



# Assessment of the Shortage of Science and Mathematics Teachers and Its Effects on Secondary Education in Karatu District

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**Abstract:** *This study assessed the shortage of science and mathematics teachers and its effects on secondary education in Karatu District. The objectives of this study were to: determine the effects of shortage of science and mathematics teachers on syllabus coverage in secondary schools and identify the effects of shortage of science and mathematics teachers on students' learning behaviour in secondary schools. This study employed descriptive survey design. Total of 158 respondents participated in the study, which included 102 students, 48 teachers selected using clustered and random sampling, while 6 Head of Schools and 2 Educational Officers were purposively selected. Questionnaires were used to collect quantitative data while interview guide was used to collect qualitative data. Research experts validated the instruments and the reliability test ( $TQ=0.91$  &  $SQ=0.89$ ) was conducted using Cronbach alpha. Quantitative data was analyzed using descriptive statistics and qualitative data was analyzed thematically. The findings revealed that shortage of science and mathematics teachers in secondary schools affects the early syllabus coverage and some topics are not covered at all. Similarly, shortage of science and mathematics teachers affects students' learning behaviour in secondary schools as students lose the passion to learn science and mathematics and decide to take arts subjects due to the negative attitude developed towards science and mathematics subjects. The study recommends that in order to mitigate the shortage of science and mathematics teachers, new systems to recruit, support, and retain teachers need to be developed and those recruited teachers should be motivated.*

**Key Words:** *Science, Mathematics, Teachers, Education, School*

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## 1. Introduction

A teacher is the most important school related factor influencing student's achievement (Aydin & Aslan, 2016). Teachers are often highly-valued members of the community who occupy a wide range of leadership roles, particularly in rural areas, where other professionals are seldom found. Losing their knowledge and skills is a

danger to national and regional stability since lack of education is inextricably linked to poverty, and consequently to ill-health and unplanned population growth (UNESCO, 2018). Schramm-Possinger (2011) state that high skilled teachers are one of the single most important factors in facilitating effective teaching and learning for student's successes, this being the fact, there is a need for teachers to be trained for having adequate and

skilled teachers for educational upbringing. Also, it is important for schools to have enough skilled teachers.

Few education issues have received more attention in the past few decades than the challenge of staffing the nation's classrooms with qualified mathematics and science teachers. Recent high-profile reports from organizations such as the John Glenn Commission in United States of America (USA) (National Commission on Mathematics and Science Teaching for the 21<sup>st</sup> Century, 2000), the National Research Council (2002), and the National Academy of Sciences (2007) have directly tied mathematics and science teacher staffing problems to a host of educational and societal problems to the inability to meet student achievement goals. In Britain, Teachers attrition is reported as a national crisis, especially in mathematics and science fields (BBC News Online, 2001; BBC News, 2001). Santiago (2001) reported that the situation is worsening in Sweden, Germany and New Zealand. Sutchter, Darling-Hammond & Carver (2019) report on teacher shortages, resultant from teacher attrition in Ontario and Australia. Also in the USA, the problems of teacher shortages as a result of turnover are widely reported in many states and the shortage of science and mathematics teachers being a growing (Ingersoll, 2002). This implies that the problem of science and mathematics teacher is a global problem such a way that secondary education may not well achieved especially in science and mathematics subjects.

In Tanzania the shortage of science and mathematics teachers is a critical problem, which has persisted for many years. The number of mathematics teachers available is very small compared to requirements of these teachers. The average shortage of mathematics teachers for 5 years from 2009-2013 was 52% and within 48% which are available, 8% of them had gone for further studies in different Universities and 3% of them turnover the teaching profession after completing their studies (MoEVT, 2014). For example, according to National Examination Council of Tanzania (NECTA) report, in 2015, out of 383,851 candidates who sat for the Basic Mathematics paper, only 64,332 (16.76%) candidates passed, while in 2014, out of 240,160 candidates who sat for the examination, only 47,001 (19.58%) candidates passed. Masele & Tweve (2018) also indicate that only 17.8% of seating candidates in 2009, and only 16.1% in 2010 passed the mathematics examination as compared to all other subjects, where passes were always more than 30% in each. This implies that due to the shortage of science and mathematics teachers in secondary schools academic performance is low, especially in these subjects, therefore, there is need to recruit more teachers in science and mathematics subjects.

