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Reframing Student Participation in Ordinary Level Mathematics as an Equity Issue in Under-Resourced Rural Zimbabwean Schools

Makuvire Claretah[1]* , **Chikuvadze Pinias**[2]

[1,2] Bindura University of Science Education, Zimbabwe
*Corresponding Author's e-mail: makuvirec@gmail.com

ABSTRACT

Student participation in mathematics is increasingly recognised as an equity issue, particularly in under-resourced rural schools, where limited resources, examination pressure, teacher workload, and socio-cultural expectations may restrict learners' opportunities to engage meaningfully with mathematical ideas. Although studies have examined mathematics anxiety, learner attitudes, teacher-centred instruction, and resource constraints, less attention has been given to how these factors interact to shape everyday participation in Ordinary Level Mathematics in rural Zimbabwe. This study examined the factors constraining and supporting students' participation in five under-resourced rural secondary schools in the Lusulu Cluster of Binga District, Zimbabwe. An explanatory sequential mixed-methods case study design was used, involving questionnaires with 150 students and six Mathematics teachers, followed by focus group discussions, semi-structured interviews with heads of Mathematics departments and school heads, classroom observations, and document analysis. The findings show that participation was constrained by negative attitudes, low confidence, fear of failure, mathematics anxiety, gendered expectations, teacher-centred instruction, examination pressure, limited resources, and workload-related constraints. Structured questioning, peer-supported group work, hands-on activities, supportive teacher feedback, and school-family communication were perceived as promising strategies for supporting participation. This study reframes mathematics participation as a socially mediated and institutionally conditioned equity issue rather than a narrow matter of learner motivation. This study contributes to equity-oriented mathematics education by showing that meaningful participation in rural classrooms requires relationally safe, culturally responsive, resource-sensitive, and community-supported pedagogical conditions.

Keywords: *mathematics participation, equity-oriented mathematics education, rural education, Ordinary Level Mathematics, Zimbabwe, social constructivism.*

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INTRODUCTION

Mathematics participation in secondary education is a critical dimension of educational equity because it shapes learners' access to further education, STEM pathways, employability, and informed participation in social and economic life.[1] Equity-oriented mathematics research emphasises that access, participation, curriculum pathways, pedagogy, and system-level inequalities are central to how students experience mathematics learning.[2] Mathematics therefore functions not only as a school subject assessed through examinations, but also as a gatekeeping domain through which learners gain or lose access to future opportunities. For students in under-resourced rural schools, limited classroom participation may reinforce educational marginalisation, restrict academic progression, and weaken opportunities for social mobility.

Student participation is central to meaningful mathematics learning because understanding develops through questioning, explanation, dialogue, collaborative problem solving, and negotiation of meaning.[3] Research shows that students' prior experiences, perceived teacher and peer support, emotions, motivation, and teacher beliefs are closely related to engagement in mathematical tasks.[4] Engagement is multidimensional, involving behavioural, emotional, cognitive, and social dimensions.[5] When students remain silent, avoid questions, or withdraw from classroom interaction, they may lose access to the social processes through which conceptual understanding is built.

The importance of participation is more pronounced in rural and under-resourced contexts. Rurality should not be treated merely as a geographical descriptor; it intersects with poverty, limited learning materials, large classes, teacher shortages, workload, examination pressure, and uneven access to technology-supported learning.[6] Recent work on rural

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[1] Seong Won Han, Chungseo Kang, and Lois Weis, "Reducing Socioeconomic Disparities in STEM Opportunities? Trends in Access to Advanced Science and Math Courses in American High Schools, 1992–2013," *Journal of Education for Students Placed at Risk (JESPAR)* 30, no. 3 (July 3, 2025): 273–310, https://doi.org/10.1080/10824669.2024.2398435; Renuka Vithal, Karin Brodie, and Reshma Subbaye, "Equity in Mathematics Education," *ZDM – Mathematics Education* 56, no. 1 (February 15, 2024): 153–64, https://doi.org/10.1007/s11858-023-01504-4.

[2] Helena Roos, "Students' Voices of Inclusion in Mathematics Education," *Educational Studies in Mathematics* 113, no. 2 (June 28, 2023): 229–49, https://doi.org/10.1007/s10649-023-10213-4; Vithal, Brodie, and Subbaye, "Equity in Mathematics Education."

[3] Haydeé Ceballos et al., "How Collaborative Problem Solving Promotes Higher-Order Thinking Skills: A Systematic Review of Design Features and Processes," *Thinking Skills and Creativity* 59 (March 2026): 102001, https://doi.org/10.1016/j.tsc.2025.102001; Malin Gardesten and Hanna Palmér, "Students' Participation in Mathematics in Inclusive Classrooms: A Study of the Enacted Mathematical and Relational Knowing of Teachers," *Mathematical Thinking and Learning* 27, no. 2 (April 3, 2025): 157–77, https://doi.org/10.1080/10986065.2023.2258485.

[4] Wen Du et al., "What Factors Influence Secondary Students' Active Participation in Mathematics Classrooms: A Theory of Planned Behavior Perspective," *Acta Psychologica* 253 (March 2025): 104694, https://doi.org/10.1016/j.actpsy.2025.104694; James A. Middleton et al., "Tracing Mathematics Engagement in the First Year of High School: Relationships between Prior Experience, Observed Support, and Task-Level Emotion and Motivation," *ZDM – Mathematics Education* 55, no. 2 (March 10, 2023): 427–45, https://doi.org/10.1007/s11858-022-01432-9.

[5] Mustafa Cevikbas and Gabriele Kaiser, "Student Engagement in a Flipped Secondary Mathematics Classroom," *International Journal of Science and Mathematics Education* 20, no. 7 (October 4, 2022): 1455–80, https://doi.org/10.1007/s10763-021-10213-x; Dirgha Raj Joshi et al., "Behavioral, Cognitive, Emotional and Social Engagement in Mathematics Learning during COVID-19 Pandemic," ed. Mohammed Saqr, *PLOS ONE* 17, no. 11 (November 22, 2022): e0278052, https://doi.org/10.1371/journal.pone.0278052.

[6] Richard M. Ingersoll and Henry Tran, "Teacher Shortages and Turnover in Rural Schools in the US: An Organizational Analysis," *Educational Administration Quarterly* 59, no. 2 (April 16, 2023): 396–431,

schooling shows that digital divides, infrastructure limitations, and resource inequality may reinforce educational inequity,[7] while mathematics achievement in rural schools is shaped by resources, learner motivation, school conditions, and support structures.[8] These conditions may make mathematics appear difficult, distant, and reserved for a small group of high-achieving students.

In Zimbabwe, Ordinary Level Mathematics occupies a central position in secondary education because it is closely linked to progression into higher and tertiary education. National Ordinary Level results indicate that overall achievement remains a persistent concern, although recent data show gradual improvement. The Zimbabwe Education Sector Analysis reported overall O Level pass rates of 27.86% in 2015, 29.98% in 2016, 28.71% in 2017, 32.80% in 2018, and 33.9% in 2019.[9] ZIMSEC releases show that the overall national O Level pass rate was 33.19% in 2024 and 35.26% in 2025.[10] These figures refer to overall O Level performance rather than Mathematics-specific pass rates, but they indicate that many learners continue to leave lower secondary education without meeting the benchmark of five subjects at Grade C or better.

