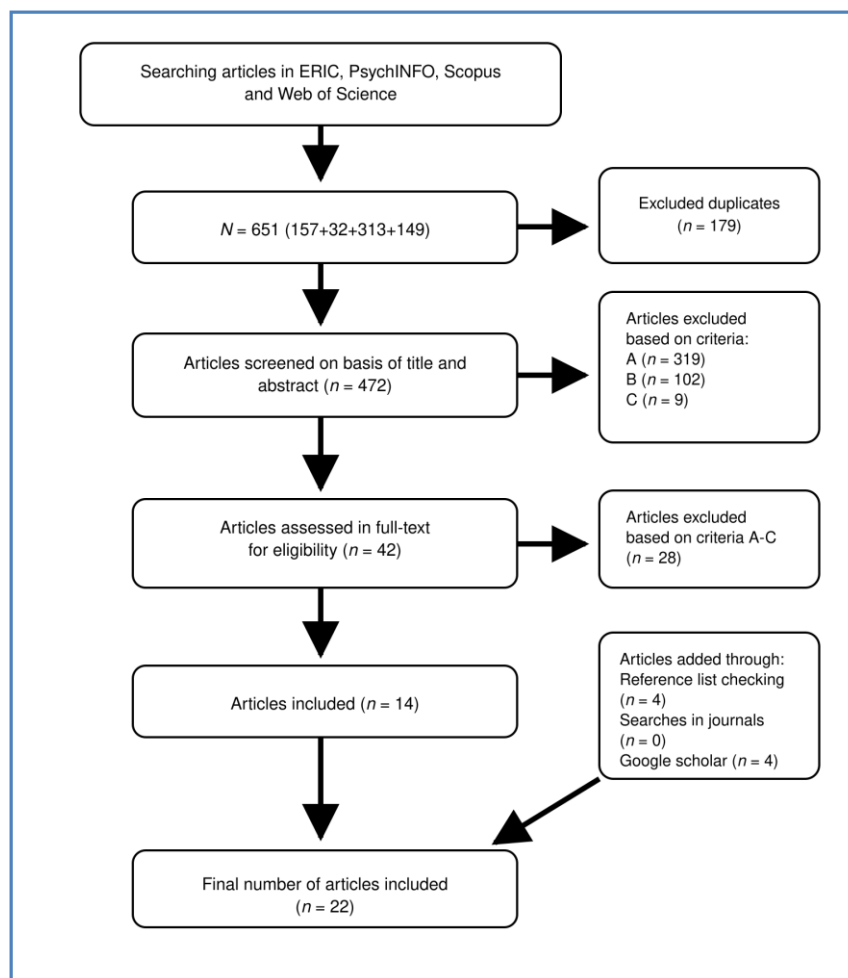


Figure 1. Flow chart showing the steps of inclusion and exclusion for articles.



In addition to online searches in databases, reference list checking (Gough et al., 2017) and searches in established journals and Google Scholar were employed. Reference list checking involved reviewing articles in the reference lists of articles already included. The abstracts of articles were screened based on the inclusion and exclusion criteria in Table 1. This resulted in the full text of 36 articles being screened from which four articles were included. The searches in journals focused on the three most occurring journals identified in the articles already included (*Gifted Child Quarterly*, *Educational Studies in Mathematics* and *Journal for the Education of the Gifted*). The same search terms and limitations as in the database searches were applied, and titles and abstracts were screened according to the inclusion criteria. The articles that fulfilled all three inclusion criteria had already been identified through the preceding search procedures. Consequently, the search yielded no additional unique articles for inclusion in the review.

Finally, Google Scholar was used as a supplementary search source. Its broad coverage may facilitate the identification of relevant material not indexed in traditional bibliographic databases, including conference proceedings and doctoral theses. Nevertheless, it is recommended as a complement to, rather than a substitute for, systematic database searching (Haddaway et al., 2015; Khalil et al., 2026). Accordingly, Google Scholar was used to identify potentially relevant articles not retrieved through the preceding search procedures. Given its more limited functionality for complex Boolean searches, the search strategy used in the bibliographic databases was adapted into two shorter searches based on the same three conceptual components: PSTs, mathematical promise, and conceptions. The searches distinguished between terms related to giftedness, promise, and talent and those related to mathematical creativity, while the same core terms representing conceptions (attitudes, conceptions, perceptions, and views) were used in both searches. The searches returned 387 and 273 results, respectively. As Google Scholar ranks results by relevance and generates large result sets, the first 100 results from each search were screened by title and abstract. Potentially relevant records were subsequently assessed against the same inclusion criteria as those applied in the primary search. This supplementary procedure resulted in four additional articles being included.

