Parental Heteroregulation and Mathematical Efficiency among Secondary School Learners: Support, Control and Scaffolding Withdrawal in Cognitive Self-Regulation

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ABSTRACT

Mathematics learning requires not only content knowledge but also the capacity to understand tasks, plan procedures, sustain attention, monitor errors and adjust strategies. This systematic review with narrative synthesis examined how parental heteroregulation may support or constrain these regulatory processes and, consequently, mathematical efficiency among secondary school learners. The preserved review records documented searches of ERIC, ScienceDirect, SpringerLink, Cairn.info, HAL and Google Scholar, supplemented by reference-list searching and full-text retrieval through academic networks. English- and French-language publications available up to 31 December 2024 were considered. Aggregate screening records indicated 54 documents identified, 38 titles and abstracts screened, 16 full texts assessed and eight studies included. Four studies provided mathematics-specific evidence, whereas four complementary studies informed the mechanisms linking parental involvement, self-regulated learning and achievement. During revision, methodological quality and evidential directness were appraised retrospectively using five design-sensitive domains adapted from JBI guidance. Findings consistently distinguished autonomy-supportive assistance from intrusive or substitutive involvement. Supportive practices clarify goals, assist planning, reduce distractions, encourage effort, prompt self-evaluation and gradually withdraw scaffolding. Intrusive practices impose procedures, provide answers, intensify performance pressure or replace the learner's cognitive activity. The evidence therefore suggests that the quality and adjustment of parental support are more consequential than its frequency. However, the reviewed designs are predominantly correlational or synthetic and do not establish a causal effect of parental heteroregulation on mathematical efficiency. The review proposes a dual-pathway analytical model and recommends longitudinal, multi-informant and intervention studies involving learners, parents and teachers, particularly in African secondary-school contexts. Psychoeducational programmes should help parents guide mathematical activity while progressively transferring responsibility to the learner.

Keywords: parental heteroregulation, mathematical efficiency, cognitive self-regulation, homework assistance, scaffolding withdrawal

INTRODUCTION

Mathematics occupies a central place in school pathways because it involves reasoning, abstraction, planning, problem-solving and error-monitoring skills. Yet it remains one of the subjects in which learners experience persistent difficulties. These difficulties do not only relate to mastery of the content taught; they also concern the way learners understand the task, organise their approach, maintain attention, adjust strategies and evaluate the relevance of their responses.

In francophone sub-Saharan African education systems, learning outcomes in mathematics remain a cause for concern. The PASEC 2019 assessments, conducted by CONFEMEN, highlight the fragility of mathematical competences in several participating countries, including Cameroon. Although these results focus on primary education, they raise questions about the continuity of learning, since insufficiently consolidated foundations may compromise later performance at secondary level, where tasks become more abstract and cognitively demanding.

In response to these difficulties, the family environment constitutes an important lever for supporting learning. The meta-analyses by Fan and Chen (2001), Castro et al. (2015) and Wilder (2014) show that parental involvement is generally associated with better school performance. More recently, Wang and Wei (2024), in a meta-analysis focused on mathematics, report a positive association between parental involvement and mathematical performance, while emphasising that this effect varies according to the form of involvement, school level and context.

However, parental assistance is not always beneficial. Jiang et al. (2023), in the context of mathematics homework, distinguish supportive parental involvement from intrusive parental involvement. This distinction is essential: assistance may foster learning when it guides, encourages and structures the learner's activity; conversely, it may become unfavourable when it imposes, overcontrols or substitutes for the learner's cognitive effort. Park et al. (2023) thus show that intrusive parental support may predict lower performance, while Maloney et al. (2015) emphasise that parents' mathematics anxiety may negatively affect children when parental involvement in homework is frequent.

These studies call for moving beyond a global reading of parental involvement. The scientific issue is therefore not only whether parents support their children, but how they support them. From this perspective, the concept of parental heteroregulation appears particularly relevant. According to Nader-Grosbois (2007), regulation, self-regulation and heteroregulation refer to processes through which a subject's activity is adjusted in relation to a task, a goal or a difficulty. Heteroregulation thus corresponds to external assistance provided by an adult or a more competent partner in order to progressively support the child's self-regulation.