According to Massi (2013), in Tanzania some measures which were taken by the Government to overcome the problem of mathematics teachers' shortage are programs like provision of full sponsorship to mathematics students, which was held at Tumaini University in Iringa, from

2003-2007. Another programme was loan given to students who studied mathematics in their degree course. There was also a crush program for science and mathematics teachers where form six leavers were trained for one month and given a teaching license with the condition that they should go for further studies to get a diploma or degree within three years after being given the teaching license. All these programmes aimed at increasing the number of teachers, but the problem of mathematics and science teachers' shortage is still a staffing problem in the teaching profession, such that according to Karatu District Educational Statistics (2022), there is a total of 118 shortages of science and mathematics teachers in secondary schools in Karatu district. Thus, there is need to carry out this study on the assessment of the Shortage of Science and Mathematics Teachers and its Effects on Secondary School Education in Karatu District Council.

## 1.1 Research Questions

1. What are the effects of shortage of science and mathematics teachers on syllabus coverage in secondary schools?
2. What are the effects of shortage of science and mathematics teachers on students' learning behaviour in secondary schools?

## 2. Literature Review

### 2.1 Theoretical Framework

This study was underpinned in Social Cognitive Theory started as the Social Learning Theory in the 1960s by Albert Bandura. It developed into Social Cognitive Theory in 1986 and posits that learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment, and behaviour. The unique feature of Social Cognitive Theory is the emphasis on social influence and its emphasis on external and internal social reinforcement (Bandura, 1986).

Social Cognitive Theory considers the unique way in which individuals acquire and maintain behaviour, while also considering the social environment in which individuals perform the behaviour. The theory takes into account a person's past experiences. These past experiences influence reinforcements, expectations, and expectancies, all of which shape whether a person would engage in a specific behaviour and the reasons why that engagement in that behaviour (Albert, 1986). Since behaviour is learnt, supplementary teaching and learning materials are subjecting students to interactive and interesting teaching and learning (Muller, Hunter & Stollak, 1995).

Bandura's social learning theory says that people learn violent behaviour through modelling or direct

reinforcement (Bandura 1977) states that most human behaviour is learned observationally through modelling: from observing others one forms an opinion on how new behaviours are performed, and on later occasions this coded information serves as a guide for action.” Social learning can influence children and adults positively or negatively (Louw & Edwards, 1993).

### **2.1.1 Application of Social Learning Theory in this Study**

Therefore, better educational upbringing in secondary schools and students’ performance in science and mathematics is influenced by adequate and skilled science and mathematics teachers in secondary schools. This is also influenced by teaching methods such as teacher centred method, students’ centred method and type of homework assignments offered to students for syllabus coverage and curriculum implementation, learning environment or learning facilities in science and mathematics as well as shaping students’ learning behaviour such that all these are influenced by adequate science and mathematics teachers for better educational achievement in secondary schools.

## **2.2 Empirical Literature Review**

Teachers’ shortage, especially qualified teachers, is a worldwide problem many countries in the worldwide are threatened by shortage of teachers as ILO Report (2012) showed that the world is facing a shortage of qualified teachers, especially in science and mathematics. The report further stated that 18 million new teachers would be needed to teach all children, youth and adults by 2015 as stated in the Millennium Development goals (MDGS) and Education for All movement. In the French speaking countries of West and Central Africa to meet these demands, countries are using contract teachers. UNESCO (2005) reported that lack of science and technology teachers is particularly striking and in an attempt to solve the problem, non-teachers are sometimes asked to teach courses like biology.

Stutz (2005) revealed that the shortage of Mathematics and science teachers was becoming worse. The report from researchers at the University of Texas in Australia also found that the shortage of teachers, particularly in schools with lower income students. The most acute teacher shortages in Texas are said to be in secondary Mathematics and science since, those shortage are said to have increased dramatically, especially in science where the shortage has jumped 30 per cent.

Science and mathematics education in secondary education in Tanzania is faced with several challenges. As a result, the failure rates and lack of interest among students in science and mathematics in secondary schools is becoming a serious problem. It has been reported that

pass rates in physics was 26.3% in 2008 and dropped to 13.7% in 2011, while that of chemistry was 32.9% in 2008 and dropped to 15.8% in 2011. A similar trend can be observed in biology and mathematics. For instance, the pass rate for biology dropped from 15.1% in 2008 to 9.4% in 2011, while that of mathematics dropped from 9.2% in 2008 to 5.8% in 2011 (MoEVT, 2012).