As such, additional searches resulted in eight articles, resulting in a total of 22 articles included in the review (Figure 1). The articles included were published between 2010 and 2024, and the publication year of each article is reported in Table 2 (see Results section). Despite the search in four databases, journals, Google Scholar, and reference lists, relevant articles may have been missed. By limiting searches to title, abstract, and keywords, articles that do not explicitly mention the search terms in these fields are excluded. The decision to only include articles available in English means that relevant articles published in other languages are not included. Eight of the 22 articles included were conference papers found in Google Scholar or reference lists, suggesting that more relevant articles may exist in for example, conference proceedings, dissertations, or book chapters.

The quality of the articles included was appraised using ten quality criteria proposed by Croucher et al. (2003), which allow qualitative and quantitative studies to be assessed within the same framework. The criteria comprise five essential criteria: clarity of the research question, appropriateness of the study design, sampling, data collection, and data analysis, and five desirable criteria concerning theoretical perspective, context, reflexivity, generalisability, and ethics. Each criterion was assessed by the first author as met or not met. All 22 articles included met the five essential criteria and were therefore retained. Importantly, the level of detail in the reporting of the analytical procedures varied across articles, with some providing briefer descriptions than others of how the data were analysed. Greater variation was found regarding the desirable criteria, particularly concerning the reporting of ethical considerations and, to a lesser extent, reflexivity and generalisability.

Analysis and Data Extraction

To address the research questions concerning (1) PSTs' conceptions of MPS characteristics, (2) educational provisions for MPS, and (3) factors influencing PSTs' conceptions, a qualitative content analysis was conducted. This approach allowed categories to be derived from the data within the scope of the research questions (Hsieh & Shannon, 2005). A systematic analysis of the results sections of the included articles was undertaken, focusing on manifest content, that is, the explicit and visible components of the text (Graneheim & Lundman, 2004).

In the first step, descriptive data were extracted from the 22 articles included, including author(s), year, school level, context, aims, research questions, theoretical frameworks, methods, and summaries of results. This information was organised in tabular form to support familiarisation with the dataset. In keeping with Gough et al. (2017), attention was also paid to how the authors defined and positioned key concepts such as mathematical promise. These data informed the interpretation of respective study's positions and are reported in Table 2 in the Results section.

In the second step, segments in the results sections that explicitly addressed each of the three research questions were identified and marked. Given the methodological heterogeneity of the research included the synthesis did not involve re-analysis or interpretation of primary data, such as interview excerpts or statistical outputs. Instead, segments in the results sections that explicitly addressed the three research questions were identified and treated as textual units of analysis. For studies reporting quantitative findings, only the original authors' narrative descriptions and interpretations of their results were included in the analysis; the statistical data were not reinterpreted. Applying this common unit of analysis enabled findings from studies employing different methodologies to be compared and synthesised at the level of the authors' reported conclusions.

Within these marked segments, initial codes were generated to capture recurring descriptions of PSTs' conceptions related to mathematical promise. While coding remained grounded in the explicit content of the articles, the analysis followed an abductive logic, involving iterative movement between data and relevant theoretical perspectives (e.g., Krutetskii, 1976; Sheffield, 2003; Thompson, 1984), which functioned as sensitising frameworks in the interpretation. Codes were compared for similarities and differences and clustered into broader patterns, forming categories within each research question. These categories were iteratively refined through repeated revisiting of the coded material to ensure internal coherence and consistency.

As an example, a segment from Yazgan-Sağ (2024), "PT-23 proposed that the teacher can guide the students to investigate these questions even if the teacher knows the answer" (p. 123) was coded as *teacher as facilitator*. Through comparison with similar expressions across the dataset, this code was interpreted as reflecting a belief about the teacher's role as guiding inquiry rather than providing direct answers. Drawing on Thompson's (1984) conceptualisation of conceptions as practice-guiding beliefs, this interpretation led to its placement within the broader category *Learning environment and teacher's role*, related to Research Question 2. In total, seven categories were identified across the three research questions in a similar manner. For research question (1), the categories were *mathematics-specific characteristics* and *non-mathematics-specific characteristics*. For Research Question 2, the categories were *differentiation*, *mathematical tasks and challenge*, and *learning environment and teacher's role*. For Research Question 3, the categories were *teacher education contexts* and *personal and cultural experiences*.

The final step involved synthesising and reporting the categories for each research question. The analysis was iterative rather than linear, involving repeated movement between steps and continuous refinement of codes and categories (Gough et al., 2017). The first author coded all articles, while the remaining authors divided the articles among themselves; consequently, each article was coded by at least two authors. Although several stages of the analysis were conducted individually, regular meetings were held to discuss interpretations and reach consensus (Graneheim & Lundman, 2004). In cases of disagreement, the relevant data and codes were revisited and discussed until consensus was achieved.



Results

First, an overview of the articles included is presented. The concepts used to refer to mathematical promise in the articles, the publication year, the geographical context, and the applied research methods, are presented in Table 2. In this review, the term mathematical promise is used as an overarching concept encompassing a range of descriptions found in the literature, including those referring to mathematical creativity. Accordingly, characteristics and educational provisions associated with mathematically creative students are interpreted as expressions of PSTs' conceptions of mathematical promise in the results.