Low participation in mathematics should not be interpreted as a deficit in learner motivation alone. This may reflect the interaction of affective, pedagogical, institutional, and sociocultural constraints. Low confidence, fear of failure, math anxiety, negative attitudes, and previous experiences of difficulty can discourage learners from asking questions or attempting challenging tasks. Evidence shows that mathematics anxiety is associated with lower classroom engagement and weaker achievement,[11] while gender stereotypes and social influences shape students' self-concept, interest, and anxiety in mathematics.[12] Classroom practices may also support or suppress participation: student-centred routines and mathematical talk can support engagement, whereas teacher-centred instruction, harsh

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https://doi.org/10.1177/0013161X231159922; Tafirenyika Mafugu, "Influences on Mathematics Achievement in Rural Schools: A Nested Study of Underprivileged Learners," *Interchange* 56, no. 1 (March 21, 2025): 1–15, https://doi.org/10.1007/s10780-024-09533-y; Faisal Mustafa, Hoa Thi Mai Nguyen, and Xuesong (Andy) Gao, "The Challenges and Solutions of Technology Integration in Rural Schools: A Systematic Literature Review," *International Journal of Educational Research* 126 (2024): 102380, https://doi.org/10.1016/j.ijer.2024.102380.

[7] Mustafa, Nguyen, and Gao, "The Challenges and Solutions of Technology Integration in Rural Schools: A Systematic Literature Review."

[8] Mafugu, "Influences on Mathematics Achievement in Rural Schools: A Nested Study of Underprivileged Learners."

[9] Ministry of Primary and Secondary Education and Cadena international development projects, "Republic of Zimbabwe: Education Sector Analysis" (UNICEF, 2020), https://www.zimta.org.zw/wp-content/uploads/2022/05/Zimbabwe-FINAL-Education-Sector-Analysis-Nov-2020-FINAL.pdf.

[10] Zimbabwe School Examinations Council, "Release of the 2024 November Ordinary Level Examination Results" (Harare, Zimbabwe: ZIMSEC, 2025), https://www5.zimsec.co.zw/wp-content/uploads/2025/04/2024-November-Ordinary-Level-Results-Release-1.pdf; Zimbabwe School Examinations Council, "Release of 2025 Ordinary Level Results" (Harare, Zimbabwe: ZIMSEC, 2026), https://www5.zimsec.co.zw/2026/02/06/release-of-2025-ordinary-level-results/.

[11] Michaela Quintero et al., "A Multidimensional Examination of Math Anxiety and Engagement on Math Achievement," *British Journal of Educational Psychology* 92, no. 3 (September 26, 2022): 955–73, https://doi.org/10.1111/bjep.12482.

[12] Sofie Henschel, Malte Jansen, and Rebecca Schneider, "How Gender Stereotypes of Students and Significant Others Are Related to Motivational and Affective Outcomes in Mathematics at the End of Secondary School," *Contemporary Educational Psychology* 73 (April 2023): 102161, https://doi.org/10.1016/j.cedpsych.2023.102161.

responses to incorrect answers, limited collaboration, and pressure to cover the syllabus may reduce willingness to participate.[13]

Socio-cultural factors also shape participation. Learners' mathematical confidence and agency may be influenced by gendered expectations, family histories of poor performance, and local beliefs about who is capable of succeeding in mathematics. Culturally responsive mathematics pedagogy emphasises the importance of integrating students' everyday experiences into instruction, assessment, and learning.[14] In African educational contexts, this highlights that mathematics learning is not culturally neutral; it is shaped by whether pedagogy recognises learners' lived realities and positions mathematics as meaningful. Participation is therefore not only an instructional issue but also a question of recognition, confidence, relational safety, and equitable access to mathematical agency.

This study is informed by social constructivist theory, which views learning as a socially mediated process shaped by interaction, dialogue, scaffolding and cultural context. Students develop mathematical understanding not merely by listening to explanations but by participating in discourse, negotiating meanings with peers, making mistakes, receiving feedback, and applying concepts to meaningful situations. Recent work on student-centred mathematics instruction emphasises making students' thinking public, structuring mathematical talk, and orchestrating discussion.[15] Inclusive mathematics research similarly shows that participation is shaped by mathematical and relational dimensions of teaching.[16]

However, participation is not equally available to all the learners. Equity-oriented mathematics education suggests that classroom participation is shaped by power relations, resources, expectations, language, gender norms, cultural beliefs, and whether pedagogy recognises learners' lived realities.[17] Previous studies have examined mathematics anxiety, learner attitudes, teacher-centred instruction, resource limitations, classroom environment, culturally responsive pedagogy, and parental involvement as separate influences on mathematics learning.[18] Less attention has been given to how these factors interact in shaping

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[13] Gardesten and Palmér, "Students' Participation in Mathematics in Inclusive Classrooms: A Study of the Enacted Mathematical and Relational Knowing of Teachers"; Eva Thanheiser and Kathleen Melhuish, "Teaching Routines and Student-Centered Mathematics Instruction: The Essential Role of Conferring to Understand Student Thinking and Reasoning," *The Journal of Mathematical Behavior* 70 (June 2023): 101032, https://doi.org/10.1016/j.jmathb.2023.101032.

[14] Daniel Gbormittah et al., "Culturally Responsive Pedagogy Model Integration in Mathematics Education: Perceptions and Practices among Ghanaian Teachers," *Social Sciences & Humanities Open* 12 (2025): 102036, https://doi.org/10.1016/j.ssaho.2025.102036.

[15] Thanheiser and Melhuish, "Teaching Routines and Student-Centered Mathematics Instruction: The Essential Role of Conferring to Understand Student Thinking and Reasoning."

[16] Gardesten and Palmér, "Students' Participation in Mathematics in Inclusive Classrooms: A Study of the Enacted Mathematical and Relational Knowing of Teachers."

[17] Meghan Comstock et al., "Toward More Equitable Instruction: How Teachers Integrate Ambitious, Traditional, and Culturally Responsive Mathematics Practices," *AERA Open* 11 (July 20, 2025), https://doi.org/10.1177/23328584251331463; Vithal, Brodie, and Subbaye, "Equity in Mathematics Education."

[18] Gbormittah et al., "Culturally Responsive Pedagogy Model Integration in Mathematics Education: Perceptions and Practices among Ghanaian Teachers"; Feifei Huang et al., "Relationship between Parental Involvement and Mathematics Achievement of Chinese Early Adolescents: Multiple Mediating Roles of Mental Health and Mathematics Self-Efficacy," *International Journal of Environmental Research and Public Health* 18, no. 18 (September 10, 2021): 9565, https://doi.org/10.3390/ijerph18189565; Quintero et al., "A Multidimensional Examination of Math Anxiety and Engagement on Math Achievement"; Thanheiser and Melhuish, "Teaching Routines and Student-Centered Mathematics Instruction: The Essential Role of Conferring to Understand Student Thinking and Reasoning."

students' everyday participation in Ordinary Level Mathematics in under-resourced rural Zimbabwean schools.

This study, therefore, explores the factors that constrain and support students' participation in Ordinary Level Mathematics in under-resourced rural secondary schools in the Lusulu Cluster of Binga District, Zimbabwe. It asks: (1) What learner-related, teacher-related, institutional, and socio-cultural factors constrain students' participation in Ordinary Level Mathematics? (2) How do students, teachers, and school leaders perceive strategies for improving participation in mathematics learning? (3) What context-sensitive, equity-oriented, and community-supported strategies emerge from the findings to strengthen mathematics participation in under-resourced rural secondary schools?

The originality of this study lies in reframing Ordinary Level Mathematics participation as an equity-related, socially mediated, and institutionally conditioned process in under-resourced rural schools in Zimbabwe. While previous studies have examined anxiety, attitudes, instruction, resources, gender stereotypes, and culturally responsive pedagogy as separate influences, this study integrates these dimensions to show how they interact to shape students' opportunities to participate. It contributes to equity-oriented mathematics education by linking learner agency, relational safety, teacher practice, examination pressure, resource constraints, and socio-cultural expectations within a single, context-sensitive analytical framework.

