Assessing Students' Performance in Mathematics in Tanzania: The Teacher's Perspective

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ABSTRACT

One of the aims of teaching and learning mathematics is to encourage and enable learners to become confident in using mathematics to analyze and solve practical problems in real-life situations. However, while a few students prosper in learning of mathematics, many students find it difficult and ultimately fail the subject. This study analyses students' mathematics performance data and examines the perception of teachers on the causes of poor academic performance in mathematics among students in Tanzania. The study also probes on teachers' emotions when teaching mathematics. The study utilizes the primary, secondary and tertiary students' performance data during the period 2008 to 2016. The data were obtained from the National Examination Council of Tanzania and the College of Business Education records as well as 28 semi-structured interviews with purposively selected teachers and lecturers. Data are analyzed through content analysis and descriptive statistics. Findings reveal higher failure rates in primary and secondary schools particularly lower secondary school. Gender differences exist at all levels of education with girls underperforming in primary, lower secondary, and college examinations due to cultural factors impacting female students' learning. Factors associated with student's poor performance in mathematics are in line with Walberg's productivity model but for Tanzania, policy environment and culture also play an important role. The findings reveal that majority of mathematics teachers and lecturers possess mixed emotions towards student's ability and the teaching-learning environment. Measures to improve the situation suggested include; enhancement in teaching-learning environments, classroom instructions, teaching skills, students learning skills, teacher training programs, attitude of the community, and accountability. The results provide information about the trends of mathematics achievement and associated factors for educators and other stakeholders to consider the implication in curriculum and instructional practices of mathematics at all levels of education.

Keywords: mathematics, students' performance, teacher's perception, productivity factors, Tanzania

INTRODUCTION

Mathematics is considered as the gate and key of science and technology that is fundamental in social and economic development of countries (Mbugua, Kibet & Muthaa, 2012; Tshabalala & Ncube, 2016). According to Ker (2013), mathematical abilities are crucial for understanding other disciplines such as science, technology

and engineering that are vital for preparation of new innovative professionals in the sciences and technology fields.

According to Maliki, Ngban, and Ibu (2009), science and technology have become central to the world culture, and for any nation to become competitive it must not undermine the significance of mathematics in her education. In Tanzania, mathematics is given paramount importance in the curriculum and policies related to education, right from pre-primary to tertiary levels. Mathematics is one of the core subjects in both primary and secondary school curricula in Tanzania.

Despite the importance given to mathematics, a large number of students struggle to understand the subject (Galadima & Yusha'u 2007; Mazana, Montero, & Casmir, 2019). This struggle is reflected with students' poor performance in the subject during national examinations in Tanzania. **Table 1** shows failure rates in mathematics examination results in the Primary School Leaving Examination (PLSE) and Certificate of Secondary Education Examination (CSEE) for five consecutive years from 2008 to 2012.

Table 1. PLSE and CSEE Percentage of failure rates in mathematics (2008-2012)

Level/Year	2008	2009	2010	2011	2012
PLSE (%)	36.4	66.6	53.0	54.2	82.6
CSEE (%)	73.1	70.1	76.9	76.6	68.7

Source: National Examination Council of Tanzania (NECTA) Results statistics, 2008 -2012

Such high failure rates have severe consequences to the youth and the nation at large. Mathematics is not only important for acquiring academic qualifications, but also prepares students for the future. Thus, a group of students who fail in mathematics face learning difficulties in mathematics and related courses in higher levels particularly science, engineering and other business-related courses. Hence, the nation will lack skilled people in the areas of technology, health, engineering, agriculture and related fields. Consequently, the country will lag behind in the technological endeavors due to lack of skilled individuals. Sa'ad, Adamu, and Sadiq (2014) highlighted that without mathematics, there is no science, without science, there is no modern technology and without modern technology, there is no modern society. Thus, Tanzanian education must emphasize on building capacity in mathematics skills to foster development in science and technology for competitiveness and economic development of the country.

Researchers, government and non-governmental organizations have tried to identify factors behind students' poor performance in mathematics at all levels of education in Tanzania. Many emphasize that high failure rates have been attributed to, amongst other factors, the absence of competent teachers; inadequate teaching/learning resources such as books (Ponera, Mhonyiwa, & Mrutu, 2011) and teaching aids; and understaffing in most schools (Kitta, 2004). Higher failure rates are also associated with low level of motivation among teachers, teachers' attitude towards students and mathematics, poor instructional strategies, teachers' weak content knowledge (Mazana et al., 2019; Michael, 2015), teachers emotions in the classroom (Frenzel et al., 2009; Klusmann et al., 2008). Other factors include, examination setting, poor preparation of teachers in the implementation of the curriculum, and ability grouping (Uysal & Banoglum, 2018).

Different initiatives were put in place by the Tanzania's government to address these issues in order to reduce students' failure in mathematics. Several projects were initiated to enhance teachers' pedagogical content knowledge and teaching approaches (Kitta, 2004), and providing schools with adequate teaching and learning resources (Sumra & Katabaro, 2014). Other initiatives include training of more mathematics teachers, and the introduction of Information and Communication Technology (ICT) in teacher education and secondary schools in early 2002 (Kafyulilo, Fisser, Pieters, & Voogt, 2015).

Despite these initiatives, students' performance in mathematics has consistently remained poor. Poor performance in mathematics is a barrier in achieving social and economic development of individuals and the country at large. In Tanzania like many other sub-Saharan Africa (SSA) countries, students' performance in mathematics is ranked far below average in international assessments (Bethell, 2016, 38; URT, 2011, p. 171-172), making the country loose economic advantage over other countries. The report of HakiElimu (2012) suggests that, the quality of education can be viewed in terms of the students' performance in examinations. Poor performance in the subject implies that the quality of mathematics education is jeopardized. To improve the quality of mathematics education, we should find ways to improve students' learning experiences and consequently their performance (Topçu, Erbilgin, & Arikan, 2016). Therefore, the study of students' performance and associated factors is worth examining. Although several studies have been conducted to identify factors associated with poor performance in mathematics in Tanzania, these studies have focused on specific levels of education (Joseph, 2013) or on students' perceptions (Kilasi, 2017; Mazana et al., 2019).

There is a research gap to uncover factors that contribute to students' poor performance in mathematics compared at all levels of education. Hence, this paper analyses students' performance data in mathematics and probes into the factors contributing to students' performance from primary, secondary and tertiary education levels in Tanzania. Specifically, data were analyzed quantitatively using descriptive statistics to establish the extent of failure in mathematics by levels and gender and explores qualitatively factors contributing to students' poor performance in mathematics according to teachers' perspectives. We employed Walberg's theory of productivity to understand factors related to students' learning of mathematics. This theory suggests that individual students' attributes and the surrounding psychological environments influence affective and cognitive learning outcomes (Walberg, Fraser, & Welch, 1986). The results of this study provide information on trends of students' mathematics performance and associated factors. This information would help educators and other education stakeholders in considering its implications in mathematics education at all levels in order to find ways for enhancing students learning experiences of mathematics hence improved performance. The study was guided by the following research questions

1. What is the extent of failure in mathematics by level and gender?
2. What are the teachers' perceptions about the factors influencing students' performance in mathematics?

Tanzania Education Structure

In Tanzania, education and training fall under the Ministry of Education, Science, and Technology; and the Ministry of regional Administration and Local government. Communities, the private sector and Non-Government Organizations (NGO's) also provide formal and informal education, but are controlled by the central government ministries and other regulatory authorities (Joseph, 2013). The formal education system follows a hierarchical structure, which ranges from pre-primary level to tertiary level. The current structure is two years pre-primary education, seven years of primary education, four years of ordinary level secondary education (O - Level), two years of advanced level secondary education (A - Level) and a minimum of three years of tertiary education, that is 2-7-4-2-3 +.

Pre-primary and primary education are compulsory in enrolment and attendance and the government has introduced pre - primary schools to all government schools for children aged 4-6 years. The medium of instruction in government schools is Kiswahili, but, recently there has been a rapid increase in the private-owned schools that use English as the medium of instruction. At the end of the fourth and seventh years of primary level, pupils sit for their national examinations. The two examinations taken at primary level are called National Standard Four Examinations (NSFE) and the Primary School Leaving Examination (PSLE) respectively. Those pupils who pass standard four examinations proceed to standard five and the unsuccessful students repeat until they pass. Standard seven examinations are the basis for selection of students to join the four-year secondary education or vocational training.

The secondary education is broken up into two levels, which are O - level (lower secondary) and A - level (upper secondary). The lower secondary takes four years to complete. At this level, students are required to take at least seven subjects, where mathematics, Kiswahili, English, Civics, and Biology are compulsory subjects. At the end of the second year, students sit for their form two examinations. Those who pass the examination advance to the third year, (i.e. Form three) and those who fail the examinations are to repeat until they pass. At the end of the fourth year, students sit for the Certificate of Secondary Education Examination (CSEE). This examination is the basis for selecting students to join upper secondary. Those who pass the CSEE with balanced combinations are admitted to the two-year upper secondary education, which consists of form five and six. Those who pass with their combinations unbalanced normally join vocational training, professional training or the workforce.

At the end of the form six students write an Advanced Level Secondary Education Examinations (ACSEE). Successful candidates join either tertiary education or the workforce. All examinations at primary and secondary education are centrally designed, regulated, conducted and administered by the National Examinations Council of Tanzania (NECTA).

THEORETICAL FRAMEWORK

Walberg's Theory of Productivity

We analyzed interview data using Walberg's productivity theoretical lens. We believe, this theory provides a better understanding of the cognitive, social and psychological factors that affect students' learning of mathematics (Mazana, et al., 2019). The theory specifies nine factors that promote students learning (Walberg, et al. 1986). These factors were grouped into three categories notably, student's aptitude attributes, instructional factors, and social psychological environment (Bruinsma & Jansen, 2007). The model was later modified by Waldrip and Giddings (1994) to include a fourth group of cultural variables namely gender, race and customs. The description of Walberg's productivity factors is given in **Table 2**.

Table 2. Walberg's productivity factors, indicators and description

Productivity factor	Indicators	Description
Students aptitude attributes	Motivation - Perseverance - Learning strategies	Represents an academic motivation which can be positive or negative. Positive motivation can be described by perseverance, teachers' perception of student ability to learn, and use of appropriate learning strategies
	Age	The age of the students at level entry
	Prior achievement - Previous results - Background knowledge in math	Achievement in mathematics tests and examinations as well as students background in mathematics
Instruction	Quantity of instruction - Instructional time - number of contact hours	Entails instructional time vs. content coverage, and the number of contact hours
	Quality of instruction	The quality of instruction encompasses the pace of instruction, language clarity, content clarity (determined by the content area knowledge of the teacher, quality of reference and text books), the quality of structure and organization of instruction (instructional strategies), and the quality of assessment
Social psychological environment	Home environment	Represent the educational level and financial position of parents
	School environment	Entails the quality of classroom climate and the availability of teachers and teaching- learning resources
	Peer environment	Involves the influence of the peer
	Mass media	Mass media include the use of ICT tools such as TV, computers as well as mobile phones to deliver instructions

METHODOLOGY

Research Approach

This study employed both quantitative and qualitative approaches utilizing students' performance data over several years and semi-structured interviews for data collection and analysis. A quantitative approach utilizing percentages was also applied because students' performance data can be understood better when descriptive statistics are employed. Qualitative design was chosen primarily to obtain teachers' personal views regarding factors influencing student performance in mathematics for better understanding of the problem. Furthermore, the interview method, although expensive in terms of time and effort, provides more information as there is a possibility of eliciting information that would have been impossible to obtain through other data collection tools such as a questionnaire (Denscombe, 2010).