Table 2
Overview of the Articles Included

No.	Articles	Year	Geographical Location	Concept	Method(s)*
1	Applebaum et al.	2011	Canada, Israel	Talented	I, Q
2	Arabacı & Danişman	2023	Turkey	Gifted	I
3	Assmus & Benölken	2021	Germany	Gifted	Q
4	Berg	2010	United States	Creative	Q
5	Bicer et al.	2022	United States	Creative	I, O, Q
6	Bolden et al.	2010	United Kingdom	Creative	I, Q
7	Chamberlin & Chamberlin	2010	United States	Gifted	WJ
8	Emre-Akdoğan & Yazgan-Sağ	2015	Turkey	Creative	I
9	Kim et al.	2019	South Korea	Creative	Q, SD, WR
10	Pagiling et al.	2021	Indonesia	Highly able	Q
11	Panaoura & Panaoura	2014	Cyprus	Creative	SD, WR
12	Safrudiannur et al.	2021	Indonesia	High achieving	Q
13	Safrudiannur et al.	2023	Indonesia	High achieving	Q
14	Shriki	2010	Israel	Creative	SD, WR
15	Sumpter & Sternevik	2013	Sweden	Gifted	Q
16	Waswa & Moore	2020	United States	Creative	O, I
17	Wessels	2017	Europe	Creative	I, Q
18	Yazgan-Sağ	2019	Turkey	Gifted	I
19	Yazgan-Sağ	2020	Turkey	Gifted	I
20	Yazgan-Sağ	2022	Turkey	Gifted	I
21	Yazgan-Sağ	2024	Turkey	Gifted	I
22	Yazgan-Sağ & Emre-Akdoğan	2016	Turkey	Creative	I

*I: interview, O: observation, Q: questionnaire, SD: student discussions, WJ: written journals and WR: written reflections.

Table 3 summarises how the articles included are categorised in this review. The table illustrates the alignment between research questions, analytical categories, and the empirical sources informing each category, and serves as a reference point for the results presented in the sections that follow according to each research question. First, PSTs' conceptions of MPS characteristics are reported, organised into the categories mathematics-specific and non-mathematics-specific characteristics. Second, PSTs' conceptions of educational provisions for MPS are presented, focusing on instructional adaptation and challenge as well as learning environments and teachers' roles. Third, influences on PSTs' conceptions of mathematical promise are reported, categorised into formal and professional learning contexts and personal, cultural, and experiential influences.



Table 3
Overview and Description of Identified Categories Related to Each Research Question (RQ)

RQ	Category	Brief Descriptions of PSTs' Conceptions	No. of articles
1	Mathematics-specific characteristics	Engagement with mathematical ideas (2*, 3, 7), advanced and abstract thinking (1, 2, 3, 7, 20), conceptual understanding (18, 19), recognition of mathematical structures and connections (2, 3, 17), flexible and advanced problem-solving (1, 2, 3, 7, 15, 17, 18) and computation skills (6), generating multiple strategies and solutions (1, 2, 5, 7, 8, 11, 15, 16, 17), explaining and justifying approaches (2), speed (1, 2, 3, 7, 18, 19, 20), developing own methods and using unique approaches (6, 7, 14, 17, 20, 22)	16
	Non-mathematics-specific characteristics	Motivation (2, 7, 15), perseverance (2, 3, 7, 17), industrious (15), curiosity (2), confidence (15), enjoyment (1, 2, 17, 18), enhanced memory (2, 3), creativity (2, 7, 15, 20), openness and willingness to learn (1, 3), boredom or frustration when insufficiently challenged (2, 3, 7, 20), and possible social challenges (2, 7, 19) are highlighted, and MPS ask challenging questions (2, 3, 8, 19) and demonstrate fast learning (15).	10
2	Differentiation	Differentiation is described through enrichment (1, 7, 19, 21) and acceleration (1, 7, 19, 21) alongside varied levels of challenge and flexible grouping practices (1, 7, 21), while also raising concerns related to equity and classroom norms (4, 10, 12, 13, 19).	5
	Mathematical tasks and challenges	PSTs emphasise challenging mathematical tasks as central to supporting MPS (7, 16, 17, 19, 21). Suitable tasks are described as open-ended (1, 7, 8, 17), inquiry-based (1, 7), non-routine (1, 14), realistic (7, 8, 11, 16, 22), and allowing multiple solution pathways (1, 7, 17) with challenge linked to depth of engagement.	10
	Learning environment and teacher's role	Learning environments that support questioning, exploration, and communication of mathematical ideas (9, 17, 21) are emphasised, where teachers are described as facilitators who scaffold students' thinking (7, 14, 16), value multiple approaches (17, 21), teach for creativity (5, 6), and support MPS through task design and interactional practices (1, 6, 14). Teachers should use MPS as resources in class (7), and use manipulatives (8, 9, 16, 22).	13
3	Teacher education contexts	Influences on conceptions by participation in teacher education courses and interventions, which contribute to shifts from viewing mathematical promise as innate and product-oriented toward understanding it as developmental and process-oriented (5, 7, 9, 11, 13, 14).	5
	Personal and cultural experiences	Influences on conceptions by personal schooling experiences (6, 11, 19, 20), emotional histories, cultural norms, societal expectations, and exposure to media, contributing to variation in how MPS is recognised and interpreted across contexts (12, 18, 20, 21).	7

*Note. Numbers in parentheses denote the included articles (see Table 2) in which the respective category was reported. The final column shows the number of unique articles contributing to each category.

