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Systematic Review

Sources of Mathematics Self-Efficacy in Primary and Secondary Students: A Systematic Review of Qualitative Research

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Abstract

Efficacy beliefs influence individuals' thinking and academic outcomes. Indeed, a growing body of literature has identified self-efficacy (SE) as a predictor of a range of favourable outcomes and a buffer against the likelihood of less desirable ones. The evidence linking high levels of SE to positive outcomes has spurred interest in understanding how such beliefs are developed and sustained, particularly via the theorised sources of efficacy information: mastery experience, vicarious experience, social persuasion and physiological state. However, while most research on the sources of mathematics SE is quantitative, no prior review has systematically examined the qualitative literature. This review analyses eight qualitative or mixed-methods studies on these sources in primary and secondary students. It demonstrates that qualitative data illuminate how SE-relevant information is individually interpreted and how even a single encouraging comment can have a lasting influence. The source-specific findings indicate that the development of mathematics SE is less about isolated experiences and more about how those experiences are socially mediated, interpreted, and emotionally supported—most notably through teachers' practices and relational environments. In addition, five broader cross-source insights are discussed following a critical examination of how future research can build on the strengths of existing qualitative studies.

Keywords: Bandura; self-efficacy; sources; social cognitive theory; mathematics education; primary school students; secondary school students

1. Introduction

Self-efficacy (SE), which is defined as one's 'beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments' (Bandura, 1997, p. 3), has been shown to predict both the goals individuals set for themselves and the associated performance outcomes. Such mastery expectations can serve as powerful motivational factors, sustaining effort and fostering self-regulated learning processes (Zimmerman, 2000). Bandura (2006) further argues that efficacy beliefs shape individuals' thought patterns, thereby influencing whether they engage in strategic or erratic thinking and promoting either an optimistic or pessimistic outlook. A growing body of literature identifies SE as a predictor of a range of favourable outcomes and a buffer against the likelihood of less desirable ones. For instance, in the context of mathematics, studies suggest that individuals' SE level predicts their mathematics performance (e.g., Chen, 2003; Doménech-Betoret et al., 2017; Pajares & Kranzler, 1995) and that individuals with high SE often outperform equally capable peers with lower SE through managing their time more efficiently, persisting for longer and employing more effective problem-solving strategies (Usher & Pajares, 2009).

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Moreover, learners with high SE tend to exert greater effort, engage in more frequent progress monitoring and adopt a broader repertoire of self-regulatory strategies, which all contribute to academic success (Schunk & Pajares, 2005).

The evidence linking high levels of SE to positive educational outcomes has spurred interest in understanding how such beliefs are developed and sustained, particularly through the four theorised sources of efficacy information: mastery experiences, vicarious experiences, social persuasion, and physiological state. According to Bandura (1997), the most influential source of SE is mastery experiences—originally known as performance accomplishments (Bandura, 1977)—which refer to individuals' perceived successes in terms of performing specific tasks. Notably, in educational settings, it is not objective success that informs SE but rather a student's perception of having succeeded (E. M. Skaalvik & Skaalvik, 2007), often influenced by the expectations teachers hold (see Rosenthal, 2002, on the Pygmalion Effect). When students interpret their efforts as being successful, their confidence in tackling similar or related tasks increases. Conversely, when they view their efforts as being unsuccessful in producing the desired outcome, their confidence in undertaking similar tasks tends to decrease (Usher & Pajares, 2008, p. 752).

Due to the lack of absolute proficiency measures in the field of education, normative comparisons whereby students measure their capabilities in relation to others' performances are common (Usher & Pajares, 2008). A feeling of 'if she can, then so can I' can increase the observer's SE. Such a source of efficacy information—vicarious experiences—entails situations in which an individual watches another person successfully perform or model behaviour that the individual is contemplating engaging in (Bandura, 1997). This source is comparatively stronger than social persuasion, which entails verbal input, evaluative feedback and encouragement from others and has the potential to enhance students' beliefs in their capabilities to perform a given task at a certain level (Bandura, 1997). The effect of social persuasion is often stronger when it comes from significant individuals—such as parents, teachers or peers—particularly when students are still developing the ability to perform accurate self-appraisals. At this stage, they are more likely to rely on others for evaluative feedback (Bandura, 1997). Moreover, according to Bandura (1997), the least influential source of SE is the physiological state—originally termed emotional arousal (Bandura, 1977)—which refers to the influence of factors such as anxiety, mood, stress and fatigue on individuals' SE beliefs. This source is not considered a reliable indicator of an individual's capabilities, given that physiological states can be influenced by various factors. However, Bandura (1997) suggests that individuals tend to perform optimally when their physiological state is at a moderate level—neither excessively high nor too low.

Bandura (1977, 1997) and his social cognitive theory have had a wide-reaching and sustained impact in multiple fields (Haggbloom et al., 2002; Zimmerman & Schunk, 2003), including educational research (Caprara, 2025; Ozer, 2022). In the context of mathematics education, research on the development of SE in individuals emerged in the mid-1980s, particularly via the experimental studies of Schunk and colleagues. Their studies commonly employ pre- and post-test designs in which students are assigned to various treatment conditions to examine the effects on both SE and academic performance (Schunk & Cox, 1986; Schunk & Gunn, 1986; Schunk et al., 1987). This body of work is widely recognised as a foundational starting point, as evidenced by its frequent citation in subsequent scholarly works. Since then, the research on SE and its sources has demonstrated a steady increase in publication volume while continuing to be dominated by quantitative designs (Bjerke et al., 2026). Why this has been the case can only be speculated upon, but the combination of theoretical (e.g., being theorised as operationalizable and measurable), historical (early demonstrations of psychometric robustness), and societal factors (alignment with policy,

accountability, and effectiveness research) has likely created a strong path dependency that helps explain the dominance of quantitative designs.