METHOD

This study employed an explanatory sequential mixed-methods case study design to examine students' participation in Ordinary Level Mathematics in under-resourced rural secondary schools. This case was defined as the Lusulu Cluster in the Binga District of Zimbabwe. The design was appropriate because the study first generated descriptive quantitative patterns through student and teacher questionnaires and then used qualitative data from focus group discussions, semi-structured interviews, classroom observations, and document analysis to explain and contextualise those patterns.[19] Quantitative and qualitative strands were integrated during interpretation through thematic comparison and joint displays, with attention to convergence, complementarity, and divergence across data sources.[20]

The study was conducted in five secondary schools in the Lusulu Cluster of the Binga District: two mission schools and three government schools. The cluster was selected because it represents a rural and under-resourced educational context where participation and achievement in Ordinary Level Mathematics have been identified as persistent concerns.

[19] John W. Creswell and Vicki L. Plano Clark, *Designing and Conducting Mixed Methods Research*, 3rd ed. (Los Angeles: Sage Publication, 2017).
[20] Michael D. Fetters, Leslie A. Curry, and John W. Creswell, "Achieving Integration in Mixed Methods Designs—Principles and Practices," *Health Services Research* 48, no. 6pt2 (December 23, 2013): 2134–56, https://doi.org/10.1111/1475-6773.12117.

Ordinary Level Mathematics was selected because of its importance for learners' progression into higher and tertiary education.

Purposive sampling was used to select participants directly involved in Ordinary Level Mathematics teaching, learning and supervision. The study involved 150 students, six Mathematics teachers, five heads of Mathematics departments, and five school heads. Thirty students were selected from each school with the assistance of the heads of the Mathematics departments. Students were included if they were enrolled in Ordinary Level Mathematics, regularly attended mathematics lessons, and were willing to participate. Teachers, departmental heads, and school heads were included because of their roles in instruction, supervision, resource allocation, parental engagement, and decision-making.

Table 1. Participants and data sources

Participant/data source	Number	Data collection method	Main information generated
Secondary schools	5	School visits, observations, document analysis	School context, resource conditions, instructional environment
Ordinary Level Mathematics students	150	Questionnaire, focus group discussions	Confidence, attitudes, participation, peer interaction, perceived support, suggested strategies
Mathematics teachers	6	Teacher questionnaire, classroom observation	Teaching methods, workload, syllabus pressure, resources, perceived barriers
Heads of Mathematics departments	5	Semi-structured interviews	Departmental support, supervision, curriculum implementation, assessment pressure
School heads	5	Semi-structured interviews	School-level policies, resource allocation, parental involvement, institutional support
Mathematics lesson observations	5	Classroom observation guide	Teacher-student interaction, feedback, group work, learner-centred activities, use of materials
School and instructional documents	5 sets	Document analysis guide	Planned pedagogy, assessment patterns, learner-centred activities, performance records

Data will be collected between July and August 2025 using student and teacher questionnaires, classroom observation guides, semi-structured interview guides, focus group discussion guides, and document analysis guides. The student questionnaire covered confidence, fear of failure, willingness to ask and answer questions, peer interaction, teacher support, resource access, parental support, attitudes, and preferred strategies. The teacher questionnaire covered teaching methods, group work, questioning, workload, syllabus pressure, resource availability, and perceived obstacles. The observations focused on student responses, teacher questioning, feedback, peer interaction, use of materials, and opportunities for reasoning. Interviews with school heads and departmental heads addressed resource allocation, professional support, examination expectations, parental involvement, and school-level intervention. The documents included scheme books, lesson plans, assessment records, and available performance records.

Questionnaires were administered to students and teachers for three weeks in July 2025. In August 2025, the researchers visited the five schools over two weeks to conduct observations, interviews, focus group discussions, and document analyses. The qualitative phase was used to explain and contextualise the questionnaire patterns. Before data collection, the instruments were reviewed for clarity, relevance, and alignment with the research questions, and the wording was revised where necessary.

Questionnaire data were analysed using descriptive statistics, including frequencies and percentages. Because this study used purposive sampling and a case study design, no inferential statistical claims were made. Qualitative data from focus groups, interviews, observations, and documents were analysed using reflexive thematic analysis.[21] The analysis involved repeated reading, open coding, grouping related codes, and refining themes aligned with the research questions and theoretical framework. Integration was achieved by comparing survey patterns with qualitative accounts and observational/documentary evidence.

Rigor was strengthened through methodological triangulation, source triangulation, detailed contextual description, and documentation of coding decisions, observation notes, and document summaries. Ethical safeguards were followed throughout the study. Permission was obtained from the relevant school authorities; participation was voluntary; the participants were informed about confidentiality and withdrawal rights; the student participants provided assent; and no personal identifiers were reported. Formal institutional ethical approval was not required under the applicable local procedures; however, permission and ethical safeguards were observed.

The study was conducted in one rural cluster and should not be generalised to all rural schools in Zimbabwe. Purposive sampling limits representativeness, questionnaire data may be influenced by social desirability, and the quantitative component was descriptive rather than causal relationships. Classroom observation data were based on one observed mathematics lesson in each school; therefore, observations should be interpreted as illustrative rather than exhaustive. These limitations were mitigated through triangulation of questionnaires, focus groups, interviews, observations, and documents.

RESULTS AND DISCUSSION

Results

This section presents the descriptive quantitative findings, followed by integrated qualitative explanations. The results are organised around learner-related barriers, sociocultural influences, classroom and pedagogical conditions, institutional resource constraints, and strategies perceived as supportive of participation.

Of the 150 student participants, 88 (58.7%) reported that negative attitudes toward mathematics hindered their active participation. All six mathematics teachers also identified

[21] Virginia Braun and Victoria Clarke, "One Size Fits All? What Counts as Quality Practice in (Reflexive) Thematic Analysis?," *Qualitative Research in Psychology* 18, no. 3 (July 3, 2021): 328–52, https://doi.org/10.1080/14780887.2020.1769238.

negative learner attitudes as a barrier to classroom engagement. Cultural factors and gender stereotypes were identified by 56 students (37.3%) as affecting their willingness to engage in mathematics. Participants also expressed strong support for participatory strategies: at least three-quarters acknowledged the value of structured group discussions, while approximately nine in ten recognised hands-on learning as important for improving engagement in the training process. These findings indicate patterns within the Lusulu Cluster, rather than statistically representative trends.

Table 2. Summary of descriptive quantitative findings

Indicator	Frequency	Percentage	Interpretation
Students reporting negative attitudes as a barrier	88 out of 150	58.7%	Negative attitudes were a major constraint related to learners.
Teachers reporting negative attitudes as a barrier	6 out of 6	100%	Teachers unanimously perceived learner attitudes as affecting their engagement.
Students identifying cultural factors/gender stereotypes	56 out of 150	37.3%	Socio-cultural expectations shaped some learners' confidence and agency.
Participants valuing structured group discussions	At least three-quarters	≥75%	Collaborative learning was widely perceived as being useful.
Participants valuing hands-on learning	Approximately nine in ten	≈90%	Practical learning was perceived as strongly supportive.

The qualitative findings explain why negative attitudes, low confidence, and fear of failure emerged as important barriers. Across student focus groups, teacher responses, and departmental interviews, participants described mathematics as difficult, intimidating, and associated with previous failure. Many learners avoided asking questions or attempting unfamiliar problems publicly because incorrect answers could lead to embarrassment, peer judgment, or discouraging responses from teachers. Thus, non-participation was not simply a sign of disinterest; it also reflected students' attempts to avoid relational and intellectual risks. Learners who repeatedly struggle with mathematical tasks tend to associate the subject with failure, which reduces their concentration, persistence, and willingness to participate.

