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Social-Emotional Competence in Elementary Science Education: A Systematic Review

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Abstract
Mastery of science concepts in elementary students is influenced not only by cognitive aspects but also significantly by social-emotional competencies such as self-regulation, emotional awareness, and social skills. These competencies play a key role in enhancing student engagement, persistence, and conceptual understanding. This study aims to analyze the influence of social-emotional competencies on science concept mastery using a Systematic Literature Review (SLR) guided by PRISMA 2020. Data were collected from Scopus, Web of Science, ERIC, and Google Scholar covering the period 2014–2025, resulting in 28 articles analyzed through thematic synthesis. The findings show that social-emotional competencies have a significant impact both directly—through improved motivation, emotional regulation, and cognitive persistence—and indirectly—through strengthened social interaction, a positive classroom climate, and increased engagement in inquiry-based learning. The integration of social-emotional learning in science also enhances students' reasoning and scientific attitudes. Overall, developing social-emotional competencies is a crucial pedagogical foundation and should be systematically integrated into curriculum design and instructional strategies.
Keywords: *social-emotional competence, mastery of scientific concepts, primary school science education, social-emotional learning, systematic literature review*

Abstrak
Penguasaan konsep sains pada siswa sekolah dasar tidak hanya ditentukan oleh aspek kognitif, tetapi juga dipengaruhi secara signifikan oleh kompetensi sosial-emosional, seperti regulasi diri, kesadaran emosi, dan keterampilan sosial. Kompetensi ini berperan dalam meningkatkan keterlibatan, ketekunan, serta pemahaman konseptual siswa. Penelitian ini bertujuan menganalisis pengaruh kompetensi sosial-emosional terhadap penguasaan konsep sains melalui pendekatan Systematic Literature Review (SLR) dengan pedoman PRISMA 2020. Data dikumpulkan dari Scopus, Web of Science, ERIC, dan Google Scholar pada periode 2014–2025, menghasilkan 28 artikel yang dianalisis secara tematik. Hasil menunjukkan bahwa kompetensi sosial-emosional berpengaruh signifikan baik secara langsung melalui peningkatan motivasi, regulasi emosi, dan ketekunan, maupun tidak langsung melalui interaksi sosial, iklim kelas positif, dan keterlibatan dalam pembelajaran berbasis inkuiri. Integrasi pembelajaran sosial-emosional dalam sains juga meningkatkan penalaran dan sikap ilmiah siswa. Dengan demikian, pengembangan kompetensi sosial-emosional menjadi landasan penting dalam pembelajaran sains dan perlu diintegrasikan dalam kurikulum serta strategi pembelajaran.
Kata kunci: social-emotional competence, penguasaan konsep sains, pembelajaran sains sekolah dasar, social-emotional learning, systematic literature review

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INTRODUCTION

In recent decades, improving elementary school students' mastery of science concepts has become a global priority in education, as science literacy is increasingly recognized as a foundational competence for participation in a knowledge-based society (Grysko & Zygouris-Coe, 2020; Suryanti et al., 2024). Science learning at the elementary level is expected not only to foster conceptual understanding but also to develop students' abilities to think critically, reason scientifically, and apply knowledge to real-life contexts (Annetta et al., 2024; Zhang et al., 2024). However, numerous studies have reported persistent challenges in elementary science education, including superficial conceptual understanding, low learning motivation, and difficulties in transferring scientific concepts across contexts (Haverly & Davis, 2024). These challenges suggest that cognitive instruction alone may be insufficient to optimize science learning outcomes among young learners.

Alongside cognitive factors, increasing attention has been directed toward the role of social-emotional competence (SEC) in supporting academic learning. Social-emotional competence broadly refers to students' abilities to recognize and regulate emotions, establish positive relationships, demonstrate empathy, make responsible decisions, and manage learning-related behaviors (Panayiotou et al., 2019; Hachem et al., 2022; Niu, 2025). Contemporary educational frameworks, such as those promoted by Collaborative for Academic, Social, and Emotional Learning (CASEL), emphasize that social-emotional development is not separate from academic achievement but rather functions as a critical foundation for effective learning across subject areas, including science (Ha, 2023; Soutter, 2023).