PSTs' Conceptions of Mathematically Promising Student Characteristics

PSTs' conceptions of MPS characteristics are reported in two categories, either as mathematics-specific or non-mathematics-specific.



Mathematics-specific characteristics

PSTs described mathematical promise in terms of how students engage with mathematical ideas, rather than in terms of specific curricular outcomes. Mathematical promise is described through the depth and structure of mathematical thinking, reflected in students' abstract reasoning, conceptual understanding, and critical engagement with mathematical ideas. PSTs reported that MPS often operate at a level described as beyond grade level (Applebaum et al., 2011; Arabacı & Danişman, 2023; Assmus & Benölken, 2021; Chamberlin & Chamberlin, 2010; Yazgan-Sağ, 2022). These students are described by PSTs as focusing on underlying structures and relationships within mathematical concepts, distinguishing them from peers in how they approach and interpret mathematical content (Yazgan-Sağ, 2019). Enjoyment of working with numbers, symbols, and complex operations is reported in connection with this form of engagement (Applebaum et al., 2011; Arabacı & Danişman, 2023; Wessels, 2017; Yazgan-Sağ, 2019).

Mathematical promise is also described through generation of and variability of mathematical approaches. PSTs reported that MPS generate multiple solution strategies, adapt methods, approach problems in flexible and varied ways (Applebaum et al., 2011; Arabacı & Danişman, 2023; Bicer et al., 2022; Chamberlin & Chamberlin, 2010; Emre-Akdoğan & Yazgan-Sağ, 2015; Panaoura & Panaoura, 2014; Shriki, 2010; Sumpter & Sternevik, 2013; Waswa & Moore, 2020; Wessels, 2017) and generate their own varied solutions (Waswa & Moore, 2020). Rather than emphasising a single correct method, these descriptions highlight the production of alternative approaches and the ability to explain and justify them using mathematical representations (Applebaum et al., 2011; Waswa & Moore, 2020).

Another pattern concerns tempo versus method. In multiple articles, PSTs associate mathematical promise with fast learning, fast processing of mathematical tasks, and quick calculations (Applebaum et al., 2011; Arabacı & Danişman, 2023; Assmus & Benölken, 2021; Chamberlin & Chamberlin, 2010; Yazgan-Sağ, 2019, 2020, 2022). In contrast, some articles reported that PSTs place less emphasis on speed and instead consider it more notable when MPS develop their own solution methods, demonstrate adaptability, and persist in exploring multiple strategies (Yazgan-Sağ, 2022).

Problem-solving appeared across the articles included, and PSTs conceived MPS as being able to solve non-routine and multiple-solution problems, draw on prior mathematical knowledge, and recognise connections between mathematical ideas (Arabacı & Danişman, 2023; Assmus & Benölken, 2021; Chamberlin & Chamberlin, 2010). However, the way this problem-solving ability is characterised varies, with some articles emphasising efficiency (Applebaum et al., 2011; Yazgan-Sağ, 2019, 2022) and others emphasising originality and flexibility (Bolden et al., 2010; Emre-Akdoğan & Yazgan-Sağ, 2015; Yazgan-Sağ & Emre-Akdoğan, 2016; Wessels, 2017).

Further variation appears in how PSTs describe the nature of mathematical promise over time. Some articles reported that PSTs describe MPS as having an innate talent for mathematics, often linked to high performance and minimal effort (Yazgan-Sağ, 2019), while others reported that PSTs describe mathematical promise as changeable, noting that it may decrease when students do not engage in effort or development (Yazgan-Sağ, 2022).

Non-mathematics-specific characteristics

Compared to mathematics-specific characteristics, non-mathematics-specific characteristics are reported more unevenly across articles and are often described as contextual or accompanying features of mathematical promise rather than defining attributes. PSTs associate mathematical promise with general learning orientations, such as working efficiently, learning quickly, and managing multiple tasks (Applebaum et al., 2011; Assmus & Benölken, 2021; Sumpter & Sternevik, 2013). These characteristics are described independently of mathematical content.

PSTs also described MPS as highly motivated, industrious, focused, confident, creative, curious, and willing to learn (Applebaum et al., 2011; Arabacı & Danişman, 2023; Assmus & Benölken, 2021; Chamberlin & Chamberlin, 2010; Sumpter & Sternevik, 2013; Wessels, 2017; Yazgan-Sağ, 2022). Chamberlin and Chamberlin (2010) reported that PSTs expect strong perseverance and sustained engagement when MPS work on challenging tasks.



