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Fostering Self-efficacy: Understanding South African Grade 9 Students' Confidence in their Mathematics Abilities

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In poor-performing, resource-constrained education systems, such as South Africa, solutions to improve academic achievement have tended to focus on resources and cognitive factors. An area that requires more attention is the importance of non-cognitive, psychosocial factors and their relationship with academic performance. These factors are strongly associated with behaviour, playing a role in either facilitating or impeding the learning process. Understanding attitudes is therefore critical in interpreting achievement results with a view to improving them. This article used data from the 2019 Trends in International Mathematics and Science Study administered to 20,829 South African students in Grade 9 to investigate the confidence these students have in their mathematics ability (their self-efficacy) and the relationship with achievement. Linear regression analysis was employed to determine: (1) the relationship between Grade 9 students' self-efficacy and mathematics achievement in South Africa; and (2) the contextual factors that were associated with the mathematics self-efficacy of the students. The results indicate a positive correlation between students' self-efficacy and their performance in mathematics. In addition, good teaching practices and parental involvement in school activities were associated with higher levels of students' mathematics self-efficacy. Being female was associated with lower levels of self-efficacy. These findings have important implications for shaping educational policy and practice in the resource constrained context of South Africa, to enhance students' self-efficacy and performance in mathematics.

Keywords: *Mathematics achievement; self-efficacy; South Africa; students' self-confidence; TIMSS*

Introduction

The South African education system is characterised by poor student performance generally, as highlighted by both national and international assessments like the Progress in International Reading Literacy Study and the Trends in International Mathematics and Science Study (TIMSS). In the 2019 TIMSS Grade 9 assessment, South African students achieved an average of 389 points in mathematics on a scale with a centre point of 500 and a standard deviation of 100 (Reddy et al., 2022). Although this was an increase in performance from 2015, where Grade 9 students scored an average of 358 points, South Africa ranked as the second lowest performing country out of the 39 participating countries in 2019. Additionally, more students are choosing to take Mathematical Literacy rather than Mathematics at the secondary school level, with an increasing percentage writing Mathematical Literacy in Grade 12 (Department of Basic Education, 2022).

Extensive research has centred on ascertaining ways to improve educational quality and to increase interest and uptake in science, technology, engineering and mathematics (STEM) studies at both the school and post-school level (Carrim, 2013; Hattie, 2009; Maarman & Lamont-Mbawuli, 2017). Much of the research has focused on understanding the determinants of student achievement. Honicke and Broadbent (2016) assert that the academic achievement of students plays a pivotal role in shaping their educational success and overall growth, and that those students who perform better are more likely to progress to further education and higher levels of employment. An area which requires further research is the impact of non-cognitive, psychosocial factors, like self-efficacy, and how they are related to academic performance. By examining the interplay between non-cognitive factors and academic performance in the resource-constrained setting of South Africa, this paper provides a nuanced understanding of how these dynamics play out in contexts similar to many other countries in the Global South. This can inform more context-specific educational interventions and policies that are tailored to the unique challenges and realities of these regions. This can help policymakers design more effective and comprehensive educational strategies that consider both cognitive and non-cognitive factors.

The increased rate of technological innovation has important implications for the labour market, leading to significant demographic and other social changes (Maass et al., 2019). There has thus been a renewed focus on identifying and improving the required student competencies in order to achieve academic and career success. One avenue that has been recognised is the development of STEM skills to respond to current and future labour market needs (Maass et al., 2019). Mathematics, in particular, is recognised as crucial for the economic success of society as well as that of the individual (Mazana et al., 2019). For example, Szabo et al. (2020) illustrate with practical examples how mathematical problem-solving capabilities translate to useful twenty-first-century skills that assist in navigating the information age. Özcan and Kültür (2021) state that 'mathematics is a systematic way of thinking that is necessary to overcome many of the problems one encounters in daily life' (p. 2). Mathematical knowledge and skills are important in a wide array of areas ranging from simple everyday calculations, such as making decisions based on selection and comparison, to academic research where mathematical processes are used in data analysis. Mathematics therefore assumes a vital role in the success of individuals at various levels (Yurt, 2014; Mazana et al., 2019).

