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Effects of Socio-economic related Mathematical Learner Identity on student Performance in Mathematics among Secondary Schools in Kilifi County Kenya

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Keywords

Mathematics Education, Mathematical Learner Identities, Performance in Mathematics, Socioeconomic Statuses, Sociocultural Theory.

Abstract

The article shares findings from the study objective to assess the effect of socio-economic related mathematical learner identity on student performance in Mathematics. The sociocultural theory of learning formed the theoretical framework. The study applied a correlational research design on a sample size of 100 students used a Student Interview Schedule and Student Mathematics Achievement Test to obtain both quantitative and qualitative data. Content analysis quantified socio-economic related mathematical learner identity data before correlated to the student performance in Mathematics. The study indicated that socio-economic related mathematical learner identity has effects on student performance in Mathematics. The analysed data was then presented in narrative and tabular forms. The study recommends building of meaningful interacting behaviors to inculcate the applicability of Mathematics in learners' socio-economic lives.

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Introduction

This article is based on a bigger study that sought to investigate the relationship between mathematical learner identities and student performance in Mathematics. Mathematical learner identity research in Mathematics Education is a key aspect in the learning and teaching of Mathematics responsible for student performance in Mathematics (Bishop, 2012). The research on mathematical learner identities was a social turn introduced in Mathematics Education by Lerman (2000) framed on sociocultural theories of learning (Darragh, 2016). Socio-economic related mathematical learner identity is based on factors such as career fulfilment, academic achievement, job, earning, assets, and resource deprivation (Rumberger & Palardy, 2004). In socio-economic related mathematical learner identity, parental expectations and community information on the relevance or irrelevance of Mathematics that student accept, influence their identities towards Mathematics either positively or negatively (Doward, 2017). This study is based on socio-cultural aspect, which focuses on identity development in Mathematics being within a community at school, at home or in a social network (Wenger, 1998) to assess the effect of socio-economic related mathematical learner identity on student performance in Mathematics.

The current study operationalized identity in Mathematics as enacted and constrained in a particular social context of secondary school learners experiencing local classroom practices (Nasir, 2002 & Bishop, 2012). An identity in Mathematics is self-view, negotiated socially, and highlighted by historical events, personal narratives, experiences, routines, and participating ways (Bishop, 2012). Therefore, mathematical learner identity is an individual's perception of "who one is mathematically" to an extent of seeing value and developing a commitment in Mathematics (Allen & Schnell, 2016). Mathematical learner identities are either positively or negatively grouped per the "narratives" students perceive themselves with Mathematics (Allen & Schnell, 2016). Whereby, learners of positive Mathematical identities view themselves as able to succeed in Mathematics either through innate qualities or persistent effort with a concern of maintaining a successful image. Unlike learners of negative Mathematical identities who are centrally characterized by oppositional identity. They avoid mathematical involvement as they view themselves of low ability in mathematics and

uselessness of Mathematics to them (Doward, 2017). However, the sources of both the positive and negative socio-economic related mathematical learner identity are little known.

Statement of the Problem

The study of mathematical learner identity is a one-dimensional idea of learning Mathematics based on the sociocultural theory of learning. Mathematical learner identities are key components of learning Mathematics that relate to performance in Mathematics. Lack of development of mathematical learner identities; result in, neither mathematical conceptual understanding nor a holistic lens for learners to examine their mathematical experiences within social context inside and outside the Mathematics classroom. However, little is known about the effect of socio-economic related mathematical learner identity on student performance in Mathematics. It is because of this identified knowledge gap that the study was designed to correlate socio-economic related mathematical learner identity and student performance in Mathematics with an intention to highlight its aspects for consideration towards the enhancement of Mathematics Education in addressing the persistent poor students` performance in Mathematics.

Research Question

How does socio-economic related mathematical learner identity affect student performance in Mathematics?