1. Socio-Cultural and Gendered Influences

Socio-cultural expectations shaped participation by influencing how students understood mathematical ability. Teacher and departmental accounts suggested that some learners' confidence was affected by family and community beliefs about who is expected to succeed in mathematics. In some families, poor performance in mathematics was normalised because previous family members had also struggled. Gendered assumptions also affected expectations of competence, particularly when girls were perceived as less likely to excel. These findings do not imply that culture itself is a deficit; rather, they show that some social narratives can restrict learners' sense of mathematical possibility and should be addressed through a culturally responsive and equity-oriented pedagogy.

2. Classroom, Institutional, and Resource Conditions

Teacher-student relationships and classroom pedagogy played a central role in shaping participation. Students were more willing to participate when teachers were supportive, approachable, and encouraging; however, negative comments after incorrect responses discouraged future attempts. Observations and teacher responses indicated that teacher-centred instruction remained common, especially for examination preparation. Explanation, demonstration, drill, and practice helped teachers cover content but reduced opportunities for peer interaction, questioning, collaborative problem-solving, and explanation of reasoning. Structured group work was perceived as promising, but it required clearer roles and monitoring to prevent domination by more confident students.

Institutional and resource-related conditions further constrained their participation. Teachers and school leaders identified examination pressure, workload, limited materials, large classes, classroom conditions, seating arrangements, lesson time, and limited access to technology as factors affecting student engagement. Document analysis suggested a strong emphasis on syllabus coverage and examination preparation, which reduced opportunities for exploratory learning. Resource scarcity restricts modelling, practical activities, differentiated support, and technology-supported learning. These findings show that participatory pedagogy must be feasible within low-resource environments and cannot depend solely on teachers' willingness.

3. Strategies Perceived as Supportive

Participants identified structured questioning, group work, peer tutoring, hands-on activities, mathematics games, writing for mathematical reasoning, technology-supported learning, professional development, and family engagement as supportive of participation in mathematics learning. Because the study did not experimentally test an intervention, these strategies are reported as perceived support rather than proven effects. Structured questioning encouraged curiosity and reasoning; group work and peer tutoring enabled learners to test ideas in less threatening settings; and hands-on activities made abstract ideas more concrete. Technology-supported learning is promising but conditional on devices, connectivity, electricity, and teacher readiness. Family engagement is important because home and community beliefs influence confidence, attitudes, and mathematical self-concept.

Table 3. Joint display of integrated findings

Theme	Quantitative pattern	Qualitative explanation	Integrated finding
Negative attitudes and low confidence	88 students and all six teachers identified negative attitudes.	Students associated mathematics with difficulty, failure, and fear of incorrect answers.	Participation was constrained by emotional insecurity.
Socio-cultural expectations	56 students identified cultural and gender factors.	Family and community narratives shape beliefs about ability.	Participation was influenced by social recognition and gender expectations.
Teacher feedback and relational safety	The data were reported across students and teachers.	Supportive teachers encouraged participation,	Relational safety was central to the willingness to participate.

Theme	Quantitative pattern	Qualitative explanation	Integrated finding
		and negative comments discouraged responses.	
Examination pressure and resources	Reported by teachers and school leaders.	Teachers relied on direct instruction and drills under resource and workload pressures.	Participation is shaped by institutional and material conditions.
Group work and hands-on learning	≥75% valued discussion; ≈90% valued hands-on learning.	Peer support and practical tasks made mathematics more accessible.	Interactive strategies were perceived as supportive but required adaptation by the teacher.

The integrated findings show that the participation barriers were mutually reinforcing. Low confidence and fear of failure reduced students' willingness to participate, while teacher-centred pedagogy and discouraging feedback limited opportunities to rebuild confidence. Examination pressure and workload encouraged coverage-focused instruction, while resource scarcity restricted interactive and hands-on teaching strategies. Socio-cultural expectations shaped students' mathematical self-concept and willingness to see themselves as capable Mathematics learners.

Participation in Ordinary Level Mathematics in the Lusulu Cluster was shaped not only by learner attitudes but also by classroom relationships, teacher practices, school resources, examination demands, cultural expectations, and school-family connections.

Discussion

The findings indicate that participation was shaped by the interaction of affective, pedagogical, institutional, and sociocultural factors. Low confidence, fear of failure, negative attitudes, gendered expectations, teacher-centred instruction, examination pressure, workload, resource constraints, and classroom conditions formed a mutually reinforcing set of conditions. This interpretation is consistent with research showing that mathematics engagement is shaped by prior experiences, teacher and peer support, emotions, and motivation,[22] and that mathematics anxiety is associated with engagement and achievement.[23] It also aligns with studies showing that gender stereotypes relate to mathematics self-concept, interest, and anxiety,[24] while rural and under-resourced schooling can constrain achievement and technology-supported learning opportunities.[25]

[22] Middleton et al., "Tracing Mathematics Engagement in the First Year of High School: Relationships between Prior Experience, Observed Support, and Task-Level Emotion and Motivation."
[23] Quintero et al., "A Multidimensional Examination of Math Anxiety and Engagement on Math Achievement."
[24] Henschel, Jansen, and Schneider, "How Gender Stereotypes of Students and Significant Others Are Related to Motivational and Affective Outcomes in Mathematics at the End of Secondary School."
[25] Mafugu, "Influences on Mathematics Achievement in Rural Schools: A Nested Study of Underprivileged Learners"; Mustafa, Nguyen, and Gao, "The Challenges and Solutions of Technology Integration in Rural Schools: A Systematic Literature Review."

1. Participation as an Equity-Related Condition

Participation should be conceptualised as more than observable classroom behaviour. While it may appear as asking questions, answering prompts, joining groups, or attempting problems, these behaviours are shaped by deeper affective, relational, institutional, and sociocultural conditions. Recent research on mathematics classroom talk indicates that discourse is central to learning and that access to discourse becomes an equity issue because it shapes who participates and whose mathematical ideas are recognized.[26] Work on epistemic agency similarly shows that classroom practices can open opportunities for sense-making or reinscribe boundaries around whose contributions are valued.[27] In this study, participation depended on whether learners felt confident, recognised, supported, and safe enough to take mathematical risks.

This study extends equity-oriented mathematics scholarship by locating participation within under-resourced rural schools. Equity requires more than formal access to classroom activities; it requires pedagogical arrangements that support mathematical identities, agency, reasoning, and meaningful engagement.[28] The findings show that opportunities to participate were mediated by resources, workload, examination pressure, gendered expectations, and community beliefs. Therefore, rurality operates as an analytical condition rather than merely a location. Teacher shortages, infrastructure constraints, limited professional support, and digital access can shape the feasibility of differentiated, learner-centred, and technology-supported mathematics pedagogy.[29]

2. Affective Barriers, Relational Safety, and Agency

This study extends the literature on mathematics anxiety by showing that anxiety and negative attitudes in rural classrooms are not only individual psychological states. They are shaped by relational and classroom conditions, including teacher feedback, peer judgment, and perceived consequences of public mistakes. Perceived teacher support, mathematics engagement, and mathematics anxiety are dynamically related[30] and teachers' handling of student errors shapes opportunities to learn from mistakes.[31] If students avoid participation

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[26] Ove Gunnar Drageset and Fiona Ell, "Using Positioning Theory to Think about Mathematics Classroom Talk," *Educational Studies in Mathematics* 115, no. 3 (March 20, 2024): 353–85, https://doi.org/10.1007/s10649-023-10295-0.

