Environment and Social Psychology (2024) Volume 9 Issue 8
doi: 10.59429/esp.v9i8.2838

RESEARCH ARTICLE

Exploring students' mathematical literacy: The role of Self-efficacy and learning environment

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ABSTRACT

This study explores the intricate relationship between mathematical literacy skills and self-efficacy within a high school learning environment in the United Arab Emirates. Focusing on 20 grade 8 students, the research employs a qualitative descriptive approach, integrating mathematical literacy assessments, self-efficacy surveys, and interviews. The findings reveal a strong correlation between high self-efficacy and advanced mathematical literacy, while moderate self-efficacy corresponds to intermediate proficiency levels. Conversely, low self-efficacy is linked to lower mathematical literacy. Notably, some students display moderate mathematical proficiency despite varying levels of self-efficacy. These insights provide a nuanced understanding of how self-efficacy influences mathematical literacy and suggest strategies to enhance mathematical proficiency in educational settings. One practical implication of this study is the recommendation for educators to implement interventions designed to boost self-efficacy, such as positive feedback and growth mindset training, to improve overall mathematical literacy.

Keywords: mathematical literacy; self-efficacy; lightening the learning climate

1. Introduction

Mathematics is a cornerstone of education, offering many benefits and advantages to students who master its intricacies. This assertion is echoed by Stoica & Wardat (2021)[1], emphasising the indispensability of mathematics in the academic curriculum. Building upon this notion, Zulfah (2019)[2] contends that proficiency in mathematics equips students with invaluable skills and practical applications. Moreover, Manalu and Zanthy (2020)[3] underscore mathematics as a fundamental discipline for organizing daily activities effectively. Despite its perceived complexity, as noted by Jarrah et al. (2022a)[4], the significance of mathematics permeates various aspects of life and is often overlooked by many. Concurrently, the overarching aim of mathematics education, as articulated by Sari et al. (2017)[5], is to foster the growth and development of students' abilities, nurturing them from rudimentary to advanced capabilities. Recognising and embracing the importance of mathematics in education is pivotal for students to unlock their full potential and navigate the complexities of the modern world.

ARTICLE INFO
Received: 21 May 2024 | Accepted: 17 June 2024 | Available online: 21 August 2024

CITATION
AlAli R, Wardat Y. Exploring students' mathematical literacy: The role of self-efficacy and learning environment. *Environment and Social Psychology* 2024; 9(8): 2838. doi: 10.59429/esp.v9i8.2838

The educational process for students integrates a scientific approach, facilitating five pivotal learning experiences: observation, questioning, information gathering, analysis, synthesis, and effective communication of their learning journey, as outlined in AlAli & Wardat (2024). [6]. This approach aligns with the principles established by the National Council of Teachers of Mathematics (NCTM, 2000), which delineates five core competencies crucial for mathematics education: mathematical problem-solving, communication, reasoning, connection, and representation. These foundational competencies empower students to navigate mathematical challenges and apply their knowledge in real-world scenarios. These competencies collectively contribute to the development of mathematical literacy, as Saleh & AlAli (2023). [7] emphasizes, ensuring that students possess the requisite mathematical abilities to thrive in their future endeavours and effectively engage with mathematics in everyday life.

Research by Wardat et al. (2022)[8] highlights the influence of school factors on students' mathematics achievements, emphasising the need for supportive educational environments. Similarly, Jarrah et al. (2020) [9] discuss the implementation of John Dewey's educational philosophy, which advocates for experiential learning in mathematics and science education. Moreover, Hidayat and Wardat (2023) [10] systematically review augmented reality in STEM education, underscoring the potential of technology-enhanced learning.

Wardat et al. (2021) [11] investigate middle school student's understanding of the equal sign, revealing the importance of foundational mathematical concepts. Additionally, Gningue et al. (2022) [12] examine the relationship between teacher leadership and school climate, finding that positive school climates contribute to better student outcomes. Tashtoush et al. (2022) [13] further explore the impact of teacher training programs on developing mathematical reasoning skills, emphasising the role of TIMSS-based training in enhancing pre-service teachers' competencies.