This approach is consistent with models of self-regulated learning. Schunk and Zimmerman (1994) define self-regulation as the set of thoughts, feelings and actions directed towards the attainment of learning goals, while Boekaerts (2002) emphasises the role of personal goals, contextual conditions and strategies mobilised by the learner. In this logic, parental assistance should not be reduced to simple homework supervision, but understood as temporary support aimed at developing the learner's planning, attention, self-correction, perseverance and cognitive autonomy. Thomas et al. (2019) also show that self-regulation plays a mediating role in the relationship between parental involvement and school achievement.

Applied to mathematics, this perspective makes it possible to better define mathematical efficiency, understood as the learner's ability to solve a task in an organised, relevant and relatively cognitively economical manner. It is therefore not limited to the grade obtained, but also refers to comprehension of instructions, quality of reasoning, accuracy of responses, self-correction and adjustment of problem-solving strategies.

A systematic review is therefore needed to organise the available knowledge on the links between parental heteroregulation, cognitive self-regulation and mathematical efficiency. This article aims to analyse the mechanisms through which parental heteroregulation may be associated with mathematical efficiency among secondary school learners. More specifically, it seeks to identify the most studied forms of parental assistance, distinguish practices that support cognitive self-regulation from those that may weaken it, and propose a psychoeducational reading useful to families, teachers and schools, particularly in contexts such as the secondary schools of Bafang.

CONCEPTUAL FRAMEWORK AND ANALYTICAL MODEL

From parental involvement to parental heteroregulation

Parental involvement generally refers to the set of practices through which parents support their children's schooling: homework monitoring, encouragement, communication with the school, educational expectations and supervision of schoolwork. Although this notion helps capture the presence of parents in the school pathway, it remains too broad to explain in detail the effects of parental assistance on mathematics learning. Indeed, two parents may be equally involved but produce different effects depending on whether their assistance supports the learner's autonomy or substitutes for the learner's cognitive effort.

This is why the concept of parental heteroregulation appears more suitable for the purpose of this review. It makes it possible to consider parental assistance as external regulation of the learner's activity. From this perspective, the parent is not merely a supervisor of schoolwork; the parent acts as a mediator who helps the learner understand the task, organise the approach, maintain attention, monitor errors and persevere in the face of difficulty. Heteroregulation becomes relevant when it progressively prepares the learner to self-regulate.

Self-regulation and mathematics learning

Self-regulation refers to the learner's ability to orient their own activity towards a goal. Schunk and Zimmerman (1994) define it as the set of thoughts, affects and actions that the learner mobilises to attain learning goals. Boekaerts (2002), for her part, emphasises the role of personal goals, situational conditions and strategies used by the learner to adapt to the task.

In mathematics, self-regulation is particularly important. Solving a problem does not simply mean applying a formula; it requires understanding the instruction, identifying useful data, choosing a procedure, checking the steps, correcting errors and sustaining effort until the solution is reached. An efficient learner is therefore one who is able to organise reasoning, monitor activity and adjust strategy when the initial approach fails.

Autonomy-supportive parental heteroregulation

According to Nader-Grosbois (2007), heteroregulation refers to external assistance provided by an adult or a more competent partner in order to support the child's self-regulation. This assistance may involve several dimensions: recalling the goal, planning, exploring means, evaluating action, supporting motivation, regulating attention and organising the material environment.

In the context of mathematics learning, autonomy-supportive parental heteroregulation therefore refers to assistance that supports the learner without doing the work in their place. It consists, for example, in asking the learner to reformulate the instruction, helping them organise the steps of a solution, encouraging them to look for another method, helping them identify errors or prompting them to explain their reasoning. This form of support differs from intrusive or substitutive assistance, in which the parent imposes the approach, corrects directly or solves the exercise on behalf of the child.

Mathematical efficiency

Mathematical efficiency is not limited to numerical performance or the grade obtained. It refers to the learner's ability to solve a mathematical task in a relevant, organised and cognitively economical way. It involves the accuracy of the response, the quality of reasoning, comprehension of the instruction, relative speed of execution, self-correction and strategy adjustment in the face of difficulties.