Alongside these descriptions, articles also reported that MPS were viewed as becoming bored or frustrated when insufficiently challenged, sometimes resulting in being off task (Chamberlin & Chamberlin, 2010). Social characteristics are mentioned in fewer articles and with less consistency. Some PSTs described MPS as introverted or socially withdrawn, while others reported that these students may experience social difficulties like, or greater than, those of their peers (Arabacı & Danişman, 2023; Chamberlin & Chamberlin, 2010; Yazgan-Sağ, 2020).

PSTs' Conceptions of Educational Provisions for Mathematically Promising Students

The second research question shifts attention to PSTs' conceptions about educational provisions for MPS. The following section synthesises patterns across the articles included and is organised according to three categories: differentiation, mathematical tasks and challenges, and learning environment and the teacher's role.

Differentiation

Across articles, PSTs' conceptualised educational provisions for MPS in terms of differentiation, grounded in an assumption of heterogeneity in this group. PSTs emphasised that MPS differ in abilities, interests, and learning trajectories, which makes uniform instruction insufficient (Applebaum et al., 2011; Chamberlin & Chamberlin, 2010). Differentiation is described as the adaptation of instruction through enrichment and acceleration (Applebaum et al., 2011; Chamberlin & Chamberlin, 2010; Yazgan-Sağ, 2020, 2024). PSTs referred to enrichment as extending or deepening mathematical content within the regular classroom, while acceleration involves allowing students to engage with more advanced content or progress at a faster pace, sometimes beyond grade-level expectations (Applebaum et al., 2011; Chamberlin & Chamberlin, 2010). These approaches are framed as ways of aligning instruction with students' existing competencies.

Variation exists within PSTs' conceptions of grouping practices. Homogeneous grouping is described as supporting academic development by allowing students to work at an appropriate level, whereas heterogeneous grouping is associated with social development and peer learning (Applebaum et al., 2011; Yazgan-Sağ, 2024).

PSTs also perceived differentiation as a pedagogical challenge involving equity and established classroom norms. They expressed concerns that providing differentiated activities may be perceived by students as unequal treatment (Yazgan-Sağ, 2019). Their willingness to assign similar or different tasks to student groups also appears to vary, with Berg (2010) identifying gender-related differences in PSTs' attitudes towards such differentiation. Moreover, PSTs' pedagogical choices seem to depend on the teaching contexts they envisage. They tended to associate student-centred and problem-solving-oriented approaches more strongly with high-achieving classes than with low-achieving classes (Pagiling et al., 2021; Safrudiannur et al., 2021, 2023).

Mathematical tasks and challenges

PSTs emphasised challenge as a central feature in the teaching of MPS (Chamberlin & Chamberlin, 2010; Waswa & Moore, 2020; Wessels, 2017; Yazgan-Sağ, 2020, 2024). An appropriate level of challenge in relation to task characteristics may stimulate deeper engagement with mathematical ideas (Applebaum et al., 2011; Chamberlin & Chamberlin, 2010). Within this pattern, PSTs described suitable mathematical tasks as open-ended, inquiry-based, and non-routine, often involving multiple solution strategies, extended time, and higher-order thinking (Applebaum et al., 2011; Chamberlin & Chamberlin, 2010; Emre-Akdoğan & Yazgan-Sağ, 2015; Panaoura & Panaoura, 2014; Shriki, 2010; Waswa & Moore, 2020; Wessels, 2017; Yazgan-Sağ & Emre-Akdoğan, 2016). These tasks were described as supporting students' motivation, interest, and sustained engagement with mathematics. Rather than progressing more quickly through standard content, PSTs emphasised enrichment through task design that allows students to explore mathematical ideas in greater depth (Applebaum et al., 2011).



Variation appeared in how PSTs related challenge to creativity and problem solving. Some emphasised non-routine problem solving and originality as central to challenging MPS, while others suggested inquiry-based or investigative tasks that allow for multiple pathways and solutions (Bolden et al., 2010; Panaoura & Panaoura, 2014; Shriki, 2010; Wessels, 2017). PSTs also stressed the importance of teachers being prepared to respond flexibly to spontaneous questions and ideas raised by MPS, framing such responsiveness as an integral part of working with challenging tasks (Yazgan-Sağ, 2024).

Learning environment and the teachers' role

Another aspect of the articles included concerns the role of the learning environment and the teacher in supporting MPS. PSTs emphasised that educational provisions are shaped not only by tasks and differentiation, but also by classroom norms, interactional practices, and the teacher's pedagogical stance.

PSTs described learning environments that encourage questioning, exploration, and communication of mathematical ideas as particularly supportive of MPS (Bolden et al., 2010; Yazgan-Sağ & Emre-Akdoğan, 2016; Wessels, 2017). Nonetheless, variation appeared in how PSTs conceived the management of such environments. Some expressed concerns that MPS' questions during lessons may disrupt classroom flow, suggesting that these interactions should occur outside whole-class instruction, while others viewed such questions as opportunities to engage peers and stimulate collective curiosity (Yazgan-Sağ, 2020; 2022).