Studies have shown that the pathway into mathematics-related careers begins early. Adolescence is a crucial phase where students begin to consider their future subject choices which informs their academic achievement and career-related decisions. At the same time, students form self-perceptions of their own abilities in different subjects (Falco, 2019; Grossman & Porche, 2013; Shoffner et al., 2015). The commitment to learn mathematics is shaped by students' enjoyment of the subject, their recognition of its value for both personal development and society, and their level of confidence in their ability to successfully complete school-based mathematics tasks and activities (self-efficacy). This article investigates students' mathematics self-efficacy. Bandura (1986), the seminal author on self-efficacy, used the term to refer to a person's perceptions of their capacity to learn or execute particular tasks. Social cognitive theory posits that self-efficacy influences behaviours and environments and is, reciprocally, shaped by them (Bandura, 1997). Taking this further, academic self-efficacy is an individual's confidence in their capacity to attain self-determined goals and standards in their educational pursuits (Ansong et al., 2019). At school, students develop self-efficacy through the evaluation and interpretation of their performance in specific tasks, which reflects a self-judgement of their competence. Research has found that students exhibiting greater self-efficacy tend to 'set goals and create adaptive learning environments for themselves' (Falco, 2019: 29) and are also more likely to perform well (Juan et al., 2018).

In mathematics education, empirical evidence suggests that students' self-efficacy is a significant determinant of achievement in mathematics (Çiftçi & Yıldız, 2019; Honicke & Broadbent, 2016; Hosein & Harle, 2018). According to Kung and Lee (2016), in many cases the avoidance of mathematics-related subjects and careers is due to an individual's inaccurate perception of their mathematics ability rather than poor preparation or skill limitations. If students do not have belief that they can succeed in a specific domain, such as mathematics, they will lose interest rather than persisting in the face of challenges (Falco, 2019). Furthermore, if students have low mathematics self-efficacy, they attribute lower importance to STEM education and exhibit less interest in STEM-related subjects and careers (Falco, 2019). Self-efficacy is therefore a core factor in determining students' engagement in and pursuit of STEM through the career pipeline (Falco, 2019; Grossman & Porche, 2013).

In poor-performing, resource-constrained education systems, such as South Africa, educational research and interventions have largely tended to focus on infrastructure and resource-related deficits, and how these impact on achievement. However, the South African National Curriculum Statement aims to equip students with the 'knowledge, skills and values necessary for self-fulfilment, and meaningful participation in society' (Department of Basic Education, 2011: 4). This requires a focus on holistically developing students, rather than only concentrating on improving their academic abilities. The Curriculum and Assessment Policy Statement for Grade 7–9 Mathematics states that through teaching Mathematics, the aim is to develop, among other aspects, 'confidence and competence to deal with any mathematical situation without being hindered by a fear of Mathematics' (Department of Basic Education, 2011: 8). This highlights the emphasis within education in the country on enhancing students' confidence in their abilities and helping them to overcome insecurities and concerns relating to mathematics.

Only 7% of Grade 9 students in South Africa reported having high mathematics self-efficacy in TIMSS 2019, with 40% indicating moderate levels and just more than half (53%) reporting low mathematics self-efficacy. To better understand this phenomenon in the country, this article addresses the following research questions:

1. What is the association between self-efficacy and mathematics achievement of Grade 9 students in South Africa?
2. What contextual factors are related to the mathematics self-efficacy of South African Grade 9 students?

Solutions for improving academic achievement have largely focused on resource availability and cognitive factors, while non-cognitive, psychosocial factors, such as attitudes, play an important role in academic performance. Addressing these research questions will contribute to a better understanding of how self-efficacy is related to mathematics achievement and what factors affect self-efficacy, which will contribute to the identification of ways in which performance in mathematics can be improved through policy and practical interventions that focus on students' self-efficacy.

