# Assessing the impact of Socio-economic related Mathematical Learner Identity on Student Performance in Mathematics among Secondary schools: A Case Study from Kilifi County, Kenya

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## Abstract

*Completion of doctoral studies is the apex of academic accomplishment. Postgraduate studies, particularly the study's goal, which was to evaluate how students' performance in mathematics was impacted by their socioeconomic identification as a mathematical learner, is shared in this article. The theoretical framework was derived from the sociocultural theory of learning. In order to collect both quantitative and qualitative data, the study used a correlational research design with a sample size of 100 students using a Student Mathematics Achievement Test and Student Interview Schedule. Prior to being connected with students' mathematical performance, content analysis quantified socioeconomically related mathematical learner identity data. The study found that student performance in mathematics is impacted by socioeconomically associated mathematical learner identities. Following analysis, the data was displayed tabulated and in narrative format. The study suggests fostering the development of meaningful interactions in order to instill in learners the relevance of mathematics in their socioeconomic situations.*

**Keywords:** Mathematical Learner Identities, Mathematics Education, Sociocultural Theory, Performance in Mathematics

## Introduction

The larger study that served as the foundation for this article looked into the connection between students' performance in mathematics and their identities as mathematical learners. A crucial component of the learning and teaching of mathematics that affects students' performance in the subject is mathematical learner identity research in mathematics education (Bishop, 2012). Based on sociocultural theories of learning, Lerman (2000) established a social turn in mathematics education with research on mathematical learner identities (Darragh, 2016). Based on elements like professional fulfillment, academic success, employment, earning, assets, and resource deprivation, socioeconomically related mathematics learner identity is determined (Rumberger & Palardy, 2004). Parental expectations and community knowledge about the applicability or lack thereof of mathematics that students accept, when it comes to socioeconomically connected mathematical learner identity, can have a favorable or negative impact on their identities about mathematics (Howard, 2003). In order to determine the impact of socioeconomically connected mathematical learner identities on student performance in mathematics, this study is based on a socio-cultural perspective and focuses on identity development in mathematics within a community at school, at home, or in a social network (Wenger, 1998).

According to Nasir (2002) and Bishop (2012), the current study operationalized identity in mathematics as enacted and restricted in a specific social context of secondary school students experiencing local classroom practices. In mathematics, an identity is one's self-perception that is socially negotiated and is emphasized by experiences, routines, historical events, and personal narratives (Bishop, 2012). Accordingly, a person's view of "who one is mathematically"—that is, their degree of appreciation for and dedication to mathematics—is referred to as their mathematical learner identity (Allen & Schnell, 2016). According to the "narratives" that students create about mathematics, mathematical learner identities are either favorably or negatively classified (Allen & Schnell, 2016). In other words, students who have positive mathematical identities believe that they may achieve in mathematics either by natural aptitude or by working hard and retaining a positive self-image. As opposed to students who have oppositional identities, which are the primary characteristic of negative mathematical identities. They stay away from mathematics because they believe they are not very good at it and that it is useless to them (Doward, 2017). Nonetheless, little is known about the origins of the positive and negative socioeconomically associated mathematics learner identities.

### Statement of the Problem

One aspect of learning mathematics that is founded on the sociocultural theory of learning is the study of mathematical learner identity. Key elements of learning mathematics that are related to mathematical performance are mathematical learner identities. Insufficient cultivation of mathematical learner identities leads to a lack of both conceptual comprehension of mathematics and a comprehensive lens through which students can analyze their mathematical experiences in the social environment both within and outside of the mathematics classroom. The impact of socioeconomically related mathematical learner identification on math student achievement, however, is not well understood. Due to this identified knowledge gap, the study's design was to establish a correlation between students' performance in mathematics and their socio-economic learner identity. The goal was to highlight aspects of this relationship that should be taken into

account when improving mathematics education to address the persistently low math performance of students.

**Research Question**

What impact does students' mathematical achievement have on their socioeconomically linked mathematical learner identity?