This conception makes it possible to move beyond a strictly school-based view of achievement in mathematics. A learner may obtain the correct answer through imitation or external assistance without being truly efficient. Conversely, a learner becomes more efficient when they understand what they are doing, justify their approach, identify their errors and transfer their method to new situations.

Analytical model adopted

The analytical model of this review is based on the proposal that parental heteroregulation may be associated with mathematical efficiency through the development of the learner's cognitive self-regulation. Parental assistance is therefore assumed to be beneficial when it supports the following processes: clarification of the goal, planning of the approach, maintenance of attention, motivational support, hetero-evaluation, self-correction and gradual withdrawal of scaffolding.

Conversely, parental assistance may become unfavourable when it takes a controlling, intrusive or substitutive form. In this case, it may reduce the learner's cognitive engagement, weaken perseverance and reinforce dependence on external help. This article therefore adopts a central distinction between two forms of parental assistance: autonomy-supportive heteroregulation, which supports self-regulation, and intrusive regulation, which may hinder mathematical efficiency.

The conceptual model may be formulated as follows: parental heteroregulation acts on the learner's cognitive self-regulation, which in turn contributes to mathematical efficiency. This relationship, however, depends on the quality of parental assistance: the more adjusted, supportive and gradually withdrawn the assistance is, the more it may support the learner's intellectual autonomy in mathematical tasks.

Figure 1: Analytical model of parental heteroregulation and mathematical efficiency

Dual pathway: autonomy-supportive assistance versus intrusive assistance

Autonomy-supportive parental heteroregulation Clarification of the goal - planning - regulation of attention - motivational support - hetero-evaluation - gradual withdrawal of scaffolding	Intrusive / substitutive parental regulation Excessive control - imposition of the approach - direct correction - substitution for the learner's work - pressure focused on grades
↓ promotes	↓ hinders
Strengthened cognitive self-regulation Task comprehension - organisation of the approach - error monitoring - perseverance - strategic adjustment - cognitive autonomy	**Weakened cognitive self-regulation Dependence on external help - low initiative - limited error monitoring - avoidance of difficulty - weak strategic adjustment**
↓ strengthens	↓ weakens
Improved mathematical efficiency More organised reasoning - accuracy of responses - relative speed - self-correction - effective problem solving	**Weakened mathematical efficiency Low-autonomy responses - persistent errors - unstable performance - limited transfer of methods - lower perseverance**

The model postulates that the association between parental assistance and mathematical efficiency depends on its regulatory quality. Autonomy-supportive assistance supports the learner's cognitive self-regulation, whereas intrusive or substitutive assistance may reduce the learner's engagement and capacity for adjustment. The model was constructed from the work of Nader-Grosbois (2007), Schunk and Zimmerman (1994), Boekaerts (2002), Jiang et al. (2023) and Park et al. (2023).

METHODOLOGY

Review design

The study used a systematic review design followed by thematic narrative synthesis. This design was selected because the available evidence combines meta-analyses, meta-syntheses and empirical studies that operationalise parental involvement, homework assistance, autonomy support, intrusive control, self-regulated learning and mathematical achievement in different ways. The purpose was not to calculate a new pooled effect size, but to identify regulatory mechanisms, compare convergent and divergent findings and develop an analytical model of parental heteroregulation in mathematics learning.

Reporting framework and scope

The review was reported with reference to PRISMA 2020. The preserved review records documented aggregate counts for identification, screening, eligibility and inclusion. The review covered publications available up to 31 December 2024. No prospective protocol registration was located; consequently, the present report does not claim

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preregistration. This limitation is acknowledged because protocol registration and a preserved search log would improve reproducibility.

Information sources and search strategy

The literature search consulted ERIC, ScienceDirect, SpringerLink, Cairn.info, HAL and Google Scholar. Reference lists of eligible publications were examined to locate additional studies, while ResearchGate was used only as a supplementary route for locating full texts and was not treated as a bibliographic database. Publications in English or French were considered. The preserved records did not retain database-specific yields or the exact date on which each query was run; the review can therefore report only the aggregate PRISMA counts.

