Socio-economic status predicts mathematics self-concept: A correlational study in OR Tambo Inland District[9]

Ntokozo Kintosh Nogobo , Walter Sisulu University, South Africa
A. Jogymol Kalariparampil, Walter Sisulu University, South Africa

ABSTRACT

The current study explored the level to which socio-economic status predicts mathematics self-concept. A correlational and regression research designs were used. The study was carried out in OR Tambo Inland District in the Eastern Cape Province. The sample size comprised of 351 Grade 9 mathematics students, of which 171 were girls and 180 were boys. For generalizability purposes and fair distribution and representation of the sample across the population, both rural and urban geographical locations were represented by three schools each. The level of socio-economic status and mathematics self-concept was measured by use of a standardized questionnaire. The data collection tool was tested valid and reliable. Statistical Package for the Social Sciences (SPSS) was used to perform regression and correlation analysis. The research findings depict that mathematics self-concept was heavily influenced by socio-economic status of a parent. Furthermore, mathematics self-concept varied according to the socio-economic status and the variation was statistically significant. Recommendations were made to all implicated stakeholders to improvise strategies of improving mathematics self-concept despite the family's economic hardships.

Key words: parent's socio-economic status, mathematics self-concept, OR Tambo Inland District

INTRODUCTION

According to Trends in International Mathematics and Science Study (TIMSS) developed countries such as France, Italy and Turkey fail to achieve above the benchmark or international average score of 500 points in Mathematics (TIMSS, 2019). Hence, it is safe to argue that poor performance in Mathematics is a global issue. This issue becomes even more severe when it comes to developing countries such as South Africa. For example, South Africa is ranked in the second last position in Mathematics achievement across the world (TIMSS, 2019). Amidst, the global issue of Mathematics poor achievements, some scholars suggest that enhancing Mathematics self-concept may yield positive Mathematics outcomes (e.g., Marsh, 2022; Sewasew et al., 2018; Chiu & Klassen, 2010). Mathematics self-concept refers to how students perceive themselves and their abilities in mathematics (Arens et al., 2022). Mathematics self-concept does not only predict mathematics achievement, but it also impacts career aspirations in mathematics-related fields (Marsh, 2022), such as Science Technology Engineering and Mathematics (STEM). It is thus significant to enhance and keep mathematics self-concept positive as one of the strongest predictors of mathematics achievement and mathematics- related courses pursuit.

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Therefore, it is necessary to explore the contributory factors towards the development of mathematics self-concept. Amongst other things, mathematics achievement is a significant predictor of mathematics self-concept (Arens et al., 2022). Students who get good marks in Mathematics tend to perceive themselves more positively about their mathematics abilities. Additionally, gender stereotypes play a significant role on the development of mathematics self-concept (Wolff, 2021). For example, regardless that girls had significant better mathematics scores than boys, girls still perceive their mathematics abilities negatively as compared to boys (e.g., Niepel, 2019; Lee & Kung, 2018). Thus, mathematics self-concept development is mediated by gender and these variations start to manifest as early as in elementary schooling (Mejía-Rodríguez et al., 2021; Erdogan & Sengul, 2014). Furthermore, mathematics self-concept is reciprocally correlated with mathematics anxiety (Ahmed et al., 2012; Rossi et al., 2022), such that students with high mathematics anxiety tend to have negative mathematics self-concept.

Despite factors such as mathematics achievement, gender stereotypes and mathematics anxiety, there are few and contradictory studies that have focused on the socio-economic status, hence the current study explores the degree to which socio-economic status predicts mathematics self-concept. The literature does not depict adequate and conclusive information on the correlation between socio-economic status and mathematics self-concept. For example, Li et al. (2020) found out that socio-economic status and mathematics self-concept are positively and statistically significant correlated. As a result, students from well-resourced families with high socio-economic status tend to have high and positive mathematics self-concept. Contrarily, Malik et al. (2017) suggest that there is no statistically significant correlation between mathematics self-concept and parent's socio-economic status. In essence, in some instances mathematics self-concept remains the same regardless of family economic hardships and background. Henceforth, the correlation between mathematics self-concept and parent's socio-economic status remains inconclusive, contradictory, and further research is necessary.