Literature

Social cognitive theory encapsulates the combination of cognition and behaviour through emphasising the function of self-factors in the regulation of behaviour (Bandura, 1977). Self-efficacy is a crucial concept in this theory and relates to one's self-beliefs regarding capacity to perform and achieve a goal (Bandura, 1977; Çiftçi & Yıldız, 2019; Kyaruzi, 2023). These self-beliefs determine the effort an individual will apply to a given activity, their persistence when faced with obstacles, and resilience when placed in difficult situations (Bandura, 1986; Kyaruzi, 2023; Özcan & Kültür, 2021; Zander et al., 2020). Unsurprisingly, self-efficacy has been recognised as a significant determinant of academic achievement (Cheema & Kitsantas, 2014; Kyaruzi, 2023; Sabah & Hammouri, 2012). Academic self-efficacy can thus be understood through the social cognitive theory framework. A student's self-belief that they can reach an academic goal significantly influences their interest, related actions and behaviour, and, ultimately, their performance in tasks and goal realisation.

The association between self-efficacy and mathematics performance has been consistently shown in the scholarship (e.g. Kung & Lee, 2016; Liu & Koirala, 2009). Ozkal (2019), for example, showed a significant, positive association between self-efficacy beliefs in their learning of, and achievement in, mathematics in Grade 6–8 students ($n = 654$) and mathematics achievement. Furthermore, the systematic review by Jaafer and Maat (2020) reported that the positive association between students' self-efficacy and their performance in mathematics was consistent across the 34 studies included. Other studies have also shown possible mechanisms through which self-efficacy is able to impact performance. For instance, Ansong et al. (2019) showed that self-efficacy enhanced academic achievement by mediating the effect of educational aspirations. Self-efficacy itself is also able to mediate relationships between contextual factors and achievement. Xu and Qi (2019) found that self-efficacy, as well as teacher–student relationships, significantly predicted mathematics achievement among 42,643 Grade 8 students. The results also showed, however, that self-efficacy mediates the association between the educator-student relationship and mathematics achievement (Xu & Qi, 2019). Research thus shows that self-efficacy not only influences academic performance, but also regulates other factors that can impact achievement.

The meaning of these findings is underscored by the understanding that self-efficacy is relatively malleable in comparison with other factors linked to achievement, including socioeconomic status (SES) (Cheema & Kitsantas, 2014). Students' academic self-efficacy is cultivated through the assessment and interpretation of one's performance on specific tasks, reflecting a self-judgement of their own competence, as well as in response to environmental influences (Ansong et al., 2019). Bandura provided insight into the sources of self-efficacy which he categorised into four groups: (1) mastery experience, arising from engagement in tasks, from which they interpret the outcomes and subsequently formulate perceptions regarding their ability to accomplish the tasks; (2) vicarious experience, stemming from students observation of peers completing tasks, and using this to evaluate their own possibility of being successful in similar tasks; (3) social persuasion, which emerges from judgements made by others in relation to students' capabilities; and (4) physiological state, where emotions such as stress, anxiety or excitement are experienced when engaging in tasks (Britner & Pajares, 2006; Zander et al., 2020). Mastery experience is the most crucial and influential self-efficacy source, being based on the evaluation of one's own past performance (Kudo & Mori, 2015; Özcan & Kültür, 2021; Yurt, 2014; Zander et al., 2020).

Efforts judged as successful increase self-efficacy beliefs for similar tasks, while those that are unsuccessful weaken self-efficacy (Kudo & Mori, 2015; Kyaruzi, 2023). However, it is noted that successive achievements requiring little effort may lead individuals to give up easily when faced with more challenging obstacles (Özcan & Kültür, 2021). Vicarious experiences involve witnessing peers' success or failure in similar tasks, or those of another similar individual that they perceive as a role model. Students assess their own capabilities based on the observed abilities of others, and witnessing success may increase their own determination to succeed (Kudo & Mori, 2015; Juan et al., 2018; Özcan & Kültür, 2021; Kyaruzi, 2023). Social persuasion refers to evaluation from elders, teachers, peers and others: positive feedback may enhance a students' confidence in their capabilities, while negative feedback may undermine it (Kudo & Mori, 2015; Kyaruzi, 2023). Finally, physiological states impact self-efficacy as individuals may base judgements of capability on their physiological responses to negative emotions, such as stress, anxiety or fatigue. Individuals who experience negative affect are less likely to be successful than those who experience positive affect (Kudo & Mori, 2015; Juan et al., 2018). This theoretical faming was used to inform the methodology of this study.