Finally, Tashtoush et al. (2023) [14] address the challenges of mathematics distance learning during the COVID-19 pandemic. They provide insights into teachers' perspectives on learning loss and the need for effective remote teaching strategies. These studies collectively highlight the multifaceted nature of mathematics education and the various factors that influence student achievement and engagement.

Mathematical literacy encompasses the ability of students to effectively formulate, apply, and interpret mathematical concepts across diverse contexts, underpinned by sound mathematical reasoning and proficiency in utilizing mathematical procedures, concepts, and facts [15,16]. According to the Organization for Economic Co-operation and Development[15], literacy skills in mathematics are structured within three overarching domains:

1. **Content Domain:** Encompassing numbers (quantity), space and shape (geometry), change and relationships (algebra), and data uncertainty (statistics and probability).

2. **Context Domain:** Spanning personal, occupational, societal, and scientific contexts, wherein mathematical concepts find application and relevance.

3. **Process Domain:** Encompassing the formulation of mathematical situations, application of mathematical concepts, procedures, and reasoning, as well as the interpretation and evaluation of mathematical outcomes.

Within the process domain, essential abilities include communication, mathematising, representation, reasoning and argument, devising problem-solving strategies, using symbolic, formal, and technical language, and operations using mathematics tools [17]. Mastery of these domains indicates that students' mathematical literacy skills are in good condition.

The United Arab Emirates' participation in the Program for International Student Assessment (PISA) aims to evaluate students' mathematical literacy skills. However, despite these efforts, the country's performance in mathematical literacy has not aligned with international standards. Initially joining PISA in 2000, the UAE's early results indicated a significant gap in mathematical proficiency. Recent assessments showed notable declines in reading compared to 2018, with average scores falling below OECD averages: 476 for reading, 485 for science, and 472 for mathematics. A total of 24,600 students across 840 schools completed assessments in mathematics, reading, or science. The gap between the highest and lowest performing students has narrowed in mathematics but widened in reading and science since 2018. The UAE's average scores were 431 in maths (ranked 43rd out of 81 countries), 432 in science (ranked 47th), and 417 in reading (ranked 48th), all below OECD averages [18,19].

The deficiency in students' mathematical literacy skills can be attributed to several factors, including using questions that require strong literacy skills and the prevalent teacher-centred approach to learning. Babys (2016)[20] highlights the adverse effects of this teacher-centred approach, often resulting in passive student engagement. Additionally, Apter et al. (2010) [21] emphasize the critical role of self-efficacy in overcoming mathematical challenges. Defined as individuals' belief in their ability to achieve desired outcomes, self-efficacy serves as a potent motivator in the face of difficulties [22].

Recent studies have consistently shown a significant relationship between self-efficacy and mathematical literacy. For instance, research by AlAli, R. & Al-Barakat, A. (2023) [23] highlights that students with higher self-efficacy tend to perform better in mathematics due to their increased persistence and resilience in problem-solving situations. Additionally, a study by the OECD (2019) [24] found that students who believe in their mathematical abilities are more likely to engage deeply with mathematical content and utilize effective strategies for learning and problem-solving.

However, despite the paramount importance of self-efficacy in mathematical learning, research by Sari et al. (2018) [25] suggests that students' self-efficacy remains low, hindering their ability to effectively tackle mathematical problems. This is further corroborated by PISA survey data, indicating below-average self-efficacy levels among mathematics students. Given the significant impact of self-efficacy on problem-solving success (Wardat et al., 2022) [26], exploring the relationship between students' mathematical literacy skills and their self-efficacy is essential.

Several studies highlight the diverse factors influencing students' mathematical achievements and literacy. For example, Alneyadi et al. (2023) [27] found that using smart e-learning apps significantly enhances the academic achievement of eighth-grade students. In another study, Alneyadi et al. (2023) [28] demonstrated the positive impact of digital environments compared to traditional methods on the literacy skills of Emirati fourth graders. Additionally, Tashtoush et al. (2023) [29] emphasized the role of ICT-based education in boosting students' enthusiasm for mathematics.