LITERATURE REVIEW

For this study, the literature review consisted of the background of both mathematics self-concept and parent's socio-economic status. The review of literature starts with general self-concept, its background and models that are related with the formulation of mathematics self-concept. Furthermore, the background of parent's socio-economic status and the models associated therewith are discussed. Lastly, the correlation between socio-economic status and mathematics self-concept was reviewed.

Background of self-concept

Rogers (1959) argues that self-concept is how a person behaves, acts and perceive themselves and the world. These perceptions are normally shaped by personal experiences and their interpretations thereof. Despite that self-concept, can be traced back to 1600s (e.g., Descartes, 2017), it was only in 1976 that ambiguities were observed from the definitions of self-concept (Shavelson et al., 1976). The common definition was therefore accrued from diverse definitions that self-concept is one's perceptions about themselves and abilities and it is influenced by factors such as culture and society (Shavelson et al., 1976). Amongst other things, Shavelson et al. (1976) suggested that self-concept is hierarchical, with general self-concept split into academic, social, emotional, and physical self-concept. Furthermore, academic self-concept is split into domain specific subjects such as mathematics self-concept, English self-concept, science self-concept etc. This study focuses on mathematics self-concept

Models related to the development of mathematics self-concept

The development of mathematics self-concept can be closely linked with Internal/ External (I/E) frame of reference model, Skills Development (SD) model and the Big-fish-little-Pond effect (BFLPE) model. I/E model originates from the views Hebert Marsh (Marsh, 1986). I/E model posits that students develop their mathematics self-concept based on frames of references such as social (external) and dimensional

(internal) comparisons (van der Westhuizen et al., 2022). According to social comparison or external frame of reference, students compare their mathematics performance and numeracy levels with other learners in the same grade (Wolff et al., 2018). When a student performs relatively or significantly higher than other students, that often boosts their confidence and consequently enable them to formulate positive and high mathematics self-concept. On the other hand, when a student performs worse than their peers, they tend to doubt their abilities in mathematics and further develop negative self-concept. As per dimensional or internal frame of reference, a student compares his performances in different subjects e.g., Mathematics and Science. A student may still develop a positive Mathematics self-concept even if their mathematics achievement is bad when compared to other students (social comparison), if his performance in mathematics is relatively higher than his performances in other subjects (Kavanagh, 2020). Summarily, I/E model depicts the extent to which students may develop their mathematics self-concept by social and dimensional comparisons.

One of the most prominent models that explain the development of mathematics is the Skills Development (SD) model. SD model originates from the views of Calsyn and Kenny (1977). This model posits that mathematics achievement is a strong predictor of mathematics self-concept (Preckel et al., 2017). Performing well in mathematics helps the students to improve the way they perceive their abilities in mathematics and that results in high mathematics self-concept. When this model is applied, the primary narrative is that teachers should implement strategies, systems and approaches that intend to derive good mathematics scores with the intentions of enhancing students' perceptions about the subject and related careers. The last model to be discussed is BFLPE. This model was proposed by Marsh in 1984 (Koivuhovi et al., 2022). BFLPE posits that students construct their mathematics self-concepts by comparing their performances with peers and this comparison and conclusion thereof are heavily influenced by the environment and learning setting (Marsh, 1987). Equally capable students may develop high Mathematics self-concept when they are in less competitive learning environment than a competitive setting (Fang et al., 2018). The students tend to formulate their mathematics self-concept in reference to the peers in line with environment. For example, a highest student with an average of 60% from one school might be the worse student in a learning setting or school where all students get an average of 80%. Thus, the highest performing student may still develop negative mathematics self-concept when placed in a competitive school or environment. All these models propose that mathematics self-concept is constructed based on internal and external comparisons. Setting learning environment may mediate the extent to which comparison is being made. Additionally, mathematics achievements play a huge and significant role on mathematics self-concept structure.