Theoretical and conceptual frameworks

This study was founded on Vygotskian (1998) sociocultural theory of learning as a basis for correlational investigation of socio-economic related mathematical learner identity and student performance in Mathematics that generates its management prototype. The sociocultural theory of learning views social relationships as the center of cognitive enhancement and identity construction, which may vary among customs. Learning is also a social task rather than being only a cognitive affair (Wenger, 1998). Behavior and learning are influenced by person, social and circumstantial issues (Vygotsky, 1998). It is perceived that by nature individuals are societal and responsive; therefore, their ideas and actions are tactful to

the complications of their social environment in particular the instructional context (Wenger, 1998).

Tenets of Vygotskian (1998) sociocultural theory of learning are of importance in this study. Perceive the need to understand individual learning practices. This enables to assess the effect of socio-economic related Mathematical learner identities in the individual learning activity more holistically (Engestrom, 1987). Therefore, Vygotskian sociocultural theory of learning informed the objective, literature review, variables under study, and the intended guiding prototype. That is, the sociocultural theory focused the significance of varying social contexts in which the students gain psychosocial assistance in their learning activities, be it family, school, friends, or context of social tasks (Williams, 2016). The learners` meaningful interactive behaviors in the family socioeconomic strata develop socio-economic related mathematical learner identity that in turn affects student performance in Mathematics (Martin, 2000).

Therefore, since the sociocultural theory of learning emphasizes social relationships as the center of identity construction under different aspects among customs, then the socio-economic related mathematical learner identity on student performance are aspects of learning Mathematics too. Also, the student performance can be attributed to the selected source of mathematical learner identities as well as intervened by other learning factors like peer influence, teacher support, parental involvement, cultural stereotypes and myths or norms in Mathematics.

Research methodology

The research was of a correlational study design that employed both quantitative and qualitative research methods. It was conducted in two purposively sampled County secondary Schools in Ganze Sub-County of Kilifi County, Kenya. A sample of twenty-five percent (n=50) Form Two learners, aged 16 to 17 years from different ethnic practices, in each sampled school were chosen resulting in a twenty-five percent (n=100) total sample size. The students` sampling process involved a preliminary investigation to identify the positive and negative mathematical learner identity groups. The study had two positive and negative mathematical identity groups in each of the sampled schools.

During the 16 weeks of learning Mathematics two research assistants were recruited and trained to interview both positive and negative mathematical identity groups in their different classrooms, once a week guided by Student Interview Schedule (SIS). Training of the interviewers includes a discussion of the schedule items about the student's socio-economic background (Masondo, 2017). The interviewers focused on student responses to each item asked as well as a tape recording them. At the end of the learning period, Student Mathematics Achievement Test (SMAT) was administered. It aimed at assessing the solving of mathematical problems using mathematical concepts learned by the students. A table of specifications was used in writing the items based on the six Bloom taxonomy levels. The questions were scored based on their weight totalling 30 marks like the learners` normal Continuous Assessment Test (CAT).

At the piloting stage, both the content and construct validity of the instruments was determined. Content validity was determined by manually computing the content validity ratio (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 content validity of the research instruments clicked CVR = 0.045 at $p < 0.05$.

Improved items were administered to the same respondents to further validate the research tools. A correlation of the test-retest outcomes was done with aid of SPSS Version 21.0 software and established the construct validity of the study tools at r (50) = .85, p = .5. This strengthened both construct and content validity. The SIS and SMAT were constructed together with experts from Social Sciences (Methods of Social Research I/II) and Educational

Psychology at Kenyatta University together with KCSE Mathematics Examiners of Mathematics Paper One (121/1).

The method of split-half established the reliability of the SMAT research tool during the piloting stage. Was done by the items coded using even or odd numbering before manual computing by:

$$rxx = [2r½½] / [1 + r½ ½]$$

Where; rxx = whole test reliability

r½ ½ = half-test reliability

The reliability of the research instruments clicked $rxx = 0.00095$ at p < 0.001 using the split-half computation in the test-retest technique.

Cronbach's alpha statistical technique (Bruce, 2015) determined the internal consistency reliability of SIS and RIT clicking 0.75 at p < 0.8 with aid of statistical Cronbach alpha version 1.2.1 software.