Factors Related to Self-efficacy

When undertaking studies within South Africa, it is important to be cognisant of home SES, as student outcomes are influenced by the socioeconomic inequalities that exist within the country (Juan et al., 2018; Reddy et al., 2022). Students in more affluent schools, and thus likely to be from prosperous homes, significantly outperform students attending poorer schools (Juan & Visser, 2017). Socioeconomic status is thus a powerful correlate of achievement, and Kalaycıoğlu (2015) showed that SES has a significant impact on mathematics achievement. Furthermore, research has revealed that SES is related to students' self-efficacy (Karaarslan & Sungur 2011; Han et al., 2015). Tan et al. (2023) also found that after controlling for classroom related factors, resources and several student variables, SES was related to students' self-efficacy in science for the majority of the 69 countries/regions involved in the 2015 Programme for International Student Assessment.

Previous studies have consistently found a relationship between gender and self-efficacy, varying across developmental stages. Huang (2013), for example, through a meta-analysis (187 studies) of differences in self-efficacy by gender, showed that males had greater self-efficacy in computers, mathematics and social sciences, while females exhibited higher self-efficacy in languages and arts (Huang, 2013). This has been supported in recent studies such as Zander et al. (2020), who illustrated that, despite similar mathematics achievement, ninth-grade girls aged 13–18 years evinced lower mathematics self-efficacy than their male counterparts. This has also been shown in science self-efficacy where females rate their capability as lower than males despite similar science achievement (Webb-Williams, 2018; Juan et al., 2018). These gender differences vary with age, with differences in mathematics self-efficacy in particular emerging in late adolescence.

There are furthermore gender differences in the sources of mathematics self-efficacy, although there are some varying accounts within the literature, which may account for the relationship between gender and self-efficacy. Two recent studies explored self-efficacy differences amongst male and female learners using the Sources of Middle School Mathematics Self-Efficacy Scale developed by Usher and Pajares (2009). This 24-item scale reflects the four sources originally proposed by Bandura while factor and reliability analyses showed that it can reliably be used with Grade 6–8 learners (Usher & Pajares, 2009). Using this scale, the study by Awofala (2023) showed that Nigerian female senior secondary school students scored higher than their male counterparts on mastery experiences and physiological states, but lower on vicarious experiences and social persuasions. However, in the second study, Kyaruzi's (2023) results showed that Tanzanian girls had lower levels of perceived mastery experiences as well as actual mathematics performance, with no other significant differences on sources of self-efficacy (Kyaruzi, 2023). To identify possible factors at play in these varying results, it is noted that the instruments used in each study differed slightly. Although both studies showed a four-factor structure in alignment with the four sources of self-efficacy, Kyaruzi (2023) removed certain items to develop a better model fit, suggesting that the scale had to be improved to suit the Tanzanian context (Awofala, 2023; Kyaruzi, 2023). Furthermore, Awofala (2023) did not explore mathematics achievement itself, which may highly impact the development of perceived mastery as it is based on evaluation of past performance (Kudo & Mori, 2015; Özcan & Kültür, 2021; Yurt, 2014; Zander et al., 2020). It is also likely that, as noted by Awofala (2023), gender-based differences are related to socio-cultural practices and sex role stereotyping within a specific context.

An additional contextual factor within the home that influences self-efficacy and achievement is parental involvement (Juan & Hannan, 2018). The latter is a multidimensional construct that incorporates various behaviours, attitudes, hopes or active contributions, such as checking their child's homework, to assist in their children's educational progress (Kung & Lee, 2016; Yıldırım, 2019). Previous studies have indicated that parental involvement can positively contribute to mathematics self-efficacy. Huang et al. (2021) showed that all three measures of parental involvement (cognitive, behavioural and personal) were positively and significantly correlated with mathematics self-efficacy in a sample of 2866 Chinese early adolescents aged 8–13 years old. Similarly, Affuso et al. (2023) conducted research with 419 adolescents that showed that both parental monitoring and teacher support (discussed below) positively and directly impacted self-efficacy over time. The literature thus supports the role that parents play in developing mathematics self-efficacy.