Data Collection and Ethics

Students' performance data

The study utilized students' mathematics performance data obtained from the National Examination Council of Tanzania (NECTA) for the period 2003 to 2016 and from the College of Business Education (CBE) Dar es Salaam campus for the period 2008 to 2017. However, while CBE could not provide data for the year 2003 to 2007, data gathered from NECTA for this period had too many missing entries. Complete data sets

were retrieved for the period 2008 to 2016, for a total of 36 data entries, which we used in our study for consistency. The data were provided in electronic format (PDF) following a request letter to the NECTA and CBE. The obtained data were summarized in terms of the total number of students who sat for the examinations (See **Table 3**), split into gender, and level of study. The researchers extracted the failure percentage rates for the period of nine years, which were used in subsequent analysis.

Table 3. Failure percentage rates in mathematics at various level of education (2008 –2016)

Level/Year	2008	2009	2010	2011	2012	2013	2014	2015	2016
Primary	81.9	79	75.5	60.6	81.2	71.4	62.4	50.4	53.4
Lower Secondary	75.7	82.1	83.9	85.4	87.9	82.2	80.4	83.3	81.9
Upper secondary	58.2	38	60.2	49.3	56.3	50.5	22.6	25.9	52
College	32.2	13.9	21.3	22.2	25.0	36	51	50	36

Source: NECTA: Examinations Statistics, 2008-2016, Dar es Salaam, Tanzania

Interview data

Purposive sampling technique was used to select the research participants. This sampling technique was preferred because the researchers believed that the information sought could be provided by experienced mathematics teachers and lecturers. The participants were selected based on the teaching experience of three or more years. The number of (28) participants was arrived at when the point of saturation was achieved where additional interviews did not result in new themes (Creswell, 2014). The participants comprised of ten secondary school teachers, eight primary school teachers and ten lecturers from four higher education institutions. Of the 28 respondents, 12 were female and 16 were male. The participants' characteristics are depicted in **Table 4**.

Table 4. Teachers and lecturers' characteristics

Variable		Number of respondents	Percentage (%)
Gender	Male	12	42.9%
	Female	16	57.1%
Years of Experience	< 5	5	17.9%
	5 – 10	7	25%
	11- 15	8	28.6%
	>15	8	28.6%

Table 4 shows that most of the participants are very experienced mathematics teachers as the majority have teaching experience of 11 or more years (57.2%) indicating that they were able to provide relevant information for the study.

All interviews were guided by an interview guide, but the interviewer probed further when participant's response to the question necessitated follow-up questioning. Sometimes prompts and checks were used to ensure the correctness of the captured data (Denscombe, 2010). During the interview, ten interviews were face to face, 16 through telephone, and two through email exchanges. The interviews were scheduled depending on the preference of the interviewee as some of them agreed for a phone call after working hours or during the weekends. In most cases, the face-to-face interviews were conducted at the interviewees' offices, and lasted for up to 1 hour. The interview guide consisted of five questions that are described in **Table 5**.

Table 5. The interview guide

	The interview question	Description
1.	Why students fail mathematics? Why don't they like it?	This question aimed at finding out the factors affecting students learning of mathematics
2.	What do we do wrong?	The question aimed at finding out teachers practices leading to higher failure rates
3.	What causes us to go wrong?	The question aimed at finding out the factors leading to teachers mistakes
4.	How do you feel when you teach mathematics?	The question aimed at finding teachers emotions when teaching mathematics
5.	What do you think should be done to revert the situation?	To identify the measures to correct the deficiencies in teaching and learning so as to enhance students' performance

As described in **Table 5**, regarding research question number four the interviewees who attended the face to face sessions were asked to also express their emotions through a drawing (visual). Only five participants expressed their emotions using a drawing, the rest were not comfortable to participate so their decision was respected. The interview guide was prepared in English language, and then translated into Kiswahili a commonly spoken language in Tanzania. The interviews were audio recorded and transcribed verbatim for

subsequent data analysis. The interview transcriptions were written in Kiswahili and then text extracts to support the findings were translated back to English.

In this study, teachers participated voluntarily. The consent of the participants was respected, and the participants were requested to sign a consent form prior to commencing. The names of the participants were kept confidential to protect their identity.

Data Analysis and trustworthiness

Students' performance data were analyzed using descriptive statistics (i.e. percentages and frequencies) which are presented in **Table 3** and further elaborated by using figures.

Interview data were analyzed using content analysis. At first each data transcript was read from the beginning to the end. Then, the transcripts were re-read this time highlighting text that appeared to be related to, for example, causes of failure or pointing to teachers mistakes in teaching, and writing a keyword or phrase that seemed to capture issues related to student poor performance in mathematics. After coding of five transcripts, preliminary codes were identified which were then used to code all the remaining transcripts, including re-coding of the five transcripts used to generate the initial codes. The codes were then reviewed to ascertain the relationship with the original data while allowing new ones to emerge. The final codes were used to describe major issues describing students' failure in mathematics in relation to Walberg's theory of productivity or measures to reduce failures. Finally, quotations were presented verbatim to present a true reflection of the voices of the participants. The quotes found in this manuscript were obtained from 28 different respondents. Whenever other teachers mentioned similar expressions, those were counted together within a theme, to indicate the frequency of the expression. Teachers' names have been replaced (i.e. coded) by numbers.

To analyze drawings, a holistic approach was employed taking into account the content as well as the context of the drawing. Interview responses and visual representation of teachers' emotions were analyzed separately as well as in combination with each other to better understand the phenomenon. Trustworthiness was ensured through member check by requesting three participants to read the transcribed data files to check if the transcriptions match the intended meaning of the participants.

The validity of the data in this research is attested, the data have been obtained from several sources and participants that were purposively selected and ware analyzed qualitatively as well as through descriptive statistics. Following established best practices in traditional qualitative research, after obtaining themes from the data, example quotes must be offered to illustrate the theme (Denscombe, 2010; 297). In qualitative methods the validity and reliability of data is assessed through several procedural mechanisms, including: a) through trustworthiness criteria which include sharing interview transcript with some interviewees to establish the authenticity of the transcript; b) by having codes generated by two or more people then comparing results; c) by the interview guide checked and approved by an expert in the field, among others (see for instance Shenton, 2004), which were adhered to in this research. Another aspect that strengthen the validity of our data is triangulation, which may be in terms of data sources, analysis and environment (Denscombe 2010; Shenton, 2004). We have triangulated the environment from which data were collected (public primary and secondary schools in rural and urban locations as well as colleges providing tertiary education), further providing evidence of the validity of the data and analysis presented.

RESULTS

The study aimed at analysing students' performance data in mathematics to find out the extent of students' failure by levels and gender, and to explore teachers' perceptions about factors influencing students' performance in mathematics. It also examined teacher's emotional aspects when teaching mathematics.

The Extent of Failure in Mathematics (RQ1)

Analysis of students' performance by level

The overall performance is shown in **Figure 1**; generally, failure rates are high in lower secondary school basic mathematics (see also **Table 3**). For example, in 2008, 75.7 percent of lower secondary school students failed mathematics. The percentage raised to 87.9 percent in 2012, and dropped to 81.2 percent in 2013, then a similar trend through 2016 followed. Looking at the students who completed their primary school education in 2009, it can be observed that 24.3 percent of them passed mathematics. These were the ones who sat in

their lower secondary school examinations in 2013 and only 17.8 percent of them passed mathematics examinations. A similar trend can be observed in the remaining years (see **Figure 1**).
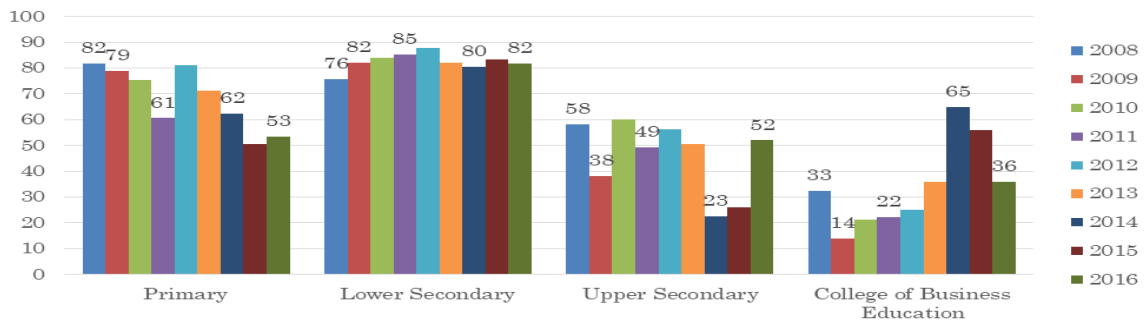

Figure 1. Failure percentage rates in mathematics at various level of education (2008 –2016)
Source: NECTA: Examinations Statistics, 2008-2016, Dar es Salaam, Tanzania

The transition from lower secondary to upper secondary portrays a different trend, taking a look at the students who completed their lower secondary school education in 2008 with 75.7 percent of them failing Basic Mathematics. These students sat for the upper secondary school examinations in 2011 and only 49.3 percent failed Basic Applied Mathematics, showing a decrease of 26.4 percent in failure rates. This fact shows that students who are good at mathematics become even better learners as they grow up and advance to higher levels of education. The transition from primary school to lower secondary school shows more passes in primary school mathematics examinations, while in lower secondary education there are more failures cases. High failure rates at this level calls for a deliberate intervention at a four-year cycle of secondary education where learning of mathematics becomes more difficult for students. This will consequently affect the higher education enrolment and quality of students' computational skills in college mathematics.

Close examination of the students' performance data revealed that the percentage rates of students failing mathematics are generally higher. Despite some exceptions at upper secondary basic mathematics examinations, where, it can be observed that in 2011, 2014 and 2015 the percentages of students who passed were 50.7, 77.4 and 74.1 percent respectively, the trend begins to descend in 2016. This good achievement could be attributed to various factors that include both students' aptitude, instructional and social psychological factors. Bachelor's degree students' results also show good performance; however, **Figure 1** indicates that, there are between 14 and 65 percent of students failing their mathematics courses where majority repeat modules.