## Theoretical and Conceptual Frameworks

The sociocultural theory of learning proposed by Vygotskian (1998) served as the foundation for this study's correlational analysis of the relationship between student performance in mathematics and socioeconomic-related mathematical learner identity, which produced the study's management prototype. Social relationships—which can differ among customs—are seen as the foundation of identity construction and cognitive enhancement in the sociocultural theory of learning. Learning is not just a cognitive process; it is also a social endeavor (Wenger, 1998). Individual, social, and contextual factors all impact behavior and learning (Vygotsky, 1998). People are thought to be socially conscious and sensitive by nature, thus they are sensitive to the complexities of their social environment—especially the educational setting—in both their ideas and behaviors (Wenger, 1998).

The sociocultural theory of learning by Vygotskian (1998) and its tenets are relevant to this investigation. Recognize the importance of comprehending unique learning styles. This makes it possible to evaluate the impact of learner identities in mathematics that are socioeconomically related on the specific learning task in a more comprehensive way (Engestrom, 1987). Thus, the goal, the literature review, the variables being studied, and the desired guiding prototype were all influenced by the sociocultural theory of learning proposed by Vygotskian. In other words, the sociocultural theory highlighted the importance of many social contexts—such as home, school, friends, or the setting of social tasks—where children receive psychosocial aid in their learning activities (Williams, 2016). Students' performance in mathematics is impacted by their relevant interacting actions in the family socioeconomic stratum, which help them establish a socioeconomically connected mathematical learner identity (Martin, 2000).

Consequently, the socio-economic associated mathematical learner identity on student performance are features of learning mathematics as well, since the sociocultural theory of learning stresses social ties as the center of identity building under varied aspects among traditions. In addition, other learning variables such as peer pressure, teacher support, parental participation, cultural stereotypes, and myths or conventions in mathematics can all have an impact on students' performance. These include the source that the learner identities for mathematics were chosen from.

## Research Methodology

The study used both quantitative and qualitative research approaches, with a correlational study design. The Ganze Sub-County of Kilifi County, Kenya, provided two purposefully sampled County secondary schools for the study. Twenty-five percent of the sample (n = 50) Structure Two students, ages 16 to 17, from various ethnic backgrounds, were selected from each school under study, yielding a sample size of 25

percent (n=100) overall. A preliminary inquiry was conducted as part of the students' sampling process in order to determine the positive and negative mathematics learner identification groups. In each of the sampled schools, there were two groups for positive and negative mathematical identities in the study.

Two research assistants were selected and trained to interview positive and negative mathematical identity groups once a week in their respective classrooms over the 16-week mathematics course, using the Student Interview Schedule (SIS). A review of the schedule items pertaining to the student's socioeconomic background is part of the interviewers' training (Masondo, 2017). The interviewers concentrated on the students' tape-recorded answers to each question posed. The Student Mathematics Achievement Test (SMAT) was given out at the conclusion of the instructional session. Its goal was to evaluate how well students applied the mathematical ideas they had learnt to solve problems. The items were written using a table of requirements based on the six Bloom taxonomy levels. Similar to the learners' typical Continuous Assessment Test (CAT), the questions were assessed according to their weight, which added up to 30 marks.

The instruments' construct validity and content were established throughout the piloting phase. The content validity ratio was manually calculated to ascertain content validity (Lawshe, 1975):

$$CVR = \frac{n_e - \left(\frac{N}{2}\right)}{\frac{N}{2}}$$

Where, CVR = content validity ratio
$n_e$ = number of correct responses
N = number of total participants

The study instruments' content validity was found to be CVR = 0.045 at $p < 0.05$.

To further validate the study instruments, the same respondents were given improved items. With the use of SPSS Version 21.0 software, a correlation between the test-retest results was performed, and r (50) =.85, p =.5 was established as the construct validity of the study instruments. This improved the validity of the construct and the content. Together with KCSE Mathematics Examiners of Mathematics Paper One (121/1), professionals in Educational Psychology and Social Sciences (Methods of Social Research I/II) at Kenyatta University collaborated to create the SIS and SMAT.