Background of socio-economic status

Socio-economic status (SES) is the social and economic position or ranking of an individual or group (Sbarra & Whisman, 2022). SES is normal measured by three indicators such as family monthly average income, parents' occupation, and level of education (Taramsari et al., 2021). SES is an important predictor for health (Stormacq et al., 2019), academic achievement (Liu et al., 2020) and overall child development (Bradley & Corwyn, 2002). Parents and families with better financial capacity and reasonable levels of literacy tend to have good chances to invest adequately on child's development which may include education, health, and well-being. The SES indicators are correlated such that, having ` good qualifications or high level of education gives one a fair chance to be employed at good paying jobs and have financial stability to take of care of their families and children. The following two models which are Family Investment model (FIM), and Family Stress Model (FSM) can be used to explain the correlation between SES and mathematics self-concept.

Socio-economic models and mathematics self-concept

Family Investment Model postulates that family investment on child development is determined by socio-economic position (Vasilyeva et al., 2018). Families with relatively enough resources are able to invest on child's education and well-being. Unlike affluent families, disadvantaged families are struggling to

afford basic needs due to economic hardships. As a result, children may value or perceive education adversely. Henceforth, children from low socio-economic backgrounds tend to have negative attitudes towards education and further develop negative mathematics self-concept as compared to their counterparts from well-equipped families (Li et al., 2020). Availability of resources plays a noticeable role to shape how children view themselves and the importance of education (Goldan et al., 2021). Parents with high SES tend to set reasonable high academic expectations for their children and fund those set expectations (Butler & Le, 2018). Academic expectations may assist to pace up child's academic achievements and lead to improved mathematics self-concept. Thus, students from well-off families tend to be more confident and perceive themselves more positively about education and mathematics in particular.

The Family Stress Model posits that families with low socio-economic status tend to succumb to economic pressure and that causes emotional instability which therefore leads to disruption to and/ or inconsistent parental involvement (Masarik & Conger, 2017). As a result, poor parenting and involvement may lead to child's behavioural issues and self-doubts. Socio-economic hardships impact the extent to which a parent may participate to invent support systems and improve/ sustain well-being of a child. Henceforth, students from disadvantaged families are normally compromised and are likely to develop negative mathematics self-concept. Both FIM and FSM explain the extent to which parent's socio-economic may predict Mathematics self-concept.

RESEARCH METHODOLOGY

This study adopted regression and correlation research designs of the quantitative approach. The quantitative research designs were used based on their ability to test relationship between variables. Furthermore, the study expected to yield the results that can be a true reflection of the district and where necessary be generalizable to a similar context, hence quantitative designs were deemed appropriate. Regression method is used to test the impact of independent variable on a dependent variable (Boateng & Abaye, 2019). In this study, the impact of parent's socio-economic status (independent variable) on Mathematics self-concept (dependent variable) was explored. Akoglu (2018) defines correlation research as the design that investigates the statistical relationship between two or more variables to test the level of significance. In the current study, the statistical relationship between Mathematics self-concept and parent's socio-economic status was tested.

Three hundred and fifty-one (351) participants were sampled from a population of all Grade 9 leaners in OR Tambo Inland District using stratified random sampling approach. The sample comprised of 171 girls and 180 boys from 6 schools (3 rural and 3 urban schools). The sample was classified by gender and school location prior random selection of participants. This was done to ensure that characteristics of the population are well represented.

A questionnaire was used to collect the data. The questionnaire consisted of three sections: Section A included personal or biological information such as gender, age, school location, Section B focused on the measurement of parent's socio-economic status using three indicators which are (i) parent's occupation or employment status, (ii) parent's level of education and (iii) family average monthly income and Section C measured mathematics self-concept using Likert scale questions. Participants had to choose an option statement (1. Strongly disagree, 2. Disagree, 3. Agree and 4. Strongly Agree) that best suits their perceptions about their Mathematics abilities. Statements such as, 'I am good in Mathematics', I enjoy solving Mathematics activities' were used to measure mathematics self-concept. The validity was tested in two ways: (i) a team of experts was requested to assess the validity of a questionnaire and the general overview was that the instrument measures what it is intended to measure and (ii) furthermore, the Pearson correlation test was performed to substantiate the measurement of the instrument's validity. Pearson correlation for all questionnaire items was above the critical value and p-value was below 0.05. Thus, the instrument was tested and found to be valid.