Analysis of students' performance by gender

With reference to **Figure 2**, a large share of female students failed their mathematics examinations in both primary, lower secondary school and college levels. The failure percentage rates of girls in both primary school, lower secondary and college examinations are higher than that of boys. For example, in 2011 the failure rates of boys stood at 56.1, 81.7, and 10.0 percent in primary, lower secondary and college respectively, while that of girls stood at 64.8, 90.4, and 11.3 percent respectively. This trend can be observed in the reaming years (see **Figure 2**) with the exception of 2008 where boys failed more in college mathematics than girls. However, in upper secondary, girls outperform boys in many occasions. It can be observed that, in 2008 the failure rate of boys stood at 59.5 percent while that of girls was 55.4 percent. In 2016 the failure rate dropped to 53.9 percent and 49.0 percent for boys and girls respectively. This trend shows that girls consistently outperformed boys in upper secondary mathematics examinations.
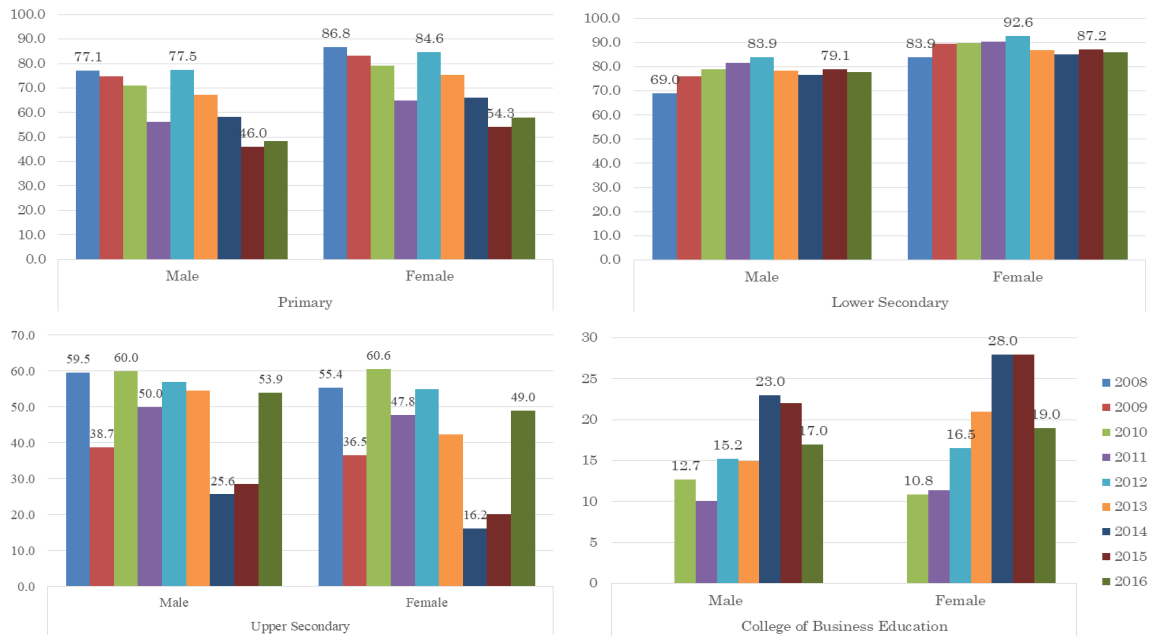
Figure 2. Distribution of students' fail percentage rates, by gender 2008-2016

Teachers' Perception Regarding Factors Influencing Students' Performance in Mathematics (RQ2)

Why students fail/avoid mathematics?

Mathematics teachers raised a number of issues contributing to students' low grades and/or avoidance of mathematics. According to Walberg's productivity model, teachers' responses fall into 3 major themes including students aptitude attributes, instructions and social psychological environment. We also discovered one more theme, 'teacher attributes' which was also evident from our data. The themes are elaborated below

Students' aptitude attributes (35 cases): Five sub-themes fell under this category namely students' attitude towards mathematics (motivation), student age, poor learning strategies, poor background in mathematics, and previous examination results (good/bad).

Student attitude towards mathematics (15 cases): Teachers described their students as fearful, perceive mathematics as difficult and that the fear of mathematics results in the lack of self-confidence, hatred and failure in examinations. One teacher had this to say. *"Students have a pre-developed concept that mathematics is difficult. This develops a sense of fear in them towards the subject. This causes them to lose confidence which results in their poor performance in the subject"* (Teacher 26, College).

Student age (2 case): The interviewed teachers highlighted that the age of students is also a big factor to consider. This means that, the student age should be consistent with the level of mathematics difficulty. During the interview one teacher said, *"…the age of the student also contributes to poor performance, some parents bring their children to join standard one at a tender age…let me give you an example of one child we demoted from standard one to nursery section. She was happier there playing around and performing well than when she was in standard one, which was her age at the time"* (Teacher 13, Primary School). Looking at the teachers' answers, only few primary teachers mentioned this aspect which is related to primary school entrance age. This imply that the age is not an important factor determining mathematics performance in higher education levels.

Poor learning Strategies (7 cases): Teachers said that students apply poor learning strategies to mathematics. They described their students as lazy, reluctant to practice, and learn mathematics as history. This implies that student adopt surface learning approaches which are ineffective. During the interview three teachers narrated *"…mathematics needs enough time and doing many exercises. This is not a case among our students today* (Teacher 19, College). *They are somewhat lazy"* (Teacher 22, Secondary). *"Students study*

mathematics like History, Geography…you study math once per week…it will not assist you pass. Mathematics requires everyday practice…" (Teacher 20, College).

Poor background in mathematics (9 cases): Teachers describe their students as those having poor background knowledge in mathematics from primary school. Poor background is a hindrance to acquiring higher order mathematics skill in higher levels. A quote from data transcription supports the finding, *"…they have poor background from primary school…"* (Teacher 7, College). Poor background in mathematics can be attributed to primary teachers' characteristics such as lack of content knowledge, and poor instructional strategies. This aspect was evident in secondary schools and college teachers' answers. Primary school teachers did not mention it as they are the ones to teach elementary level mathematics which sets background for secondary school levels.

Previous Exam Results (good/bad) *(2 cases):* Receiving a bad grade in examinations is linked to discouragement in pursuing mathematics further. Teachers explained that, everyone wishes for good results in life. So, if it happens the results are bad they feel disappointed, hate or speak ill of the subject, consequently perform even poorer. This was evidenced by a quote from the interview transcript, *"…students always expect good results. In cases where their results are not promising, they do not probe for the cause of such results rather develop a sense of hatred on the subject and influence others to hate it as well especially if they have also failed the subject too"* (T2, Secondary School).

Teachers' attitude towards student's ability and the subject (2 cases): Teachers describe their attitude towards students and mathematics as affecting their students' attitude toward mathematics and performance. They opined that teachers have developed negative attitude towards students' abilities, they see them as weak and incapable of learning mathematics. Some primary school teachers said, they are compelled to teach the subject that they do not like and perceive as difficult. They added that, primary school teachers do not specialize in any subject, after employment they have to teach everything, so teaching mathematics becomes difficult as some of them did not understand and or had failed the subject. Some teacher had this to say. *"We have developed a negative attitude towards our students as a result, we brand them as incapable and unable to learn"* (Teacher 4, Secondary School). *"Teachers themselves have built an attitude that mathematics is difficult, so even in teaching they believe that they are teaching something very difficult…so it is obvious that students also find it difficult."* (Teacher 25, Primary School). Such behaviors affect students' learning and performance in mathematics; education administrators should assign only competent teachers to teach the subject.

Instruction: Coding of interviewee responses pointed to two issues namely, the quality of instruction (three sub-themes) and quality of assessment (two sub-themes).

Quality of instruction (22 cases): Under the quality of instruction category three subthemes were evident. These subthemes are language clarity, content clarity and the quality of organization and structure.

Language clarity vs. change of language of instruction (3 cases): Teachers consider the abrupt change of the language of instruction - Swahili in primary school to English in secondary schools as a barrier to learning in higher levels. This change results into language barriers in converting mathematics taught in Swahili into English causing failures in examinations. This is demonstrated by the following quote: *"Change of language from Swahili to English is yet another problem. This abrupt change of language causes problems. Conversion of mathematical concepts from Swahili to English escalates the problem and leads to language barriers. This leads them to scoring poorly"* (Teacher 1, Secondary School).

Content clarity: in relation to this subtheme, issues such as poor methodology and knowledge of the subject matter, and lack of linkage with real life application were related to poor content delivery by the teachers that causes failures in mathematics.

Poor methodology and knowledge of the subject matter (10 cases): Teachers describe poor teaching methodology as a cause of student failure in mathematics. Their answers revolved around poorly trained teachers with poor pedagogical approaches, teachers lacking content knowledge, incompetency, lacking child psychology knowledge and relying on teacher-centered approach to deliver instructions. During the interview one teacher had this to say, *"…students fail because they are not taught. If they are taught with competent teachers using appropriate methodological approaches, they will ultimately like the subject… a variety of methodological approaches used by competent teacher will end up making students interested in the subject"* (Teacher 28, College). There was some consistency in the interviewees' remarks at all levels regarding this issue. However, we noted that, inadequate knowledge was linked with primary school teachers as revealed by one of the College teacher who was quoted saying *"But the other thing that I also find challenging is the*

teachers at the primary level they are not competent particularly the current teachers…Nowadays most teachers who are sent to primary or secondary education are those who have performed poorly, which is different from the higher levels" (Teacher 11, college), Cementing this, a primary teacher said, "*In primary there is no specialization of subject, we teach all the lessons, now it gets harder even the teachers themselves are employed to find that math is difficult*" (Teacher 25, Primary School).

***Lack of linkage with real life experience (5 cases)*:** Mathematics is taught as an abstract subject in such a way that students do not see the value of the subject in real life applications. One teacher expressed that some topics in secondary school syllabus do not have direct connection with everyday life. The finding is supported by the following quote "*Students do not see the application of mathematics in real life… they just see it as numbers without knowledge of where they are coming from and how useful they are in life…*" (Teacher 1, Secondary). This theme was evident in the answers of secondary school and college teachers.

The quality of organization and structure of math lessons (4 cases) is connected to poor lesson preparation by the teachers.

Poor lesson preparation (4 cases): Teachers explained their behaviors notably lack preparation for lessons, being harsh and use of punishment as causing students' negative attitude towards the subject, hence poor grades. These practices affect negatively on the quality of instruction. During the interview some teachers said "*…sometimes a teacher does not prepare well to get in class. The teacher enters in class, think of an example right there, solves the question and fails at some point… It makes students believe that mathematics is difficult as the teacher himself has failed to solve the question*" (Teacher 6, Secondary School).

Quality of assessment (6 cases): Teachers raised their concerns about the quality of assessment especially the end of primary school examinations. Their responses point to two sub-themes notably; examination type and the time allocated to attempt national examination.

Examination type (4 cases): Multiple choice exams in primary schools do not prepare students to compute when they get to higher education levels. Teachers expressed that, this type of examination encourages guess works. Students can pass while they do not know anything. The following quote supports the finding. "*The examination system that does not give students a chance to compute is a big problem; for example, in primary schools all mathematics examinations are of multiple choice type…if they cannot compute they will make sure that by any means they pass even through guesswork…In secondary school they are required to compute…*" (Teacher 4, Secondary School).

***Time allocated to attempt national examinations (2 cases)*:** Some teachers said that the time for writing mathematics examination is not adequate. They narrated that time allocated should be more than the time for other subjects, even the current half an hour extra time is not enough. During the interview one teacher had this to say, "*…the biggest challenge is the time allocated for writing mathematics examination-it is not enough, and it should be longer than it is now… We are used to giving them additional 30 minutes. This is not helpful especially to slow students…it takes them a long time to write the examination*" (Teacher 24, Primary School).

Social psychological environment (35 cases): Coding of this category generated three sub-themes namely home environment, school environment (Three subthemes), and peer environment.

Home environment - *family background* **(7 cases):** Poor education background and financial position of the family is also a challenge. The home environment is not supportive. Some parents cannot afford breakfast or a few shillings for their children's transport and or food. Teachers said some students have to walk a long distance and some go to school with an empty stomach. This makes them tired even before the lessons begin. The following quote supports the finding "*Parents should motivate their children…they should make the home environment supportive to schooling, many students in community schools come from families with poor education backgrounds, their economic status is poor too. Thus, they can neither support their children academically nor financially*" (Teacher 1, Secondary School).

School environment - *unfriendly* **(28 cases):** Two aspects related to teachers working conditions and classroom atmosphere emerged.

Working conditions - Scarcity of teaching-learning materials (4 cases): Teachers said that, the teaching-learning materials such as books, models, and geometrical sets are not enough, making it difficult for students to understand mathematical concepts, consequently hate the subject and fail. The following narration supports the finding, "*… we have many students but teaching resources are scarce, for example, mathematical sets…let say in a particular lesson we are measuring 120 degrees and there is only one set for the teacher while students*

have no such sets. Thus, learning will take place to only a few students...so if you ask them about geometry, student will always brand it to be difficult and will develop a negative attitude towards it" (Teacher 20, Primary School).

The classroom atmosphere (28 cases): Two aspects emerged notably large classes vs. number of teachers, the punitive nature of teachers, and discouragement from teachers of other subjects.