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

Where, rtt = reliability alpha,

n = items,

s^2 = tool variance,

p = correct item respondents,

q = incorrect item respondents, and

∑pq = total of product item respondents.

Thereafter, improved research tools were applied to the sampled participants during the actual research.

The data collection was preceded by a period of preliminary investigation for four (4) weeks at the onset of Term One. General classroom observations and background discussions with all Form Two students carried out in their sampled schools. This enabled the researcher to familiarize with the locale for the activity of investigation as well as identifying the mathematical identities of learners to subdivide them into negative and positive Mathematical identity groups. Also during the preliminary investigation period, the researcher consulted the School of Education coordinators in the University campuses within Kilifi County to purposively choose two research assistants using the following specifications: only graduate students in Mathematics Education, having interpersonal, communication, observational, and time-management skills. The research assistants administered the Student Interview Schedule (SIS) to gather qualitative data on learners` socio-economic related mathematical identities to assess their effect on student performance in Mathematics during analysis. Lastly, students assessed on the mathematical concepts learned within the 16 weeks using the Student Mathematics Achievement Test (SMAT).

The tape-recorded responses to the Student Interview Schedule (SIS) were transcribed before undergone content analysis with aid of NVivo software. Content analysis involved establishing categories by coding the learners' recorded responses to the interview items before counting the number of instances in which they were used with their performance in the Mathematics achievement test. Then the counted instances resulted to quantitative data of socio-economic related mathematical learner identities; that was also correlated to the quantitative data of the Student Mathematics Achievement Test (SMAT) with aid of SPSS Version 21.0 software to assess the effect of socio-economic related Mathematical learner identities on student performance in Mathematics.

Presentation of findings and discussion

The study ought to assess the effect of socio-economic related mathematical learner identity on student performance in Mathematics. The results of content analysis of socio-economic related mathematical learner identities are presented in *Table 1* and *2*.

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
Family status	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
Parental Expectations and Involvement	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
Self-perception	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

The content analysis of positive socio-economic related mathematical learner identity focused on the positive effects of interacting behaviors, family status, parental expectations and involvement, community Messages, and self-perception. The study established that interacting behaviors involve reminding, motivating, valuing, disciplining, and doing Mathematics. Family status includes middle-living class, affording, assistance, exposure, and study environment. The parental expectations and involvement entail investment, monitoring,

orienting career, and reinforcement of Mathematics. Mathematics is a prerequisite, for societal identification, and community concern summarizes community messages. The self-perception in socio-economic related mathematical learner identity is attached to wealth, employment status, recognition, self-responsibility, inheritance, and determination. These results contribute to the innate-ability, persistent-effort, and image-maintenance positive mathematical identities developed by Doward in 2017.

Table 2
Negative Socio-economic related Mathematical Learner Identity Quantified Data

		Counted Instances	
Sub-Themes	**Main Codes**	**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
Self-perception	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 negative socio-economic related mathematical learner identity content analysis focused on the negative effects of interacting behaviors, family status, parental expectations and involvement, community messages, and self-perception. The study established that the negative effects of interacting behaviors involve neither lack of reminding, motivating, valuing, disciplining, or doing Mathematics. Family status includes low living class, not affording nor assistance, lack of exposure, and an unconducive study environment. The parental expectations and involvement entail just responsibility, weakly monitoring, liberty in career, and less reinforcement of Mathematics. Mathematics is not a prerequisite nor for societal identification since is of less community concern, which summarizes the negative community messages. The negative self-perception in socio-economic related mathematical learner identity possesses doubt on wealth, employment status, recognition, self-responsibility, inheritance, and determination in Mathematics. These results contribute to the oppositional or negative mathematical identity established by Doward in 2017.