Furthermore, Jarrah et al. (2022) [30] identified misconceptions about addition and subtraction of fractions among seventh-grade students, suggesting a need for targeted instructional strategies. Zakariya and Wardat (2023) [31] explored job satisfaction among mathematics teachers, highlighting the contributions of teacher self-efficacy and motivation to teach.

Wardat et al. (2024)[32] investigated mathematics teachers' perspectives on artificial intelligence in education, uncovering various practices and challenges. These studies collectively underscore the multifaceted nature of mathematical education and the critical role of self-efficacy in student success. This study aims to elucidate these dynamics, particularly among grade 8 students, to inform targeted interventions aimed at enhancing both mathematical proficiency and self-efficacy. Educators can develop strategies to empower

students and foster a more conducive learning environment by understanding how self-efficacy influences mathematical literacy.

1.1. Study purpose

This study explores the relationship between students' mathematical literacy skills and their self-efficacy, specifically focusing on grade 8 students in Abu Dhabi schools. By investigating how self-efficacy influences mathematical literacy within Abu Dhabi's educational system, the study aims to uncover potential factors contributing to low levels of mathematical proficiency and self-efficacy among students in the region. Ultimately, the research seeks to provide insights that can inform targeted interventions and educational strategies tailored to the unique needs of Abu Dhabi schools, aiming to improve mathematical proficiency and self-efficacy among students and enhance overall learning outcomes in the region.

1.2. Study significant

The significance of this study lies in its potential to address critical issues in mathematics education within Abu Dhabi schools. By investigating the relationship between students' mathematical literacy skills and their self-efficacy, the study aims to shed light on factors hindering students' academic success and overall learning experiences. Understanding how self-efficacy influences mathematical proficiency can inform the development of targeted interventions and educational strategies tailored to the specific needs of students in Abu Dhabi schools. Improving students' mathematical literacy and self-efficacy has far-reaching implications for their academic achievement and future success in higher education and the workforce. Additionally, by contributing to the body of research on mathematics education in the Abu Dhabi context, this study can provide valuable insights and recommendations for policymakers, educators, and stakeholders striving to enhance the quality of education and promote academic excellence in the region.

1.3. Research questions

The research questions for this study could be formulated as follows:

1. What is the relationship between students' self-efficacy and mathematical literacy skills among grade 8 students in Abu Dhabi schools?

2. How does the level of self-efficacy influence students' mathematical problem-solving abilities, communication skills, and overall mathematical proficiency?

3. What factors contribute to variations in self-efficacy levels among grade 8 students in Abu Dhabi schools, and how do they impact their mathematical literacy development?

4. To what extent do teaching methods, curriculum design, and classroom environment influence students' self-efficacy beliefs and mathematical literacy outcomes in Abu Dhabi schools?

5. What are the implications of the findings for educational policymakers, school administrators, and educators seeking to enhance students' mathematical proficiency and self-efficacy in Abu Dhabi schools?

1.4. Conceptual framework

The conceptual framework for this study can be based on Bandura's Social Cognitive Theory, which emphasizes the reciprocal interaction between personal factors, environmental influences, and behaviour. In the context of mathematical literacy and self-efficacy, this framework suggests that students' beliefs in their ability to succeed in mathematics (self-efficacy) are influenced by their past experiences, social modelling, and the support they receive from their teachers, peers, and families.

The conceptual framework can be further expanded to include key constructs such as:

Self-efficacy: Students' belief in their capability to successfully perform mathematical tasks and overcome challenges.

Mathematical literacy: Students' ability to formulate, apply, and interpret mathematical concepts in various contexts, encompassing problem-solving, reasoning, communication, and representation skills.

Personal factors: Individual characteristics and experiences that may influence students' self-efficacy and mathematical literacy, such as prior achievement, motivation, and attitudes towards mathematics.

Environmental influences: Classroom practices, teaching methods, curriculum design, and school culture that shape students' perceptions of their mathematical abilities and impact their learning experiences.

Behavior: Students' engagement in mathematical tasks, problem-solving strategies, and their overall mathematical performance, which are influenced by their self-efficacy beliefs and environmental factors.