Large classes vs. number of teachers (18 cases): Large number of students in a classroom is a problem. This situation impairs teacher's ability to manage the class. Teachers explained that being few in schools (i.e. very low students-teacher ratio) they fail to assist students, mark their homework and control the overall class atmosphere. The following quote illustrate the finding *"There are too many students…a subject like mathematics requires teacher's close supervision on students. Consider a situation where you have 250 students and all have to attempt various questions daily, you will not be able to mark and correct all students. To save time, you just teach for only few minutes and leave them with some questions which you do not mark because of time constraints"* (Teacher 1, Secondary School).

Punitive nature of teachers (4 cases): Teachers explained their behaviors of being harsh and use of punishment as causing students' negative attitude towards the subject, hence poor grades. During the interview one teacher had this to say *"…teachers themselves too are very scary and threaten students that mathematics is difficult in some moments they punish and abuse students for failing. Thus, students suffer the disadvantage of the abuse from their own teachers"* (Teacher 17, College).

Behaviors like these discourage students to learn mathematics, teachers are urged to be polite to raise their students' self-confidence in mathematics. *"We should be polite we do not have to lose our temper when students make mistakes so that they can see that they are capable"* (Teacher 7, College). By adopting such practices, teachers will enhance positive students' attitude and performance in Mathematics.

Discouragement from teachers of other subjects (6 cases): Teachers mentioned that students' failure is also connected to discouragement received from teachers of other subjects. A quote from interview transcript support the finding*"…teachers of other subjects may be a problem... as you pass by the class you hear them discouraging students to study mathematics and concentrate more on other subjects"*(Teacher 5, Secondary School).

Some teachers associated girls with over engagement in home-based activities, early marriages and caring for the family. They were hesitant to offer help when girls face difficulties in understanding some concepts. One lecturer opined that these behaviours may have contributed to girls' difficulties in learning mathematics as they are the ones who fail more in the subject. The lecturer narrated that *"When I was in secondary school, we had a male teacher, he used to discourage us reading and kept saying we would be married soon….in some situations when we needed his assistance, he would not help us at all saying we would be married any time"* (Teacher 20, College). This finding shows some elements of **culture** indicated by gender stereotyping in mathematics. People tend to associate mathematics with **masculinity** thus affecting female students' perception towards mathematics hence more failures.

This result suggests that positive culture towards female mathematics learners is important for enhancing their performance. However, this factor has not been mentioned in the Walberg's theory of productivity, hence we propose an additional factor to the productivity model.

Peer environment (8 cases): Teachers' responses also indicate that peer groups of those performing poorly in mathematics have a bad influence on their counterparts. They also mentioned the influence of the family and other people including teachers who associate mathematics with boys so girls tend to shy away from the subject hence increasing failure rates. During the interview some teachers said. *"I think they are influenced by the peer groups…other students perceive mathematics as a difficult subject. Girls are also discouraged by other people who reiterate that mathematics is for men…"* (Teacher20, College), *"…sometimes you wonder why family members and the community at large amplify the concept of mathematics being a difficult subject"* (Teacher 6, Secondary School).

Policy environment - *Government rules and policies* (4 cases): Teachers describe some government rules as unreal and demotivate teachers, for instance, the restriction of corporal punishment and fairness in the national diagnostic examinations (Lower primary standard ten) examinations as a problem. Primary teachers believe that without punishing the students it will be difficult to make them understand mathematics. The following quote support the finding *"Now mathematics has become increasingly difficult because it is not permitted to hit a student…without hitting them I assure you, it is impossible...and this is a*

government concept that the teacher should not punish children, so teachers do what is possible and leave the rest to them" (Teacher 25, Primary School).

Secondary school teachers orated that, some guidelines including allowing those who fail the form two diagnostic national examination to continue to form three (grade eleven) contributes to the problem. Teachers reiterated that students' needs to repeat a year after failing this examination; since everyone continues to the next stage, those who were supposed to repeat face many challenges in understanding mathematics concepts in the reaming level. This is evidenced by the following narration "*Policies also have their impacts as it is now compulsory that everyone who joined form one must complete four form. Such policies contribute to a decline in the quality of education"* (Teacher 1, Secondary School).

It seems that policy and Government rues affect secondary and primary school mathematics education as most of interviewees who mentioned this factor were primary and secondary school teachers. Even if it was mentioned by college teachers, they always point to either secondary or primary schools.

What do we do wrong?

Initial coding of this question resulted in 16 categories. In the next round, some categories were merged which resulted into six major themes of which five are in line with Walberg's productivity theory. These themes included, quality of instruction (eight subthemes), quantity of instruction, and quality of assessment, school environment (two subthemes), and home environment. We propose to add one more factor namely policy environment to the productivity model from analysis of our data.

Quantity of instruction (2 cases): During data analysis the issue of focus on syllabus coverage and time to cover the syllabus vs. pace of instruction arose. The quantity of instruction is measured by instructional time in the Walberg's productivity model.

Focus on syllabus coverage and time vs. pace of instruction (2 cases): Teachers opinions revolve around directives from school administrators to finish the syllabus at an earlier date. The teachers explained that limiting the time to complete the syllabus has an effect on instruction delivery and student learning. Teachers move faster to finish the content within the given time as a result the focus shifts from student learning to content coverage. One teacher had this to say, "*The authority instructs you to complete the syllabus within a short period of time that is the first offense, you go faster to be within the given time which is shorter than the time required to complete the syllabus"* (Teacher 9, Secondary School). These results indicate high pace of instruction as a result of poor time management in the teaching and learning of mathematics. Schools should make sure teachers and student attend classes on time and they should follow school calendar to avoid a shift of focus.

Quality of instructions (41 cases): coding of this category resulted in three sub-themes namely quality of organization and structure, content clarity and quality of assessment.

Quality of organization and structure (24 cases): there were three issues related to this subtheme including instructional strategies, poor preparation and use of teaching aids, and lack of time and strategies to sensitize/motivate students to like mathematics.

Instructional strategies (11 cases): Teachers views pointed to instructional strategies as a cause of students' low grades in mathematics. Teachers explained that they mostly use teacher-centered methods which do not involve students' active participation which hinders students understanding of mathematics. "*The methodology we use, the teacher-centered approach still exists…and contributes greatly to our mistakes because teacher-centered does not consider students' abilities and roles in the learning process*" (Teacher4, Secondary School).

Teachers described their teaching strategies as those which do not recognize the different students' abilities. Since the classroom consists of students with varying learning abilities, teachers must understand their students' learning abilities so that they can help those in need. One teacher had this to say, "*…we think they know, yet the class has a mix, there are those who understand, the average and the most elusive, so the teacher must control the class by looking and reading from on their faces to identify whether they understand or not. We should not discourage them, rather try to bring them closer …"* (Teacher7, College).

Poor preparation and use of teaching aids (6 cases): Teachers' views depict that they do not prepare well for lessons and they do not use teaching aids to help students understand lessons. These teachers consider their behavior as a mistake affecting students learning and performance in mathematics. During the interview one teacher said, "*The correct way is when a teacher goes to class with a pre-prepared summary (the teacher's*

notes)…*he must be prepared and strive to use the teaching aids…when they go to class they do not use such items, they are not ready and they do not use teaching aids* (Teacher6, Secondary School). Such results emphasize the importance of preparedness and use of teaching aids. Teachers are urged to prepare themselves for lessons and use of teaching aids to help student understand lessons.

Regarding this issue other teachers said they do nothing wrong but the working conditions especially overcrowded classrooms cause their wrong doing. "*I do not do wrong instead the circumstances force me to do wrong. Large classes are a problem, I fail to support students through checking their work*" (Teacher13, Primary School). Such a statement implies that the teacher-students' ratio should be looked upon to simplify the work of the teachers. Class size should be within the teachers' capacity so that they can help students with their work.

Lack of time and strategies to sensitize/motivate students to like mathematics (7 cases): Teachers need to allocate time and find strategies to motivate students to learn mathematics. Teachers answers to interview questions points to lack of time and strategies to create the environment to motivate students to study mathematics. One teacher said, "*… the student who needs time for consultation on how to study and pass mathematics is not given that time because we do not have such time. Sometimes we miss the approach to make them like the subject*" (Teacher22, Secondary School).

Content clarity (13 cases)*:* two issues notably teacher competency vs. subject specialization, and lack of linkage to real life applications are linked to unclear content delivery to students' populations.

Teacher competency vs. subject specialization (10 cases): Many interviewed teachers explained that understanding of the subject matter is required to perform well in mathematics. Regarding teachers' competency, some teachers expressed that, other teachers particularly in primary schools are not good at mathematics as they did not understand the subject themselves. The lack of content understanding really affects delivery of instructions hence students' failure. The following quote supports the finding; "*But our background also contributes to our mistakes. In any case, the example is, perhaps you have been allocated to teach a subject that you do not understand well … it will bring you troubles. Sometimes students will ask you questions that you are unable to respond to because of your limited understanding of the subject itself*" (Teacher 20, Primary School).

Teachers' reactions also pointed to reasons for poor competency in mathematics such as the lack of subject specialization in teacher training especially for the primary school teachers. Their responses indicate that some primary school teachers had failed their mathematics examinations. These teachers fail to deliver properly as they teach something they do not like, have no knowledge of and pedagogical skills consequently, affecting students' learning and performance. The following quote supports the finding; "*Lack of specialization is a contributing factor, a teacher may be assigned to teach a lesson he/she is not capable of. So when a student gets lost at the lower levels, he becomes unable to perform well at a later stage…*" (Teacher13, Primary School), "*…a teacher does not have the content knowledge, it leads to poor delivery of the subject matter, poor understanding among pupils which leads to poor performance* (Teacher26, Primary School).

It is clear from the result that another strong contributor of students' performance is teacher content knowledge of the subject matter. It is also clear that there are problems in primary teacher training programs. In order to train competent teachers, there should be subject specialization.

The issue of *lack of linkage to real life applications* (3 cases) also arose. Teachers said that failure to link mathematics with real life experiences affect students in a negative way. These students do not see the value of mathematics in everyday life, hence avoid it. One teacher said, giving real life application examples would enhance their learning experience. He added that "*…there is a real life application to each topic you study in mathematics. For example a topic like combination and permutation is not taken to be important by many students but when you explain to them that it is applied when registering cars, then they say wow! Is that so?* (Teacher 11, College). Such results emphasize the importance of linking mathematics with real life applications. Teachers should give real life application examples of mathematics while teaching to motivate students to learn.

Quality of assessment - *Deficiency in the evaluation process* **(4 cases):** Teachers' responses indicate some deficiencies in the evaluation process. Teachers' revealed that due to overcrowded classroom they fail to conduct a thorough evaluation of students work including marking of the assignments. One teacher had this to say, "*…the assessment becomes unsatisfactory…you give questions to the class, mark a segment of it just to show that you taught on that day. But in reality you did not make a thorough examination of the students' work which I think is the biggest mistake especially in the assessment element*" (Teacher9, Secondary School).

School environment (10 cases): Two sub-themes notably working conditions, and classroom atmosphere fell under this category.

Working conditions (5 cases): are characterized by teachers who lack commitment and motivation, and teachers of other subject discouraging students to study mathematics.

Lack of commitment and motivation (3 cases): Teachers describe themselves as unmotivated and lacking commitment due to *poor working environment*. They describe the working environment as heavy workload with less pay consideration compared with other subject teachers, so they just teach to fulfil their obligations. These practices really affect students in a negative way. This is evidenced by the following quote*"…they are not motivated…heavy workload as compared to other subjects…when you teach mathematics you have to mark exercises every day…if you are not motivated you may end up teaching differently"* (Teacher 3, College).

