Factors Associated with Mathematics Academic Underperformance Among Secondary Students in Azerbaijan: A Systematic Review

Elnaz Firuzian [0009-0008-8425-2913][1*]
[1]Khazar University, 122 Bashir Safar-Oghlu St, Baku 1009., Azerbaijan

ABSTRACT

Mathematics underperformance among secondary students in Azerbaijan persists despite ongoing educational reforms. No systematic synthesis of associated factors has been conducted. This review aimed to identify and synthesize empirical evidence on factors associated with mathematics underperformance (low achievement or course failure) in grades 5–11. Following PRISMA 2020, six databases were searched in April 2026 for studies in English, Azerbaijani, or Russian. A supplementary search with neutral keywords was performed in May 2026. Two reviewers independently screened records and appraised quality using the Mixed Methods Appraisal Tool. A convergent integrated synthesis was applied. Three studies met inclusion criteria. Mathematics anxiety showed a negative association with performance, particularly in female students. Analysis of official curriculum documents indicated misalignment between intended problem-solving goals and textbook tasks, with low cognitive demand and insufficient reasoning opportunities. Expert consultation highlighted teacher quality and professional development as potentially influential, though without direct mathematics-specific measurement. Mathematics course failure or grade retention was not directly measured in any study. Evidence is extremely limited. Mathematics anxiety, curriculum coherence, and teacher preparation are regarded as plausible contributors, but causal conclusions cannot be drawn. Nationally representative surveys, longitudinal designs, and intervention trials are urgently needed.

Keywords: **Mathematics Underperformance, Mathematics Anxiety, Curriculum Alignment, Secondary Education, Systematic Review, Azerbaijan.**

1. *INTRODUCTION*

Mathematics underperformance among secondary students constitutes a significant educational challenge in Azerbaijan. International assessments reveal concerning patterns. In TIMSS 2023, eighth graders reached the intermediate benchmark, indicating basic computational competence alongside substantial difficulties with problem-solving and reasoning [11]. In PISA 2022, only 38% of students in Baku achieved at least Level 2 proficiency, compared to the OECD average of 69%; merely 1% performed at the highest levels (OECD average 9%) [7]. Average mathematics scores dropped from 420 in 2018 to 397 in 2022, while the proportion of students below Level 2 grew by 11 percentage points [7]. This decline coincided with global COVID-19 disruptions, which likely compounded existing challenges. Azerbaijan ranked 56th among 81 participating countries [7]. Consequences of underperformance include increased risk of grade repetition, dropout, restricted access to higher education and technical careers, and constraints on national economic and technological development. Despite reforms, measurable improvement remains absent [6]. A critical gap exists: no systematic review has synthesized evidence on factors associated with mathematics underperformance in Azerbaijan. Individual studies are fragmented and often inaccessible. The present review addresses one primary and three secondary questions:

Primary: What factors are associated with mathematics underperformance among secondary students in Azerbaijan according to existing empirical literature?

Secondary: (1) How is mathematics underperformance conceptualized and measured in these studies? (2) What methodological approaches have been used, and what are their strengths and limitations? (3) What gaps exist in the evidence base?

The review includes secondary students (grades 5–11) in general education schools, covering the period 2000 to April 2026, with a supplementary search in May 2026. Only empirical studies employing quantitative, qualitative, or mixed methods are considered.

2. METHODS

2.1 PRISMA Framework

The PRISMA 2020 statement was followed [9]. A flow diagram documents the selection process (Figure 1).

2.2 Search Strategy

Six databases were searched: Scopus, ERIC (ProQuest), Web of Science, Google Scholar (first 200 records), e-library.az, and the Russian Science Citation Index (RSCI). The primary search, conducted in April 2026, combined terms for geography, subject, outcome, and population:

("Azerbaijan" OR "Azeri" OR "Azerbaijani") AND ("mathematics" OR "math" OR "mathematical") AND ("fail" OR "underperform" OR "difficult" OR "low achiev" OR "poor perform" OR "unsuccess") AND ("student" OR "pupil" OR "school" OR "secondary" OR "grade").

To ensure comprehensiveness, a supplementary search using neutral keywords was performed on 14 May 2026:

("Azerbaijan" OR "Azeri" OR "Azerbaijani") AND ("mathematics" OR "math") AND ("achievement" OR "performance" OR "attainment") AND ("secondary" OR "grade 5" … "grade 11" OR "middle school" OR "high school") AND ("student" OR "pupil").

The supplementary search retrieved 76 additional records after deduplication; none met the inclusion criteria. This confirmed that the scarce yield reflected a genuine absence of research. Equivalent keywords in Azerbaijani and Russian were used in local databases. Table 1 summarizes the search.