This conceptual framework guides the research design, data collection, and analysis, facilitating the identification of effective strategies to support students' mathematical learning and enhance their self-efficacy beliefs in Abu Dhabi schools see **Figure 1**.

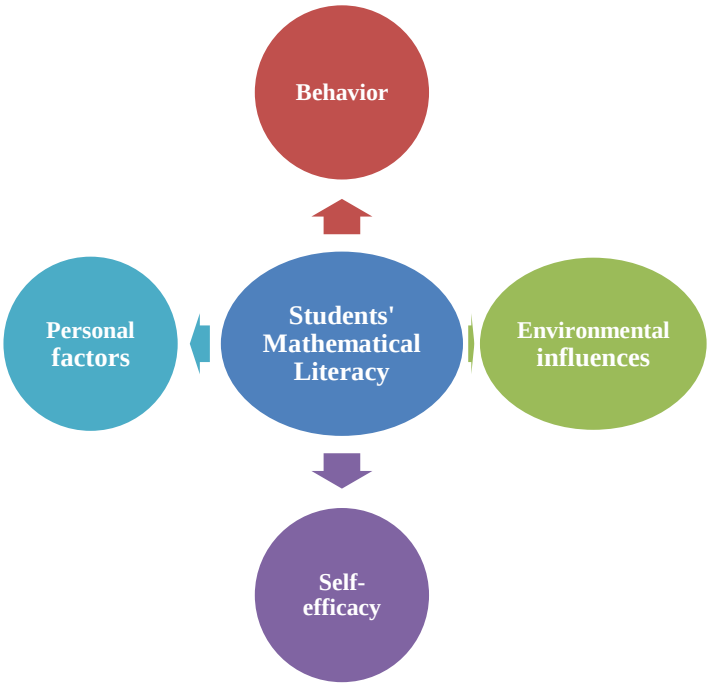

Figure1. Conceptual framework of students' mathematical literacy.

2. Literature review

The literature review presented by Steecey and Turner (2015) [33] emphasizes mathematical literacy as the ability to solve mathematical problems and apply mathematical concepts in real-world scenarios, enabling students to navigate contemporary challenges effectively. This notion is reinforced by Steen and Turner [34], who highlight mathematical literacy as encompassing problem-solving, communication, and application of mathematical concepts in everyday life. Additionally, (Ginanjar & Wita, 2018) [34] underscores the importance of mathematical literacy in formulating and interpreting problems within contextual frameworks, asserting that true mathematical literacy manifests in the ability to apply mathematical knowledge to practical situations.

Self-efficacy, as defined by Surya & Widhiyani (2016) [35] and Saleh et al. (2023) [36], is an individual's belief in their capacity to succeed in specific tasks involving the organization and execution of actions

necessary to manage future situations. This belief system influences individuals' approach to challenges, with high self-efficacy leading to proactive engagement and low self-efficacy resulting in avoidance of complex tasks, as noted by Santrock (2012) [37] and Setiana (2015) [38]. Moreover, Erliana et al. (2015) [39] highlight the significance of self-efficacy in students' academic development, emphasizing its role in navigating learning challenges and improving academic performance.

Several factors contribute to the development of self-efficacy, as Hendriana et al. (2017) [40], including familial, peer, and school influences, as well as individual characteristics such as gender, age, education level, and prior experiences.

As described by Mulyadi (2021) [41] and Assor et al. (2002) [42], lightening the learning climate is an active learning strategy to create a relaxed and engaging classroom atmosphere by incorporating humour and creativity into lesson delivery. This approach, as outlined by (Andriani et al., 2019) [43], involves interactive exercises where students are encouraged to explore topics creatively and share their insights with peers, fostering deeper understanding and retention of learning material.

In summary, the literature review highlights the interconnectedness of mathematical literacy, self-efficacy, and instructional strategies, such as lightening the learning climate in shaping students' learning experiences and academic outcomes.

3. Methodology

A qualitative descriptive approach is appropriate for this study, as it emphasizes depicting or portraying a concept or phenomenon within the context of learning. Descriptive research seeks to understand the "what" of the phenomenon, providing a detailed and accurate account of the characteristics and functions of the subject under investigation.