Teachers of other subjects discourage students to study math (2 cases): The interviewed teachers reported that some school administrators and teachers of other subjects discourage students to concentrate on mathematics as it will reduce their overall GPA. These leaders aim at enhancing students' overall performance but at the cost of mathematics. They emphasize students to concentrate on other subjects such as English and Kiswahili. One teacher reported that, *"…they discourage students by telling them to put mathematics aside and allocate maximum concentration on other subjects like English, Swahili because they are passable* (Teacher5, Secondary School). This kind of a behavior really affects students' perception towards mathematics. Teachers should find other strategies to enhance students' overall performance in such a way that mathematics should contribute to the overall good performance.

Classroom atmosphere (19 cases): Coding of this subtheme lead to four aspects notably teachers are angry and punitive, poor classroom interaction, failure to support and supervise students work, and streaming.

Teachers are angry and punitive (5 cases): With regards to this issue, teachers had different opinions. Some teachers described themselves as being angry at students whenever they make some mistakes. Some teachers believe that this behavior scare students and makes them avoid them and mathematics as a subject. They opined that teachers should listen to their student's problems before resorting to punishment. *"…as humans we bring our frustrations and anger to the classroom. Evidently, things that you will teach on that day no student will understand... sometimes we even punish without knowing reasons behind students' errors. For instance, a student may have family problems. Punishing him/her will sire hatred to you and your subject"* (Teacher 4, Secondary School).

Other teachers believed that using reinforcement strategies such as corporal punishment could help students work hard. They said, lack of punishment in schools impair their efforts to teach as some students need a push. One teacher had this to say, *"…when the government abolished corporal punishments in schools, teachers also decided to become hesitant in correcting children even if they go wrong claiming that some students cannot work hard if not pushed by a stick"* (Teacher 23, primary School).This implies that teachers' behavior and reinforcement strategies they adopt also affect students learning and performance. They should adopt reinforcement strategies that increase students' confidence and encourage them to learn.

Poor classroom interactions (3 cases): Poor student-teacher interactions in the classroom was also mentioned as a reason for students' failure. Teachers opined that students fails to express their views in the classroom, they do not even ask questions or seek for clarification. *"…there is poor interaction between teachers and students, hence students fail to express themselves to the teacher about their level of understanding…"* (Teacher22, Secondary School). This situation may be caused by teachers' behaviors of being angry and punitive and or language problems. Teachers are urged to show a good sense of humor while teaching mathematics to reduce fear among students. They should also encourage students to speak. For example, in the question and answer sessions it will help build their confidence.

Failure to support and supervise students' work (9 cases): Teachers' responses pointed to the lack of time to supervise and support students' work due to overcrowded classrooms leading to poor performance. One teacher said, failure to supervise students' work during lessons frustrate students and those who are unattended will be left behind leading to failures. A primary teacher was quoted saying; *"In mathematics a child should participate to calculate…you have to take time to stay as he/she calculates... for the number of students in these schools...to supervise each student, determine the arrangement, quality and correctness of his/her work is limited. In a class session, when time goes out, those who have not been marked will be marked in the following session which is sometimes frustrating to students and leads them to lag behind and at the end of the day results get worse"* (Teacher 12, Primary School).

Streaming (2 cases): Teachers' reactions indicate that, distribution of students in different classes confuse teachers regarding the mathematics ability of students. One teacher explained that in some schools, students are placed into streams based on their previous levels' overall performance. But this performance does not mean they are good at mathematics, so some teachers confuse and treat some classes to be good in mathematics while they are not. During the interview this teacher said; "*In my school we grade students according to their capability…we have streamed them based on the average scores in all subjects. Though, you find they are still poor in mathematics…I relax when teaching them believing that I teach capable people but it is not true that they have good ability in mathematics but have a great potential for alternative subjects…*" (Teacher4, Secondary School). This implies that teachers should understand that classes have students with mixed abilities and that student's need a variety of teaching techniques, so they should employ strategies that will attract the different types of learners.

Home environment- *trust on tuition centers (2 cases):* Some teachers voiced their concerns regarding students' trust in tuition centers than their school teachers. They said that those who teach in these centers are not qualified teachers, they do not have mastery of teaching methodology, and most of the time they use Swahili for instruction delivery while exams are in English. These practices impair students' ability to understand examinations given in English, consequently, affecting students' performance. The following quote supports the finding "*…students trust tuition (coaching) centers than their subject teachers. Such centers are run by poorly prepared teachers with poor mastery of subject content and pedagogical skills. Thus they half-baked students which contributes greatly to the decline in performance*" (Teacher4, Secondary).

Policy environment (5 cases): Two subthemes emerged namely poor implementation of education policies and the concept of free education.

Poor implementation of education policies (3 cases): Teachers voiced their concerns about some education policies which they think as confusing and sometimes misleading. Teachers have described some policies such as the free education concept and Big Results Now (BRN) have made things worse. They said that the BRN idea could be good, but the implementation may have had some deficiency. Teachers opined that the idea of teaching for examinations was not good, giving teachers specifications to concentrate on some topics as they are likely to appear in examinations was not the best option. This practice really affected students' as they had to cram only to pass exams hence impairing their computational ability in later stages. "*What did the government do after seeing that competence-based approach has failed? It changed to TEC. TEC is something that came with BRN, they gave us specific topics to be read by students, because they were likely to come in the exam. So now instead of competence-based approach, they are focusing on the results because the results have often been getting worse*" (Teacher4, Secondary School).

The concept of free education **(2 cases)** was regarded as a hindrance to teacher's efforts to improve the teaching-learning process of mathematics. The idea came with influx of students with limited number of resources. Teachers opined that this kind of practice can jeopardize their efforts, for example, with unavailability of textbooks, parents would buy for their kids, but they no longer want to do so, as education is free. "*…this concept of free education will lead into extra massive failure because sometimes you find books are not enough…so asking a parent to buy his/her child a book becomes very difficult, but in the past it was easy to tell each child to have a book and parents would buy…*"(Teacher25, Primary). Such results imply that the government should supply enough teaching-learning materials including textbooks in schools since parents would no longer buy for their children.

What causes us to go wrong?

Coding of this question in accordance with Walberg's theory of productivity resulted in 3 interpretable themes that include instruction (two sub-themes), school environment, and mass media.

Instruction: two sub-themes notably quality of instruction (four sub-themes) and quantity of instruction emerged. The subthemes are described in relation to our data set in the following paragraphs.

Quality of instruction (11 cases): Quality of instruction is affected by the quality of reference/text books, lack of in-service training, teacher recruitment process, heavy workload, and lack of collaboration among teachers.

Quality of reference/text books (2 cases): Teachers responses point to deficiencies in the mathematics textbooks especially in secondary schools. They said that, some textbooks contain wrong formula and or wrong answers to exercise questions. These mistakes make students learn wrong content hence misconception leading to failure. The following quote supports the finding "*…there are new books that have been published*

and released just recently, they contain incorrect formula and answers. So when students refer to these books end up having wrong concepts which if used in exams leads them lose the marks, hence fails" (Teacher 6, Secondary School).

Lack of in-service training (3 cases): Teachers views revolves around seminars, workshops, in-service courses which are not regularly organized for teachers. In-service training is necessary for enhancing teachers' knowledge and pedagogical skills. "*No in-service training are conducted…if they are, very few primary and secondary school teachers get a chance maybe once a year or after two years which is not enough*" (Teacher 17, College).

Teacher recruitment process (4 cases): Teachers views varied; the primary school teachers pointed to the weaknesses in the distribution of teachers in schools without considering school needs. They said that some schools have more language teachers or other subjects, but they are expected to teach any subject they are allocated to. This is a problem as some teachers are not good at mathematics so if they are assigned to teach, they will not deliver properly; thus, hindering students learning. One teacher said, "*Some teachers are assigned to schools without considering what we need. Authorities just count the number of teachers you have in a school not of which subjects. Problems start when you assign a teacher to teach a subject that he/she is not competent in (like mathematics)*" (Teacher 20, Primary School).

In higher education, teachers are recruited based on higher GPA, there is a possibility that they are not professional teachers, thus they lack subject content and methodological approaches for carrying out teaching activities. One teacher had this to say, "*The teacher who teaches them is probably not a professional teacher, so he/she does not even know teaching strategies... they know little of teaching methodology and no training is given to them, after all, this is one among the biggest mistakes being done*" (Teacher 17, College).

Lack of collaboration among teachers (2 cases): Teachers need to collaborate to complement each other's weaknesses in some mathematical aspects. Teachers voiced their concern regarding unwillingness of some teachers to offer help or seek help from others to teach the topics they are not good at. This is considered a mistake that affects student learning and consequently performance. One teacher narrated "*The cooperation among teachers ourselves is very poor, sometimes you request assistance from someone who, instead of helping you, ignores you. This makes us live and carry out our activities in isolation*" (Teacher 22, Secondary School).

Quantity of instruction (3 cases): This is indicated by the number of contact hours. Our findings show that the number of contact hours is affected by ***teachers' absenteeism.*** Interview responses indicate that, teachers miss lessons due to personal reasons, such as sickness and family problems; or official reasons including being assigned official tasks for example marking of national examinations, and or invigilation tasks. Teachers opined that truancy leads to non-completion of syllabus and or high pace of instruction. One of them reported, "*We are required to attend 195 periods but in the middle…the student either miss school or the same happens to the teacher. To teachers it might be attributed to office or personal factors. Personal causes may be like illness or family related ones. Official reasons include special task such as invigilating national or regional examinations for two weeks, two weeks for the mathematics teacher has lost too many sessions* (Teacher 4, Secondary School). These kinds of practices really affect students learning and performance so teachers and education administrators need to find ways to compensate for the lost hours.

School environment (25 cases): this theme consists of two sub-themes including working conditions and classroom atmosphere.

Working conditions (15 cases): it was discovered that the working environment is characterized with teachers who lack motivation due to inadequate remuneration, lack of support from school management, and lack of commitment.

Lack of motivation vs. inadequate remuneration (3 cases): Teachers were not motivated to teach due to various reasons including inadequate remuneration. Teachers explained that, they are busy with other things to sustain their living, demotivated due to delay of various rights/teachers' interest. One teacher narrated, "*…we've been very busy with personal things…you teach a little and then run for another business, so that's the problem. The need for extra income that can meet the needs of the home causes us to run for other businesses and fail to concentrate on teaching*" (Teacher 19, College).

Their responses indicated that lack of motivation lead to poor concentration on teaching. This attribute really affects the teaching-learning process and consequently students' learning. One teacher narrated, " *…not motivated, the teacher enters in the classroom to fulfill his duty only, but the motivation to educate these*

students so that they will eventually be good people in their field is completely absent"(Teacher 1, Secondary School).

Lack of support from school management (2 cases): The interview responses indicated that school administrators' failure to attend to teachers needs especially providing them with teaching resources at the required time demotivate teachers to fulfil their duties. During the interview one teacher had this to say,*"…I think that when you get the right leaders, makes you work better… for example, if they fulfill your demands as far as academic resources are concerned, it motivates you to work with all your efforts than having uncaring and unsupportive management"*(Teacher 5, Secondary School).

Lack of commitment (10 cases): Teachers describe themselves as not committed, not ready to find solutions to the problems facing students. One teacher said *"we are not ready to volunteer and work hard to deal with learners' problems* (Teacher 10, College). This behavior really affects instruction delivery, as teachers would just fulfill their duties without looking at students learning needs.

Classroom atmosphere- *large classes* **(10 cases):** Large classes was also a hindrance. Teachers explained that having large classes makes it difficult to prepare well for lessons and use of the appropriate approaches to cater for students' different learning abilities *"…the number of students makes us unable to go with the correct approach…you find rooms with 200 students, you cannot focus on individual students and help them, so large classes hinder teachers from teaching well*(Teacher 11, College), "The *main reason is the teaching load, it bars teachers from preparing themselves well…"* (Teacher 6, Secondary School).