The search logic combined four concept blocks in forms adapted to the syntax of each source: (1) parental involvement, parental support, parental homework involvement, homework assistance, heteroregulation, scaffolding, autonomy support or parental control; (2) mathematics, mathematical achievement, mathematical performance or mathematical problem solving; (3) adolescents, secondary school, middle school, high school, learners or students; and (4) self-regulation, self-regulated learning or cognitive regulation. A representative Boolean structure was: ("parental involvement" OR "parental support" OR "parental homework involvement" OR "homework assistance" OR heteroregulation OR scaffolding OR "autonomy support" OR "parental control") AND (mathematics OR "mathematical achievement" OR "mathematical performance" OR "problem solving") AND (adolescent* OR "secondary school" OR "middle school" OR "high school" OR learner* OR student*). Self-regulation terms were added in complementary searches designed to identify studies explaining the proposed mediating mechanisms.

Eligibility criteria

Studies were eligible for the mathematics-specific evidence strand when they: (a) were peer-reviewed empirical studies, systematic reviews or meta-analyses; (b) examined learners in primary or secondary education, with priority given to adolescent, middle-school and high-school samples; (c) assessed parental involvement, homework assistance, autonomy support, control, scaffolding or a closely related form of external regulation; and (d) reported a mathematical outcome such as achievement, performance, problem solving, engagement or mathematics anxiety linked to achievement. Studies involving primary-school children were retained only when they provided direct mathematics-specific evidence relevant to the developmental origins of the regulatory mechanisms.

A complementary mechanism strand included studies of adolescents or mixed school-age samples that explicitly connected parental involvement with self-regulated learning or general achievement, even when mathematics was not reported separately. These studies were used to interpret the regulatory pathway and were not presented as direct evidence of mathematical effects. Non-scientific texts, publications without an identifiable method, studies unrelated to learning, and parenting studies without an educational outcome were excluded. This two-strand structure corrects the risk of treating general-achievement evidence as if it were mathematics-specific.

Study selection and corpus structure

Records were pooled and duplicates removed before title-and-abstract screening. Potentially eligible texts were then assessed in full against the criteria above. The aggregate screening records indicated 46 records from databases and academic search engines and eight additional documents from complementary sources. After removal of 11 duplicates and five clearly non-scientific or off-topic documents, 38 records were screened; 18 full texts were sought, two could not be obtained, and 16 were assessed for eligibility. Eight studies were excluded at full text, leaving eight studies for synthesis. Four constituted the mathematics-specific evidence strand (Jiang et al., 2023; Maloney et al., 2015; Park et al., 2023; Wang & Wei, 2024), and four contributed complementary evidence on parental involvement, achievement and self-regulated learning (Castro et al., 2015; Fan & Chen, 2001; Thomas et al., 2019; Wilder, 2014).

Data extraction

A standardised extraction grid recorded the author and year, study design, country or context, population, form of parental regulation, mathematical or educational outcome, principal findings and limitations. The studies were first classified by evidential strand and then compared according to whether parental practices supported autonomy, imposed control or substituted for learner activity. Findings were not pooled statistically because the designs, constructs and outcomes were not sufficiently homogeneous.

Methodological quality appraisal

During revision, a retrospective, design-sensitive appraisal was conducted using five domains adapted from JBI critical appraisal guidance (Aromataris & Munn, 2020): clarity of the research question and design; transparency of sampling or literature searching; validity of the parental and outcome measures; appropriateness of the analysis; and acknowledgement of bias and limitations. Each domain was judged as met, partly met or not met. Overall methodological quality was classified as high when at least four domains were met, moderate when two or three were met, and low when zero or one was met. Evidential directness to the present question was rated separately because a methodologically strong study of general achievement does not constitute direct mathematics-specific evidence. No study was excluded solely on the basis of quality; the appraisal was used to weight interpretation.

Narrative synthesis and causal interpretation

The synthesis followed six regulatory axes derived from the conceptual framework: goal clarification, planning, attention regulation, motivational support, hetero-evaluation and gradual withdrawal of scaffolding. Evidence was compared for supportive and intrusive pathways, and greater interpretive weight was given to mathematics-specific studies with stronger methodological appraisal. Because the retained empirical studies were observational and the review also relied on previous syntheses, findings were interpreted as associations and plausible mechanisms rather than causal effects.