[27] Wan-Yue Zhan and Nicole L. Louie, "Promoting Epistemic Agency and Reinscribing Boundaries in Mathematics Education," *International Journal of Educational Research* 123 (2024): 102271, https://doi.org/10.1016/j.ijer.2023.102271.

[28] Meghan Comstock et al., "A Culturally Responsive Disposition: How Professional Learning and Teachers' Beliefs About and Self-Efficacy for Culturally Responsive Teaching Relate to Instruction," *AERA Open* 9 (January 7, 2023), https://doi.org/10.1177/23328584221140092; Comstock et al., "Toward More Equitable Instruction: How Teachers Integrate Ambitious, Traditional, and Culturally Responsive Mathematics Practices."

[29] Ingersoll and Tran, "Teacher Shortages and Turnover in Rural Schools in the US: An Organizational Analysis"; T.B. Maphumulo and P. Biccard, "Differentiated Instruction in Rural and Peri-Urban KwaZulu–Natal Primary School Mathematics Classrooms," *African Journal of Research in Mathematics, Science and Technology Education* 29, no. 2 (May 4, 2025): 158–70, https://doi.org/10.1080/18117295.2025.2460286; Jayaluxmi Naidoo, "Exploring Mathematics Teachers' Perceptions of Integrating Digital Pedagogy in Rural Schools," *Discover Education* 4, no. 1 (June 10, 2025): 162, https://doi.org/10.1007/s44217-025-00589-1.

[30] Hongxia Li et al., "Examining the Dynamic Links among Perceived Teacher Support, Mathematics Learning Engagement, and Dimensions of Mathematics Anxiety in Elementary School Students: A Four-Wave Longitudinal Study," *Contemporary Educational Psychology* 75 (October 2023): 102211, https://doi.org/10.1016/j.cedpsych.2023.102211.

[31] Kirsten Benecke and Gabriele Kaiser, "Teachers' Approaches to Handling Student Errors in Mathematics Classes," *Asian Journal for Mathematics Education* 2, no. 2 (June 11, 2023): 161–82, https://doi.org/10.1177/27527263231184642.

because they fear embarrassment or criticism, they lose access to the social processes through which conceptual understanding develops. Therefore, teachers need classroom norms in which mistakes are normalised, partial reasoning is valued, and supportive feedback, wait time, probing questions, and recognition of effort build mathematical agency.

3. Socio-Cultural Expectations and Culturally Responsive Participation

The finding that 37.3% of students identified cultural factors and gender stereotypes as barriers indicates that participation was socially and culturally mediated. Mathematics-related gender stereotypes held by students and significant others are associated with mathematics self-concept, interest, and anxiety.[32] Such social narratives can restrict learners' sense of mathematical possibility, particularly where Mathematics is viewed as a subject for a small group of naturally able students. Culturally responsive mathematics pedagogy emphasises connecting instruction with students' lived realities.[33] However, the present findings suggest that culturally responsive participation also requires challenging restrictive narratives about who is recognised as mathematically capable. Equitable mathematics instruction therefore requires ambitious and culturally responsive practices that ask students to reason while affirming their identities and experiences.[34]

4. Feasibility of Constructivist Pedagogy

The findings reveal a tension between participatory, social-constructivist learning and examination-oriented rural classrooms. Teachers relied on explanation, demonstration, drills, and practice, particularly when preparing students for examinations. This should not be read simply as a resistance to learner-centred pedagogy. Rather, it reflects the institutional conditions under which teachers work: syllabus coverage demands, large classes, heavy workloads, limited preparation time, and resource scarcity. Student-centred mathematics instruction requires routines for understanding student thinking, structuring mathematical talk, and orchestrating discussion.[35] Cooperative learning also requires teachers to scaffold mathematical interaction.[36] Without time, resources, professional support, and school-level encouragement, learner-centred pedagogy may remain an ideal that is difficult to sustain.

5. Resource-Sensitive and Community-Supported Strategies

Participants valued structured questioning, group work, peer tutoring, hands-on learning, technology-supported learning, professional development, and family engagement as important. These strategies should be interpreted as promising perceived support rather than proven interventions. Collaborative problem solving can support reasoning when tasks

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[32] Henschel, Jansen, and Schneider, "How Gender Stereotypes of Students and Significant Others Are Related to Motivational and Affective Outcomes in Mathematics at the End of Secondary School."

[33] Gbormittah et al., "Culturally Responsive Pedagogy Model Integration in Mathematics Education: Perceptions and Practices among Ghanaian Teachers."

[34] Comstock et al., "Toward More Equitable Instruction: How Teachers Integrate Ambitious, Traditional, and Culturally Responsive Mathematics Practices."

[35] Thanheiser and Melhuish, "Teaching Routines and Student-Centered Mathematics Instruction: The Essential Role of Conferring to Understand Student Thinking and Reasoning."

[36] Rangmei Li, Mustafa Cevikbas, and Gabriele Kaiser, "Mathematics Teachers' Beliefs about Their Roles in Teaching Mathematics: Orchestrating Scaffolding in Cooperative Learning," *Educational Studies in Mathematics* 117, no. 3 (November 5, 2024): 357–77, https://doi.org/10.1007/s10649-024-10359-9.

and interaction processes are carefully structured,[37] while group work requires clear roles and monitoring so that confident learners do not dominate. Hands-on learning was valued because it made abstract ideas concrete and could be implemented with locally available materials. Technology-supported learning should be approached cautiously because rural digital pedagogy is constrained by infrastructure, access, and teacher readiness.[38] Family engagement is also important because parental involvement is associated with mathematics performance and self-efficacy.[39]

6. Theoretical, Practical, and Policy Implications

Theoretically, this study extends the concept of participation beyond visible classroom behaviours. Recent scholarship conceptualises participation in Mathematics as a socially situated and relational practice, in which teacher–student interactions, mathematical opportunities, and the recognition of students' contributions shape who participates and how.[40] Participation is therefore socially mediated and institutionally conditioned by learner affect and engagement, teacher support and practice, assessment pressure, resource availability, cultural expectations, and wider school and community conditions.[41] This framing moves beyond individualistic explanations of non-participation and foregrounds the broader ecology of Mathematics learning in under-resourced rural contexts.[42]

Practically, teachers can enhance participation by cultivating emotionally supportive relationships, acknowledging student contributions, responding constructively to partial or incorrect ideas, providing deliberate wait time, and using open questions that elicit explanation and justification.[43] School leaders should support participatory teaching through

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[37] Ceballos et al., "How Collaborative Problem Solving Promotes Higher-Order Thinking Skills: A Systematic Review of Design Features and Processes."

[38] Mustafa, Nguyen, and Gao, "The Challenges and Solutions of Technology Integration in Rural Schools: A Systematic Literature Review"; Naidoo, "Exploring Mathematics Teachers' Perceptions of Integrating Digital Pedagogy in Rural Schools."

[39] Huang et al., "Relationship between Parental Involvement and Mathematics Achievement of Chinese Early Adolescents: Multiple Mediating Roles of Mental Health and Mathematics Self-Efficacy"; Xueshen Wang and Yun Wei, "The Influence of Parental Involvement on Students' Math Performance: A Meta-Analysis," *Frontiers in Psychology* 15 (December 17, 2024), https://doi.org/10.3389/fpsyg.2024.1463359.