Mass media (2 cases): Mass media was indicated by teachers' emphasis on the use of technology in teaching mathematics. Their responses pointed to issues of lack of innovativeness among teachers as affecting student motivation to study mathematics. Teachers emphasizes on the importance of technology in mathematics education. They opined that technology could help motivate students to learn mathematics and understand it. Their reactions indicate that lack of innovativeness limit their options to adopt strategies utilizing new technologies that can improve students learning experiences. One teacher said, *"We are also not innovative, so far there are various technological advances, we can use them in motivating students to love mathematics but very few of us have done so"* (Teacher 16, College). Such a response indicates that teachers are reluctant to try other teaching approaches which could be effective in improving students' learning and performance.

How do you Feel when Teaching Mathematics?

Interview data: Teachers were asked about their feelings when teaching mathematics. They were also asked to draw a visual image portraying their fillings when teaching mathematics. A total of 23 teachers answered this question from which 9 showed positive emotions, two negative emotions, and 12 mixed emotions. Aural data resulted in 17 codes including positive and negative ones. The codes were grouped into two themes, notably positive emotions such as *"Good, comfortable, enjoy…"* and negative emotions such as *"bad, carrying heavy load, angry…"* Responses depicting both positive and negative emotions were labelled mixed emotions. **Table 6** displays teachers' emotions when teaching mathematics based on aural information.

Table 6. Teachers' emotions when teaching mathematics

Sub-themes	Emotions	No of respondent	Reasons for the formed emotions
Comfortable, enjoy	Positive	9	- Teaching skills - To motivate students
Dizziness, bad about it	Negative	2	- overcrowded classes vs. failure to assist students
so happy and feel hurt	Mixed feelings	12	- Students unresponsiveness to instructions - Large classrooms - Inadequate resources

Table 6 depicts that the majority of teachers showed mixed emotions (12 teachers). Reasons for mixed emotions are related to unfriendly teaching-learning environment characterized with inadequate resources. *"Due to unfriendly environment in which teachers are not supported with adequate resources"* (Teacher 5, Secondary School). Positive emotions on the other hand are linked with good teaching skills such as the ability to apply appropriate teaching strategies and knowledge of the subject matter. One teacher narrated, *"I feel comfortable when I see all pupils carefully listening to me because I'm using so many techniques to make them attentive"* (Teacher 10, College). Negative emotions are associated with failure to manage and assist students due to overcrowded classrooms *"because of overcrowded classrooms I do not have the ability to know to what extent every student understands…"* (Teacher 16, College).

Visual data: Visual data also demonstrate three types of emotions notably positive, negative and mixed feelings among teachers. Visual representations of teachers' emotions are depicted in **Figure 3 a-c**.
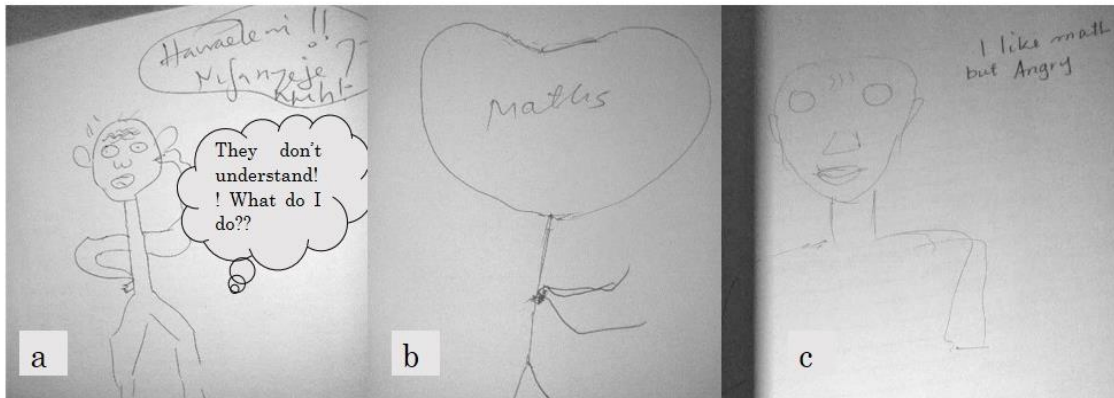

Figure 3. Visual representation of mathematics teachers' emotions when teaching mathematics. a. college teacher showing confusion (negative emotions). b. college teacher showing love of mathematics (positive emotions). c. Secondary school teacher showing liking of mathematics and being angry at the same time (mixed emotions)

What do you Think should be Done to Revert the Situation?

Coding of this question initially resulted in 21 categories. In the next round, some categories were combined which resulted into 11 major themes. They included, enhance students' learning strategies**,** improve teaching and learning environment (7 subthemes), provide education to sensitize parents, and teachers (2 subthemes), improve the recruitment process (2 subthemes), enhance teacher training programs (3 subthemes), Provide incentives and competitive salary to mathematics teachers, encourage innovativeness, Provide frequent in-service trainings, and accountability for all.

Enhance students learning strategies (5 cases): Teachers suggested that students should be aware of the best learning strategies. They should be acquainted with basics of learning mathematics such as time management and frequency of individual studies. During the interview one teacher commented **"***Each student is required to build a foundation for understanding the mathematical fundamentals. There are mathematical basics that should be monitored within a certain interval of time"* (Teacher2, Secondary School).

Improve teaching and learning environment (31 cases): Seven subthemes fall under this category. These include reduction of teaching load vs. increased number of classrooms and teachers, scheduling of math classes, link mathematics to real life and offer encouragement and support to students, assess students more frequently; assign experienced mathematics teachers at lower education levels; regulate the syllabus/curriculum; and Ensure availability of teaching aids and materials.

Reduction of teaching load vs. increased number of classrooms and teachers* (14 cases):* Teachers opined that reduction of teaching load should go together with building of more classrooms and recruitment of new mathematics teachers. Reduction of workload will help to enhance their classroom management skills, and allow them to make a thorough assessment of students' work. Quotes from two teachers support the finding *"The teaching load should be reduced…the number of teachers should be increased…more classrooms should be built, so that we have smaller classes"* (Teacher 3, College). *"If the number of teachers is increased…you have time to sit down and make enough assessment"* (Teacher 5, Secondary School).

Scheduling of mathematics lessons (2 cases): Teachers' responses indicated that students learn mathematics better during morning hours. They proposed that mathematics lessons should be conducted between seven and eleven in the morning. One teacher said, *"But the one I teach at three o'clock, at two, while some students have not eaten do you think they will understand?…if there are enough teachers, mathematics should be taught at the right time, from seven to eleven o'clock, we should not teach until noon"*(Teacher 4, Secondary School).

Link mathematics to real life and offer encouragement and support to students (3 cases): Students need help from their teachers, they need to understand the value of mathematics in real life and teachers who encourage them to do mathematics. Teachers proposed the allocation of time for consultation, telling the value of mathematics in life, avoiding being angry to students, and to encourage them will make

students learn better, hence improve their performance. During the interview two teachers commented that, "*Mathematics teachers should educate students about the importance of mathematics*" (Teacher 2, Secondary School). "*You can set aside your time...for those who need extra consultation and avoiding being angry when in class*" (Teacher7, College).

They proposed also that female teachers should act as role models for girls, to encourage them to study mathematics. One teacher said "*Encourage our students to realize that mathematics requires practice and most especially to female students as they are the ones who fail the most. Female teachers should encourage female students. This will help them to see that there are women who are good in mathematics…I distributed small leaflets to just a few female students that motivated them to do well* (Teacher 16, College).

Assess students more frequently (3 cases): Teachers proposed regular classroom exercises, tests and exams to identify learning difficulties and clear students' misconception earlier. A comment from one teacher supports the finding "*Frequent classroom practice, tests…and practices, will help us discover their problems and will help to clear where we have gone astray*" (Teacher20, Primary School).

Assign experienced mathematics teachers at lower education levels (3 cases): Good foundation in mathematics should be built at an earlier stage of education. Teachers proposed engagement of experienced mathematics teachers from primary schools or even nursery schools in order to build good foundation. One teacher said "*Teachers who are experienced in teaching mathematics, should be allocated in lower levels especially primary schools, so that they can build a solid students' foundation in mathematics*" (Teacher22, Secondary School).

***Regulate the syllabus/curriculum* (2 cases):** Teachers proposed a review of the lower secondary school mathematics syllabus to reduce its content and adjust it up to the levels to remain with elementary mathematics and statistics topics. One teacher advised that, "*I think they should regulate the syllabus or mathematics curriculum for O-level and especially in the fee-free education system...to reduce some of the items...adjust them to higher levels...while remaining with elementary mathematics and statistics*" (Teacher1, Secondary School).

Ensure availability of teaching aids and materials (4 cases): Teachers emphasized on the importance of using teaching aids and materials for enhancing students learning experiences. These teaching-learning resources should be provided timely. It will help students to link theory and practice, hence become competent in their fields. One teacher had this to say, "*Mathematicians or engineers in other countries becomes competent because they are prepared to be, so they become engineers who are familiar with engineering tools. As for us a person begins to study engineering at the university, even those professors do not have all such teaching materials... I was talking to one engineer who disclosed to me that some of the equipment were known in the field and not in the class*" (Teacher 2, Secondary School).

Educate parents, teachers and the community (6 cases): Two subthemes emerged including sensitize parents, teachers and community; and advice parent to contribute food in schools

***Sensitize parents and the community* (4 cases):** Education begins at home, and parents are the first teachers of a child. Teachers proposed to educate the community to change their perception towards mathematics. These people interact with children first before they go to school, thus if they have positive perceptions, they can pass that on to children. "*Community education should be provided…beginning from home with parents, and the general public to believe that mathematics is a simple subject so that students begin to love it. Because the notion of mathematics being difficult starts from home and thereafter the entire community…with such notions they will not be able to learn*" (Teacher 6, Secondary School).

Advice parents to contribute food in schools (2 cases): The interviewed teachers proposed that parents should contribute to provide food in primary schools to help students learn better. One teacher had this to say "*Parents are advised to contribute food to school. This will facilitate learners to be active as they will not be hungry…children do not get enough food so that they can learn*" (Teacher 24, Primary School).

Improve the recruitment process (11 cases): Under this category, two subthemes were identified. They included recruit competent teachers, and allocation of teachers in schools to consider school needs.

***Recruit competent teachers* (9 cases):** Teachers proposed hiring of teachers who have both content knowledge and methodology. Their responses emphasized on primary teachers because they do not specialize in subjects so some do not have the content knowledge. One teacher asserted that, "*Hire teachers who are good…I may say that some primary teachers teach mathematics but they do not understand what they are teaching... hire teachers who know the content as well as good in methodology*" (Teacher 6, Secondary School).

***Allocation of teachers basing on schools' needs* (2 cases)*:* Teachers opined that those who hire teachers for public schools should consider school needs. Some schools may be in need of mathematics teachers, but they are provided with more English teachers. "*There are teachers teaching mathematics but more competent in English language. When more English teachers are hired, one of them will be forced to teach mathematics a subject he/she is not competent in. At least allocation should consider school needs*" (Teacher 12, Primary School). This practice really affects students' performance as a few available qualified teachers will endure heavy workloads which will definitely affect instructional delivery.

Enhance teacher training programs (4 cases): Three codes were evident notably provide scholarship for mathematics courses in colleges, and introduce mathematics bias schools from lower levels

Provide scholarship for mathematics courses in colleges (2 case): Teachers proposed provision of scholarship to students wishing to study mathematics further in diploma, bachelor and masters' degree levels to attract more students specialize in mathematics teaching. One teacher narrated "*…you cannot employ many teachers because they are not trained from the college. You have to give a lot of scholarships to those wishing to study mathematics and physics at the diploma and bachelor's degree level. This will attract many to study mathematics*" (Teacher 6, secondary School).