Qualitative Approach: Qualitative research in this study involves examining natural objects or phenomena where the researcher is the primary instrument. Data collection employs triangulation, combining interviews, observations, and documentation. This approach ensures a comprehensive understanding of the phenomena from multiple perspectives. The collected data are predominantly qualitative, and the analysis is conducted inductively, aiming to interpret or understand the uniqueness of phenomena, construct insights, and develop hypotheses.

Data Collection Methods: Data collection methods include mathematical literacy tests, self-efficacy questionnaires, and interviews. These methods comprehensively understand the relationship between self-efficacy and mathematical literacy skills among grade 8 students.

3.1. Mathematical literacy tests

- The mathematical literacy tests assess students' ability to formulate, apply, and interpret mathematical concepts across various contexts. These tests are structured within three overarching domains: content domain (numbers, geometry, algebra, statistics, and probability), context domain (personal, occupational, societal, and scientific contexts), and process domain (formulation, application, reasoning, and evaluation of mathematical outcomes).
- **Criteria and Validation:** The criteria for these assessments include the clarity of mathematical reasoning, the accuracy of mathematical procedures, and the relevance of the application in real-world contexts. The tests are validated through expert reviews and pilot testing with a sample of students to ensure reliability and validity.

3.2. Self-efficacy questionnaires

- The self-efficacy questionnaires measure students' beliefs in their ability to achieve desired outcomes in mathematical tasks. The questions are designed to capture students' confidence in their problem-solving skills, persistence in challenging tasks, and overall mathematical competence.
- Criteria and Validation: The criteria for the self-efficacy assessments include the specificity, generality, and strength of self-efficacy beliefs. The questionnaires are validated through factor analysis and internal consistency checks, such as Cronbach's alpha, to ensure they accurately measure the construct of self-efficacy.

3.3. Interviews

- Semi-structured interviews provide qualitative insights into students' experiences and perceptions related to their mathematical learning and self-efficacy. The interviews explore students' attitudes towards mathematics, their experiences with mathematical challenges, and the strategies they use to overcome difficulties.
- Criteria and Validation: Interview questions are developed based on existing literature on self-efficacy and mathematical literacy. They are validated through peer reviews and pilot interviews to ensure they effectively capture the necessary information.

Population and Sample: The population for this study comprises grade 8 junior high school students in the United Arab Emirates, representing the target group with specific qualities and characteristics defined by the researcher. The sample consists of 20 individuals selected through convenience sampling. Convenience sampling selects participants based on accessibility and availability, allowing for the inclusion of anyone who meets the researcher's criteria and is deemed suitable as a data source.

4. Data analysis

In this study, a self-efficacy questionnaire was compiled, adapted from existing sources, specifically from Samsudin (2019) [44]. The questionnaire utilized a Likert scale, where responses were categorized as strongly agree (SA), agree (A), disagree (DA), and strongly disagree (SDA). Positive statements were scored as 4, 3, 2, 1, while negative statements were scored in reverse order.

To assess students' self-efficacy levels, the responses were classified into five categories, as outlined in **Table 1** below:

Table 1. Classification of student self-efficacy.

No.	Classification	Percentage Range
1	Very high	66 - 88
2	High	51 - 66
3	Medium	37 - 51
4	Low	22 - 37
5	Very low	0 - 22

In addition, the researchers assessed the validity, reliability, and difficulty index of the mathematical literacy instrument, comprising 12 questions. Responses to the test were analyzed using a scoring rubric developed by the researcher. This rubric facilitated the categorization of students' proficiency in solving mathematical literacy problems, thereby providing insights into their mathematical literacy abilities. The scores obtained were classified according to **Table 2** below:

Table 2. Classification of students' mathematical literacy ability.

No.	Classification	Percentage Range
1	Very high	18 - 24
2	High	14 - 18
3	Medium	10 - 14
4	Low	6 - 10
5	Very low	0 - 6

This classification system allowed for a comprehensive analysis of students' mathematical literacy abilities based on their performance on the instrument.