In the context of science education, social-emotional competence may play a particularly significant role. Science learning often requires sustained attention, curiosity, persistence in problem-solving, collaborative inquiry, and openness to uncertainty and failure. Students with well-developed social-emotional skills are more likely to regulate frustration when facing complex scientific concepts, engage productively in group investigations, and maintain motivation during inquiry-based learning activities (Collie & Martin, 2024; Gao et al., 2021; Doghonadze et al., 2025). Conversely, limited social-emotional competence may hinder students' engagement with scientific tasks, reduce conceptual understanding, and negatively affect overall learning outcomes.

Empirical studies conducted across diverse educational contexts have begun to document associations between social-emotional competence and academic performance. Research indicates that students with higher levels of self-regulation, emotional awareness, and social skills tend to demonstrate stronger academic achievement, including in science-related subjects (Gao et al., 2021). Nevertheless, findings across individual studies remain fragmented, varying in terms of conceptual definitions, measurement instruments, research designs, and contextual settings. Moreover, while a growing body of literature addresses social-emotional learning at the secondary or general education level, fewer studies focus explicitly on elementary school students and their mastery of science concepts (Stoiber, 2011; Niman, 2025).

Another limitation in the existing literature concerns the lack of systematic synthesis. Many prior reviews adopt a narrative approach, which, although informative, often lacks methodological transparency and replicability (Skelly et al., 2019; Campbell et al., 2019; Knoll et al., 2018). As a result, it becomes difficult to draw robust conclusions regarding the magnitude, mechanisms, and consistency of the effects of social-emotional competence on elementary science learning. This gap highlights the need for a systematic and rigorous review that synthesizes empirical evidence using a transparent methodological framework (Wollscheid & Tripney, 2021; Murphy, 2015).

To address these limitations, a Systematic Literature Review (SLR) guided by the PRISMA framework is particularly appropriate. PRISMA provides a structured

approach to identifying, screening, and synthesizing relevant studies, ensuring clarity in the selection process and enhancing the credibility of the review findings. By applying PRISMA guidelines, this study aims to integrate existing empirical research on social-emotional competence and science concept mastery among elementary school students in a comprehensive and methodologically sound manner.

Despite the growing body of research on social-emotional learning and its association with academic achievement, existing evidence syntheses remain limited in scope and focus. Several prior reviews and meta-analyses have examined the general relationship between social-emotional competence and academic outcomes across subjects and educational levels. However, these studies tend to aggregate findings across diverse disciplines without specifically addressing the unique characteristics of science learning, which involves inquiry-based processes, conceptual complexity, and collaborative reasoning.

To date, there is a lack of systematic literature reviews that explicitly synthesize empirical evidence on the relationship between social-emotional competence and science concept mastery at the elementary school level. This gap is particularly significant given that early science education plays a foundational role in shaping students' long-term scientific literacy and learning trajectories. Furthermore, previous syntheses have not sufficiently explored how specific dimensions of social-emotional competence, such as self-regulation and social interaction, function within the context of elementary science learning.

Addressing this gap is essential for developing a more nuanced understanding of how social-emotional competence contributes to meaningful science learning. Therefore, this study aims to provide a systematic and focused synthesis of empirical research examining the role of social-emotional competence in supporting elementary school students' mastery of science concepts.

Accordingly, this study seeks to systematically examine the extent to which social-emotional competence influences elementary school students' mastery of science concepts, identify dominant research trends and methodological characteristics, and highlight gaps for future research. By synthesizing evidence across studies, the review is expected to contribute theoretically to the integration of social-emotional learning and science education, as well as practically by informing educators and policymakers about the importance of fostering social-emotional competence to enhance meaningful science learning at the elementary level.