The bulk of the prior research investigating the development of mathematics SE in primary and secondary education comprises quantitative correlation studies that examine various constructs' impact on SE (Bjerke et al., 2026). These studies report on gains in relation to SE stemming from different teaching methods (e.g., Schukajlow et al., 2012; Sengul, 2011; Zulkarnain et al., 2021)—including methods influenced by technologies (Plant et al., 2009)—and learner characteristics, such as self-regulatory strategies (e.g., Chatzistamatiou et al., 2015; S. Skaalvik & Skaalvik, 2004) and learning goal orientation (e.g., Wolters et al., 1996). Furthermore, positive teacher–student interactions, such as the provision of emotional support (e.g., Sakiz, 2017; E. M. Skaalvik et al., 2015) and clear, effective explanations in mathematics, have been shown to strengthen students' confidence and interest in the subject (e.g., Lewis et al., 2012; Riconscente, 2014; You et al., 2016; Zhu & Kaiser, 2022). Sakiz (2017), for example, notes that increased teacher affective support in mathematics classrooms can enhance students' sense of belonging, foster academic enjoyment and promote higher academic SE. Similar results are reported with regard to parental support, where parents' aspirations for their children's education are positively associated with mathematics SE (Choi et al., 2015; Fan & Williams, 2010) and both maternal and paternal support positively impact adolescents' mathematics SE, with maternal support playing a crucial role in shaping adolescents' expectations regarding mathematical outcomes (Turner et al., 2004).

In addition to quantitative correlational studies that do not explicitly address the theorised sources of SE, a comparatively smaller body of research both theorises and discusses the hypothesised sources of mathematics SE (Bjerke et al., 2026). While some such studies do so without directly measuring the sources of SE (e.g., Ata Baran & Kabael, 2021; Jungert et al., 2014; Yurt, 2022), many explicitly measure them using Likert-type response scales, as recommended by Bandura (2006). Among the available scales, the most frequently employed is the Sources of Middle School Mathematics Self-Efficacy Scale developed by Usher and Pajares (2009). This scale comprises 24 first-person statements that are rated on a six-point Likert scale to indicate the extent to which each statement is true or false. Other frequently used instruments include the five-item academic efficacy scale from the Patterns of Adaptive Learning Scales (Midgley et al., 2000), various adapted versions of the Sources of Mathematics Self-Efficacy Scale developed by Lent et al. (1991) and the five-item SE subscale of the Motivated Strategies for Learning Questionnaire by Pintrich et al. (1993). In addition, some studies develop and validate their own instruments based on Bandura's (1986, 1997) terminology (e.g., Zander et al., 2020), whereas others adopt a less systematic approach, selecting items from multiple existing instruments (e.g., Friedel et al., 2010). This diversity of measurement tools has resulted in limited consistency across studies and reported findings (Usher & Pajares, 2008), although such studies still account for much of the current knowledge on the sources of mathematics SE in primary and secondary education.

In sum, to date, studies investigating the sources of mathematics SE have been limited to a narrow set of methodological approaches (Bjerke et al., 2026; Usher et al., 2019). This issue is highlighted in three major reviews addressing the sources of SE in education. First, Usher and Pajares (2008) examine the sources of SE across school subjects (not limited to mathematics or science) during the period 1990–2007. Second, Zakariya (2022) provides an integrative review of intervention studies on mathematics SE conducted from 1995 to 2021. Finally, Bjerke et al. (2026) synthesise a broad range of studies on the development of SE in mathematics and science from the mid-1980s to the end of 2022. Despite their differing scopes and methodologies, all three reviews reach the same conclusion—namely, there is a

pressing need for more qualitative research on the sources of mathematics SE, particularly in the context of primary and secondary education.

Despite calls for more qualitative research on the sources of SE, little systematic attention has been paid to what can be learned from the relatively small number of qualitative studies that do exist. To address this marginalised focus, the present literature review is guided by the following research questions:

1. What insights into Bandura's four sources of mathematics SE can be drawn from the existing qualitative research?
2. How can future research build on the strengths of prior qualitative studies on the sources of mathematics SE?

The remainder of this paper is structured as follows: Section 2 outlines the methodological approach of this review, including a detailed account of the analytical procedures employed, while Section 3 presents the results of the analysis. Section 4 then discusses the implications of the results and offers some concluding remarks.

2. Methodology

This paper builds on the systematic review conducted by Bjerke et al. (2026) on the development of SE in mathematics and science from the mid-1980s to the end of 2022. Hence, I begin this section by briefly recapping the systematic review process that led Bjerke and colleagues from an initial pool of 5981 studies to a final sample of 139 (for the full methodological details, see Bjerke et al., 2026). I then detail the updated search conducted to include publications in 2023–2024, explain how I selected a sub-group of qualitative studies, and describe the procedures I used for data analysis, including the coding and quality assessment.

2.1. Search Strategy in the Foundational Study

The initial search strategy was structured around three core concepts—namely, (1) sources of SE (theoretical construct), (2) science and mathematics (school subjects) and (3) primary and secondary school (educational level, categorised in accordance with the International Standard Classification of Education framework of the United Nations Educational, Scientific and Cultural Organization [UNESCO], 2017).