Thereafter, the counted instances of the Socio-economic related Mathematical Learner Identity and Student Mathematics Achievement Test descriptive results were correlated per group. The results presented 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 found that there was weak positive correlations, r (25) = .1293, p = .538849 and r (25) = .2053, p =.324876, between positive Socio-economic related Mathematical Learner Identity and student performance in Mathematics, for Boys and Girls, respectively. The positive socio-economic related Mathematical Learner Identity based on gender; does have a positive effect on student performance in Mathematics. This finding agrees with Martin`s (2000) views on socio-economic related mathematical identity as complexity of family financial status, community social background, and gender equity in access to education that in turn influence student performance in Mathematics.

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)**

Also, there was weak positive correlations, r (25) = .2506, p = .226952 and r (25) = .2642, p = .201888, between negative Socio-economic related Mathematical Learner Identity and student performance in Mathematics, for Boys and Girls, respectively. The negative Socio-economic related Mathematical Learner Identity does have negative effect on student performance in Mathematics based on gender. This is because, according to Wenger (1998), students have capability to negotiation and construct new meanings or identities based on socioeconomic experiences. The study can argue that learners` perception that doubts the contribution of wealth, employment status, recognition, self-responsibility, inheritance, and determination when solving mathematical problems within their socio-economic statuses, then do develop negative socio-economic related mathematical identity that in turn influence student performance in Mathematics.

In the view of contributing new knowledge towards improving Mathematics Education, the implication of the study findings generates a prototype guideline for the management of socio-economic related mathematical learner identity in Mathematics classrooms. The guiding management prototype is fused into the critically reviewed studies related to Mathematical Learner Identities. The study of Mathematical Learner Identities was founded on the Vygotskian (1998) sociocultural theory of learning that stems from Wenger`s (1998) sociocultural aspect of identity. Doward (2017) subdivided the Mathematical Learner Identities into Innate-Ability, Persistent-Effort, and Image-Maintenance positive identities while Oppositional identity is negative. Based on the tenet of Vygotskian's (1998) sociocultural theory of learning the study established that Mathematical Learner Identities are of socio-economic sourced aspect. This aspect underlies the improvement of Mathematics Education by enabling mathematics teachers to investigate and understand individual learning practices more holistically.

Therefore, the prototype guideline is a procedural, continuous, and repeated process in the teaching and learning of mathematics. The management of socio-economic related mathematical learner identity in Mathematics classrooms can be well achieved using the following sequenced guidelines:

a) Mathematics teachers to identify socio-economic related mathematical identities among learners by analysis of data collected using Student Interview Schedule that focus on learners` interacting behaviors and socioeconomic statuses in the mathematics classroom.
b) Mathematics teachers to make explicit classroom mathematical activities and learners' daily socio-economic lives so that the students identify the applicability of their commitment in mathematics.
c) Mathematics teachers to build meaningful interactive behaviors that curb the effect of socioeconomic strata among students during mathematics practices.
d) Mathematics teachers to administer Student Mathematics Achievement Test and determine the improvement index of performance in Mathematics.

Conclusion

The research concluded that socio-economic related Mathematical learner identity has effects on student performance in Mathematics. There are positive correlations between socio-economic related mathematical learner identities and student performance in Mathematics. Therefore, socio-economic related mathematical learner identity is significantly linked to student performance in Mathematics. The students` poor performance in Mathematics is often a concern despite its critical value in the community and needs to be effectively addressed. The consideration of the prototype guideline for the management of socio-economic related mathematical learner identity in Mathematics classrooms is an effective way of addressing the persistent poor student performance in secondary school Mathematics.

Recommendation

Based on the foregoing discussion of the findings and conclusion, the research article recommends that practicing Secondary School Mathematics Teachers should build meaningful interactive behaviors that inculcate the applicability of mathematical activities in daily socio-economic lives to curb the effect of socioeconomic strata among students during mathematics practices. This would handle the positive and negative effects of socio-economic related mathematical learner identity on student performance in Mathematics that is widened by gender.

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Conflict of Interest

The author declares that there is neither conflict of interest nor affiliation with nor involvement in any organization or entity with any financial interest such as educational grants or non-financial interests such as personal relationships in the subject matter discussed in this manuscript.

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