Introduce mathematics bias schools from lower levels (2 cases): Teachers proposed the introduction of mathematics bias schools from lower levels of education to generate people with good understanding of mathematics. One teacher said, "*Even at the primary level they should have mathematics biased schools, at least we can find reliable people of mathematics…*" (Teacher 22, Secondary School).

Increase remuneration (3 cases): Teachers' responses indicated that incentives and competitive salaries are crucial especially in public schools to motivate them to stay. The interviewed teachers said that good mathematics teachers prefer private schools which pay more. One teacher narrated "*The difference in salary has to be reduced, in private schools, the payment is good. In these schools, you sign a contract. The more distinctions you achieve, the more you are paid. This motivates you to work even harder*" (Teacher 6, secondary School).

Encourage innovativeness (2 cases): Teachers are urged to be innovative. They should make use of technology, give real life examples and be role models especially for girls who seem to fail math more than boys do. "*We teachers should be innovative to use technology, make mathematics just as a song, motivate students, and as women, we are role models to girls who seem to be failing than the expected rate*" (Teacher 16, College).

With regards to technology, teachers proposed use of media such as TV programs and other ICT applications to make mathematics attractive to students and enhance their learning experiences. One teacher had this to say "*…there is a program of East Africa TV, they teach a lot of mathematics. I think the government should investigate how such sessions should be promoted that each student is fascinated to love mathematics and perceive mathematics as simple like other subjects*"(Teacher 9, Secondary School).

Provide frequent in-service trainings (3 cases): Teachers proposed regular in-service trainings including seminars, workshop, and short time courses on how to teach, the different teaching strategies, preparation of teaching aids to update their knowledge. Their answers indicated a multiplier effect as those who attend these trainings could teach those who did not attend. One teacher said "*Regular seminars, workshop at least for two days…one year we had mathematics seminars…there is something new that I got there, preparation of teaching aids and how to teach, so when I returned, I was able to teach my colleagues*" (Teacher 14, Primary School). This implies that few teachers can attend seminars and after that they will be able to provide regular in-house trainings to other teachers.

Accountability (2 cases): Teachers and students are urged to be accountable for their actions, they should fulfill their duties accordingly. Teachers should prepare well for lessons, to teach and to regularly update their knowledge through reading books. Students should regularly practice internalizing what they have been taught. "*Teachers need to read books when preparing lessons and should encourage students to read as well so that they follow and practice what they have been taught. This will help them perform better in their exams*" (Teacher 26, College).

DISCUSSION

The aim of this study was to examine the extent of failure in mathematics examination and to probe on teachers' perception about factors influencing students' performance in mathematics. Results show high

failure rates and that female students underperform male students in most educational levels with the exception of upper secondary school mathematics where girls outperform boys.

The Extent of Failure in Mathematics at Various Levels of Education and Gender (RQ1)

Data analysis from this study shows that there are high failure rates at all levels of education examined. With the exception of upper secondary (A-level) where it can be seen that the percentages of those who fail in the subject are lower compared to that of primary and lower secondary mathematics examinations; but overall, they both converge to higher failure rates as years advance. The best performance at upper secondary could be explained by the fact that only a few good students make it to the advanced level of secondary education (URT, 2011, p. 186).

Analysis by levels shows that failure rates are higher in lower secondary school (O - Level) examinations. This implies that the level of mathematics difficulty increases among students in lower secondary basic mathematics. This is indicated by the lower pass rates compared to both primary and upper secondary mathematics examination results. This can be explained by the rapid expansion of secondary school intake with limited supply of teaching and learning resources (URT, 2011). Students seem to perform better in upper secondary and College mathematics, although the pass rates are not very much promising. This observation is consistent with the results of Galadima and Yusha'u (2007) whose study revealed the existence of learning difficulties in mathematics among senior secondary schools in Nigeria.

Gender differences in mathematics examination results were observed at all levels examined where girls underperformed boys. The failure percentage rates of girls in primary and lower secondary gives a clear picture. This observation is in line with the study of Maliki et al. (2009) who found that male students performed better than their female counterparts in lower secondary school mathematics examinations. In contrast, the results of Galadima and Yusha'u (2007) revealed insignificant differences in the performance of boys and girls in learning mathematics concepts, symbols and ideas. However, in their study, both boys and girls performed poorer in the test provided. Looking at upper secondary students' performance in mathematics the pass percentage rate of girls was much greater than that of boys. This indicates that girls are not very different from the boys; they can equally learn mathematics concepts as boys.

High failure rates could be the result of rapid expansion of education during this period (2007-2014). The government through its Primary Education Development Program (PEDP) and Secondary Education Development Program (SEDP) aimed at reaching the Universal Primary Education by 2005. In 2002, the government abolished school fees in primary schools that resulted in a sudden increase in enrollment in primary schools (URT, 2011, p. 83). The PEDP program was successful in terms of increasing enrollment but went without a proportional supply of resources including teachers, and books (URT, 2011, p. 183-184). Ponera et al. (2011, p. 3) noted that only three percent of standard six pupils had been using mathematics textbooks in 2007; the student teacher ratio exceeded the national benchmark of 40 students per teacher. This can reduce the capacity of teachers to assist individual student with their learning difficulties.

The implementation of SEDP, on the other hand, involved the hurried construction of schools to cater for the expanded intake, as a result, there were no prior preparation with regards to teachers and other necessary inputs. Even though, many students selected to join the schools had lower pass rates (Sumra & Katabaro, 2014). Other reasons for high failure rates are examination setting, poor teacher competencies, poor teaching, motivation and weak content knowledge (Mazana et al., 2019; Ponera et al., 2011).

Teachers' Perception about Factors Influencing Students' Performance in Mathematics (RQ2)

In order to identify factors influencing students' learning of mathematics from teachers' perspective, teachers were asked three questions: *why students fail/avoid mathematics? What do we do wrong*? And *what causes us to do wrong?* Teacher's responses to each question were separately analyzed to reveal different sets of factors based on the original Walberg's theory of productivity but allowing new factors to image. In this section we combine findings and discuss them in relation to Walberg's theory of productivity factors.

Based on Walberg's theory, our analysis revealed that, factors influencing students learning of mathematics in Tanzania involve students' aptitude, mode of instruction, and socio-psychological environment. Furthermore, we also found a cultural variable "gender" having a direct impact on mathematics learning, which is similar to Waldrip and Giddings (1994) findings reporting among other factors, gender as a significant predictor of outcomes for science learning. In view of our findings, we suggest that the socio-

psychological environment needs to include the policy environment. Policy environment in this case affects what teachers do in the classroom, impacting classroom practices in a negative way. That is, it was felt that some changes and reforms made to educational policies were inappropriate and caused ineffective teaching. For example, according to secondary school teachers, the introduction of BRN for education, emphasizes some easy to memorize topics while neglecting other topics despite their practical importance. This resulted in a widespread confusion and misunderstanding surrounding this policy implementation. Thus, affecting instruction delivery and consequently students' overall knowledge in mathematics. The productivity factors and their interrelationship with aspects related to mathematics learning (affect, cognitive, behavioral) are depicted in **Figure 4** and discussed further in the following sections. Mathematics learning aspects correspond to an attitude towards mathematics which are recognized as precursors of mathematics learning behavior (Mazana et al., 2019). This means that, positive learning behavior requires manipulation of these factors mentioned in **Figure 4**.
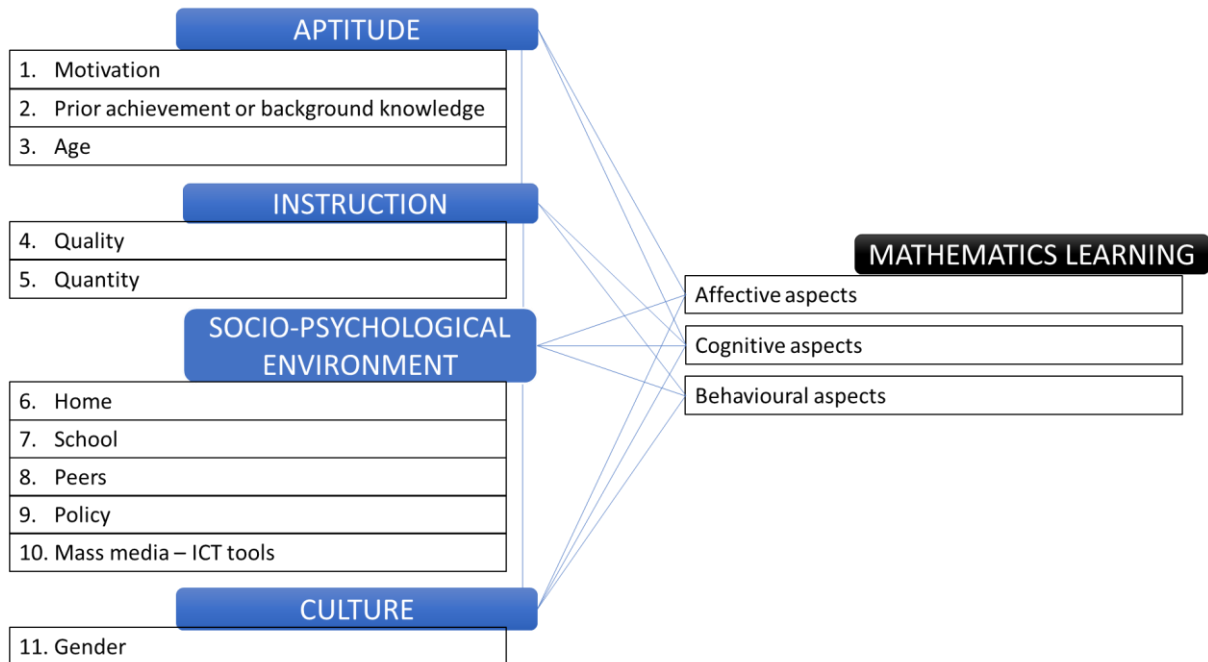

Figure 4. Educational productivity model for mathematics education within Tanzania

Student aptitude

It was found that motivation, entry level age especially at primary level, prior achievement, and mathematics background knowledge of students influence the learning of mathematics. In most cases older students (secondary school and college) were described to have low motivation characterized with a dislike of mathematics, laziness, apply poor learning strategies to mathematics, and had poor background knowledge in mathematics. The relationship between students' background, motivation, and prior achievement has been demonstrated in past studies. Bruinsma and Jansen (2007) in their study found major effect of prior achievement on students' scores in the first-year university mathematics examination. They also found an effect on motivation in terms of expectancy on grades.

Instruction

The quality and quantity of instructions were among the evident factors in our data. **The quantity of instruction** in our study was indicated by less contact hours due to teacher absenteeism leading to no coverage of the syllabus or high pace of instruction that had an impact on students' grade. Such results are supported by Michael (2015) where in his study students admitted having obtained low marks in mathematics due to teachers coming late to the classes or missing classes and that the lost sessions are not usually compensated. Researcher Bruinsma and Jansen (2007) in the examination of part of productivity model on University students' performance found an effect (0.22) of the number of contact hours on the performance of students in mathematics. Regarding the **quality of instruction**, findings revealed lack of language clarity, content clarity, quality of structure and organization, and poor quality of assessment. On **language clarity**

it was found that students had English language problems. English language is a language of instruction in secondary schools and higher education, yet most students struggle with the language indicating that these students had difficulties in understanding instructions in mathematics. This finding corroborates that of Mazana et al. (2019) and Joseph (2013) who found that English language problems among secondary school students hindered their learning of mathematics.