The final significant factor associated with academic self-efficacy discussed here is the classroom environment created by teachers and how they approach the teaching and encouragement of their students (Juan & Hannan, 2018). For example, Maulana et al. (2016) found that views of teachers' instructional behaviour accounted for 19% of the variance in students' self-efficacy. In particular, students' perception of teachers' instructional clarity was the most significant predictor of students' self-efficacy (Maulana et al., 2016). Additionally, through the evaluation of videos of 85 mathematics teachers and their classes, Zhu and Kaiser (2022) showed significant positive associations between social–emotional care and instructional quality, and mathematics self-efficacy, indirectly also impacting mathematics achievement. It is thus vital to consider the teacher's role when exploring self-efficacy and sources of its development.

Inclusion of the above factors within the analysis—related to our second objective—is not only important to render generalisable results, but also to contextualise conclusions and proposed practices or interventions. Incorporation of SES for example, while not generally subject to intervention, contributes to the scholarship given the unique South African context and highlights the financial constraints under which many schools and communities operate. Gender, also not malleable, shows the key part played by gender roles and how they are perceived within the context. As shown above, gender norms and societal roles are key role-players in shaping self-efficacy and exploring these relationships in a novel context adds to this body of work. In addition, proposed changes and interventions could focus on changing gender biases so as to improve equality. Finally, the role of parents and teachers is worth exploring as they are direct role-players in children's development of self-efficacy. It is therefore possible that working with parents and teachers could be fundamental in improving self-efficacy, and thus achievement.

Methodology

This paper uses South African data from TIMSS 2019 which was conducted by the International Association for the Evaluation of Educational Achievement (IEA). All authors were part of the research team which administered the assessment. The TIMSS data is open source and available on the IEA website (Mullis et al., 2020). This study was approved by the Human Sciences Research Council Research Ethics Committee (REC4/16/03/11).

Sample

The sampling procedure for TIMSS employed a two-stage stratified cluster sample design. Initially, the total number of South African schools offering Grade 9 classes was divided into strata based on province and school type (public or independent). Subsequently, schools were selected using a systematic random proportional to size method. In the second stage, whole classes were randomly chosen from each selected school with equal probability. The study comprised 20 829 students from 524 schools. Consent for learners' participation in the study was obtained from school principals on behalf of learners, *in loco parentis*. The data obtained is nationally representative and can be generalised to the population of South African Grade 9 students.

Measures and Variables

All of the students who participated in the TIMSS mathematics assessment were asked to complete a contextual questionnaire. The questions of interest for this article fall into three broad categories: students' enjoyment of mathematics; their judgement of its value; and their self-efficacy in mathematics. The IEA created a scaled index for mathematics self-efficacy, combining responses to the following statements: 'I usually do well in mathematics'; 'Mathematics is not one of my strengths'; 'I learn things quickly in mathematics'; 'Mathematics is harder for me than any other subject'; 'I am good at working out difficult mathematics problems' (first five statements relate to mastery experience); 'Mathematics is more difficult for me than for many of my classmates' (vicarious experience); 'My teacher tells me I am good at mathematics' (social persuasion); 'Mathematics makes me confused'; and 'Mathematics makes me nervous' (last two relate to physiological state). The data pertaining to these nine items underwent calibration across all participating countries in TIMSS 2019, employing the Rasch partial credit model. Through this calibration process, item parameters were estimated on a logit scale specific to the 2019 assessment cycle. Subsequently, weighted maximum likelihood estimation was applied to generate Rasch logit scale scores, utilising the estimated item parameters for all countries and benchmarking participants. Consequently, student scores were aligned with this 2019 logit metric (Martin et al., 2020).

Other variables included in the analysis were students' classroom (instructional clarity) and home experiences. The IEA created an instructional clarity scale using the following seven statements: 'My teacher explains a topic again when we don't understand'; 'My teacher is good at explaining mathematics'; 'I know what my teacher expects me to do'; 'My teacher does a variety of things to help us learn'; 'My teacher has clear answers to my questions'; 'My teacher is easy to understand'; and 'My teacher links new lessons to what I already know'. Home experiences were explored based on the following items: 'My parents make sure that I set aside time for my homework'; 'I read because my parents tell me to'; and 'My parents check if I do my homework'. Responses to the statements about the student's home experiences were converted into dichotomous variables, where one (1) represents that the activity was undertaken and nill (0) indicates its absence.