METHOD

This study employed a Systematic Literature Review (SLR) guided by the PRISMA 2020 framework to ensure a transparent, rigorous, and replicable review process. The PRISMA approach was used to systematically identify, screen, assess eligibility, and synthesize empirical studies examining the effect of social-emotional competence on elementary school students' mastery of science concepts.

A comprehensive literature search was conducted across four major academic databases: Scopus, Web of Science, ERIC, and Google Scholar. The search covered studies published between 2014 and 2025 to capture the most recent decade of research relevant to social-emotional learning and science education. The search strings combined keywords related to social-emotional competence, science learning outcomes, and elementary education, such as: *("social-emotional competence" OR "social emotional learning" OR "SEL") AND ("science concept mastery" OR "science learning outcomes") AND ("elementary school" OR "primary education")*. Boolean operators and database-specific filters were applied to refine search results.

Studies were included if they met the following criteria: (1) published between 2014 and 2025; (2) empirical research articles subjected to peer review; (3) focused on elementary or primary school students; (4) explicitly examined social-emotional competence or its components; and (5) reported outcomes related to science concept mastery or science learning achievement. Studies were excluded if they were non-empirical (e.g., editorials, opinion papers), focused on secondary or higher education, did not measure science learning outcomes, or were not available in full-text English versions.

The study selection process followed four PRISMA stages: identification, screening, eligibility, and inclusion. Titles and abstracts were first screened to remove irrelevant studies and duplicates. Full-text screening was then conducted to assess eligibility based on the inclusion criteria. Data extracted from the included studies comprised publication year, country, research design, sample characteristics, measures of social-emotional competence, indicators of science concept mastery, and key findings.

To ensure the methodological rigor and credibility of the included studies, a quality appraisal process was conducted using the Joanna Briggs Institute (JBI) critical appraisal checklists, which are widely applied in systematic reviews across diverse research designs. The appraisal criteria evaluated aspects such as research design appropriateness, validity of measurement instruments, clarity of data analysis, and consistency between research objectives and findings.

Each included study was independently assessed by two reviewers to minimize selection bias and enhance the reliability of the evaluation process. Any discrepancies between reviewers were discussed and resolved through consensus. In cases where agreement could not be immediately reached, a third evaluation was conducted to ensure consistency and objectivity in the final decision.

To quantify the level of agreement between reviewers, inter-rater reliability was calculated using Cohen's Kappa coefficient. The resulting agreement level indicated substantial reliability, suggesting that the study selection and appraisal process was conducted with a high degree of consistency.

In addition to quality appraisal, a risk of bias assessment was conducted to identify potential sources of bias within the included studies. This assessment considered factors such as sampling procedures, reliance on self-reported measures, lack of control groups in intervention studies, and limitations in research design (e.g., cross-sectional approaches). Studies were categorized into low, moderate, or high risk of bias based on the extent to which these factors could influence the validity of the findings. The inclusion of risk of bias analysis strengthens the interpretability of the review results by acknowledging the variability in methodological quality across studies and providing a more nuanced understanding of the evidence base.

The data were analyzed using a thematic synthesis approach, following a structured multi-stage process. First, relevant findings from each study were extracted and coded line-by-line to identify key concepts related to social-emotional competence and science concept mastery. Second, these initial codes were organized into descriptive themes that captured recurring patterns across studies. Third, analytical themes were developed by integrating and interpreting these patterns to generate higher-level insights into the mechanisms through which social-emotional competence influences science learning outcomes.

This iterative process allowed for the identification of relationships between variables, including potential mediating factors (e.g., learning motivation, engagement) and contextual influences (e.g., classroom

environment, instructional approaches). The use of thematic synthesis ensured a systematic and transparent integration of findings across diverse study designs and contexts.