Regarding **content clarity** the findings show that many teachers are unskilled, have poor content knowledge particularly primary school teachers. As a result they fail to deliver instructions appropriately. It is expected that good mathematics foundation should be built early from primary possibly in nursery schools. If teachers are unable to teach properly, students might be completely lost and once they are left behind it will be difficult to understand the subject at higher levels of education. Findings also indicate that poor quality textbooks are in use in secondary schools suggesting that students learn wrong content resulting in failures. It was also revealed that mathematics is taught as an abstract subject. Teachers fail to link mathematics with real life examples affecting students' understanding of basic concepts. Content clarity has been shown to be associated with student's performance in mathematics. Teodorović (2011) revealed an association between clarity of presentation, mastery of teaching and student performance.

In regard to **the quality of structure and organization,** findings show that teachers do not prepare well for lessons, hence, they fail when demonstrating knowledge of a given concept, affecting students understanding and attitude towards the subject. Lack of in-service training, poor instructional strategies and content knowledge of the teacher also contribute to the poor quality of mathematics instruction delivery to students' population. With regards to the **quality of assessment**, findings indicate deficiencies in the evaluation process. It was reported that teachers fail to conduct thorough evaluation of students work and support those in need due to large classes and heavy workloads. In line with this finding the study by Bruinsma and Jansen (2007) showed that quality of assessment is an important predictor of achievement in mathematics.This imply that educators and educational administrators should find ways to improve the quality of assessment including assessment of classroom activities, tests and examinations.

Environment

The social and psychological environment factors were evident in our data. The environment consisted of home, school, peer, mass media and policy environments.

The home environment is influenced by the educational and financial statuses of parents in our data. Most secondary and primary school teachers described low level of education and poor financial position of parents as contributors of students' poor performance in mathematics in government schools. It was found from the interview with teachers that, some parents could not afford bus and/or lunch fares for their children. During the interview teachers said that, students have to walk a long distance hence arriving at schools already tired and or have to go without food for the entire day. In line with this finding, past research have revealed that education and financial position of parents have an effect on students' performance in mathematics. For example, the study of Michael (2015) showed that students whose parents have higher levels of education, a more prestigious occupation, or greater income tend to have higher performance than those whose parents have lower social-economic positions. This is consistent with international comparative studies Topçu, et al. (2016) who revealed that the educational level of parents was significantly correlated with students' achievement in science and mathematics.

The school environment consisted of working conditions, and classroom atmosphere. Regarding the *working conditions*, it was found that there are deficiencies in resources such as textbooks, and teaching aids; inadequate classrooms; scarcity of teachers; unsupportive school administrators; and teachers are unmotivated due to poor remuneration. Researcher Michael (2015) found similar results regarding teacher scarcity and school administration. In his study schools headmasters reported that the number of teaching staff does not meet demand in such a way that teachers are overloaded whereby you find them having up to 33 periods per week. Furthermore, school observations revealed that, mathematics department in schools were not well managed because school administration interfered in department activities. Teachers are the biggest resource in schools; however, their effectiveness is hampered by several factors and in turn affecting students learning and performance.

Looking at the *classroom atmosphere* it was found that classrooms are overcrowded, characterized by poor interactions between teachers and students. During the interview some teachers narrated that teachers are harsh and punitive making students fearful which causes them to lose concentration. This finding is similar to that of (Mazana, et al., 2019) who found that students dislike mathematics when they are punished.

It was reported in Michael (2015) that use of corporal punishment negatively affect the relationship between teachers and students. For effective learning, classrooms should be tension free (Mazana, et al., 2019). Another factor related to classroom atmosphere is connected to the way students are allocated in different classes (streaming) particularly in secondary schools. In our study, it was revealed that in some schools, students are grouped according to their general ability. Researchers Uysal and Banoglum (2018) found that ability grouping influence students learning and help the teacher to adopt instructional methods, pace and materials to students' ability, level and needs. However, this is not the case for Tanzania because, in some schools, students are grouped according to their GPA reflecting their general ability. However, this does not reflect their mathematics ability thus teachers' fail to adopt instructional methods appropriately.

With regards to **peer environment,** it was found that peer influence is an important factor influencing mathematics learning. It was revealed that peers who are poor in mathematics, or those with negative perceptions about mathematics discourage their counterparts to study the subject. Regarding **mass media - ICT tools,** findings reveal that specific use of ICT tools particularly television, computers, mobile phones, and scientific calculators are important in enhancing teacher's productivity and students learning. Looking at the **policy environment** the findings indicate that poor implementation of some policies issued by relevant organs cause confusion among teachers, impacting negatively the delivery of instruction and students learning. These findings reflect the results reported in a recent study by (Mazana et al., 2019) who found that factors influencing students learning of mathematics constituted student aptitude, instructions, and social psychological environment. However, in their study, policy environment was not.

Culture

In our study gender was found to be one of the factors influencing students' mathematics outcomes. It was found that some teachers, parents and other community members form a stereotypic view about mathematics. They have associated mathematics with boys, consequently these views discourage girls to study mathematics. Girls are described by teachers as the ones who fail the most. This finding corroborates the finding of Waldrip and Giddings (1994) who found that the Walberg's productivity model was applicable in a developing country with an additional cultural factor. Their findings indicated that students' performance in science was influenced by the quality and quantity of instructions, learning environment and gender. Their findings also show that male students performed better than female in both science achievement examination and attitude towards science while girls performed better on science process test. Our study has proven that based on teachers' perceptions the students' gender could have contributed to students' poor performance in mathematics.

Generally, most factors we found in this study were common to all levels, but we noted some few differences in teachers' responses regarding factors affecting students learning in various levels. Factors such as entry age, the quality of examinations, subject specialization, distribution of teachers depending on school needs and need for food in schools were mentioned to affect primary school students. The policy environment and use of punishment are affecting both primary and secondary schools. Factors that were mentioned to affect mathematics learning in both colleges and secondary schools include the language of instruction (English), and poor background in mathematics. Furthermore, streaming, quality of reference /textbooks and syllabus issues, and discouragement from other subject teachers were mentioned to affect secondary school students.

Teachers Emotions when Teaching Mathematics

Teachers were asked an additional question regarding their feelings when teaching mathematics. The findings showed that majority had mixed feelings due to poor working conditions such as overcrowded classrooms; inadequate resources including textbooks, teaching aids; and students' unresponsiveness to instructions. The study by Frenzel et al. (2009) shows that teachers' emotions is related to students' emotions and behaviors, thus teachers' positive emotions in the classroom enhances the quality of instructions. This imply that conditions affecting teachers' positive emotions should be optimized for effective instructional delivery.

Measures to Revert the Situation

Based on the findings, several measures could be proposed to alleviate the situation and improve the quality of mathematics instruction delivery. They fall into 9 major categories that are depicted in **Table 7**.

Table 7. Proposed measures to reduce massive failure in mathematics examinations

Improve teaching – learning environment	-	**Ensure availability of teaching-learning resources**
	-	**Provide food in schools especially in primary schools**
Improve teacher working conditions	-	Allocate teachers in schools depending on school needs
	-	Increase remuneration to teachers
Improve classroom instructions	-	Reduce teaching load through increasing the number of teachers and classrooms
	-	Schedule mathematics lessons during morning hours
	-	Emphasize on real life application of mathematics
	-	Provide support to and encourage students to study mathematics
	-	Encourage innovativeness among teachers including the use of ICT tools in teaching and learning
	-	Regulate the curriculum/syllabus
	-	Assess students more frequently
	-	Assign experienced teachers at lower levels
	-	Increase positive feelings of mathematics teachers
Enhance teachers' teaching skills	-	Provide regular in-service trainings
Accountability for all	-	Teachers, students, parents, and school administrators should be accountable for their actions to make the teaching and learning of mathematics a success
Enhance students learning skills	-	Enhance students learning strategies
Improve teacher training programs	-	Provide scholarship to those aspiring to study mathematics courses in colleges, and
	-	Introduce mathematics bias schools
Improve the recruitment process for teachers	-	allocate teachers in schools reflecting school needs
Change the attitude of the community about mathematics	-	Educate parents, teachers, and the community about the importance of mathematics

The proposed measures are consistent with some of the recommendations stated by the government of Tanzania through the Teacher Development and Management Strategy (TDMS) 2008-2013 as specified in (Sumra & Katabaro, 2014)**.** But these recommendations focused on teachers' development and working conditions. In our study, the proposed measures are holistic as they focus on both teachers, students, school environment, and the community at large. Therefore, education stakeholders should take immediate action in considering the measures proposed in this study to enhance students' mathematics achievement.

LIMITATIONS

The study involved 28 teachers from public schools and colleges from four regions, out of over 30 regions. Hence, the sample may not represent teachers from private schools and the remaining regions. Although the findings from this study cannot be generalized to all teachers in all schools and colleges in Tanzania, they are indicative of the phenomenon that is observed in mathematics teacher populations in other public schools and colleges. Future studies should consider expanding the pool of participants to include more schools possibly, including private schools and colleges, to provide clear insights into the factors influencing students' performance in mathematics. Further studies should also focus on finding ways, possibly through action research, to tackle those factors related to students learning and teacher teaching skills (particularly, enhancement of teacher student interactions using ICT tools). In this study we present an attempt at understanding through a qualitative lens, the poor mathematics performance of students from the perspective of the teachers. A follow up research will employ quantitative methods to further our understanding of the factors and the suggested solutions.

CONCLUSIONS AND RECOMMENDATIONS

This study was conducted to examine the extent of failure in mathematics in Tanzania. It also sought to find the factors influencing students' performance in mathematics examinations. From the discussion of the results, the study concludes that failure rates are generally higher at all levels investigated with lower secondary basic mathematics being the most failed subject. Gender difference was observed at all levels of education investigated. It was observed that while male students perform better in primary school, lower secondary school, and college mathematics, female students perform better in upper secondary school basic applied mathematics. This shows that female students are equally capable as male students, only some circumstances hinder their academic progress in mathematics. Factors influencing students' performance in mathematics examinations include aptitude, instructional, psychological environment, and cultural factors.

Measures to reduce massive failure suggest improvement in the teaching-learning environment, and teachers' working conditions. It also require improvement in teacher training programs and the recruitment process of teachers. Other measures are enhancement of teachers' teaching skills, students' learning skills, and accountability for all (See **Table 7**).

Generally, data analysis revealed students' poor performance in mathematics at all levels. The percentages of students passing mathematics are in most cases below 50 percent especially at lower secondary school level. This observation has a lot of implications for entry requirements of higher education institutions as credit passes are basic for selection of students to study science, technology as well as courses such as accounting, economics, and finance. Thus, the big number of students who fail mathematics may not be eligible to enter into these careers. This implies that, Tanzania would continue to lag behind in these areas where knowledge of mathematics is of paramount importance in learning these courses and other business related ones. Besides, students' who manage to enter into business courses struggle with mathematics as many find themselves repeating the module and some fail to complete their studies due to failure in mathematics examinations. The study revealed a number of factors affecting the process of teaching and learning mathematics that need to be optimized so as to enhance students learning of mathematics including students' aptitude, instructional, psychological environment, and cultural factors.

From the findings, the study recommends that, students should be taught to apply appropriate learning strategies. The government should provide regular in-service training to enhance teachers' knowledge and teaching skills, and administrators should ensure adequate availability of teaching -learning resources in schools and colleges. Further, relevant organs should provide scholarship to mathematics specializing students' in colleges to attract more students to study mathematics. Furthermore, the introduction of subject specialization in teacher training programs right from primary teacher training colleges may be a solution. The government should provide competitive salaries and incentives to attract and retain competent mathematics teachers, and the introduction of ICT in the teaching and learning of mathematics to enhance teacher productivity and students learning achievement.

Disclosure statement

No potential conflict of interest was reported by the authors.

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