Each of the three core concepts included a set of alternative search terms intended to capture relevant variations in the literature. To ensure comprehensive literature coverage, systematic searches were conducted in databases with broad coverage of education and learning: ERIC, Education Source and Teacher Reference Centre (both via EBSCOhost) and PsycINFO (via Ovid). Three interdisciplinary databases were also searched: Academic Search Ultimate (via EBSCOhost), Web of Science (Clarivate) and Scopus (Elsevier). As supplementary measures, a strongly modified search was executed in Google Scholar, followed by two rounds of strategic searches conducted after the inclusion and exclusion criteria had resulted in a workable provisional selection of studies (see Bjerke et al., 2026 for details, including complete documentation of each search).

2.2. Identification of Studies

The identification, screening and inclusion stages reported in Bjerke et al. (2026) resulted in a total of 139 studies published before the end of 2022, 83 of which focused specifically on mathematics. An updated search conducted in January 2025 to capture any additional studies published in 2023–2024 yielded 895 further studies in the mathematics and science fields. Applying the same screening and inclusion procedures as described in Bjerke et al. (2026) resulted in the identification of 67 additional eligible studies for the two-year search period, 40 of which focused on mathematics.

To identify studies that employed qualitative methodologies, I followed a two-step process. First, I extracted all of the qualitative and mixed-methods studies from the 123 identified studies (83 from Bjerke et al. (2026) and 40 from the updated search), which left me with 13 eligible studies—that is, 3 qualitative studies and 10 mixed-methods studies. A critical examination of the mixed-methods studies revealed that they fell into two distinct categories: those measuring the sources of SE in combination with several constructs in the quantitative phase, albeit without any further elaboration of SE or its sources in the qualitative phase, and those measuring the sources of SE in the quantitative phase while also elaborating on SE and its sources in the qualitative phase. Five studies were excluded because they fell into the first category. Consequently, eight studies were included in the in-depth analysis for the present review.

2.3. Data Extraction and Analysis

The analysis of the eight included qualitative and mixed-methods studies was conducted in three comprehensive steps. First, after repeated thorough full-text readings, an Excel spreadsheet was created to extract key information, including the purpose and aim, research questions, methods and limitations, description of context (including the country of origin), role of qualitative data in mixed-methods studies and which sources were focused on. This analytical step—which involved examining the similarities and differences across the eight included studies—provided an overview of the data and enabled the identification of cross-study patterns.

The qualitative and mixed studies reviewed here span diverse socioeconomic backgrounds, educational contexts, school types, and support programme settings. Such heterogeneity presents challenges analogous to those encountered in quantitative syntheses, where variation in measurement tools has been shown to limit consistency across studies and reported findings (Usher & Pajares, 2008). Hence, when identifying cross-study patterns, I approached the analysis of the sources of SE with caution. In this regard, the fact that the studies were conducted in diverse contexts is considered a strength, as it allows patterns to be examined across varying educational settings.

Nevertheless, at this stage of the analysis, I noted two key factors of importance when interpreting the findings. First, whether the studies:

- collect responses to open-ended questions in large-scale surveys that are subject to deductive coding (Butz & Usher, 2015; Usher et al., 2019) or
- draw on interviews and observations with a comparably smaller number of participants (Burton & Campbell, 2019; Hungnes et al., 2022; Katz, 2015; Olivares & Ceglie, 2020; Özdemir & Pape, 2013; Usher, 2009).

Second, whether the studies

- focus on students who, for various reasons, require additional support—that is, those experiencing difficulties in learning mathematics (Katz, 2015), those at risk of dropping out of school (Hungnes et al., 2022) and those performing substantially below their grade level (Burton & Campbell, 2019) or
- focus on students with differing levels of SE or performance accomplishments (i.e., Butz & Usher, 2015; Olivares & Ceglie, 2020; Özdemir & Pape, 2013; Usher, 2009; Usher et al., 2019).

In the second step of the analysis, given the limited examination of how the four sources of SE 'work'—specifically in terms of how they impact SE development for different groups of students—additional rounds of reading took place, where ideas and references to Bandura and the four sources of SE were marked in the margins. In doing so, Bandura's (1977, 1997) four sources were first operationalised in relation to their presentation in this review's introduction. The repeated readings, however, expanded my understanding of

the sources, and each source's operationalisation was refined accordingly. Table 1 provides an illustration of the final operationalisation.

Table 1. Operationalisation of the four sources of SE.

Mastery experiences	Students' performance accomplishments, including how they perceive their successes, how these successes occur and the factors that enable or hinder them.
Vicarious experiences	Situations in which students observe others successfully performing or modelling behaviours they are considering, including social comparison, how these experiences occur and the factors that enable or hinder them. Also termed vicarious learning.
Social persuasion	Verbal persuasion, verbal input, evaluative feedback and encouragement from others (e.g., parents, teachers, peers) that may enhance students' beliefs in their capabilities, including how these forms of persuasion occur and the factors that enable or hinder them.
Physiological state	Emotional arousal and the effects of anxiety, mood, stress and fatigue, including how these states occur and the factors that enable or hinder them.

In the third and final step of the analysis, the identified text segments were organised under each source and interpreted in relation to the two key factors identified in step one of the analysis ('open-ended questions in large-scale surveys' versus 'interviews/observations', and 'students needing additional support' versus 'students with differing levels of SE or performance accomplishments').

3. Results

Of the 123 studies that report on the sources and development of mathematics SE in primary and secondary education, only eight utilise qualitative data to explore the theorised and hypothesised sources of SE—that is, six conducted in the United States (Burton & Campbell, 2019; Butz & Usher, 2015; Olivares & Ceglie, 2020; Özdemir & Pape, 2013; Usher, 2009; Usher et al., 2019), one in Israel (Katz, 2015) and one in Norway (Hungnes et al., 2022)—all published in the period 2009–2022. A systematic examination of these eight studies—of which the first was published approximately 20 years after the earliest quantitative study on the topic—made it possible to explore what insights into the sources of mathematics SE can be drawn from existing qualitative research.