The reliability of the instrument was tested by Cronbach Alpha. The results reflected Cronbach Alpha at 0.933 which is way above acceptable reliability score of 0.70. Hence, the instrument was found to be reliable. All ethical considerations and protocols such as obtaining signed consent forms, anonymity, confidentiality, right to withdraw the participation were observed. IBM SPSS software was used to effect correlational and regression analysis. The following results were found.

Findings

Table 1:
Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.768[a]	.590	.589	6.50989

a. Predictors: (Constant), SES
b. Dependent Variable: MSC

Table depicts $R^2 = .589$. In essence, parent's socio-economic status constitutes 58.9% of mathematics self-concept. Almost 60% of mathematics self-concept is explained by or accounted for by socio-economic background of the students. This implies that socio-economic position is a strong determinant of mathematics self-concept.

Table 3 reflects that $p < .001$ and $F(1.349) = 502.9$. P-value is below .05 this shows that the regression model in table 1 is statistically significant. Parent's socio-economic status predicts mathematics self-concept, and the prediction is statistically significant. The following analysis shows correlation between the two variables of interest.

Table 3:
Correlations

		MSC	SES
Pearson Correlation	MSC	1.000	.768
	SES	.768	1.000
Sig. (1-tailed)	MSC	.	<.001
	SES	.000	.
N	MSC	351	351
	SES	351	351

Table 3 shows that $r(349) = .768$, and $p < .001$. This indicates a strong positive correlation between mathematics self-concept and parent's socio-economic status. This shows mathematics self-concept increases and varies according to the level of parent's socio-economic status. The following analysis shows the means scores of mathematics self-concept distributed according to socio-economic status.

Table 4:
Multiple Comparisons

Dependent Variable: MSC

	(I) SES Level	(J) SES Level	Mean Difference (I-J)	Std. Error	Sig.
Tukey HSD	Low SES	Med SES	-14.40690*	.73803	<,001
		High SES	-19.55714*	.90947	<,001
	Med SES	Low SES	14.40690*	.73803	<,001
		High SES	-5.15025*	.89983	<,001
	High SES	Low SES	19.55714*	.90947	<,001
		Med SES	5.15025*	.89983	<,001

*. The mean difference is significant at the 0.05 level.

Table 4 reveals that the mean scores of mathematics self-concept measured by socio-economic status: Low, Medium, and High were 32.0, 46.4 and 51.6 respectively. There was a significant mean difference in mathematics self-concept as measured by socio-economic status (Low/ Med SES, *MD = 15.4, p <.001;* Low/ High SES, *MD = 19.6, p <.001;* Med/ High SES, *MD = 5.2, p <.001*). Mathematics self-concept varied according to parent's socio-economic status and the variation in mean scores was statistically significant. The results are discussed as below

DISCUSSION OF THE RESEARCH FINDINGS

Mathematics self-concept is an important construct to be enhanced in order to achieve improved results in mathematics (Marsh, 2022). This concept is also linked with future mathematics-related careers. Some scholars propose that it is predicted by mathematics achievements while some endorse the significance of the social and dimensional comparisons as primary basis of the development. The current study reveals that above half of the mathematics self-concept is predicted by socio-economic status. These results replicate the findings of Li et al. (2020). In essence, students from well-resourced have high mathematics self-concept as compared to the ones from struggling families. The mean differences are statistically significant.

In consideration that Eastern Cape Province is dominated by schools in poverty-stricken communities (e.g., Ngumbela, 2021), this means that a relatively high number of learners might have negative mathematics self-concept due to their family's economic hardships. For example, according to National Senior Certificate School Subject Report (2021), in all nine provinces in South Africa, Eastern Cape is always the worse performing province in athematics. Socio-economic conditions in Eastern Cape may cause students to perceive themselves negatively in mathematics and that may lead to poor Mathematics exam results. It may therefore be vital for Department of Education in the province to establish sound programmes to enhance student's mathematics self-concept. The programmes may have to be inclusive and built on the basis that these students are from disadvantaged backgrounds. Future studies may investigate the extent to which other factors such as age, gender and school location mediates the impact of parent's socio-economic status on the development of mathematics self-concept.

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