Home SES is a composite variable of the availability of books and home study supports in the home, and the highest level of education completed by either parent or guardian/caregiver.

Mathematics achievement scores, measured by five plausible values, were reported on a common scale centred at 500 with a standard deviation of 100, using item response theory (Martin et al., 2020). Centring the scores at 500 allows for a meaningful reference point. This means that an average student, according to the TIMSS assessment, would typically score around 500. Scores above 500 indicate performance above the average, while scores below 500 indicate performance below the average. All data were weighted to the full population of Grade 9 students in South Africa ($N = 876$ 525), using the Department of Basic Education's master list of schools to ensure representation of the population.

Table 1 provides descriptive statistics of the variables and constructed indices.

Data Analysis

First, linear regressions were run to determine the basic, bivariate relationships, where:

$$Y = \beta_0 + \beta_1 X_1$$

Here, Y represents the dependent variable (self-efficacy), while achievement and contextual factors from teachers and parents are the independent variables (X_1). This was done to gauge the nature and significance between the variables.

Third, a multiple regression analysis was conducted to build a model that examines the relationship between self-efficacy and mathematics performance, along with various contextual factors where:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \varepsilon$$

where Y is the dependent variable (self-efficacy), X_1, X_2, etc., are independent variables (achievement, teacher and parent contextual factors), β_0 is the intercept, β_1, β_2, etc., are regression coefficients and ε is the error term. All categorical data was recoded into dummy variables so that they could be included in the regressions.

Residual by predicted plots were generated where each residual value was plotted against the corresponding predicted value. This was done to confirm that the assumptions of linear regression analysis (linearity, statistical independence of the errors, homoscedasticity and absence of multicollinearity) were met.

Student measures that reached statistical significance at the 95% ($p < 0.05$) and 99% ($p < 0.01$) confidence levels were identified. The model considered the impact of gender, age, instructional

Table 1. Descriptive statistics of predictor variables

Variable $N = 20$ 829	Continuous variable		Dichotomous variable
	Mean	Standard deviation	Percentage of students with value = 1
Maths achievement	389	76.9	
Self-efficacy	9.60	1.71	
Age	15.49	1.08	
Home socioeconomic status	9.1	1.54	
Gender (girl = 1)			52
Instructional clarity	10.23	1.81	
Parents make sure that I set aside time for my homework (yes = 1)			84
Parents check if I do my homework (yes = 1)			77

Source: Authors' own calculations from the TIMSS 2019 Grade 9 dataset.

clarity, home experiences and home SES on the association between mathematics performance and self-efficacy. The data analysis was performed using SPSS version 28 and the IEA International Database Analyser (v 5), specifically designed for the analysis of IEA survey data. This software accounts for the complex sampling design and utilises plausible values methodology.

Results

Table 2 sets out the results of the bivariate associations. All the variables were related, in varying degrees, to self-efficacy at a statistically significant level ($p < 0.01$). Being female and older were negatively associated with self-efficacy. All other associations were positive.

Table 3 presents the multiple regression analysis results of testing if self-efficacy significantly relates to overall mathematics performance. As all the variables showed a significant association in the bivariate model, they were all included in the multiple regression. This model explained 15% of the variation in mathematics achievement (adjusted $R^2 = 0.15$, $p < 0.00$). While this value may appear relatively modest, it should be interpreted within the specific context of South Africa, where SES and language exert substantial influence on academic achievement. Recognising the complexity of these factors and their interactions is crucial for understanding the limitations and implications of the statistical model.