In reporting the results, as noted above, I have cautiously considered what can be inferred about the sources across studies. Accordingly, although this chapter is structured around Bandura's four sources of SE, it is important to acknowledge that substantial overlap between the sources—particularly evident in the qualitative and mixed-methods studies—makes it challenging to discuss each source in isolation. Where this overlap presents analytical difficulties, this is explicitly noted in the text.

Table 2 provides a summary of each included study, in alphabetic order. Readers are encouraged to review these summaries in order to better follow the remainder of this section.

Table 2. Summary of each included study.

Burton and Campbell (2019)	A mixed-methods study exploring how one school developed an Essential Skills Course (ESC) designed for small groups of Grade 9 students performing substantially below their grade level. Nineteen students provided pre- and post-test data and were observed through videorecorded classroom sessions, while five students and their teacher participated in interviews. An open-coding content analysis revealed how participation in the ESC could enhance students' SE beliefs and indicators of engagement in mathematics.
Butz and Usher (2015)	A mixed-methods study investigating what 2511 Grade 4–8 students report making them feel more confident in maths and reading. Surveys were administered to students on two separate occasions, including open-ended prompts and a self-report measure of SE in maths/reading. The data were qualitatively analysed at the individual level and then quantitatively at the group level. As a result of the deductive and inductive approaches, 5203 codes contributed to revealing group trends in the sources of SE.
Hungnes et al. (2022)	A mixed-methods study investigating students' experiences of an extra school year between lower and upper secondary school, targeting students at risk of dropping out for scholastic and/or social reasons. Twenty-three interviews with students near the end of their extra preparatory school year complemented a quantitative survey measuring SE. Thematic analysis allowed for a more comprehensive understanding of the students' increased SE than that derived from quantitative data alone.
Katz (2015)	A qualitative action research study focusing on eight Grade 6 students who experience difficulties in learning mathematics. Interviews, informed by observations, were conducted before and after an intervention comprising a goal-setting component, where students recorded the agreed-upon goals with their teacher; a skill and strategy component focusing on gradually teaching key mathematical topics; and open reflection tasks. A constant comparative analysis resulted in the students' efficacy profiles when it comes to learning mathematics.
Olivares and Ceglie (2020)	A mixed-methods study investigating the ways in which students internalise the mathematics attitudes of their parents. Instruments measuring SE were administered to all high school students and their parents in a suburban school district, followed by interviews with eight students and one of parent. The interview data were coded, followed by a constant comparative analysis, revealing that a child's belief system varies according to the parent's level of mathematics SE and mathematics attitudes.
Özdemir and Pape (2013)	A mixed-methods study exploring how three Grade 6 students with different levels of SE and mathematics achievement interact with instructional practices. Through videotaped classroom observations, the researchers focused on how mastery experiences and social persuasion manifested differently for the three students. Qualitative analyses identified how each student's enactive mastery experiences were structured in the classroom and how the teacher's social persuasion related to each student's performance.
Usher (2009)	A qualitative study examining the heuristics students use to form their mathematics SE. Interviews with eight Grade 8 students—four with high SE and four with low SE—were followed by interviews with the mathematics teachers of each student participant and with one of the student's parents, providing a unique look at the complex environments in which SE beliefs take root. An open-coding analysis resulted in an understanding of how mathematics efficacy beliefs take hold during middle school.
Usher et al. (2019)	A mixed-methods study examining the experiences that raise and reduce the mathematics and science SE of Grade 6–12 students living in a rural, high-poverty area. This multi-year study collected survey data from 673 students, including open-ended questions subjected to deductive coding. Integrative analyses showed that students consider information from multiple sources when judging their capabilities, highlighting factors that not only increase but also decrease their perceived efficacy.

3.1. Mastery Experiences

Guided by the theory-driven operationalisation of mastery experiences, I examined references to students' performance accomplishments, including their perceptions of success, the conditions under which these successes occur, and the factors that enable or

constrain them. Across the reviewed studies, key agents played a conspicuous role in shaping the extent to which students benefit from mastery experiences. Consequently, mastery experiences appear to be strongly influenced by another source of SE—namely, social persuasion. In the following section, still within the framework of mastery experiences, I show how the qualitative research literature finds that although mastery is highly dependent on social persuasion, it manifests differently depending on students' levels of SE or prior performance, with particular attention given to students with low SE or low achievement accomplishment.

Mastery experiences do not arise in isolation but are co-constructed through pedagogical practices, with teachers playing a decisive role in framing, supporting, and amplifying students' perceptions of success. In Katz's (2015) intervention study involving Grade 6 students who experience difficulties in learning mathematics, the teacher's decisive role entails delivering structured support and guiding students in selecting challenging yet realistic goals (from daily to weekly and, eventually, monthly goals) while reinforcing their progress (Katz, 2015, pp. 52–53). The teacher is perceived as 'the guard' and 'the facilitator' of a support system that sees students primarily attribute their success to mastery experiences, which they perceive as key drivers of further success (Katz, 2015). The teacher's role is 'to maximize the impact of mastery experience by providing feedback and encouragement' and to prompt students to reflect and engage in self-regulated learning (Katz, 2015, p. 52). This tailored support is decisive, especially considering how mastery is often subject to individual interpretation, noting that 'what one student describes as a striking experience of personal mastery might be considered a negligible event to the student sitting next to her' (Butz & Usher, 2015, p. 60).