RESULTS

The results are presented in four stages: the selection process, the characteristics and methodological appraisal of the retained studies, the synthesis by dimensions of parental heteroregulation and an integrative summary of the two regulatory pathways.

Selection process

The search and screening process yielded eight retained studies from 54 initially identified documents. The four mathematics-specific studies provided the direct evidential base, while the four complementary studies informed the proposed self-regulatory mechanism. The distinction between these strands was maintained throughout interpretation.

Figure 2: PRISMA flow summary of the study-selection process

Systematic review on parental heteroregulation and mathematical efficiency

Phase	Main flow	Exclusions and adjustments
Identification	Records identified in databases and academic search engines (n = 46) Additional documents from reference lists and complementary sources (n = 8)	Duplicates removed (n = 11) Clearly non-scientific or off-topic documents removed (n = 5)
Screening	Titles and abstracts screened (n = 38)	Records excluded (n = 20): no mathematics or regulatory relevance (n = 7); non-relevant population (n = 5); parenting not studied (n = 4); general achievement without regulatory relevance (n = 4)

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Phase	Main flow	Exclusions and adjustments
Eligibility	Full texts sought (n = 18) Full texts assessed (n = 16)	Full texts unavailable (n = 2) Full texts excluded (n = 8): no mathematical or mechanism relevance (n = 2); inappropriate school level (n = 2); insufficient methodology (n = 1); parental assistance not analysed (n = 2); overlapping synthesis (n = 1)
Inclusion	Studies included in the narrative synthesis (n = 8) Mathematics-specific strand (n = 4) Complementary mechanism strand (n = 4)	Narrative synthesis organised around goal regulation, planning, attention, motivational support, hetero-evaluation and gradual withdrawal of scaffolding

Note. Adapted from the PRISMA 2020 flow model (Page et al., 2021). The preserved records contained aggregate rather than database-specific counts.

Characteristics and methodological appraisal of the retained studies

The retained corpus comprised five research syntheses and three empirical studies. The strongest direct evidence came from two recent mathematics-focused meta-analyses and the longitudinal work on intrusive homework support. General-achievement syntheses and the adolescent self-regulation study were interpreted as complementary rather than direct mathematical evidence.

Table 1: Characteristics, contribution and appraisal of the retained studies

Study	Design and sample	Contribution to the review	Outcome	Principal finding	Appraisal and directness
Fan & Chen (2001)	Meta-analysis; 31 studies, 92 effects; cumulative N ≈ 133,600	General parental involvement; subject-specific moderators	General and subject-specific achievement	Overall positive association; effects vary by involvement and outcome domain	High quality; moderate directness
Castro et al. (2015)	Meta-analysis; 37 studies across kindergarten, primary and secondary education	General parental involvement	Academic achievement	The form of involvement and school level moderate associations	High quality; moderate directness
Wilder (2014)	Meta-synthesis of nine meta-analyses	Broad synthesis of involvement practices	Academic achievement	Parental expectations are more consistently favourable than homework help	Moderate quality; indirect evidence and possible overlap
Wang & Wei (2024)	Meta-analysis; 25 articles, 42 independent effects	Parental involvement in mathematics across grade levels	Mathematics performance	Small positive overall association; involvement type and grade level moderate effects	High quality; high directness
Jiang et al. (2023)	Meta-analysis; 20 studies, 41 independent effects; N = 16,338	Supportive versus intrusive homework involvement	Mathematics achievement	Supportive involvement is weakly positive; intrusive involvement is negative	High quality; high directness

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Study	Design and sample	Contribution to the review	Outcome	Principal finding	Appraisal and directness
Park et al. (2023)	Two longitudinal studies; N = 563 and N = 1,613	Intrusive homework support in primary and secondary samples	Mathematics achievement	Intrusive support predicts larger declines among learners with a fixed mindset	High quality; high directness for the secondary sample
Maloney et al. (2015)	Longitudinal field study; 438 first- and second-grade children	Parental mathematics anxiety and frequent homework help	Mathematics achievement and anxiety	Frequent help from mathematics-anxious parents is associated with less learning	High quality; direct outcome but limited age transferability
Thomas et al. (2019)	Cross-sectional survey and mediation analysis; 5,939 Flemish first-year middle-school students	Parental involvement and self-regulated learning	General school achievement	Self-regulated learning statistically mediates the involvement-achievement association	Moderate quality; strong mechanism relevance but indirect mathematical evidence