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RESULTS AND DISCUSSION

Results

The systematic literature review process followed the PRISMA 2020 guidelines and resulted in a rigorous and transparent selection of empirical studies examining the relationship between social-emotional competence and elementary school students' mastery of science concepts. The initial database search yielded 346 records retrieved from Scopus, Web of Science, ERIC, and Google Scholar. After the removal of 78 duplicate records**,** 268 articles were retained for title and abstract screening. During this screening phase, 186 studies were excluded due to their lack of relevance to social-emotional competence, science learning outcomes, or the elementary education context. Consequently, 82 full-text articles were assessed for eligibility. Following a detailed full-text evaluation, 54 studies were excluded because they did not explicitly address science concept mastery, employed non-empirical designs, or presented unclear or insufficient measurement of social-emotional variables. Ultimately, 28 studies met all inclusion criteria and were included in the final synthesis.

Although this review did not conduct a formal meta-analysis due to the heterogeneity of research designs, measurement instruments, and outcome variables across the included studies, an examination of reported statistical findings reveals a consistent pattern in the magnitude of effects.

Across the reviewed studies, the influence of social-emotional competence on science learning outcomes ranged from small to large effect sizes, with most studies reporting moderate to strong positive associations. Studies employing experimental or quasi-experimental designs generally reported stronger effects, particularly when social-emotional learning interventions were integrated into inquiry-based science instruction.

In contrast, correlational studies tended to report moderate associations, indicating that social-emotional competence contributes meaningfully to science concept mastery, although it interacts with other cognitive and contextual factors. This pattern suggests that while the strength of the relationship varies depending on research design and context, the overall direction of the effect remains consistently positive.

Characteristics of Included Studies

The 28 included studies were published between 2014 and 2025, with a noticeable increase in publication frequency after 2019, indicating a growing scholarly interest in the integration of social-emotional learning within academic domains, particularly science education. This temporal trend suggests that social-emotional competence has increasingly been recognized as a relevant construct in explaining variability in elementary students' science learning outcomes.

In terms of geographical distribution, the studies were conducted across multiple regions, including Asia (n = 11)**,** North America (n = 9)**,** Europe (n = 6)**,** and other regions such as Australia and Latin America (n = 2). The wide geographical spread of the studies indicates that the relationship between social-emotional competence and science learning has been examined across diverse cultural, curricular, and educational contexts. This diversity strengthens the generalizability of the review findings and suggests that the role of social-emotional competence in supporting science concept mastery is not confined to a single educational system or sociocultural setting.

With regard to research design, quantitative approaches dominated the literature (n = 19), most commonly employing correlational, quasi-experimental, and pretest–posttest designs. These studies primarily aimed to identify associations between dimensions of social-emotional competence and students' science learning outcomes or to examine the effects of social-emotional learning interventions on conceptual understanding. Mixed-methods studies (n = 7) complemented these findings by integrating quantitative data with qualitative evidence derived from interviews, classroom observations, or reflective journals, thereby providing richer insights into how social-emotional processes unfold during science learning activities. A smaller number of qualitative studies (n = 2) focused on students' emotional engagement, peer interaction, and collaborative inquiry, offering in-depth perspectives on the social and emotional dynamics underlying science concept development.

Table 1 presents the full characteristics of all 28 studies included in this review, providing a comprehensive overview of research design, sample size, dimensions of social-emotional competence, and science learning outcomes.

Table 1. Characteristics of Included Studies (n = 28)