The results in Table 3 show that, even when accounting for significant background characteristics such as age and socioeconomic status, self-efficacy remained significantly and positively linked to mathematics achievement. For each standard deviation increase in mathematics achievement,

Table 2. Linear regression results investigating the bivariate associations between contextual factors, mathematics achievement and self-efficacy

	Regression coefficient	Standard error (SE)	*t*-Value	*p*-Value
Gender (girl)	–0.17	0.03	–5.3	<0.01
Age	–0.12	0.01	–8.5	<0.01
SES	0.10	0.01	8.0	<0.01
Instructional clarity	0.26	0.01	22.5	<0.01
Parents make sure set aside time for homework	0.35	0.05	7.3	<0.01
Parents check homework	0.33	0.04	7.7	<0.01
Maths achievement	0.01	0.00	20.3	<0.01

Source: *Authors' own calculations from the TIMSS 2019* Grade 9 dataset.

Table 3. Multiple regression results investigating the association between contextual factors and self-efficacy

	Regression coefficient	Regression coefficient (SE)	Regression coefficient (*t*-value)	*p*-Value
Gender (girl)	–0.20	0.03	–5.6	<0.01
Age	0.01	0.02	0.9	
SES	0.01	0.01	0.1	
Instructional clarity	0.23	0.01	21.1	<0.01
Parents make sure set aside time for homework	0.06	0.05	1.12	
Parents check homework	0.32	0.04	7.3	<0.01
Maths achievement	0.01	0.00	19.0	<0.01
Constant	4.41	0.32		

Source: Authors' own calculations from the TIMSS 2019 Grade 9 dataset.
SES, Socioeconomic status.

there was a corresponding 0.01 scale score point increase in the self-efficacy index ($\beta = 0.01$, $p < 0.01$). Furthermore, students whose parents checked their homework showed a positive association with their mathematics self-efficacy.

Classroom interaction between students and teachers was assessed through the instructional practices implemented by teachers in the classroom. Positive engagements in the classroom were found to be significantly associated with moderate increases in students' self-efficacy ($\beta = 0.23$, $p < 0.01$).

The impact of gender is noteworthy. After accounting for factors such as mathematics achievement, SES and classroom experiences, it was observed that females were less likely to exhibit confidence in their mathematics ability ($\beta = -0.2$, $p < 0.01$). Notably, the SES of students, student age and parents setting time aside for homework were not related to self-efficacy, when controlling for other factors.

Discussion

The primary objective of this study was to investigate the correlation between self-efficacy and mathematics achievement among Grade 9 students in South Africa. In addition, we explored contextual factors associated with students' mathematics self-efficacy.

The cross-sectional design of the study limited the ability to establish the direction of the relationship between self-efficacy and achievement. Furthermore, the focus on Grade 9 delineated the population under investigation and did not allow for an investigation of students' self-efficacy in later grades or in relation to changes over time. However, the study offers valuable insights into students' self-efficacy and mathematics achievement. The results revealed a positive and significant link between students' self-efficacy and mathematics achievement and suggest a predictive role of self-efficacy on mathematics achievement within the studied context. This is consistent with earlier research conducted by Britner and Pajares (2006), Juan et al. (2018), Ozkal (2019) and Sabah and Hammouri (2012). The study contributes to the existing literature in this field in at least four further ways.

Firstly, the study adds to the expanding body of literature on self-efficacy and mathematics in South Africa by using data that is generalisable to the national population of Grade 9 students. Most existing studies have been conducted at a smaller scale and are not generalisable at the national level, and there is a limited focus on mathematics and self-efficacy. In addition, much of the literature on self-efficacy is from the Global North and this study adds to knowledge emerging within the Global South.

Secondly, the results highlight contextual factors related to self-efficacy and provide points for policy intervention. These findings highlight the role of the classroom (instructional practices) in shaping students' self-efficacy (Kung & Lee, 2016; Maulana et al., 2016; Yıldırım, 2019; Zhu & Kaiser, 2022). As students spend most of their time at school, it is critical to implement approaches at the classroom level that infuse positive attitudes and learning behaviours, with a view to enhancing students' self-efficacy (Juan & Hannan, 2018). Based on Bandura's classification of the sources of self-efficacy, teachers can contribute to the development of students' self-efficacy through implementing various strategies. Teachers should encourage repetitive problem solving until students feel confident in their grasp of the subject matter (mastery experience), while offering support and encouragement and highlighting students' successes in mathematics tasks, demonstrating how others can achieve similar success (vicarious experience). Constructive feedback, task guidance and motivational encouragement (social persuasion) are also essential to enhancing students' self-efficacy. Furthermore, teachers should aim to minimise students' anxiety related to mathematics tasks, such as exams or presentations by reducing classroom pressure (physiological states). To foster self-efficacy from an early age and make it a habit, teachers need to foster a school culture that emphasises doing one's best and putting in sustained effort to succeed. It is essential for teachers to acquire the knowledge and skills to observe and nurture their students' self-efficacy. Developing these skills should be a fundamental aspect of teacher training programmes, through both theoretical and practical components. These interventions are not resource dependant, and can thus be encouraged in all schools, including those that are resource constrained.