In addition, there is severe shortage of qualified school science teachers in Tanzania. According to the World Bank project paper (World Bank, 2014), the country needs 26,998 secondary school science teachers immediately but the tertiary education institutions in the country can only produce 2,300 graduates annually. The project paper added that of the current 10,400 in-service secondary school science teachers, many do not have sufficient pedagogical and subject content knowledge. The World Bank (2014) report emphasised on the recruiting enough science and mathematics teachers as secondary school education is faced with shortage of teachers in respective subjects.

A study by Chuwa (2014) on the determinants of Mathematics and Science Career Choices among Secondary School Female Students in Ilala District Dar es Salaam Region used descriptive cross-sectional, whereby data was collected in a single place at a time. Questionnaires, interviews and observation-checklists were used to collect data from 160 respondents. The participants were clustered in the groups of students, teachers and parents, from each cluster, the sample was taken. The major findings revealed that science and mathematics teachers used tuitions, extra hours and weekends to assist students in those subjects. Although the majority of parents assist their female students in mathematics and science in doing their homework - thus encouraging them to do science and mathematics subjects, the home environments continue to follow the traditional gender roles that leave household duties to females hence impeding them from concentrating on school work.

Furthermore, the findings revealed that, although the few present science and mathematics teachers were trying to cover the syllabus early, the quality of schools in promoting science and mathematics related subjects was poor due to lack of laboratories, laboratory supplies and inadequate number of qualified science and mathematics teachers.

## **3. Methodology**

This study employed a survey research design for the purpose of describing a situation systematically and accurately (Gay et al., 2015). The target population for the study consisted of students, science and mathematics teachers, heads of schools and the district education officer. Cochran formula was used to obtain the study sample which consisted of 2 education officers, 6 heads of schools, 102 students and 48 teachers to make a total number of 158 respondents. The samples were selected

using stratified and purposive sampling techniques. The researchers used self-responding questionnaires and interview guides as the tools for data collection whereby students and teachers filled the questionnaires while the heads of schools and education officers were interviewed. These tools were first validated by three experts in the field of research before being used for data collection. Reliability was estimated using Cronbach alpha whereby coefficient Alpha values of 0.91 and 0.89 were obtained for teachers and students questionnaires respectively. Descriptive statistics was used to analyze the quantitative data from questionnaires whereas frequencies and percentages were generated through the aid of SPSS version 25. For the case of qualitative data thematic analysis was used to generate themes rising from the data as per research questions.

## 4. Results and Discussion

**Table 1: Quantitative Findings on the Effects of Shortage of Science and Mathematics Teachers on Syllabus Coverage in Secondary Schools in Karatu District**

<b>Effects of Shortage of Science and Mathematics Teachers on Syllabus Coverage in Secondary Schools</b>	<b>Students n=102 f(%)</b>	<b>Teachers n=48 f(%)</b>	<b>Total n=150 f(%)</b>
Slow coverage of syllabus as teachers take many sessions per day	77(75)	39(81)	116(77)
Poor syllabus coverage due to overload of teaching sessions among science and math teachers	99(97)	41(85)	140(93)
Slow mastery of content among students as teachers teach frequently	95(93)	39(81)	134(89)
Students are overdosed due to a lot of assignments and home works	90(88)	37(77)	127(85)
Teachers fail to cover the topics since they are few	100(98)	43(90)	143(95)
Poor preparation of lesson plans and scheme of work	97(95)	40(44)	137(91)

f = frequency, % = percentages, values in brackets are percentage of students who agreed with the statement. Those with contrary opinion to the statement are implied.

Source: Field Data (2022)

The findings in table 1 indicated the assessment of the effects of shortage of science and mathematics teachers on syllabus coverage in secondary schools in Karatu district. Accordingly, 77(75%) of students and 39(81%) of secondary school students which made the total of 116(77%) of respondents who agreed that shortage of science and mathematics teachers results to the slow coverage of syllabus as the few teachers are overburdened due to many sessions per day. The results showed that 77% of respondents indicated that shortage of science and mathematics teachers leads to slow pace of syllabus coverage early even though the few teachers present take many sessions per day. However, due to many classes which are also overcrowded, the rate of syllabus coverage is regrettably low. The findings also indicate that there is a tendency of the few science and mathematics teachers to take many sessions per day and in extra hours to cover the syllabus. The study findings opine that the few science and mathematics teachers present volunteered in extra hours and in the weekends to take science and mathematics

The findings were discussed in regard to research objectives.