Student responses will be examined to identify errors based on indicators of mathematical literacy ability. Following analysis, conclusions will be drawn, and interviews will be conducted. The interviews will address students' difficulties in solving mathematical literacy problems and understanding their self-efficacy during the learning process. The indicators of mathematical literacy ability in this study are aligned with the PISA indicators (OECD, 2016) [15], as outlined in **Table 3** below:

Table 3. Indicators of mathematical literacy ability.

Indicator	Rated aspect
Communication skills	Can translate statements, questions, questions, objects, and pictures entirely and correctly.
Mathematical ability	Can identify the underlying mathematical variables and structures in real-world problems.
Ability to choose a strategy	Can design strategies and apply facts, operations, algorithms, and structures in finding solutions.

5. Result and discussion

The data collected from distributing questionnaires to 20 grade 8 students were analyzed to assess their levels of self-efficacy, which were categorized into five levels: Very high, High, Medium, Low, and Very low.

Table 4. Results of Self-Efficacy Levels.

No	Classification	Students total
1	Very high	6
2	High	6
3	Medium	5
4	Low	3
5	Very low	0

Additionally, **Table 5** provides a recapitulation of each student's self-efficacy responses, including their total self-efficacy score and the corresponding category:

Table 5. Recapitulation of Student Self-Efficacy Responses.

Student Code	Total Self-Efficacy Score	Category
A-1	60	High
A-2	62	High
A-3	77	Very high
A-4	82	Very high
A-5	70	Very high
A-6	65	High
A-7	71	Very high
A-8	55	High
A-9	53	High
A-10	36	Low
A-11	72	Very high
A-12	49	Medium
A-13	72	Very high
A-14	42	Medium
A-15	60	High
A-16	48	Medium
A-17	33	Low
A-18	51	Medium
A-19	41	Medium
A-20	29	Low

These tables provide a comprehensive overview of the students' self-efficacy levels and enable further analysis and interpretation of the data.

5.1. Description of mathematical literacy ability analysis results based on self-efficacy

The analysis focused on two students selected to represent different levels of self-efficacy. The findings regarding their mathematical literacy skills are summarized in **Table 6** below.

Table 6. Results of analysis of mathematical literacy ability in terms of self-efficacy.

Category Self Efficacy	Student Code	Total Mathematical Literacy Score	Category
High	A-3	13	Medium
	A-4	18	High
Medium	A-12	12	Medium
	A-18	12	Medium
Low	A-17	10	Low
	A-20	14	Medium

5.2. Refining the analysis of mathematical literacy ability based on self-efficacy

Table 6 illustrates varying levels of self-efficacy among students, each corresponding to their proficiency in mathematical literacy. One student demonstrates a commendable mathematical literacy score of 18 out of 24 for those categorised with high self-efficacy. However, contrasting this, another student's score indicates a lower proficiency, totaling only 14. The discrepancy arises from their approach to problem-solving. While

both students can recognize the problem, the latter struggles with articulating the questions precisely, resulting in incomplete responses.

6. Discussion

The discussion section elaborates on the findings in the context of existing literature, comparing results with previous studies to situate this study within the broader research landscape.

Moderate Self-Efficacy and Mathematical Literacy: In instances where self-efficacy is deemed moderate, students' mathematical literacy skills also reflect this middle ground, evident in their average score of 12. Their tendency to engage with questions without meticulous analysis contributes to this moderate performance. This finding is consistent with research by AlAli, R. & Al-Barakat, A. (2023) [23], who noted that moderate self-efficacy often leads to moderate engagement and performance in academic tasks. The students' lack of meticulous analysis may be attributed to a moderate level of confidence that does not sufficiently motivate them to delve deeper into problem-solving strategies.

Low Self-Efficacy and Variable Outcomes: For students falling into the low self-efficacy category, outcomes vary. One student managed a moderate score of 14, indicating some grasp of mathematical concepts, whereas others struggled, achieving only 10 out of 24. This variability aligns with Bandura's (1977) [22] theory, which posits that individuals with low self-efficacy are less likely to persist in the face of challenges, leading to inconsistent performance. Despite their ability to decipher statements and apply basic operations, the lack of strategic problem-solving hinders their performance. This finding is also supported by the work of Fakhriyana et al. (2018) [45], which highlights the difficulty many students face in discerning appropriate problem-solving techniques when their self-efficacy is low.