Results by dimensions of parental heteroregulation

Across the two evidential strands, six regulatory dimensions emerged: goal clarification, planning, attention regulation, motivational support, hetero-evaluation and gradual withdrawal of scaffolding. Mathematics-specific studies most directly supported the distinction between autonomy-supportive and intrusive involvement, while complementary studies helped explain the self-regulatory pathway.

Table 2: Dimensions of parental heteroregulation and their implications for mathematical efficiency

Dimensions of parental heteroregulation	Regulatory function	Favourable parental practices	Risks in cases of intrusive or substitutive regulation	Effects on self-regulation and mathematical efficiency
Goal regulation	Helping the learner understand what is expected in the mathematical task.	Asking the learner to reformulate the instruction, helping identify useful data, asking what they are trying to solve.	Providing the goal directly or directing the learner towards the answer without allowing them to analyse the task.	Improves task comprehension, limits impulsive responses and supports an organised entry into the problem.
Planning regulation	Supporting the organisation of work and problem-solving steps.	Helping break the task down, organise time, prepare materials and encourage a progressive method.	Imposing a single approach or carrying out the steps in the learner’s place.	Strengthens cognitive organisation, time management and the ability to follow a problem-solving procedure.
Attention regulation	Creating conditions favourable to concentration and sustained effort.	Reducing distractions, offering a calm setting and reminding the learner to remain engaged in the task.	Excessively monitoring, exerting constant pressure or turning the work into a constraint.	Supports concentration, maintenance of information in memory and error monitoring.

Dimensions of parental heteroregulation	**Regulatory function**	**Favourable parental practices**	**Risks in cases of intrusive or substitutive regulation**	**Effects on self-regulation and mathematical efficiency**
Motivational support	Maintaining learner engagement in the face of difficulty.	Encouraging, valuing effort, reassuring the learner about errors and supporting confidence in progress.	Exerting excessive pressure, dramatising failure or transmitting anxiety related to mathematics.	Strengthens perseverance, reduces discouragement and supports engagement in complex tasks.
Hetero-evaluation	Helping the learner examine the quality of their work.	Inviting the learner to check the answer, reread the instruction, repeat a step, explain the reasoning and seek another strategy.	Correcting directly, giving the solution or evaluating without involving the learner in the analysis of their error.	Promotes self-correction, autonomous monitoring of activity and adjustment of strategies.
Gradual withdrawal of scaffolding	Gradually withdrawing assistance to promote cognitive autonomy.	Guiding at first, questioning, allowing the learner to search alone and reducing assistance as progress occurs.	Maintaining dependence on parental assistance, doing the work in the learner's place or controlling the whole approach.	Develops intellectual autonomy, transfer of strategies and efficiency in problem solving.

Integrative synthesis

The evidence supports a dual-pathway interpretation. In the autonomy-supportive pathway, parental assistance helps the learner interpret the task, organise a strategy, maintain effort and examine errors while responsibility is progressively transferred to the learner. In the intrusive pathway, unsolicited control, direct correction, performance pressure or substitution for learner activity may reduce initiative and reinforce dependence on external help.

The quantitative syntheses indicate that these associations are generally small and heterogeneous rather than uniform. Jiang et al. (2023) reported a weak positive association between supportive homework involvement and mathematics achievement and a larger negative association for intrusive involvement. Wang and Wei (2024) likewise found that the overall association varied according to involvement type, grade level and mathematical content. The results therefore justify cautious claims about regulatory quality, but not a causal claim that parental heteroregulation alone determines mathematical efficiency.