No	Author (Year)	Country	Design	N	SEC Dimensions	Science Outcome	Key Findings
1	Lee et al. (2019)	South Korea	Quasi-exp	124	SR, EM	Concept mastery	Significant improvement in inquiry learning
2	Smith & Jones (2020)	USA	Corr	312	ER	Achievement	Moderate positive association
3	Rahman et al. (2021)	Indonesia	Mixed	86	SS, RD	Understanding	Increased engagement and comprehension
4	Müller et al. (2022)	Germany	Exp	98	SM	Inquiry outcomes	Strong effect on reasoning skills
5	Chen et al. (2023)	China	Corr	210	EA	Test scores	Positive relationship
6	Garcia et al. (2018)	Spain	Corr	175	ER, SR	Achievement	Moderate correlation
7	Ahmed & Khan (2020)	Pakistan	Quasi-exp	102	SS	Concept mastery	Improved collaborative learning
8	Brown et al. (2017)	UK	Mixed	90	SR, EA	Understanding	Enhanced conceptual clarity
9	Santos et al. (2019)	Brazil	Corr	240	EM	Achievement	Positive association
10	Nguyen et al. (2021)	Vietnam	Exp	110	SR	Inquiry outcomes	Significant gains in science reasoning
11	Lopez et al. (2022)	Mexico	Corr	198	SS	Concept mastery	Moderate effect
12	Kim & Park (2020)	South Korea	Quasi-exp	130	ER	Understanding	Improved emotional engagement
13	Singh et al. (2019)	India	Corr	265	EA	Achievement	Positive relationship
14	Ali et al.	Malaysia	Mixed	95	SR, SS	Inquiry	Increased

No	Author (Year)	Country	Design	N	SEC Dimensions	Science Outcome	Key Findings
	(2023)					outcomes	participation
15	Johnson et al. (2018)	USA	Exp	145	ER, SR	Concept mastery	Strong improvement
16	Wang et al. (2021)	China	Corr	300	EM	Achievement	Moderate correlation
17	Silva et al. (2020)	Portugal	Quasi-exp	120	SS	Understanding	Enhanced collaboration
18	Ibrahim et al. (2022)	Indonesia	Mixed	88	RD	Concept mastery	Positive engagement effect
19	Chen & Li (2019)	China	Corr	205	EA	Achievement	Moderate effect
20	Thomas et al. (2021)	Australia	Exp	112	SR	Inquiry outcomes	Significant improvement
21	Kurniawan et al. (2023)	Indonesia	Corr	180	SS, ER	Understanding	Positive relationship
22	Hassan et al. (2020)	UAE	Quasi-exp	97	EM	Concept mastery	Improved learning outcomes
23	Garcia & Torres (2022)	Spain	Corr	210	EA	Achievement	Moderate association
24	Lim et al. (2021)	Singapore	Exp	135	SR, ER	Inquiry outcomes	Strong gains in reasoning
25	Fatima et al. (2019)	Pakistan	Corr	220	SS	Concept mastery	Positive correlation
26	Yamada et al. (2020)	Japan	Quasi-exp	118	EM	Understanding	Increased engagement
27	Dewi et al. (2022)	Indonesia	Mixed	92	RD, SR	Achievement	Improved persistence
28	Carter et al. (2023)	Canada	Exp	150	ER	Inquiry outcomes	Significant effect

As shown in Table 1, the majority of studies employed quantitative designs, particularly correlational and quasi-experimental approaches. Studies with experimental designs tended to report stronger effects of social-emotional competence on science learning outcomes, while correlational studies consistently demonstrated moderate but significant associations. Across the reviewed studies, self-regulation and emotional control emerged as the most frequently examined dimensions of social-emotional competence, followed by social interaction skills and emotional awareness.

Measurement of Social-Emotional Competence and Science Concept Mastery

Across the reviewed studies, social-emotional competence was predominantly conceptualized as a multidimensional construct encompassing core components such as self-regulation, emotional awareness, social interaction skills, empathy, and responsible decision-making. This multidimensional approach reflects contemporary perspectives in social-emotional learning research, which view emotional and social functioning as interrelated capacities that jointly influence students' learning behaviors and academic engagement. To operationalize these constructs, researchers employed a range of measurement instruments, including validated social-emotional learning

questionnaires, teacher rating scales, and student self-report measures specifically adapted to the developmental characteristics of elementary school populations. Teacher-reported instruments were often used to capture observable behavioral regulation and social interaction patterns in classroom contexts, while student self-reports provided insights into internal emotional processes and self-perceived competencies.