Similarly, Hungnes et al. (2022) describe the teachers in the extra preparatory school year in their study as highly present and available 'facilitators' who tailor their instruction to students' needs by closely monitoring their progress. This also applies to the teacher in Burton and Campbell's (2019) study—an experienced and highly qualified educator—who has 'earned this perceived award' (p. 280): Contrary to the practice of assigning inexperienced teachers to low-performing students—a practice the authors note to be common—this teacher is able to remove topics that require higher-order mathematical skills while focusing on students building a strong foundational understanding. The students recognise their teacher's passion, which increases their engagement, motivation to succeed and sense of mastery (Burton & Campbell, 2019). While Burton and Campbell (2019) reveal how students experience success through a curriculum adapted to their skill levels, Hungnes et al. (2022) emphasise how students consider that collaborative goal-setting and encouragement from teachers make them move beyond their comfort zones and enhance their SE via mastery experiences. A key success factor appears to be that, rather than having externally imposed goals, students are encouraged to set their own, with teachers actively supporting them and reinforcing the attainability of these goals (Hungnes et al., 2022; Katz, 2015).

As an extension of this, in their exploration of how three Grade 6 students with different levels of SE and mathematics achievement interact with instructional practices, Özdemir and Pape (2013) observe that it is not only the amount of mastery experiences that matters—the quality is decisive. Again, the form of teacher assistance is key, with both favourable and less desired outcomes observed. The low-SE student in Özdemir and Pape's (2013) study usually requires teacher pressure and encouragement to participate, which often results in mixed and less consistent information regarding this student's enactive mastery experiences. Related to this, Olivares and Ceglie (2020) report that low-SE students tend to accept their struggles in mathematics and use their parents' beliefs to excuse their low performance and lack of mastery. In such cases, even when these students receive

extra assistance, it does not appear to translate into enhanced SE, not even when they eventually master the content. In this way, Olivares and Ceglie (2020) find that low-SE students highlight their parents' beliefs more than their experiences with teachers at school.

While teachers are pivotal in shaping mastery experiences, students' SE levels appear to mediate how such experiences are interpreted and taken up. Özdemir and Pape's (2013) portrayal of a low-SE student accords with how low-SE students in Usher's (2009) qualitative study report that, even if teachers are central to their sense of mastery due to scaffolding learning in manageable steps, they tend to also attribute their lack of mastery to their teachers (but note that the same researcher subsequently reports that low-SE students tend to experience greater difficulty than their high-SE peers in recalling mastery experiences; see Butz & Usher, 2015). Even when teachers propose strategies to enhance mastery, some students resist and remain in environments that fail to support their success, lacking the ability to self-regulate their mathematics learning. By contrast, the high-SE student in Özdemir and Pape's (2013) study, however, who is encouraged by her teacher to choose challenging homework assignments, is given opportunities to convey additional information regarding her capabilities. Hence, the high-SE student's experiences of mastery are most often enactive, experienced via solution procedures, problem-solving strategies and commenting on others' ideas. Yet high-SE students report that teachers play a key role in interpreting success in ways that strengthen their beliefs (Usher, 2009, p. 291).

3.2. Vicarious Experiences

Vicarious experiences, understood as situations in which students observe others successfully performing or modelling behaviours they are considering, is, in all but one study (Özdemir & Pape, 2013), explicitly investigated. In doing so, besides addressing vicarious experiences involving significant individuals, such as peers and parents, three studies talk about vicarious experiences in terms of 'social comparison', signposting an overlap (or rather combination) between vicarious experiences and mastery experiences.

When vicarious experiences do appear in the reviewed studies, they are often difficult to disentangle from processes of social comparison. For example, Butz and Usher (2015) distinguish between vicarious experiences derived from observing peers or adults and social comparison experiences, defined as comparisons that provide insight into one's relative progress in mathematics (e.g., course placement), which may signal perceived ability and evoke a sense of pride. Similarly, Usher et al. (2019) argue that overlapping information from different sources of SE makes it possible to interpret social comparison as a vicarious experience (e.g., when a student interprets a peer's performance as self-relevant), while Burton and Campbell (2019) use social comparison to explain what vicarious experience is. More specifically, they argue that social comparisons 'occur most frequently within a class and rarely with peers in different classes', further arguing that 'students develop greater self-efficacy when social comparison aligns with similar ability groups' (pp. 274–275). Relatedly, Hungnes et al. (2022) emphasise the importance of belonging to a group of like-minded peers for the emergence of vicarious experiences, as these contexts allow students to interpret others' struggles and successes as self-relevant.

Beyond contextual variation, gender emerges as an important dimension shaping social comparison and vicarious experiences. These social comparison processes (and, hence, vicarious experiences) are more frequent among girls than boys (Butz & Usher, 2015; Usher et al., 2019), with girls reporting more social comparisons that undermine their confidence in comparison with boys (Butz & Usher, 2015). Hence, Butz and Usher (2015) argue that girls may more often rely on observing models. In addition to these gender-based differences, in Hungnes et al.'s (2022) study, observing peers who have previously struggled but eventually succeeded is identified as a vicarious source of SE.