During the piloting phase, the split-half method proved the SMAT research tool's dependability was completed by manually computing the elements that were coded with even or odd numbering by:

$$rxx = [2r½½] / [1 + r½ ½]$$

Where, $r_{xx}$ = whole test reliability
$r_{½ ½}$ = half-test reliability

Using the split-half computation in the test-retest method, the research instruments' reliability clicked at rxx=0.00095 at $p < 0.001$.

Using statistical Cronbach alpha version 1.2.1 software, the internal consistency reliability of SIS and RIT was found to be 0.75 at $p < 0.8$ using the Cronbach's alpha statistical technique (Bruce, 2015).

Thus, $rtt = [n/(n-1)]\left[\frac{s2 - \sum pq}{s2}\right]$

Where, $r_{tt}$ = reliability alpha,
n = items,
$s^2$ = tool variance,
p = correct item respondents,
q = incorrect item respondents, and
$\sum pq$ = total of product item respondents.

Afterwards, during the actual investigation, the sampled students were used with enhanced research instruments.

At the beginning of Term One, a four-week preparatory investigation period preceded the data collection. All Form Two pupils were interviewed, and general classroom observations were made in the studied schools. This made it possible for the researcher to become acquainted with the study area and to categorize the learners into groups based on their positive and negative mathematical identities. The researcher also conferred with the coordinators of the School of Education at the University campuses in Kilifi County during the initial phase of the investigation in order to purposively select two research assistants who met the following requirements: they had to be graduate students studying Mathematics Education and possess interpersonal, communication, observational, and time-management skills. Using the Student Interview Schedule (SIS), the research assistants collected qualitative information on the mathematical identities associated with learners' socioeconomic backgrounds in order to evaluate the impact of these identities on students' mathematical performance during analysis. Lastly, using the Student Mathematics Achievement Test (SMAT), students were evaluated on the mathematical principles they had mastered over the course of 16 weeks.

With the use of NVivo software, the taped answers to the Student Interview Schedule (SIS) were transcribed before being subjected to content analysis. By first categorizing the learners' recorded answers to the interview questions and then counting the number of times those responses were applied to their performance on the mathematics achievement test, content analysis was able to create categories. Then, using SPSS Version 21.0 software, the counted instances produced quantitative data of socio-economic related mathematical learner identities. This data was then correlated with quantitative data from the Student Mathematics Achievement Test (SMAT) to determine the impact of socio-economic related mathematical learner identities on mathematical student performance.

## Presentation of Findings and Discussion

The purpose of the study is to evaluate how student performance in mathematics is impacted by their socioeconomic identification as a mathematical learner. By first categorizing the learners' recorded answers to the interview questions and then counting the number of times those responses were applied to their performance on the mathematics achievement test, content analysis was able to create categories. Since

theme analysis was outside the purview of this study, the categorization of the replies followed Doward's (2017) concepts of student background information that characterizes students' socio-economic condition, which created the analyzing criteria for coding the learners' responses. Positive and negative socioeconomically connected mathematical learner identification groupings that were discovered during sampling are among the primary topics. The sub-themes were generated by the analytical criteria, which include interpersonal behaviors, family status, parental expectations and involvement, community messages, and self-perception. The primary codes that were established by the qualities that were replied to produce quantitative data about the identity of mathematics learners related to socioeconomic status. *Tables 1* and *2* exhibit the findings from the content analysis of mathematics learner identities connected to socioeconomic factors.