Across articles, PSTs emphasised the teacher's role as a facilitator who scaffolds students' thinking, values alternative solutions, and encourages creative and flexible engagement with mathematics (Chamberlin & Chamberlin, 2010; Shriki, 2010; Waswa & Moore, 2020). Learning environments in which mistakes are accepted and risk-taking is encouraged are described as supporting both mathematical understanding and creativity (Bicer et al., 2022; Bolden et al., 2010). Some PSTs also highlighted the teacher's use of varied resources, such as manipulatives, as ways of fostering students' engagement and motivation (Emre-Akdoğan & Yazgan-Sağ, 2015; Kim et al., 2019; Waswa & Moore, 2020; Yazgan-Sağ & Emre-Akdoğan, 2016).

Within this broader understanding of the teacher's role, PSTs also reflected on teachers' professional backgrounds. While PSTs in Yazgan-Sağ's (2024) study emphasised that teachers need to be educated about MPS, they did not consider it necessary for teachers to be mathematically promising themselves. At the same time, some PSTs suggested that personal experience of being mathematically promising may be beneficial for teaching this group (Yazgan-Sağ, 2024).

Influences on Pre-service Mathematics Teachers' Conceptions of Mathematically Promising Students

Across the articles included, PSTs' conceptions of mathematical promise are described as being shaped by both teacher education contexts and by personal and cultural experiences beyond formal training. These influences are reported as contributing to how PSTs conceived MPS characteristics, and educational provisions related to MPS.

Teacher education contexts

Participation in teacher education courses or interventions influences PSTs' conceptions of mathematical promise. Several articles reported changes in how PSTs conceptualised mathematics as a subject, shifting from viewing mathematics as a closed and non-creative domain toward viewing it as open and allowing for multiple forms of mathematical expressions (Bicer et al., 2022; Kim et al., 2019; Panaoura & Panaoura, 2014; Shriki, 2010). In this context, mathematical promise is predominantly described in terms of fluency, flexibility, and originality, rather than solely as correctness or the production of final answers (Panaoura & Panaoura, 2014).

Articles reported changes in PSTs' conceptions of teaching in relation to mathematical promise following course participation or interventions. Prior to participation, PSTs are described as associating mathematical promise with strong prior knowledge and innate ability, often viewing it as belonging to



a limited group of individuals and, in some cases, as inappropriate for K–12 classrooms (Bicer et al., 2022). After participation, PSTs are reported to reconceptualise mathematical promise as something that can be expressed by a broader range of students, including young students, and as something that can be supported through instruction. Correspondingly, PSTs' views of teaching shifted from emphasising the provision of explanations and final solutions toward motivating students, supporting exploration, and engaging with students' mathematical processes (Bicer et al., 2022; Shriki, 2010). This includes a reported move from teaching creatively toward teaching for mathematical creativity, where instructional practices are designed to support students' active engagement with mathematical ideas (Kim et al., 2019). University mathematics courses emphasising problem-solving are similarly reported to influence PSTs' instructional orientations, with shifts toward a problem-solving view of teaching when such perspectives are explicitly supported within coursework (Safrudiannur et al., 2023).

Practicum also influenced PSTs' conceptions. It is suggested that engagement in classroom settings increases PSTs' awareness of MPS diverse needs and contributes to their understanding of how mathematical promise is expressed in practice (Chamberlin & Chamberlin, 2010). At the same time, Chamberlin and Chamberlin (2010) also reported that neither methods courses nor practicum necessarily challenge all stereotypical conceptions of MPS.

Personal and cultural experiences

PSTs' conceptions are reported to be shaped by experiences that precede or exist alongside formal teacher education. PSTs' schooling experiences as students are described as influential, contributing to how they perceived mathematics, mathematical promise, and teaching practices (Panaoura & Panaoura, 2014; Safrudiannur et al., 2021; Yazgan-Sağ, 2022, 2024). These experiences included both positive and negative encounters with mathematics education, with some articles highlighting the salience of negative emotional experiences in shaping PSTs' conceptions (Bolden et al., 2010).

Personal experiences are also reported to be connected to broader cultural and societal understandings of mathematical promise. Conceptions of mathematical promise vary across contexts and societies and PSTs' conceptions may reflect these variations (Yazgan-Sağ, 2022). Such influences contribute to how PSTs conceptualise who can be mathematically promising and how mathematical promise is recognised and valued. In addition, cultural resources, such as films and books, are reported as influencing PSTs' conceptions. References to popular culture are described as shaping ideas about mathematical background, maturity, and experience, thereby contributing to images of MPS (Yazgan-Sağ, 2019, 2022, 2024).