Thirdly, the home, in particular parents checking homework, emerged as an important context for fostering positive self-efficacy. Within the home environment, parental involvement plays an important role in shaping students' attitudes. This emphasises the need to involve parents or caregivers further in learning and encourage them to actively engage with students in relation to their schooling experiences and homework (Juan & Hannan, 2018). Home SES (availability of books, home study supports and highest level of education completed by either parent or guardian/caregiver) was also found to be important. This corroborates findings of the association between SES and students' self-efficacy by Karaarslan and Sungur (2011), Han et al. (2015) and Tan et al. (2023). School policies should encourage active involvement by parents or caregivers in children's education from an early age, and throughout their schooling. This could include workshops with parents or the provision of reading material that outlines the importance of supporting students, providing books and home study supports, and encouraging their confidence.

Lastly, the study highlights the significant association of self-efficacy with gender. Even after accounting for factors such as mathematics achievement, SES and classroom experiences, females remained less likely to be confident in their mathematics ability. This could be attributed to the influence of 'traditional' societal gender roles, where careers requiring mathematics and science have historically been perceived as more suitable options for men. Low self-efficacy reported by girls may influence their pursuit of mathematics, which will in turn influence the presence and representation of women in STEM-related careers. These findings align with similar studies conducted in African contexts, such as Juan et al. (2018) and Awofala (2023) and findings from the Global North (Huang, 2013; Zander et al., 2020). It is likely that context-specific factors such as culture and ethnicity play important parts in perceived gender roles and self-efficacy development, as alluded to by Britner and Pajares (2006) where they note that studies need to be completed with ethnically diverse groups to explore the low number of students of colour entering STEM careers. There is thus a need for comparative studies in this area that seek to explore the contextual differences in gender roles and their implications for encouraging girls into STEM-related subjects and career paths. The gender disparity must also be given due consideration in classrooms and at home (Juan & Hannan, 2018), through teachers actively engaging both girls and boys in mathematics lessons, and parents and teachers encouraging girls to pursue STEM subjects and be confident in their ability to succeed. At the societal level, government should develop and enact initiatives that confront the prevailing discourse around appropriate subjects and careers for different genders.

Conclusion

This study highlights the importance of non-cognitive aspects such as attitudes in mathematics achievement, and the need for policymakers, parents and teachers to actively engage in the promotion of students' self-efficacy. The findings suggest that fostering self-efficacy, particularly in resource-constrained environments, can be a transformative strategy for enhancing academic outcomes.

The gender disparity in self-efficacy underscores the deep-rooted societal constructs that shape educational experiences. To bridge this gap, educational policies must transcend mere resource allocation, embedding within them a commitment to nurture every student's intrinsic belief in their potential. This shift calls for an education system that not only imparts knowledge but also cultivates self-belief, thereby empowering all students, irrespective of gender, to excel academically and beyond. The responsibility for the establishment of such a system lies with policymakers, teachers and parents.

In the broader context of the Global South, this study advocates for a holistic approach to education —one that acknowledges and harmonises cognitive and non-cognitive factors, recognises the cultural nuances influencing self-efficacy, and promotes an inclusive, equitable learning environment. Through such an approach, we can move closer to an education system that truly democratises opportunity and nurtures the full spectrum of human potential.

Future research should explore the evolution of learners' self-efficacy through their secondary school years, and in response to interventions aimed at instilling greater confidence in their mathematics abilities. The investigation of additional contextual factors would also provide more insight into how self-efficacy can be enhanced. Considering the interactions among the contextual factors that influence self-efficacy should also be examined through future research.

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