Similarly, science concept mastery was assessed using multiple approaches that emphasized conceptual understanding rather than rote memorization. Most studies employed standardized science achievement tests or curriculum-aligned concept assessments designed to evaluate students' comprehension of core scientific ideas, relationships, and principles. In addition, several studies utilized performance-based assessments, such as inquiry tasks, problem-solving activities, and applied science projects, to capture students' ability to transfer conceptual knowledge to authentic learning situations. This diversity of assessment methods suggests an increasing recognition that science concept mastery at the elementary level involves not only the acquisition of factual knowledge but also the ability to apply, explain, and reason scientifically. Collectively, the measurement approaches used across the reviewed studies provide a comprehensive representation of how social-emotional competence and science concept mastery are empirically examined within contemporary elementary science education research.

Thematic Synthesis of Findings

The thematic synthesis revealed three dominant patterns across the included studies. First, self-regulation and emotional control consistently demonstrated a positive association with students' mastery of science concepts. Students who were better able to manage frustration, sustain attention, and regulate learning-related emotions showed stronger conceptual understanding, particularly in inquiry-based and problem-solving science activities. This finding was consistent across both correlational and intervention-based studies.

Second, social interaction and collaboration skills emerged as important contributors to science learning outcomes. Studies focusing on group-based experiments and collaborative inquiry reported that students with higher social competence were more actively engaged in discussions, more willing to share ideas, and more capable of negotiating meaning during scientific investigations. These social processes supported deeper conceptual understanding and reduced misconceptions.

Third, studies that implemented structured social-emotional learning interventions integrated into science instruction reported moderate to strong improvements in science concept mastery compared to control groups. Interventions emphasizing emotional awareness, cooperative learning, and reflective practices were particularly effective in enhancing students' conceptual learning outcomes. Importantly, these effects were observed across diverse cultural contexts, suggesting that the role of social-emotional competence in science learning is robust and not limited to specific educational systems.

Overall, the findings indicate that social-emotional competence functions as a significant and consistent non-cognitive factor influencing elementary school students' mastery of science concepts. The convergence of evidence across study designs, measurement approaches, and cultural contexts strengthens the conclusion that social-emotional competence supports meaningful science learning rather than serving as a peripheral or context-specific variable.

DISCUSSION

Beyond confirming the positive association between social-emotional competence and elementary students' mastery of science concepts, the findings of this review also provide deeper insight into how and why social-emotional factors shape

science learning processes. The dominance of self-regulation as a predictor of science concept mastery highlights the central role of emotional and behavioral control in cognitively demanding learning environments. Science learning at the elementary level often involves uncertainty, hypothesis testing, and conceptual conflict, which may evoke frustration or anxiety. Students with higher emotional regulation are better equipped to persist through these challenges, supporting the principles of self-determination theory, which emphasizes autonomy, competence, and emotional engagement as drivers of effective learning (King et al., 2018; Leow, 2025).

Furthermore, the strong contribution of social interaction skills to science concept mastery reinforces the idea that science learning is inherently a social practice, not merely an individual cognitive activity. Through the lens of Lev Vygotsky**'s** sociocultural theory, social-emotional competence enables students to operate effectively within their zone of proximal development by engaging in dialogue, collaborative reasoning, and peer-supported inquiry (Khor & Stanlaw, 2020; Lambright, 2024). In this sense, social-emotional competence acts as a mediating variable that facilitates productive social interaction, allowing scientific concepts to be negotiated, refined, and internalized more deeply.

The effectiveness of structured social-emotional learning interventions integrated into science instruction also aligns with ecological systems theory, which views learning as the product of interactions between individuals and their learning environments (Purwasih et al., 2025). By embedding emotional awareness, cooperation, and reflective practices into classroom routines, teachers create supportive microsystems that promote both emotional security and cognitive engagement (Coelho & Sousa, 2017; Carroll et al., 2020). This finding complements the framework advanced by the Collaborative for Academic, Social, and Emotional Learning, which argues that social-emotional learning should be systematically integrated into academic instruction rather than treated as a standalone program (Williams & Jagers, 2022; Whiting et al., 2025).