Challenges in Problem-Solving: The analysis revealed that while students could identify known information, they struggled to apply effective strategies to find solutions. This difficulty aligns with prior research by Fakhriyana et al. (2018) [45], which emphasized the importance of strategic problem-solving in achieving high levels of mathematical literacy. The inability to apply strategies effectively suggests a gap in both self-efficacy and instructional methods that should be addressed to improve students' problem-solving skills.

Comprehension Difficulties: Interviews with six students provided additional insights into their difficulties with complex mathematical literacy questions. Many expressed challenges in comprehending lengthy passages, leading to misunderstandings of the problem's context. This finding echoes the research by Warih et al. (2016) [46], who found that lengthy and complex texts can hinder students' comprehension and problem-solving abilities. Students admitted to struggling with comprehension due to a lack of attentiveness during reading or a failure to connect new material with previously covered content. This issue is compounded by uncertainty and fear of making mistakes, which further inhibits their confidence in tackling mathematical tasks effectively.

Comparison with Existing Literature: The findings of this study are consistent with the broader literature on self-efficacy and mathematical literacy. Usher and Pajares (2009) [23] highlighted the critical role of self-efficacy in academic performance, noting that students with higher self-efficacy tend to engage more deeply with academic tasks and achieve better outcomes. Similarly, the OECD (2019) [24] found that students who believe in their mathematical abilities are more likely to utilize effective learning strategies and persist in the face of challenges.

However, this study also reveals specific nuances not widely discussed in existing literature, such as the variability in performance among students with low self-efficacy and the specific difficulties related to

comprehension of complex texts. These findings suggest that interventions aimed at improving mathematical literacy should not only focus on boosting self-efficacy but also on developing students' reading comprehension and strategic problem-solving skills.

Implications for Practice: The study's findings underscore the need for targeted interventions to enhance both self-efficacy and mathematical literacy among students. Educators should consider incorporating strategies that build students' confidence in their mathematical abilities and provide explicit instruction in strategic problem-solving and reading comprehension. Additionally, creating a supportive learning environment that reduces the fear of making mistakes can help students engage more deeply with mathematical tasks and improve their overall performance.

In conclusion, this study contributes to the understanding of the relationship between self-efficacy and mathematical literacy, highlighting the importance of strategic problem-solving and reading comprehension in achieving high levels of mathematical proficiency. By addressing these factors, educators can develop more effective interventions to support students in their mathematical learning journey.

7. Conclusion

Through meticulous research and analysis, this study sheds light on the intricate relationship between students' self-efficacy and their mathematical literacy proficiency among grade 8 students in junior high schools. The findings gleaned from mathematical literacy tests, self-efficacy questionnaires, and interviews provide valuable insights into this dynamic interplay.

Our research underscores a significant correlation between students' self-efficacy levels and their mathematical literacy skills. Those with high self-efficacy demonstrate commendable proficiency in mathematical literacy, while moderate self-efficacy aligns with intermediate levels of mathematical literacy. Conversely, students with low self-efficacy exhibit diminished mathematical literacy skills. However, it is worth noting the existence of exceptions, where students with moderate self-efficacy showcase varying degrees of mathematical proficiency.

In summary, our findings emphasize the pivotal role of self-efficacy in shaping students' mathematical literacy development. Educators and policymakers can leverage these insights to devise targeted interventions aimed at bolstering students' self-efficacy and, consequently, enhancing their mathematical proficiency. By fostering a supportive learning environment that nurtures students' self-belief and provides tailored support, we can empower students to unlock their full potential in mathematical literacy. Further research should explore these dynamics across diverse educational contexts and through longitudinal studies to develop more effective educational practices.

8. Implications

The implications of this study extend beyond the realm of academic research, offering practical insights that can inform educational policies and classroom practices to enhance students' mathematical literacy skills and self-efficacy.