[40] Gardesten and Palmér, "Students' Participation in Mathematics in Inclusive Classrooms: A Study of the Enacted Mathematical and Relational Knowing of Teachers"; Jose Angel Mendez and Elizabeth A. van Es, "Examining Teachers' Relational Noticing: Promoting Equity through Positive Interactions in Mathematics Education," *Journal of Mathematics Teacher Education* 28, no. 7 (December 17, 2025): 1541–66, https://doi.org/10.1007/s10857-024-09635-5.

[41] Sunghwan Byun and Beth Herbel-Eisenmann, "'Guess What They Would Make You Do on This One': The Discourse of a High-Stakes Exam in an AP Calculus Classroom," *The Journal of Mathematical Behavior* 73 (March 2024): 101127, https://doi.org/10.1016/j.jmathb.2024.101127; Li et al., "Examining the Dynamic Links among Perceived Teacher Support, Mathematics Learning Engagement, and Dimensions of Mathematics Anxiety in Elementary School Students: A Four-Wave Longitudinal Study"; Leon Marongedza, Promise Machingo Hlungwani, and Precious Hove, "Institutional Constraints Affecting Secondary School Student Performance: A Case Study of Rural Communities in Zimbabwe," *Cogent Education* 10, no. 1 (December 31, 2023), https://doi.org/10.1080/2331186X.2022.2163552; Vithal, Brodie, and Subbaye, "Equity in Mathematics Education."

[42] Mafugu, "Influences on Mathematics Achievement in Rural Schools: A Nested Study of Underprivileged Learners"; Marongedza, Hlungwani, and Hove, "Institutional Constraints Affecting Secondary School Student Performance: A Case Study of Rural Communities in Zimbabwe"; Vithal, Brodie, and Subbaye, "Equity in Mathematics Education."

[43] Benecke and Kaiser, "Teachers' Approaches to Handling Student Errors in Mathematics Classes"; Kathryn Early et al., "Rethinking Wait Time: What Can 3 Seconds Do?," *Mathematics Teacher: Learning and Teaching PK-12* 116, no. 2 (February 2023): 108–14, https://doi.org/10.5951/MTLT.2022.0201; Patrik Gustafsson, "Productive Mathematical Whole-Class Discussions: A Mixed-Method Approach Exploring the Potential of Multiple-Choice Tasks Supported by a Classroom Response System," *International Journal of Science and Mathematics Education* 22, no. 4 (April 23, 2024): 861–84,

collaborative planning, peer observation and lesson study, resource sharing, and sustained professional dialogue.[44] Policy responses should not be limited to pass rates or other outcome indicators, because such a narrow focus risks intensifying examination discourse and obscuring dimensions of participation, identity, power, and access.[45] Support for rural Mathematics education should include adequate staffing, professional development, access to teaching materials, and learner-centred strategies that are feasible in low-resource settings.[46] Community engagement should position parents and communities as partners in strengthening supportive learning routines and challenging gender-stereotyped expectations about mathematical ability.[47]

The central argument is that participation in rural Mathematics classrooms should not be understood merely as observable behaviour; it is integral to equity because it is closely connected to learners' access to mathematical voice, epistemic agency, reasoning, self-efficacy, and educational pathways.[48] Accordingly, improving participation calls for coordinated and context-responsive strategies, including positive teacher–student interactions that recognise learners' contributions,[49] differentiated and learner-responsive pedagogy adapted to rural classroom realities,[50] culturally responsive Mathematics teaching,[51] accessible hands-on representations using manipulatives and locally improvised materials,[52] structured peer roles that distribute opportunities to contribute more

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https://doi.org/10.1007/s10763-023-10402-w; Mendez and van Es, "Examining Teachers' Relational Noticing: Promoting Equity through Positive Interactions in Mathematics Education."

[44] Meixia Ding et al., "A Scoping Review of Mathematics Teachers' Learning and Professional Growth through Lesson Studies," *Asian Journal for Mathematics Education* 2, no. 4 (December 17, 2023): 492–510, https://doi.org/10.1177/27527263231213406; Pinkie Mthembu et al., "Collaborative Practices in Professional Learning Communities: Perspectives from Middle-Grade Mathematics Teachers in a Semi-Rural District in South Africa," *Teacher Development* 29, no. 4 (August 8, 2025): 829–48, https://doi.org/10.1080/13664530.2024.2438727.

[45] Byun and Herbel-Eisenmann, "'Guess What They Would Make You Do on This One': The Discourse of a High-Stakes Exam in an AP Calculus Classroom"; Vithal, Brodie, and Subbaye, "Equity in Mathematics Education."

[46] Mafugu, "Influences on Mathematics Achievement in Rural Schools: A Nested Study of Underprivileged Learners"; Maphumulo and Biccard, "Differentiated Instruction in Rural and Peri-Urban KwaZulu–Natal Primary School Mathematics Classrooms"; Marongedza, Hlungwani, and Hove, "Institutional Constraints Affecting Secondary School Student Performance: A Case Study of Rural Communities in Zimbabwe."

[47] Henschel, Jansen, and Schneider, "How Gender Stereotypes of Students and Significant Others Are Related to Motivational and Affective Outcomes in Mathematics at the End of Secondary School"; Mafugu, "Influences on Mathematics Achievement in Rural Schools: A Nested Study of Underprivileged Learners"; Wang and Wei, "The Influence of Parental Involvement on Students' Math Performance: A Meta-Analysis."

[48] Gardesten and Palmér, "Students' Participation in Mathematics in Inclusive Classrooms: A Study of the Enacted Mathematical and Relational Knowing of Teachers"; Roos, "Students' Voices of Inclusion in Mathematics Education"; Vithal, Brodie, and Subbaye, "Equity in Mathematics Education"; Wang and Wei, "The Influence of Parental Involvement on Students' Math Performance: A Meta-Analysis"; Zhan and Louie, "Promoting Epistemic Agency and Reinscribing Boundaries in Mathematics Education."

[49] Mendez and van Es, "Examining Teachers' Relational Noticing: Promoting Equity through Positive Interactions in Mathematics Education."

[50] Maphumulo and Biccard, "Differentiated Instruction in Rural and Peri-Urban KwaZulu–Natal Primary School Mathematics Classrooms."

[51] Gbormittah et al., "Culturally Responsive Pedagogy Model Integration in Mathematics Education: Perceptions and Practices among Ghanaian Teachers."

[52] Jeremy Hodgen et al., "Low-Attaining Secondary School Mathematics Students' Perspectives on Recommended Teaching Strategies," *International Journal of Science and Mathematics Education* 22, no. 6 (August 12, 2024): 1325–43, https://doi.org/10.1007/s10763-023-10420-8; Mmakgabo Angelinah Selepe, "Teachers' Beliefs in Enhancing Number Concepts through Manipulatives in the Foundation Phase in Rural Schools," *E-Journal of Humanities, Arts and Social Sciences* 6, no. 12 (November 25, 2025): 3094, https://doi.org/10.38159/ehass.202561215.

equitably,[53] and reciprocal school–family partnerships that draw on family and community knowledge.[54]

CONCLUSION

This study has shown that students' participation in Ordinary Level Mathematics in under-resourced rural schools cannot be understood merely as classroom behaviour or individual motivation. Participation emerges from the interaction of affective experiences, teacher-student relationships, instructional practices, institutional constraints, resource conditions, and sociocultural expectations. By examining these dynamics in the Lusulu Cluster of Binga District, the study reframes mathematics participation as an equity-related condition that shapes access to mathematical voice, confidence, reasoning, and future educational opportunities. This framing extends social constructivist and equity-oriented perspectives by demonstrating that opportunities for mathematical dialogue, peer interaction, and problem solving are not equally available to all learners.