***Table 1: Positive Socio-economic related mathematical learner identity quantified data***

| **Sub-Themes** | **Main Codes** | **Counted Instances** | |
|---|---|---|---|
| | | **Boys (n=25)** | **Girls (n=25)** |
| Interacting behaviors | Constantly reminding to work hard | 5 | 6 |
| | Motivating and rewarding | 6 | 5 |
| | Stressing the value of Mathematics | 7 | 7 |
| | Disciplining to perform | 4 | 3 |
| | Mathematical activities are doable | 3 | 4 |
| | Middle-class background | 5 | 6 |
| | Afford mathematical revision materials | 7 | 7 |
| | Home-based tutorial assistant | 3 | 4 |
| | Exposure in mathematical oriented careers | 4 | 3 |
| | Conducive home study environment | 6 | 5 |
| | Constantly expecting better grades | 6 | 7 |
| | Paying fees is worthy investment | 7 | 6 |
| | Closely monitoring progress | 5 | 5 |
| | Determine mathematical oriented career | 4 | 4 |
| | Authorize negative reinforcement on failure | 3 | 3 |
| Community Messages | Mathematics is a prerequisite for courses | 7 | 7 |
| | Societal-identified mathematician | 6 | 5 |
| | Mathematics performance concerns community | 5 | 4 |
| | Studying Mathematics for the community | 4 | 5 |
| | Communal persuasion for Mathematics | 3 | 4 |
| | Believing Mathematics success is based on wealth | 3 | 4 |
| | Perceiving employment status determines mathematics success | 4 | 3 |
| | Recognition is through Mathematics performance | 5 | 6 |
| | Mathematics success is both in inheritance and determination | 6 | 7 |
| | Self-responsibility in Mathematical practices | 7 | 5 |

Positive socioeconomic learner identities in mathematics were the subject of a content analysis that concentrated on the benefits of self-perception, family status, parental expectations and involvement, community messages, and interacting behaviors. According to the study, interacting actions include assigning consequences, encouraging, reminding, inspiring, and practicing math. The family status encompasses middle class lifestyle, financial stability, support, exposure, and educational environment. Parental engagement and expectations include job orientation, investment, monitoring, and reinforcement of mathematics. For societal identity, mathematics is necessary, and community concern encapsulates community messaging. In socioeconomically associated mathematics learner identities, the student's self-perception is linked to factors such as inheritance, determination, wealth, work status, and acknowledgment. These findings support the positive mathematical identities for innate ability, persistent effort, and image maintenance that Doward established in 2017.

***Table 2: Negative Socio-economic related mathematical learner identity quantified data***

| **Sub-Themes** | **Main Codes** | **Counted Instances** | |
|---|---|---|---|
| | | **Boys (n=25)** | **Girls (n=25)** |
| Interacting behaviors | Lack of persistent reminder to work hard | 3 | 4 |
| | Demotivating and none-rewarding | 4 | 3 |
| | Undermining the value of Mathematics | 7 | 7 |
| | Lack of disciplining for performance | 6 | 5 |
| | Mathematical activities are difficult | 5 | 6 |
| Family status | Low-class background | 6 | 5 |
| | Challenged to afford mathematical materials | 4 | 3 |
| | Lack of home-based tutorial assistant | 3 | 4 |
| | None-exposure in mathematical oriented careers | 7 | 7 |
| | Unconducive home study environment | 5 | 6 |
| Parental Expectations and Involvement | Lack of persistent expectation on better grades | 3 | 3 |
| | Paying fees is just a responsibility | 4 | 4 |
| | Less monitoring progress | 5 | 5 |
| | Liberty on choice of mathematical career | 7 | 6 |
| | Less negative reinforcement on failure | 6 | 7 |
| Community Messages | Mathematics is not a prerequisite for many courses | 3 | 4 |
| | Lack of societal-identified mathematician | 4 | 5 |
| | Mathematics performance is not a community concern | 5 | 4 |
| | Lack of studying Mathematics for the community | 6 | 5 |
| | No communal persuasion for Mathematics | 7 | 7 |
| | Doubting Mathematics success is based on wealth, | 7 | 5 |
| | Employment status does not determine mathematics success | 6 | 7 |
| | Recognition is not through Mathematics performance | 5 | 6 |
| | Mathematics success is only in inheritance | 4 | 3 |
| | Lack of self-responsibility in Mathematical practices | 3 | 4 |

The detrimental socioeconomic implications of interacting behaviors, family status, parental expectations and involvement, community messaging, and self-perception were the main topics of the negative socioeconomic associated mathematics learner identity content analysis. The results of the study demonstrated that engaging in negative behaviors does not include not practicing mathematics, reminding, motivating, valuing, or punishing others. Low socioeconomic position, lack of access, lack of financial support, and an unfavorable learning environment are all consequences of family status. Just duty, lax supervision, professional freedom, and a lack of emphasis on mathematics are all aspects of parental engagement and expectations. Since mathematics is not as important to society, it is not a requirement for societal identification. This sums up the negative messages that the community sends out. Mathematical learners who have a negative self-perception in socioeconomic contexts are doubtful of their riches, employment status, recognition, self-responsibility, inheritance, and math determination. The oppositional or negative mathematical identity that Doward developed in 2017 is strengthened by these findings.