Table 1. Search Strategy and Records Retrieved.

Database	***Search date***	***Filters***	***Records***
Scopus	*10 April 2026*	*2000–2026, article/review*	*98*
ERIC (ProQuest)	*10 April 2026*	*2000–2026, peer-reviewed*	*52*
Web of Science	*11 April 2026*	*2000–2026, article*	*67*
Google Scholar	*11 April 2026*	*First 200 records*	*120*
e-library.az	*12 April 2026*	*2000–2026*	*30*
RSCI	*12 April 2026*	*2000–2026*	*20*
Total (primary search)			*387*
Supplementary search (neutral terms)	*14 May 2026*	*2000–2026*	*76*
Combined total retrieved			*463*

2.3 Eligibility Criteria

Inclusion: Studies were included if they (a) were conducted in Azerbaijan; (b) focused on secondary students (grades 5–11) or examined proximal factors with a direct conceptual link to secondary mathematics learning (e.g., textbooks, teacher preparation); (c) empirically examined factors associated with mathematics underperformance (low achievement, course failure, grade retention, or correlates of poor performance); (d) used quantitative, qualitative, or mixed methods; (e) were published between 2000 and April 2026 (updated to May 2026 for the supplementary search); (f) were written in English, Azerbaijani, or Russian.

Exclusion: Studies were excluded if they focused solely on primary grades (1–4) or higher education, special education or vocational schools, reported only mathematics attitudes without a link to performance, were theoretical essays or curriculum documents without empirical analysis, or were duplicates.

Given the near-absence of research directly measuring mathematics failure, criteria were deliberately broad. Mikayilova and Huseynzada (2023) addressed student underperformance broadly without isolating mathematics; it was included as the only empirical study examining system-level factors within Azerbaijani general education, with findings plausibly relevant to mathematics learning. However, its non-specificity to mathematics means it is treated as indirect contextual evidence and receives less interpretive weight in the synthesis.

2.4 Screening and Selection

Titles and abstracts were screened independently by two reviewers using Rayyan [8]; disagreements were resolved by discussion. Full texts were assessed independently, and exclusion reasons were recorded.

2.5 Data Extraction

A piloted standardized form captured: authors, year, location, design, sample, definition/measurement of underperformance or proximal factor, factors examined, main findings, and author-identified limitations.

2.6 Quality Assessment

The Mixed Methods Appraisal Tool (MMAT) version 2018 was applied [3]. No study was excluded solely on quality, but ratings informed the strength of conclusions.

2.7 Data Synthesis

A convergent integrated synthesis was used. Quantitative findings were converted into qualitative descriptions, and qualitative findings were analyzed thematically. Findings were organized using an ecological framework (individual, teacher, curriculum, school, family levels), with explicit distinction drawn between direct empirical associations and indirect evidence.

3. RESULTS

3.1 Study Selection

After deduplication, 399 records were screened; 368 were excluded as irrelevant. Thirty-one full texts were assessed; 28 were excluded (19 lacked an empirical measure or conceptual link, 6 focused on primary grades, 2 were duplicates, 1 unavailable). Three studies met all criteria (Figure 1).

3.2 Characteristics of Included Studies

Table 2 summarizes the three studies (2023–2025), reflecting an emerging research area.

Table 2. Characteristics of Included Studies.

ID	Authors (year)	Location	Design	Sample	Factors examined
S1	Ismayilova (2024)	National	Qualitative document analysis (encyclopedia chapter)	Secondary mathematics curriculum and textbooks	Problem-solving tasks, curriculum alignment, cognitive demand
S2	Mikayilova & Huseynzada (2023)	Baku	Mixed-methods (expert consultation)	Education experts (sample size not disclosed)	Teacher quality, professional development, school evaluations
S3	Gasimova (2025)	Baku	Mixed-methods (survey + interviews)	60 students (grades 5–7) + 6 teachers	Mathematics anxiety, gender differences

3.3 Quality Assessment

MMAT ratings appear in Table 3. S1, as a chapter in the peer-reviewed TIMSS 2023 Encyclopedia, was based on official curriculum documents and national expert input; it was assessed as meeting four of five qualitative criteria due to limited transparency in document selection and analysis procedures. S2 met four of five criteria; the undisclosed sample size and expert selection procedure limited confidence in representativeness. S3 met all five criteria within its design; the small volunteer sample from a single city constrained generalizability but did not violate MMAT criteria.

Table 3. Methodological Quality Ratings (MMAT).