The study offers contextually grounded implications for strengthening mathematics participation in under-resourced rural schools in Zimbabwe. Participation-enhancing efforts should combine emotionally safe feedback, structured peer interaction, low-cost hands-on learning, culturally responsive examples, teacher's professional development, and sustained school-family communication. Because the study was conducted in one rural cluster using a case-based mixed-methods design, its findings should be interpreted as analytically transferable rather than generalisable. Future research should examine how specific participation-oriented interventions influence students' confidence, conceptual understanding, achievements, and longer-term educational pathways.

REFERENCES

Benecke, Kirsten, and Gabriele Kaiser. "Teachers' Approaches to Handling Student Errors in Mathematics Classes." *Asian Journal for Mathematics Education* 2, no. 2 (June 11, 2023): 161–82. https://doi.org/10.1177/27527263231184642.

Braun, Virginia, and Victoria Clarke. "One Size Fits All? What Counts as Quality Practice in (Reflexive) Thematic Analysis?" *Qualitative Research in Psychology* 18, no. 3 (July 3, 2021): 328–52. https://doi.org/10.1080/14780887.2020.1769238.

Byun, Sunghwan, and Beth Herbel-Eisenmann. "'Guess What They Would Make You Do on This One': The Discourse of a High-Stakes Exam in an AP Calculus Classroom." *The Journal of Mathematical Behavior* 73 (March 2024): 101127. https://doi.org/10.1016/j.jmathb.2024.101127.

Ceballos, Haydeé, Theo van den Bogaart, Stan van Ginkel, Jeroen Spandaw, and Paul Drijvers. "How Collaborative Problem Solving Promotes Higher-Order Thinking Skills: A Systematic

[53] Mona Røsseland and Eva Elise Tvedt, "Assigned Roles in Mathematics Education: A Path to More Equitable Participation?," *Mathematics Education Research Journal*, April 11, 2026, https://doi.org/10.1007/s13394-026-00567-2.

[54] Jennifer M. Suh and Stephanie C. Calabrese, "Culturally Responsive Mathematics Engagement through a Family-Inspired Mathematizing Routine," *Educational Studies in Mathematics*, June 16, 2025, https://doi.org/10.1007/s10649-025-10411-2; Wang and Wei, "The Influence of Parental Involvement on Students' Math Performance: A Meta-Analysis."

Review of Design Features and Processes." *Thinking Skills and Creativity* 59 (March 2026): 102001. https://doi.org/10.1016/j.tsc.2025.102001.

Cevikbas, Mustafa, and Gabriele Kaiser. "Student Engagement in a Flipped Secondary Mathematics Classroom." *International Journal of Science and Mathematics Education* 20, no. 7 (October 4, 2022): 1455–80. https://doi.org/10.1007/s10763-021-10213-x.

Comstock, Meghan, Erica Litke, Kirsten Lee Hill, and Laura M. Desimone. "A Culturally Responsive Disposition: How Professional Learning and Teachers' Beliefs About and Self-Efficacy for Culturally Responsive Teaching Relate to Instruction." *AERA Open* 9 (January 7, 2023). https://doi.org/10.1177/23328584221140092.

Comstock, Meghan, Kenneth A. Shores, Erica Litke, Laura M. Desimone, Camila Polanco, and Kirsten Lee Hill. "Toward More Equitable Instruction: How Teachers Integrate Ambitious, Traditional, and Culturally Responsive Mathematics Practices." *AERA Open* 11 (July 20, 2025). https://doi.org/10.1177/23328584251331463.

Creswell, John W., and Vicki L. Plano Clark. *Designing and Conducting Mixed Methods Research*. 3rd ed. Los Angeles: Sage Publication, 2017.

Ding, Meixia, Rongjin Huang, Catherine Pressimone Beckowski, Xiaobao Li, and Yeping Li. "A Scoping Review of Mathematics Teachers' Learning and Professional Growth through Lesson Studies." *Asian Journal for Mathematics Education* 2, no. 4 (December 17, 2023): 492–510. https://doi.org/10.1177/27527263231213406.

Drageset, Ove Gunnar, and Fiona Ell. "Using Positioning Theory to Think about Mathematics Classroom Talk." *Educational Studies in Mathematics* 115, no. 3 (March 20, 2024): 353–85. https://doi.org/10.1007/s10649-023-10295-0.

Du, Wen, Tommy Tanu Wijaya, Yiming Cao, and Xinxin Li. "What Factors Influence Secondary Students' Active Participation in Mathematics Classrooms: A Theory of Planned Behavior Perspective." *Acta Psychologica* 253 (March 2025): 104694. https://doi.org/10.1016/j.actpsy.2025.104694.

Early, Kathryn, K. Elizabeth Hammonds, Brea Ratliff, Mariya Rosenhammer, and W. Gary Martin. "Rethinking Wait Time: What Can 3 Seconds Do?" *Mathematics Teacher: Learning and Teaching PK-12* 116, no. 2 (February 2023): 108–14. https://doi.org/10.5951/MTLT.2022.0201.

Fetters, Michael D., Leslie A. Curry, and John W. Creswell. "Achieving Integration in Mixed Methods Designs—Principles and Practices." *Health Services Research* 48, no. 6pt2 (December 23, 2013): 2134–56. https://doi.org/10.1111/1475-6773.12117.

Gardesten, Malin, and Hanna Palmér. "Students' Participation in Mathematics in Inclusive Classrooms: A Study of the Enacted Mathematical and Relational Knowing of Teachers." *Mathematical Thinking and Learning* 27, no. 2 (April 3, 2025): 157–77. https://doi.org/10.1080/10986065.2023.2258485.

Gbormittah, Daniel, Christopher Yarkwah, Japhet Kwasi Osiakwan, and George Adom. "Culturally Responsive Pedagogy Model Integration in Mathematics Education: Perceptions and Practices among Ghanaian Teachers." *Social Sciences & Humanities Open* 12 (2025): 102036. https://doi.org/10.1016/j.ssaho.2025.102036.

Gustafsson, Patrik. "Productive Mathematical Whole-Class Discussions: A Mixed-Method Approach Exploring the Potential of Multiple-Choice Tasks Supported by a Classroom Response System." *International Journal of Science and Mathematics Education* 22, no. 4 (April 23, 2024): 861–84. https://doi.org/10.1007/s10763-023-10402-w.

Han, Seong Won, Chungseo Kang, and Lois Weis. "Reducing Socioeconomic Disparities in STEM Opportunities? Trends in Access to Advanced Science and Math Courses in American High Schools, 1992–2013." *Journal of Education for Students Placed at Risk (JESPAR)* 30, no. 3 (July 3, 2025): 273–310. https://doi.org/10.1080/10824669.2024.2398435.

Henschel, Sofie, Malte Jansen, and Rebecca Schneider. "How Gender Stereotypes of Students and Significant Others Are Related to Motivational and Affective Outcomes in Mathematics at the End of Secondary School." *Contemporary Educational Psychology* 73 (April 2023): 102161. https://doi.org/10.1016/j.cedpsych.2023.102161.

Hodgen, Jeremy, Colin Foster, Margaret Brown, and David Martin. "Low-Attaining Secondary School Mathematics Students' Perspectives on Recommended Teaching Strategies." *International Journal of Science and Mathematics Education* 22, no. 6 (August 12, 2024): 1325–43. https://doi.org/10.1007/s10763-023-10420-8.

Huang, Feifei, Zhaofeng Huang, Zhe Li, and Minqiang Zhang. "Relationship between Parental Involvement and Mathematics Achievement of Chinese Early Adolescents: Multiple Mediating Roles of Mental Health and Mathematics Self-Efficacy." *International Journal of Environmental Research and Public Health* 18, no. 18 (September 10, 2021): 9565. https://doi.org/10.3390/ijerph18189565.