Following that, each group's counted examples of the descriptive findings from the Student Mathematics Achievement Test and the Socio-economic linked Mathematical Learner Identity were associated. The findings shown in *Tables 3* and *4*:

***Table 3: Correlation between positive socio-economic related MLI and SMAT***

| | **Gender** | **Student Mathematics Achievement Test** | |
|---|---|---|---|
| Positive Socio-economic related MLI | Boys | Pearson correlation | .1293* |
| | | Sig. | .000 |
| | | n | 25 |
| | Girls | Pearson correlation | .2053* |
| | | Sig. | .000 |
| | | n | 25 |

***Correlation is significant at the 0.05 level (2= tailed)***

The study discovered weak positive associations between positive Socio-economic related Mathematical Learner Identity and student performance in mathematics for boys and girls, respectively, at r (25) =.1293, p =.538849 and r (25) =.2053, p =.324876. There is evidence that students' performance in mathematics is positively impacted by their positive gender-based, socioeconomically associated Mathematical Learner Identity. This result is consistent with Martin's (2000) theories regarding socioeconomic factors that influence mathematical identity, such as the intricacy of a family's financial situation, the social background of the community, and gender fairness in educational opportunities, all of which have an impact on students' arithmetic ability.

***Table 4: Correlation between negative socio-economic related MLI and SMAT***

| | Gender | Student Mathematics Achievement Test | |
|---|---|---|---|
| Negative Socio-economic related MLI | Boys | Pearson correlation | .2506* |
| | | Sig. | .000 |
| | | n | 25 |
| | Girls | Pearson correlation | .2642 * |
| | | Sig. | .000 |
| | | n | 25 |

**Correlation is significant at the 0.05 level (2= tailed)*

Additionally, there were weak positive correlations between students' performance in mathematics for both boys and girls and negative socioeconomic-related Mathematical Learner Identity, with r (25) =.2506, p =.226952 and r (25) =.2642, p =.201888, respectively. Based on gender, students' performance in mathematics is negatively impacted by the unfavorable socioeconomically associated Mathematical Learner Identity. This is so because students are able to negotiate and create new identities or meanings based on their socioeconomic realities, according to Wenger (1998). According to the study, students who doubt the role that money, employment status, recognition, self-responsibility, inheritance, and determination play in solving mathematical problems within their socioeconomic statuses do not develop positive mathematical identities related to their socioeconomic status, which in turn affects students' performance in mathematics.

The implications of the study findings result in a prototype guideline for the management of socioeconomically associated mathematical learner identity in mathematics classrooms, with the goal of adding new knowledge to improve mathematics education. The critical reviews pertaining to Mathematical Learner Identities are integrated with the guiding management prototype. Based on Wenger's (1998) sociocultural element of identity, Vygotskian's (1998) sociocultural theory of learning serves as the foundation for the research of mathematical learner identities. The Mathematical Learner Identities were separated by Doward (2017) into three positive identities: Innate-Ability, Persistent-Effort, and Image-Maintenance; the oppositional identity is negative. The study proved that the socio-economic sourced part of mathematical learner identities is based on the principles of Vygotskian's (1998) sociocultural theory of learning. The advancement of mathematics education is based on this feature, which gives math teachers the ability to look more deeply into and comprehend the unique ways that students learn.