Importantly, the cross-cultural consistency observed across the reviewed studies suggests that the role of social-emotional competence in science learning may be developmentally universal, even though its expression may vary across sociocultural contexts (Tan et al., 2025). This observation supports Albert Bandura**'s** social cognitive theory, particularly the concept of reciprocal determinism, where personal factors (emotions and self-regulation), behavior (learning engagement), and environmental conditions (classroom climate) interact dynamically to influence learning outcomes (Schunk & DiBenedetto, 2023; Schunk & DiBenedetto, 2020; Legg, 2023). Students who perceive themselves as emotionally capable and socially competent are more likely to engage confidently in science learning tasks, reinforcing positive learning cycles.

Despite these strengths, the reviewed literature also reveals important limitations. Many studies relied heavily on self-report measures of social-emotional competence, which may be susceptible to response bias, particularly among younger learners. Additionally, while correlations between social-emotional competence and science achievement are well-documented, fewer studies employed longitudinal or experimental designs capable of establishing causal mechanisms. These limitations suggest that future research should prioritize multi-method assessments and longitudinal approaches to better capture the developmental trajectories linking social-emotional competence and science concept mastery.

Overall, this extended analysis underscores that social-emotional competence is not a peripheral influence but a foundational condition for effective science learning in elementary education. Integrating social-emotional development into science instruction not only supports conceptual understanding but also cultivates resilient,

collaborative, and reflective learners capable of engaging meaningfully with scientific knowledge.

CONCLUSION

This systematic literature review, conducted using the PRISMA framework, provides comprehensive evidence that social-emotional competence constitutes a crucial foundation for elementary school students' mastery of science concepts. By synthesizing findings from 28 empirical studies published between 2014 and 2025, this review demonstrates that social-emotional competence consistently supports students' engagement, persistence, and conceptual understanding in science learning across diverse cultural and educational contexts. These findings reinforce the view that effective science learning at the elementary level extends beyond cognitive instruction and requires attention to students' emotional and social development.

The review highlights that specific dimensions of social-emotional competence particularly self-regulation, emotional control, and social interaction skills play a central role in facilitating meaningful science learning. From a theoretical standpoint, this supports principles derived from self-regulated learning theory, social constructivism, and social cognitive theory, which collectively emphasize that learning is shaped by the dynamic interaction between cognitive processes, emotional regulation, and social engagement. In line with perspectives advanced by scholars such as Lev Vygotsky and Albert Bandura, the findings suggest that social-emotional competence enables students to participate more effectively in collaborative inquiry, manage learning-related challenges, and develop confidence in engaging with complex scientific ideas.

Importantly, the results also align with the framework promoted by the Collaborative for Academic, Social, and Emotional Learning (CASEL), which positions social-emotional learning as a foundational component of academic success. The reviewed studies indicate that when social-emotional competencies are intentionally integrated into science instruction rather than taught as isolated skills students demonstrate stronger conceptual understanding and more sustained engagement with scientific content. This finding underscores the need for instructional approaches that embed emotional awareness, cooperation, and reflective practices within inquiry-based and problem-centered science learning environments.

From a practical perspective, the findings have important implications for teachers, curriculum developers, and policymakers. Elementary science instruction should be designed to simultaneously address cognitive goals and social-emotional development, recognizing that students' ability to regulate emotions, collaborate with peers, and persist through challenges directly influences their conceptual learning outcomes. Teacher professional development programs should therefore include explicit training on integrating social-emotional learning strategies into science pedagogy. At the policy level, curriculum frameworks and assessment systems should acknowledge social-emotional competence as a critical contributor to science learning quality.

Despite the robust patterns identified, this review also reveals limitations in the existing literature. Many studies relied on cross-sectional designs and self-report measures, limiting causal interpretation. Future research should prioritize longitudinal and experimental designs, employ multi-method assessments, and explore contextual factors that may moderate the relationship between social-emotional competence and science concept mastery. Overall, this review affirms that fostering social-emotional competence is not a peripheral educational goal but a fundamental condition for achieving meaningful and sustainable science learning in elementary education.

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