DISCUSSION

This review shows that parental involvement should not be treated as a single, uniformly beneficial practice. The most consistent pattern concerns the quality, timing and adjustment of assistance. This interpretation extends the general findings of Fan and Chen (2001), Castro et al. (2015) and Wilder (2014), while the mathematics-specific meta-analyses by Jiang et al. (2023) and Wang and Wei (2024) provide more direct support for distinguishing supportive from intrusive forms of involvement.

Autonomy-supportive heteroregulation is theoretically relevant because it describes how external guidance can become a temporary bridge toward self-regulation. Clarifying the goal, prompting a plan, structuring attention and asking the learner to justify or check an answer may support strategic engagement without replacing it. Thomas et al. (2019) strengthens this interpretation by showing that self-regulated learning statistically mediates the association between parental involvement and achievement among middle-school learners, although the outcome was not mathematics-specific.

The intrusive pathway is supported more directly by mathematics-focused evidence. Park et al. (2023) found that intrusive homework support predicted declines in mathematics achievement over time, particularly among learners with a fixed mindset. Maloney et al. (2015) showed that frequent help from mathematics-anxious parents was associated with weaker mathematics learning among young children. These studies do not imply that all homework help is harmful; rather, they show that unsolicited control, anxiety transmission and substitution can alter the meaning and effectiveness of parental assistance.

The analytical contribution of the review is therefore the proposed transition from parental involvement as a broad behavioural category to parental heteroregulation as a process. The framework specifies what the parent regulates, how the regulation is delivered, and whether responsibility is transferred back to the learner. Mathematical efficiency is consequently viewed not only as an obtained score, but as organised, monitored and increasingly autonomous problem solving.

Psychoeducationally, parents should be supported in asking guiding questions, helping learners organise time and materials, encouraging explanation of reasoning, normalising errors and reducing assistance as competence increases. Schools can reinforce these practices through brief parent workshops and homework instructions that clarify the expected role of adults. Such programmes should avoid presenting parental presence as sufficient in itself.

Limitations

Several limitations constrain interpretation. First, the review combines constructs that are related but not identical, including parental involvement, homework assistance, autonomy support, control and scaffolding. Second, only four retained studies provided direct mathematics-specific evidence; the remaining studies informed the proposed mechanism and cannot be used to estimate a mathematical effect. Third, several retained designs are correlational, and the use of published syntheses creates a risk of overlap among primary studies. Fourth, the original records preserved aggregate screening counts but not database-specific yields, verbatim queries or independently duplicated screening decisions. Fifth, primary-school evidence was used for developmental insight, but its transferability to secondary learners is limited. Finally, evidence from African and Cameroonian settings remains scarce. These limitations mean that the model should be treated as an evidence-informed framework to be tested, rather than a demonstrated causal sequence.

Directions for future empirical research

Future research should test the model directly through longitudinal, observational and intervention designs involving learners, parents and teachers. Multi-informant data would make it possible to compare parents' intended support with learners' perceptions and teachers' observations of autonomy and performance. Studies should distinguish goal clarification, planning support, attention regulation, motivational support, hetero-evaluation and scaffolding withdrawal, and should measure both mathematics achievement and self-regulatory processes. In Cameroon, studies conducted in secondary schools in Bafang and other settings could examine how parental education, mathematics anxiety, socioeconomic resources, language and school expectations shape these processes.

CONCLUSION

This systematic review with narrative synthesis examined how parental heteroregulation may be associated with mathematical efficiency among secondary school learners. The evidence does not support a simple conclusion that more parental involvement necessarily produces better mathematics outcomes. It instead points to the regulatory quality of assistance: guidance that clarifies, prompts and gradually withdraws is more compatible with cognitive self-regulation than assistance that controls, pressures or substitutes for learner activity.

The proposed dual-pathway model should nevertheless be interpreted cautiously. The evidence base is heterogeneous, partly indirect and largely non-causal. Its principal value is to organise testable mechanisms and translate them into psychoeducational practices. Empirical studies involving students, parents and teachers are now required to determine how these mechanisms operate across educational and cultural contexts, particularly in African secondary schools.

DATA AVAILABILITY

All evidence analysed in this review was drawn from published sources listed in the references. The aggregate screening counts and study-characteristics table reported in the manuscript constitute the available review dataset.

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