As a result, the prototype guideline is a methodical, ongoing, and repetitive procedure used in mathematics education. A set of sequential guidelines can effectively regulate the socio-economic aspects of mathematical learner identity in mathematics courses. The management of socioeconomically associated mathematical learner identification in mathematics classrooms is the focus of the paper, as illustrated in Figure 1 below, wherein the following sequential recommendations are employed:

- Through the study of data acquired using the Student Interview Schedule, which focuses on students' interacting behaviors and socioeconomic statuses in the mathematics classroom, math teachers can detect socio-economic linked mathematical identities among students.
- To help students recognize the relevance of their mathematical commitment, math teachers should draw a clear connection between classroom mathematical tasks and students' everyday socioeconomic situations.
- Math teachers should develop purposeful, participatory behaviors that reduce the impact of students' socioeconomic backgrounds on their mathematical practices.
- Math teachers will give out the Student Mathematics Achievement Test and calculate the math performance improvement index.

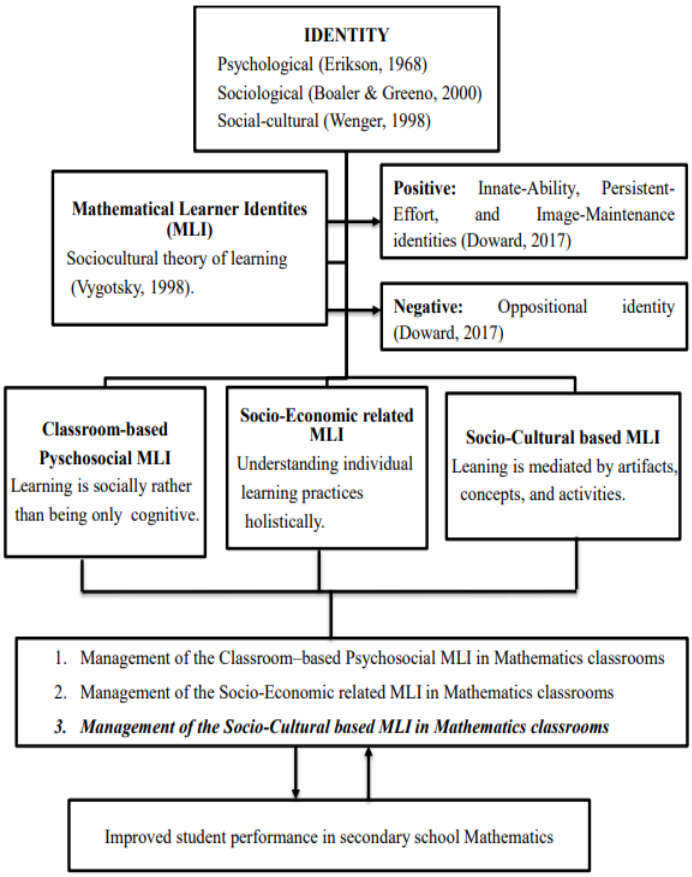


***Figure 1: A prototype guideline for the management of mathematical learner identities in mathematics classrooms***

## Conclusion

The study came to the conclusion that a student's success on mathematics exams is determined by their socioeconomically associated mathematical learner identity. As a result, there is a strong correlation between students' mathematical performance and their mathematical learner identities. Despite mathematics' vital importance to the community, pupils' low performance in the subject is frequently cause for concern and requires effective intervention. One strategy to effectively address the persistently low student performance in secondary school mathematics is to take into consideration the prototype guideline for the management of socio-economic related mathematical learner identity in mathematics classrooms.

## Recommendation

The research article suggests that, in order to mitigate the impact of socioeconomic strata on students' mathematical practices, practicing secondary school mathematics teachers should develop meaningful interactive behaviors that instill the applicability of mathematical activities in everyday socioeconomic lives. This recommendation is based on the discussion of the findings and conclusion presented above. This

would address the mixed impacts of socioeconomically linked mathematical learner identity—both positive and negative—on gender-wide student performance in mathematics.

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**Conflict of Interest**

The author certifies that there is no conflict of interest and that there is no affiliation with or involvement in any body that has a financial interest in the subject matter of this manuscript—such as funding for education—or a non-financial interest—such as personal ties.

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