Extending the discussion beyond the classroom, vicarious experiences are also shaped within the home environment. Perhaps unsurprisingly, in both studies involving interview data obtained from parents (Olivares & Ceglie, 2020; Usher, 2009), vicarious experience is connected to the way in which parents model interest in mathematics to their children, which is most often evidenced by how children copy their parents' level of interest (Olivares & Ceglie, 2020). However, Usher (2009) reminds us of the danger of generalising: one of the four low-SE students in Usher's (2009) study exhibits intrigue with regard to how none of his family members have mastered mathematics. He reports this observation to have inspired him to find someone who has. Still, the low-SE students generally characterise their mothers as being deficient in mathematics, indicating the lack of people at home who could model interest for them. Unfortunately, this causes them to not report more peer-referential self-judgements. Moreover, the low-SE students often compare themselves negatively to classmates, reflecting what Butz and Usher (2015) observe about girls reporting more social comparisons that undermine their confidence. On the contrary, the high-SE students make more comments in reference to peers than to adults when comparing themselves in relation to the performances of classmates. These students have high internal standards and are competitive in nature—sometimes being seen as 'perfectionists'—and all of them have parents who push them while modelling an interest in the subject themselves.

3.3. Social Persuasion

In line with Bandura's (1997) theory, the eight reviewed studies treat social persuasion, especially from significant individuals such as parents, teachers and peers, as a key source of SE. Across the studies, what emerges as critically important lies in the finer details of instructional interactions. As Butz and Usher (2015) observe, 'sometimes a single comment can have lasting effects on self-efficacy' (p. 53). For such effects to occur, however, social persuasion must be carefully tailored to students' individual needs, since each student both receives and interprets social persuasion differently (Özdemir & Pape, 2013). When seen in context with what is already revealed about mastery experiences in Section 3.1, tailored social persuasion from teachers is particularly important for those students requiring additional support (see Burton & Campbell, 2019; Hungnes et al., 2022; Katz, 2015). These students describe their teachers as encouraging, with a genuine desire for them to succeed (Burton & Campbell, 2019), not only in relation to academic tasks but also in them as 'whole' individuals, focusing more on them developing 'than on getting better grades' (Hungnes et al., 2022, p. 9).

While social persuasion appears to be particularly important for low-SE students, the need for such persuasion decreases as levels of SE increase (Katz, 2015). At higher levels of SE, other mechanisms come into play; for example, Katz (2015) reports that 'social support was reduced when self-regulation appeared' (p. 53). Related, Özdemir and Pape (2013) report that high-SE students require less social encouragement and demonstrate more accurate judgments of their own performance. They found that high-achieving students most often received social persuasion as confirmation, whereas middle-ranked students with low SE rarely received social persuasion and, when they did, it typically focused on areas for improvement.

Notably, evidence from the reviewed studies indicates that the role of social persuasion becomes clearer when students' own accounts are brought into view. While Usher et al. (2019) find that social persuasion does not significantly predict SE in their quantitative analyses, their qualitative data reveal that many rural students nonetheless identify messages from others as a salient source of SE. In particular, girls, who sometimes report social persuasion more frequently than boys (e.g., Butz & Usher, 2015; Usher et al., 2019), describe how a specific teacher's approach makes them feel more confident. Such messages have

mixed effects: while some messages enhance SE—for example, when asked for help by a peer, as one student put it, 'because they think I can do it' (Usher et al., 2019, p. 41)—other messages undermine students' confidence. Instances of undermining messages are reported by Usher (2009): high SE-students describe peers that are envious of their success, while low-SE students 'rarely reported hearing such messages and instead remarked that receiving little or no positive feedback curtailed their beliefs about their own capabilities' (p. 303). Such enhancing social persuasion is also highly present for students who are performing substantially below their grade level in Burton and Campbell's (2019) study.

Alongside teachers and peers, parents also emerge as influential sources of social persuasion, though their impact is often more ambiguous. Social persuasion from parents is a complex matter. It ranges from being empowering to being demoralising, where the latter type can take the form of discouraging comments from home, resulting in low SE (Usher, 2009). For instance, Usher (2009) reports one boy who tends to repeat the words of his mother: 'You ain't gonna pass it anyway' (p. 302). This serves as a self-fulfilling prophecy that the teacher is unable to diminish. Yet the opposite is also true. In the same study, one boy talks about the strong sources of encouragement from his family. The teacher perceives the quality of this feedback and recognises its influence to be pervasive. Similarly, in the study by Olivares and Ceglie (2020), encouragement from parents is found to promote persistence, albeit with some danger of causing stress due to high expectations, while in the case of students who have parents with low mathematics SE, there is a danger of them copying their parents' anxiety and mathematics-related beliefs.

3.4. Physiological State

The fourth source, physiological state, captures emotional arousal and the effects of anxiety, mood, stress, and fatigue. The reviewed studies suggest that such arousal becomes a source of SE primarily when it is interpreted as diagnostic of competence (e.g., anxiety construed as inability). Consistent with this, although the quantitative phase of Usher et al.'s (2019) study identifies physiological state as a significant predictor of mathematics SE, their qualitative findings do not indicate it as a salient source of SE. This pattern reflects the overall tendency among the eight qualitative or mixed-method studies reviewed here: physiological states represent by far the least visible source of SE, being most commonly mentioned when students express discomfort and stress in confronting unfamiliar topics or tests (e.g., Usher, 2009). Usher (2009) found that 'all students expressed at least brief moments of heightened physiological and affective arousal in mathematics', but '[o]nly the students with low self-efficacy, however, interpreted this as a sign of incompetence' (p. 305). Teachers often recognise these affective states and attempt to mitigate them, for example, by framing tests as puzzles or quizzes (Usher, 2009).