Discussion

Mathematical promise lacks a universally agreed-upon definition and remains context-dependent (Dai & Chen, 2013; Singer et al., 2017; Sriraman, 2005). Against this conceptual ambiguity, this review demonstrates that PSTs frequently describe MPS through mathematics-specific characteristics. By systematically synthesising PSTs' conceptions of MPS characteristics, educational provisions, and the factors shaping these conceptions, this review addresses an identified gap in research on preparing PSTs for their future profession (Hine & Herbert, 2022) and contributes to understanding how mathematical promise is interpreted within the context of developing professional practice.

In the articles reviewed, PSTs often linked mathematical promise to general characteristics, including speed (e.g., the ability to quickly learn new topics, process mathematical tasks, and carry out calculations), spatial ability, and remembrance of symbols. A strong emphasis on speed risks narrowing mathematical promise to efficiency and rapid performance. Although Krutetskii (1976) acknowledged pace as one possible present characteristic, he recognised qualitative structure of mathematical thinking rather than quickness. When speed becomes a marker of promise, slower but conceptually deep and reflective forms of mathematical engagement may be undervalued. In this sense, PSTs' interpretations may reflect a conception where measurable performance overshadows structural understanding. Some PSTs, however, did not prioritise speed but instead emphasised the development of personal problem-



solving strategies, the ability to “play with numbers”, perform complex operations, and demonstrate strong problem-solving skills. While these qualities can be interpreted within Krutetskii’s broader emphasis on flexibility, generalisation, and synthesis of mathematical information, they also point toward a conception of mathematical promise where creativity is highlighted.

PSTs also emphasised characteristics beyond mathematical ability when discussing mathematical promise, including motivation, interest and curiosity in mathematics, and a willingness to learn (Arabacı & Danişman, 2023; Chamberlin & Chamberlin, 2010; Sumpster & Sternevik, 2013; Wessels, 2017; Yazgan-Sağ, 2022). Although these characteristics are consistent with Sheffield’s (2003) description of mathematical promise, their prominence raises questions about how promise is defined and recognised. If motivation and related dispositions are shaped by social and educational contexts (Dai & Chen, 2013), what PSTs recognise as mathematical promise may partly reflect the opportunities and support available to students rather than their underlying potential alone. From this perspective, attention shifts from simply identifying promising students to considering how educational practices create or constrain opportunities for mathematical promise to emerge. At the same time, emphasising behaviours and attitudes alongside cognitive abilities may privilege certain expressions of promise, potentially overlooking students whose potential is manifested in other ways.

While PSTs’ views on differentiating teaching activities and the use of homogeneous or heterogeneous grouping for promising students appear inconsistent, this inconsistency points to deeper complexities in defining and supporting mathematical promise. The concept of a MPS is inherently ambiguous and highly context-dependent (Dai & Chen, 2013), hence, a lack of consensus among PSTs regarding teaching strategies for MPS is not surprising. The PSTs emphasised various teaching activities that challenge and motivate MPS to learn at their levels of understanding, also outside of the school context. This is in line with claims from previous research that students’ development of gifted behaviour is promoted by variation in learning opportunities, and that activities in and outside of school provide students with different mathematical contexts where their mathematical potential may develop (Leikin, 2010; Renzulli, 2005). These claims risk oversimplifying the complex interplay between cognitive ability, motivation, contextual conditions, and social factors. In this regard, there is a need for more nuanced inquiry into how PSTs translate ambiguous concepts into equitable and effective teaching practices.

According to PSTs, learning environments and social interaction are crucial for MPS’ development. Group work is often highlighted as promoting interaction and creativity (e.g., Bolden et al., 2010; Wessels, 2017), though PSTs differ in their views on homogeneous versus heterogeneous grouping. The teacher’s role is considered central in both contexts, requiring mathematical and pedagogical competence to identify and support MPS (Leikin, 2011; Singer et al., 2016). Although some PSTs (e.g., Yazgan-Sağ, 2024) viewed personal experience as a MPS as beneficial, others emphasised the importance of formal preparation. Additionally, PSTs stressed the need to promote creativity, distinguishing between teaching creatively and teaching for creativity (Bicer et al., 2022; Shriki, 2010). Together, these perspectives suggest that supporting MPS is understood by PSTs as dependent on learning environments that enable meaningful interaction, foster creativity, reflection, and risk-taking (cf. Nadjafikhah et al., 2012), as well as on teachers’ mathematical and pedagogical competence to organise such environments.

The PSTs’ conceptions on teaching, learning, and thinking processes are reflected in their mathematics teaching practices (Senawongsa et al., 2023), making it crucial to study and understand these perspectives. Consistent with Senawongsa et al. (2023), who found that PSTs’ conceptions of different groups of students are shaped by prior studies, practicum, and social interactions, this review similarly indicates that PSTs’ conceptions of MPS are influenced by educational and personal experiences, including course participation, social interactions, films, and books. PSTs’ participation in courses has an impact on their understanding of mathematics as a subject, mathematical promise, the role of teachers, and teaching strategies that foster mathematical promise.