1. **Educational Policies**: Policymakers can use the findings to formulate policies that prioritize the integration of self-efficacy development strategies into the curriculum. By incorporating interventions that bolster students' belief in their ability to succeed in mathematics, educational systems can cultivate a conducive learning environment that fosters mathematical literacy.

2. **Teacher Training and Professional Development**: Educators play a crucial role in shaping students' self-efficacy beliefs and mathematical proficiency. Therefore, teacher training programs and professional

development workshops should emphasize pedagogical approaches that promote positive self-efficacy beliefs among students. Teachers equipped with strategies to nurture students' confidence can facilitate more effective learning experiences.

3. **Curriculum Design**: Curriculum designers can use the findings to revamp existing curricula to include activities and assessments that explicitly target the development of students' self-efficacy in mathematics. By aligning instructional materials with the identified indicators of mathematical literacy and self-efficacy, curricula can better support students' holistic development.

4. **Student Support Services**: Schools can establish support services such as peer tutoring, mentoring programs, and counseling sessions aimed at addressing students' self-efficacy issues. Providing students with additional resources and emotional support can empower them to overcome challenges and build resilience in their mathematical learning journey.

5. **Parental Involvement**: Encouraging parental involvement in students' mathematical education can further reinforce positive self-efficacy beliefs. Schools can organize workshops and informational sessions for parents to familiarize them with effective strategies for supporting their children's mathematical development at home.

In conclusion, the implications of this study underscore the importance of fostering students' self-efficacy beliefs alongside their mathematical literacy skills. By implementing targeted interventions at various levels of the education system, stakeholders can collaborate to create an inclusive and supportive learning environment that equips students with the confidence and skills necessary for success in mathematics and beyond.

9. Recommendations

Building upon the findings of this study, the following recommendations are proposed to further enhance students' mathematical literacy skills and self-efficacy:

1. **Implement Self-Efficacy Interventions:** Educational institutions should integrate self-efficacy development interventions into their academic programs. These interventions may include goal-setting exercises, positive reinforcement strategies, and self-assessment techniques aimed at fostering students' confidence in their mathematical abilities.

2. **Provide Targeted Support for Low Self-Efficacy Students:** Identify students with low self-efficacy beliefs early on and provide targeted support through personalized learning plans, mentoring programs, and counseling services. Addressing the root causes of low self-efficacy can help students build resilience and develop a growth mindset towards mathematics.

3. **Promote Active Learning Strategies:** Encourage the use of active learning strategies, such as problem-based learning, collaborative projects, and real-world applications of mathematical concepts. These interactive approaches can empower students to take ownership of their learning process and build their confidence through hands-on experiences.

4. **Offer Professional Development for Educators:** Provide professional development opportunities for teachers to enhance their pedagogical skills in fostering self-efficacy beliefs among students. Training sessions on effective feedback strategies, motivational techniques, and differentiated instruction can equip teachers with the tools they need to support diverse learners in the classroom.

5. **Foster a Positive Learning Environment:** Create a supportive and inclusive learning environment where students feel valued, respected, and encouraged to take risks in their mathematical explorations.

Celebrate students' achievements, provide constructive feedback, and cultivate a growth mindset culture that emphasizes effort and perseverance.

6. **Engage Parents and Guardians:** Collaborate with parents and guardians to reinforce positive self-efficacy beliefs outside the classroom. Organize workshops, informational sessions, and family engagement activities to educate parents about how to support their children's mathematical learning journey at home.

7. **Continued Research and Evaluation:** Encourage further research to explore the long-term effects of self-efficacy interventions on students' mathematical literacy outcomes. Regular evaluations should be conducted to assess the effectiveness of existing programs and identify areas for improvement based on feedback from students, teachers, and parents.

By implementing these recommendations in educational settings, stakeholders can work together to empower students with the confidence, skills, and mindset needed to excel in mathematics and succeed academically and professionally.

Acknowledgements

The authors thank the Deanship of Scientific Research at King Faisal University, Saudi Arabia for the financial support under Annual research grant number GrantA396.

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