However, returning to those studies concerning interventions in students who are experiencing difficulties in learning mathematics (Katz, 2015), who are at risk of dropping out of school (Hungnes et al., 2022) and who are performing substantially below their grade level (Burton & Campbell, 2019), physiological and affective states play a pivotal role in the development of these students. A safe learning environment—characterised, for example, by students being grouped with like-minded peers—combined with strong teacher support appears to prompt changes in both students' behaviour and their interactions with peers and teachers (Burton & Campbell, 2019; Hungnes et al., 2022). For example, in Burton and Campbell's (2019) study, following placement in small groups, students reported helping peers with homework, an unfamiliar experience for many. Such unexpected opportunities to support peers contributed to more positive physiological and affective states. These relational changes were accompanied by positive socio-emotional outcomes: students exhibited "a positive change in self-efficacy and emotional engagement; in other words,

the descriptions conveyed happiness, excitement, and enjoyment" (Burton & Campbell, 2019, p. 282). Moreover, reduced stress levels appeared to enhance students' capacity to remain present and focused. Likewise, in Hungnes et al.'s (2022) study, the students developed higher SE during their extra preparatory school year as a result of the warm and supportive environment. A similar pattern emerges in Katz's (2015) study, where the pre-intervention profiles reveal negative emotions such as anxiety, frustration, low self-confidence and sadness, with stress emerging as the main factor hindering progress, whereas the post-intervention profiles reflect self-confidence, self-regulation and calm.

4. Discussion and Concluding Remarks

Unanimously, researchers call for more qualitative and mixed research on the sources of mathematics SE (e.g., Bjerke et al., 2026; Usher & Pajares, 2008; Zakariya, 2022). In this section, I will start by critically summarising the key insights into the sources of mathematics SE that can be drawn from the existing qualitative research (addressing the first research question posed). Next, I discuss how future research can build on the strengths identified in existing qualitative studies of sources of mathematics SE (answering the second research question posed).

4.1. Key Insights

Across the four sources, the qualitative literature highlights that the development of SE in mathematics is less about isolated experiences and more about how those experiences are socially mediated, interpreted, and emotionally supported—most notably through teachers' practices and relational environments. In stark contrast to the way existing quantitative measures distinguish between sources of self-efficacy (e.g., Lent et al., 1991; Usher & Pajares, 2009), the analysis presented in this paper demonstrates the messy, complex, and interdependent nature of these sources. Against this backdrop, I argue that quantitative studies that neatly group the sources into four discrete "buckets" risk oversimplifying the underlying processes.

In what follows, I critically summarise the key insights into the sources of mathematics SE that can be drawn from the existing qualitative research by highlighting five broader but significant cross-source findings that extend beyond Bandura's (1977, 1997) conceptualization of sources. In undertaking this task, I do not provide a separate citation for each of the eight studies that constitute 'my data'; however, I do not advance any claims that are inconsistent with, and across, those studies. To improve readability and emphasise key insights, the cross-source findings are presented as a bulleted list:

- *Sources are interdependent rather than discrete.* Although quantitative research consistently identifies mastery experiences as the most prominent source of mathematics SE, the qualitative literature suggests that their efficacy-enhancing impact is strongly mediated by teachers' instructional practices—particularly for low-SE students. Teachers structure achievable challenges, support goal-setting, frame what counts as success, and help students recognise and interpret mastery. In this way, social persuasion from teachers—often described as influential yet fragile—shapes students' perceptions of mastery rather than operating as a separate, independent source. Similarly, the reviewed studies indicate that social comparison frequently blends information from mastery and vicarious experience, as students interpret peers' performance as self-relevant evidence of capability. Such interdependencies occasionally complicate efforts to determine which sources are 'in operation', suggesting that the four sources may function less as discrete categories and more as interacting mechanisms within instructional and social contexts.

- *Social mediation is central across all sources.* Across the four sources, mathematics SE development emerges as a socially mediated process rather than the product of isolated individual experiences. Teachers, peers, and parents consistently shape how events are framed, interpreted, and internalised, for example, through feedback, task structuring, comparison cues, and the emotional climate in which performance is evaluated. SE is therefore not merely 'built' through exposure to experiences but actively constructed through interaction.
- *Interpretation matters more than exposure.* The meaning students assign to experiences outweighs the mere occurrence of those experiences: Mastery experiences must be recognised as such, vicarious experiences must be perceived as self-relevant, social persuasion must be credible and tailored, and physiological arousal must be interpreted as manageable rather than threatening. Across sources, interpretive processes function as a key mechanism linking experience to SE.
- *Teachers act as source facilitators.* Teachers emerge as a cross-source catalyst: their practices can amplify or dampen the effects of all four sources. Through feedback, relational care, and emotional framing, teachers enhance or undermine mastery experiences, structure vicarious learning opportunities, shape the impact of social persuasion, and influence how students interpret stress and affect. This suggests that teacher influence cannot be reduced to a single source but operates systemically across them. In this respect, the finding resonates with expectancy-based accounts such as the Pygmalion effect, whereby teachers' expectations can shape students' opportunities, feedback, and self-beliefs in self-reinforcing ways (Rosenthal, 2002).
- *SE level moderates how sources function.* Across the four sources, students' existing levels of SE shape both the salience and effectiveness of efficacy-relevant experiences. Students with low SE are more likely to benefit from external scaffolding, targeted social persuasion, and supportive learning environments, and they appear more vulnerable to negative interpretations of setbacks and affective arousal. By contrast, high-SE students rely more on self-regulation, enactive mastery, and internal standards, with less need for external feedback. Thus, the same source may operate in qualitatively different ways depending on students' SE profiles.

Having unpacked these key insights, I agree with the call made by my predecessors (i.e., Bjerke et al., 2026; Usher & Pajares, 2008; Zakariya, 2022) and posit the need for more qualitative and mixed-methods research on the sources of mathematics SE. To help address this issue, in the next section, I will discuss the ways in which future research can build on the strengths identified in the existing qualitative and mixed studies and, therefore, advance the field.