The results concerning teaching are in keeping with some of the results from Uysal’s (2025) review about effects of teacher training for teaching promising students. The subjects which the teachers

studied to teach were not in focus in Uysal's study, however, it showed positive effects from courses on understanding of promise, and the present study adds with subject specific features of PSTs' education. The PSTs and teachers did benefit from courses regarding their teaching practices, even though Uysal's results were somewhat ambiguous concerning the effects of teacher training on teachers' practice. Courses focusing on promise in relation to the subject matter may help concretise teaching strategies for PSTs and/or teachers. Safrudiannur et al. (2023) suggested that PSTs' conceptions of mathematics teaching shift from an instrumentalist view towards a problem-solving approach as a result of course participation. This finding underscores the importance of teacher education and its potential to influence PSTs' conceptions. Similarly, practicum during teacher education has been found to increase PSTs' awareness of the needs of MPS and the importance of addressing those needs in practice (Chamberlin & Chamberlin, 2010). These findings align with Dai and Chen's (2013) characterisation of mathematical promise as a culturally situated concept whose meaning varies across individuals and contexts. Taken together, the results of this review suggest that PSTs' conceptions of mathematical promise are closely linked to their educational and personal experiences and may differ depending on the societal and educational contexts in which those experiences are formed.

Concluding Remarks

Several conclusions can be drawn from this study's findings. Firstly, PSTs possess various conceptions of MPS and approaches to teaching them. Some PSTs regard mathematical promise as something static and innate, which does not align with previous research emphasising that mathematical promise can be developed under favourable conditions and is affected by both internal and external factors (Krutetskii, 1976; Renzulli, 2005; Sheffield, 2003). Many conceptions, however, align with previous research, such as PSTs expressing cognitive, affective, and social characteristics outlined in frameworks by Krutetskii (1976) and Sheffield (2003). PSTs also consider challenge as important, in terms of mathematical problems, when teaching MPS.

It seems, there are differences, sometimes opposing, in PSTs' conceptions concerning educational provisions. For example, some believe MPS need less instruction than peers while also needing opportunities to learn, or that teaching in homogenous groups is both beneficial for learning and an obstacle for social development. In some cases, PSTs expressed conceptions not aligning with research which then changed after their participation in an intervention in their teacher education programs. This highlights the important role of teacher education in preparing PSTs for meeting the needs of MPS and to influence and challenge their conceptions.

Implications

The results imply a need for teacher education programs to include elements related to mathematical promise to deepen and broaden PSTs' understanding of the concept. One such element could be addressing PSTs' conceptions about MPS from a contextual perspective, since PSTs may be affected by their experiences from, for example, school and media. Other possible elements are aspects of orchestrating teaching, such as differentiation, equity and what supplementary materials to use, and aspects closer to the subject matter, such as problem solving and creation of tasks. This review underscores the role of practicum in shaping PSTs' conceptions of mathematical promise. Directed reflection assignments, supported by theoretical framing, may help PSTs recognise MPS through their reasoning and choice of strategies rather than test performance or speed, while critically examining how their own experiences shape these interpretations. The results also show that PSTs' conceptions on teaching mathematics are influenced by personal experiences and interactions. These results in combination with the result that course experiences have an impact on PSTs' perspectives on mathematics teaching indicate that course design in mathematics teacher education should focus on developing PSTs' teaching strategies in a problem-solving direction, focusing on abilities of MPS rather than their performance on tests. However, few empirical studies in the articles investigated how



different elements of teacher education programs affect PSTs' conceptions of mathematical promise. Future research on the impact of activities with various educational contexts and methodologies on PSTs' understanding of mathematical promise would provide deeper insights into how course participation influences PSTs' teaching strategies and comprehension of mathematical promise. The activities could be authentic cases for discussions or specific practicum days for testing ideas and tasks. Activities with focus on consequences of a results perspective versus a developmental perspective on MPS learning are also important to study, to further understand how PSTs understand MPS. Further research exploring how PSTs' personal experiences as students shape their understanding of mathematical promise would add an interesting dimension to this field of research.

Limitations of the Study

Limitations in this study are addressed in this section for clarity. The processes of applying inclusion and exclusion criteria, selecting articles, and extracting and interpreting data involved researcher judgement and may therefore have introduced bias, potentially affecting the results of this review (Xiao & Watson, 2019). To minimise this risk, the authors calibrated the application of the criteria and the data extraction approach and discussed uncertainties and decisions throughout the review process.

The articles included use different methodologies, including qualitative, quantitative, and mixed methods, leading to differences in how PSTs' conceptions were measured and analysed. While this diversity can enrich the findings, it complicates comparisons across articles and may lead to inconsistencies in how the results are interpreted. Lastly, the concept of mathematical promise varies across the articles included in terms of terminology and interpretation, which means that our application of the concept may differ from applications in some of the articles.

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Acknowledgements

The authors acknowledge the support of the REMATH Research School.

Funding

Funded by the Swedish Research Council, Grant No. 2021-00534.

Competing interests

The authors declare that there are no competing interests.



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