Study ID	***Design***	***Criteria met (out of 5)***	***Quality level***
S1 (Ismayilova, 2024)	*Qualitative document analysis*	*4*	*High (credible source)*
S2 (Mikayilova & Huseynzada, 2023)	*Mixed-methods*	*4*	*Moderate*
S3 (Gasimova, 2025)	*Mixed-methods*	*5*	*High*

3.4 Synthesis of Factors

Curriculum and textbook factors

Ismayilova (2024) described the intended secondary mathematics curriculum in Azerbaijan and noted that, although national standards emphasize problem-solving and reasoning, available textbooks predominantly feature procedural exercises with low cognitive demand. The chapter provided an overview of textbooks and noted a predominant emphasis on procedural exercises over complex problem-solving tasks. This misalignment may constrain opportunities for deep understanding. The evidence remains indirect, as no direct link to student achievement was established.

Teacher quality factors

Mikayilova and Huseynzada (2023) identified teacher quality, teacher education, and professional development as decisive factors for student success, alongside standardized testing and school evaluations. The consultation addressed general underperformance, not mathematics specifically; thus, findings are treated as indirect contextual evidence. Wealthier parents were reported to hire private tutors to compensate for perceived public-school deficiencies, creating unequal opportunities.

Mathematics anxiety

Gasimova (2025) found a significant negative correlation between mathematics anxiety and performance across cognitive, emotional, and environmental dimensions. Female students were more likely to internalize anxiety, while male students tended to mask or disengage silently. Performance was measured on a continuous scale, yielding an association with lower achievement rather than a direct measure of failure or retention. This is the sole direct empirical evidence linking a specific factor to student mathematics performance in the reviewed literature.

3.5 Patterns, Gaps, and Contradictions

The three studies individually highlight mathematics anxiety, curriculum misalignment, and teacher preparation as potential concerns, but these derive from separate sources and have not been jointly validated. No longitudinal or nationally representative student-level studies exist; rural areas are entirely unrepresented. No intervention study has tested whether addressing these factors improves outcomes. School-level (e.g., resources, class size) and family-level (e.g., parental education, socioeconomic status) factors remain completely unexplored. No direct contradictions emerged, consistent with the distinct designs and foci.

4. DISCUSSION

4.1 Interpretation of Findings

This review offers the first synthesis of empirical evidence on mathematics underperformance in Azerbaijan. Three categories of potential contributors emerge: curriculum–textbook factors (low cognitive

demand, insufficient problem-solving), teacher quality factors, and individual factors (mathematics anxiety). Only mathematics anxiety has been directly linked to student performance (S3). The other categories rest on document analysis and non-specific expert consultation. Because no study measured binary failure, these factors should be viewed as plausible contributors, not established determinants of grade retention or course failure.

The anxiety–performance link aligns with international meta-analytic findings [5], and the gender difference mirrors global patterns. The sharp PISA 2022 decline, likely exacerbated by the pandemic, may have intensified anxiety-related barriers and widened inequalities in access to private tutoring – contextual considerations that underscore the urgency of local evidence. The curriculum analysis in the TIMSS Encyclopedia [4] is policy-relevant, but its findings remain inferred. A sensitivity analysis confirms that even if the curriculum study were excluded, the overall conclusion of extremely scarce direct evidence and urgent need for research would remain unchanged.

4.2 Comparison with International Research

International syntheses have identified a broad range of factors – student (anxiety, prior knowledge), teacher (pedagogical content knowledge, instruction quality), school (resources, class size), and family (socioeconomic status, parental education) [2]. Their absence in the Azerbaijani literature reflects a lack of research, not absence in reality. Effective mathematics anxiety interventions exist [10] but have never been trialed in Azerbaijani secondary schools. This gap is critical.

4.3 Implications for Practice and Policy

Given the limited evidence, implications are tentative. Schools could pilot anxiety-reduction strategies (e.g., growth-mindset interventions, supportive classrooms) with rigorous evaluation. Textbook tasks should be reviewed for cognitive demand and coherence. Teacher professional development might address both mathematics content knowledge and strategies to reduce anxiety and foster problem-solving. All such actions should be treated as testable hypotheses and implemented alongside built-in evaluation to avoid wasting resources on untested assumptions.

4.4 Strengths and Limitations of This Review

This is the first systematic synthesis in this context, using PRISMA 2020 guidelines, a comprehensive search with a neutral supplementary strategy, dual independent screening, and quality appraisal. Strengths include transparency and methodological rigor.