4.2. Future Research Directions

In conducting this review, I made several deliberate methodological choices. Most importantly, I opted to downplay many of the detailed contextual factors described in the eight included studies (e.g., whether a study was situated in a mid-sized suburban town or a rural high-poverty area; the socioeconomic composition of the sample; eligibility for free or reduced-price lunch; ethnicity). Ultimately, I regard the diversity of contexts as a strength. The commonalities identified across highly varied populations suggest that the findings may reflect more general processes and be less context dependent than sometimes assumed. A synthesis such as the present one can therefore contribute to advancing the field—here, in particular, by pointing to the need for more qualitative or mixed-methods research. Additional studies using these approaches would help clarify how the sources of SE operate and which mechanisms are sensitive to contextual variation. However, given that only eight studies were included, these issues remain difficult to assess definitively.

The limitations of purely quantitative approaches are well documented, particularly their failure to adequately capture the diverse and temporal conditions under which students evaluate their beliefs and experiences (Usher & Pajares, 2008, p. 784). Such studies are limited by for instance the use of rating scales that inadequately capture vicarious experiences, that restrict the item wording to a single valence (i.e., negative for physiological and affective states and positive for other sources; Usher et al., 2019) and that fail to capture the nuanced ways students interpret experiences and the complex processes involved (e.g., motivation from others' failures or the influence of specific teaching strategies; Usher, 2009). As highlighted by Butz and Usher (2015), efficacy-relevant information is subject to individual interpretation, where a single comment may have lasting effects on an individual's SE, something a typical survey item cannot capture at this level of interpretation (Butz & Usher, 2015, p. 53). Furthermore, the abundance of cross-sectional designs used in quantitative studies (Bjerke et al., 2026) prevents insights into how SE and its sources develop dynamically over time (Usher et al., 2019), overlooking how and why students interpret their experiences to build SE (Usher, 2009). As shown in this review, many studies have sought to address these shortcomings by incorporating insights that are more effectively revealed via qualitative inquiry.

Future studies can build on the strengths identified in terms of existing qualitative studies on the sources of mathematics SE. Rather than merely documenting students' exposure to the theoretical sources of SE (an approach that often emphasizes quantification and prevalence typical of much quantitative research), I argue for a focus on how students interpret and make meaning of these experiences. This interpretative focus includes how mastery experiences are recognised (or dismissed), when social comparison becomes self-relevant, why certain feedback is perceived as credible, and how physiological arousal is framed as either a challenge or a threat. In this regard, physiological and affective states are of particular importance, as they are typically the least visible source in both qualitative and quantitative studies, yet they fundamentally influence how other sources operate. Although quantitative studies have linked emotional support to SE (e.g., Sakiz, 2017; E. M. Skaalvik et al., 2015), such research often identifies these effects only when students explicitly report discomfort and stress, in particular moments when physiological and affective experiences are most salient (e.g., Usher, 2009). An in-depth interpretative approach can capture not just instances of stress, but the ongoing role of emotional safety as a contextual backdrop that enables or constrains SE development. Across the included qualitative studies, physiological and affective states emerge less as standalone sources and more as conditions that moderate or frame other sources: reduced stress, feelings of belonging, and emotional safety allow mastery experiences, vicarious experiences, and social persuasion to more effectively enhance SE (e.g., Burton & Campbell, 2019; Hungnes et al., 2022, Katz, 2015). In the absence of such conditions, these other sources often fail to translate into strengthened efficacy beliefs.

Understanding these interpretive mechanisms is essential for explaining variability in SE development across students. Hence, I assert that future research on SE should shift from measuring sources in isolation to examining the socially mediated, interpretive, and emotionally situated processes through which SE develops, with qualitative research playing a critical role in uncovering how these processes unfold across contexts, student profiles, and time. Furthermore, rather than merely applying Bandura's (1977, 1997) framework, qualitative research can refine the boundaries between sources, clarify overlaps (e.g., between mastery and social persuasion), and theorise emotional safety as a cross-source condition. In this way, qualitative research has the potential to contribute to theoretical development, in particular when it comes to SE development among low-performing and low-SE students, students at risk of disengagement, and students from marginalised

backgrounds. This review has shown that these groups are overrepresented in qualitative studies, while being under-theorised in the broader SE literature.

4.3. Concluding Remarks

To conclude this paper, I return to the hypotheses offered in the introduction about why research on SE and its sources has remained dominated by quantitative designs. I suggested that this dominance might be driven by a combination of theoretical tendencies (e.g., conceptualising SE as operationalizable and measurable), historical factors (such as the longstanding emphasis on psychometric robustness), and broader societal pressures (including alignment with policy priorities, accountability metrics, and effectiveness research). Indeed, there is a long tradition of using established Likert-type scales to assess sources of mathematics SE, such as various adapted versions of the Sources of Mathematics Self Efficacy Scale (Lent et al., 1991), the Motivated Strategies for Learning Questionnaire (Pintrich et al., 1993), the Patterns of Adaptive Learning Scales (Midgley et al., 2000), and the Sources of Middle School Mathematics Self Efficacy Scale (Usher & Pajares, 2009)—all developed well before the first qualitative studies in this area appeared, meaning that qualitative insights could not have influenced their design. With one partial exception—the Usher and Pajares (2009) scale, which was developed alongside qualitative work (Usher, 2009)—existing measures largely reflect only the conceptualisations embedded in earlier quantitative traditions. I therefore argue that new scales must be developed, particularly ones that explicitly incorporate the five cross-source findings presented in Section 4.1 that extend beyond Bandura's (1977, 1997) original conceptualisation of SE sources.

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Abbreviations

The following abbreviations are used in this manuscript:

SE Self-efficacy

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