Ingersoll, Richard M., and Henry Tran. "Teacher Shortages and Turnover in Rural Schools in the US: An Organizational Analysis." *Educational Administration Quarterly* 59, no. 2 (April 16, 2023): 396–431. https://doi.org/10.1177/0013161X231159922.

Joshi, Dirgha Raj, Krishna Prasad Adhikari, Bishnu Khanal, Jiban Khadka, and Shashidhar Belbase. "Behavioral, Cognitive, Emotional and Social Engagement in Mathematics Learning during COVID-19 Pandemic." Edited by Mohammed Saqr. *PLOS ONE* 17, no. 11 (November 22, 2022): e0278052. https://doi.org/10.1371/journal.pone.0278052.

Li, Hongxia, Mingliang Zhang, Shuyang Hou, Bijuan Huang, Chang Xu, Zifeng Li, and Jiwei Si. "Examining the Dynamic Links among Perceived Teacher Support, Mathematics Learning Engagement, and Dimensions of Mathematics Anxiety in Elementary School Students: A Four-Wave Longitudinal Study." *Contemporary Educational Psychology* 75 (October 2023): 102211. https://doi.org/10.1016/j.cedpsych.2023.102211.

Li, Rangmei, Mustafa Cevikbas, and Gabriele Kaiser. "Mathematics Teachers' Beliefs about Their Roles in Teaching Mathematics: Orchestrating Scaffolding in Cooperative Learning." *Educational Studies in Mathematics* 117, no. 3 (November 5, 2024): 357–77. https://doi.org/10.1007/s10649-024-10359-9.

Mafugu, Tafirenyika. "Influences on Mathematics Achievement in Rural Schools: A Nested Study of Underprivileged Learners." *Interchange* 56, no. 1 (March 21, 2025): 1–15. https://doi.org/10.1007/s10780-024-09533-y.

Maphumulo, T.B., and P. Biccard. "Differentiated Instruction in Rural and Peri-Urban KwaZulu–Natal Primary School Mathematics Classrooms." *African Journal of Research in Mathematics, Science and Technology Education* 29, no. 2 (May 4, 2025): 158–70. https://doi.org/10.1080/18117295.2025.2460286.

Marongedza, Leon, Promise Machingo Hlungwani, and Precious Hove. "Institutional Constraints Affecting Secondary School Student Performance: A Case Study of Rural Communities in Zimbabwe." *Cogent Education* 10, no. 1 (December 31, 2023). https://doi.org/10.1080/2331186X.2022.2163552.

Mendez, Jose Angel, and Elizabeth A. van Es. "Examining Teachers' Relational Noticing: Promoting Equity through Positive Interactions in Mathematics Education." *Journal of Mathematics Teacher Education* 28, no. 7 (December 17, 2025): 1541–66. https://doi.org/10.1007/s10857-024-09635-5.

Middleton, James A., Adi Wiezel, Amanda Jansen, and Ethan P. Smith. "Tracing Mathematics Engagement in the First Year of High School: Relationships between Prior Experience, Observed Support, and Task-Level Emotion and Motivation." *ZDM – Mathematics Education* 55, no. 2 (March 10, 2023): 427–45. https://doi.org/10.1007/s11858-022-01432-9.

Ministry of Primary and Secondary Education, and Cadena international development projects. "Republic of Zimbabwe: Education Sector Analysis." UNICEF, 2020. https://www.zimta.org.zw/wp-content/uploads/2022/05/Zimbabwe-FINAL-Education-Sector-Analysis-Nov-2020-FINAL.pdf.

Mthembu, Pinkie, Zanele A. Ngcobo, Sebenzile Ngema, Bongani Nhlanhla Mkhize, Free-Queen Zulu, and Sarah Bansilal. "Collaborative Practices in Professional Learning Communities: Perspectives from Middle-Grade Mathematics Teachers in a Semi-Rural District in South Africa." *Teacher Development* 29, no. 4 (August 8, 2025): 829–48. https://doi.org/10.1080/13664530.2024.2438727.

Mustafa, Faisal, Hoa Thi Mai Nguyen, and Xuesong (Andy) Gao. "The Challenges and Solutions of Technology Integration in Rural Schools: A Systematic Literature Review." *International Journal of Educational Research* 126 (2024): 102380. https://doi.org/10.1016/j.ijer.2024.102380.

Naidoo, Jayaluxmi. "Exploring Mathematics Teachers' Perceptions of Integrating Digital Pedagogy in Rural Schools." *Discover Education* 4, no. 1 (June 10, 2025): 162. https://doi.org/10.1007/s44217-025-00589-1.

Quintero, Michaela, Leslie Hasty, Tianyu Li, Seowon Song, and Zhe Wang. "A Multidimensional Examination of Math Anxiety and Engagement on Math Achievement." *British Journal of Educational Psychology* 92, no. 3 (September 26, 2022): 955–73. https://doi.org/10.1111/bjep.12482.

Roos, Helena. "Students' Voices of Inclusion in Mathematics Education." *Educational Studies in Mathematics* 113, no. 2 (June 28, 2023): 229–49. https://doi.org/10.1007/s10649-023-10213-4.

Røsseland, Mona, and Eva Elise Tvedt. "Assigned Roles in Mathematics Education: A Path to

More Equitable Participation?" *Mathematics Education Research Journal*, April 11, 2026. https://doi.org/10.1007/s13394-026-00567-2.

Selepe, Mmakgabo Angelinah. "Teachers' Beliefs in Enhancing Number Concepts through Manipulatives in the Foundation Phase in Rural Schools." *E-Journal of Humanities, Arts and Social Sciences* 6, no. 12 (November 25, 2025): 3094. https://doi.org/10.38159/ehass.202561215.

Suh, Jennifer M., and Stephanie C. Calabrese. "Culturally Responsive Mathematics Engagement through a Family-Inspired Mathematizing Routine." *Educational Studies in Mathematics*, June 16, 2025. https://doi.org/10.1007/s10649-025-10411-2.

Thanheiser, Eva, and Kathleen Melhuish. "Teaching Routines and Student-Centered Mathematics Instruction: The Essential Role of Conferring to Understand Student Thinking and Reasoning." *The Journal of Mathematical Behavior* 70 (June 2023): 101032. https://doi.org/10.1016/j.jmathb.2023.101032.

Vithal, Renuka, Karin Brodie, and Reshma Subbaye. "Equity in Mathematics Education." *ZDM – Mathematics Education* 56, no. 1 (February 15, 2024): 153–64. https://doi.org/10.1007/s11858-023-01504-4.

Wang, Xueshen, and Yun Wei. "The Influence of Parental Involvement on Students' Math Performance: A Meta-Analysis." *Frontiers in Psychology* 15 (December 17, 2024). https://doi.org/10.3389/fpsyg.2024.1463359.

Zhan, Wan-Yue, and Nicole L. Louie. "Promoting Epistemic Agency and Reinscribing Boundaries in Mathematics Education." *International Journal of Educational Research* 123 (2024): 102271. https://doi.org/10.1016/j.ijer.2023.102271.

Zimbabwe School Examinations Council. "Release of 2025 Ordinary Level Results." Harare, Zimbabwe: ZIMSEC, 2026. https://www5.zimsec.co.zw/2026/02/06/release-of-2025-ordinary-level-results/.

Zimbabwe School Examinations Council. "Release of the 2024 November Ordinary Level Examination Results." Harare, Zimbabwe: ZIMSEC, 2025. https://www5.zimsec.co.zw/wp-content/uploads/2025/04/2024-November-Ordinary-Level-Results-Release-1.pdf.