Limitations are substantial. Only three studies could be included, none measuring binary failure. The synthesis combines direct and indirect evidence. The supplementary search confirmed that the sparse yield reflects a genuine absence of research, although some grey literature may have been missed. Publication bias cannot be assessed due to the extremely small number of studies; unpublished reports or theses with negative findings may exist. The small, city-based samples prevent generalization to rural Azerbaijan.

4.5 Recommendations for Future Research

Priorities include a nationally representative survey of mathematics achievement and its correlates, including rural regions. Longitudinal cohort studies tracking students from grade 5 through grade 9 are needed to establish temporal relationships. Intervention trials should test whether anxiety-reduction programs, textbook revisions, or professional development improve outcomes. Qualitative work should explore how students, teachers, and parents experience mathematics underperformance within the Azerbaijani cultural context, with purposeful sampling of underrepresented groups.

5. CONCLUSION AND RECOMMENDATION

This first review confirms that empirical evidence on mathematics underperformance in Azerbaijan is extremely sparse. Mathematics anxiety is the only factor directly associated with lower performance, with female students appearing more affected. Curriculum alignment problems and insufficient problem-solving tasks are identified through document analysis of official curriculum materials, and teacher quality is highlighted by experts, though without mathematics-specific measurement.

Crucially, no study has directly measured mathematics failure as a binary outcome, no longitudinal or nationally representative research exists, and rural areas remain unstudied. The review's most important contribution is documenting what is not known. Despite persistent underperformance in TIMSS and PISA, only three empirical studies exist, leaving a critical gap that must urgently be addressed to enable evidence-informed policy. Priorities are nationally representative surveys, longitudinal studies, and intervention trials. Until then, educators can cautiously attend to mathematics anxiety and textbook quality, treating all actions as hypotheses in need of rigorous testing.

Given the extremely limited evidence base identified in this systematic review, future research must urgently prioritize three complementary approaches: nationally representative surveys that directly measure binary outcomes such as course failure across urban and rural schools; longitudinal cohort studies tracking students from grade 5 through grade 9 to establish temporal relationships between potential predictors and underperformance; and rigorous intervention trials testing anxiety-reduction programs, textbook revisions, and teacher professional development. In parallel, educational practice should pilot evidence-based strategies to reduce mathematics anxiety—such as growth-mindset messaging and low-stakes formative assessments—while curriculum specialists review textbook tasks for cognitive demand and reasoning opportunities, and professional development programs equip teachers with both content knowledge and anxiety-sensitive pedagogies.

REFERENCES

[1] *Gasimova, J. (2025). Math anxiety among secondary school students: Causes and consequences in Azerbaijani schools [Master's thesis, ADA University]. ADA University Digital Repository. http://hdl.handle.net/20.500.12181/1517*

[2] *Hattie, J. (2009). Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement. Routledge.*

[3] *Hong, Q. N., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., ... & Pluye, P. (2018). The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. Education for Information, 34(4), 285-291.*

[4] *Ismayilova, S. (2024). Azerbaijan: Mathematics curriculum and textbooks in secondary education. In M. O. Martin, M. von Davier, & I. V. S. Mullis (Eds.), TIMSS 2023 Encyclopedia: Education policy and curriculum in mathematics and science. Boston College, TIMSS & PIRLS International Study Center. https://timssandpirls.bc.edu/timss2023/encyclopedia/*

[5] *Ma, X. (1999). A meta-analysis of the relationship between anxiety toward mathematics and achievement in mathematics. Journal for Research in Mathematics Education, 30(5), 520-540.*

[6] *Mikayilova, U. T., & Huseynzada, G. Z. (2023). Student underperformance in Azerbaijan: Who is to blame and what to do? Psychological Science and Education, 28(5), 34–45. https://doi.org/10.17759/pse.2023280503*

[7] *OECD. (2023). PISA 2022 results (Volume I and II) – Country notes: Baku (Azerbaijan). OECD Publishing.*

[8] *Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan—a web and mobile app for systematic reviews. Systematic Reviews, 5(1), 210.*

[9] *Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ, 372, n71.*

[10] *Ramirez, G., Shaw, S. T., & Maloney, E. A. (2018). Math anxiety: Past research, promising interventions, and a new interpretation framework. Educational Psychologist, 53(3), 145–164.*

[11] *von Davier, M., Kennedy, A., Reynolds, K. A., Fishbein, B., Khorramdel, L., Aldrich, C. E. A., Bookbinder, A., Bezirhan, U., & Yin, L. (2024). TIMSS 2023 international results in mathematics and science. Boston College, TIMSS & PIRLS International Study Center.* https://doi.org/10.6017/lse.tpisc.timss2023