### 4.1 Effects of Shortage of Science and Mathematics Teachers on Syllabus Coverage in Secondary Schools in Karatu District

Objective one of this current study assessed the effects of shortage of science and mathematics teachers on syllabus coverage in secondary schools in Karatu district. Table 1 presents the summary of the responses and the results of quantitative findings through questionnaires on the effects of shortage of science and mathematics teachers on syllabus coverage in secondary schools in Karatu district.

sessions with the aim of covering the syllabus on time. This revealed that the few science and mathematics teachers in secondary schools in Karatu district use a lot of efforts to cover the syllabus early with mechanisms of taking many sessions per day, extra hours and even in weekends as they are few and they aim at covering the syllabus early but there effort which nonetheless appreciated does not bore much fruits.

The findings are in agreement with the study by Chuwa (2014) on the determinants of mathematics and science career choices among secondary school female students in Ilala District Dar es Salaam Region. The major findings revealed that science and mathematics teachers use tuitions, extra hours and weekends to assist students in those respective subjects although the majority of parents assist their female students in mathematics and science in doing their homework. By encouraging them to do science and mathematics subjects, the home environments continue to follow the traditional gender roles that leave

household duties to females hence impeding them from concentrating on school work. Therefore, from the findings, it implies that, the present few science and mathematics teachers in Karatu district are putting their efforts in covering the syllabus early but still the quality of education in those respective subjects is poor in secondary schools.

In table 1 the results show that, 99(97%) of secondary school students and 41(85%) of secondary school teachers which made a total of 140(93%) of respondents were in agreement with the statement that among the effects of shortage of science and mathematics teachers is poor syllabus coverage due to overload of teaching sessions among science and mathematics teachers while 7% held contrary opinion. The majority of respondents (93%) indicated that, although the present few science and mathematics teachers are trying their level best and put more efforts in syllabus coverage but still there is poor syllabus coverage especially in effective teaching and learning. The results reported that, there is the use of extra hours, weekends and tuitions to cover the syllabus in science and mathematics subjects but still there is poor syllabus coverage as the students are overloaded and the teachers also get exhausted. Further, the findings indicated that, for effective teaching and learning in science and mathematics subjects, there should be with adequate and qualified science and mathematics teachers for ensuring effective coverage of syllabus in respective subjects.

The findings concur with a study by Projest (2013) on the shortage of teacher's on implementation of the Curriculum used cross-sectional survey aimed at collecting data from large number of samples of various categories at a particular time so as to describe the nature of the problem. From the findings, it implies that, although few science and mathematics teachers in secondary schools in Karatu district are putting more efforts in syllabus coverage especially in science and mathematics subject still some of the subjects were not covered or taught at all due to the shortage of science and mathematics teachers.

The results in table 1 show that, slow mastering of content among students is the effect of shortage of science and mathematics teachers especially in syllabus coverage as 95(93%) of secondary school students and 37(77%) of secondary school teachers agreed to the statement to make a total of 134(89%) of respondents while 11% of respondents were contrary to the statement. This majority of respondents (89%) of respondents indicated that, due to the fact that there is shortage of science and mathematics teachers in secondary schools in Karatu district, it brings the negative effects to the students as they fail to cover the subject content as the teachers trying to cover the syllabus and forget that teaching and learning should be effective. The findings reported that, most of teachers in science and mathematics subjects have many sessions per week and they have acquitted with many streams, therefore they teach frequently and quickly as a result the students fail to master the content matter of a particular subject.

The findings are supported by the project papers of MoEVT (2012) & Semali (2013) who added that, of the current 10,400 in-service secondary school science teachers, many do not have sufficient pedagogical and subject content knowledge. While science and mathematics account for 46 percent of the curriculum, only 28 percent of teachers are qualified to teach these subjects. It has been revealed that students fail to master the subject content in science and mathematics due to the shortage of science and mathematics teachers. Several interventions exist to address the situation. Some of the interventions include the School Science project, the School Mathematics Project, and iSPACES. For instance, the iSPACES project aimed to enable students and teachers in secondary schools use Information and Communication Technologies (ICT) to improve the quality of teaching and learning science, mathematics and English (Semali, 2013). The majority of these projects have been focused on students as well as equipping schools with ICT equipment. However, less effort has been made to upgrade science and mathematics teachers in pedagogy and subject content knowledge of the subjects they teach. Therefore, from the findings it implies that, there are implementations taken to improve the coverage and mastering of content knowledge in science and mathematics resulting from the shortage of science and mathematics teachers in secondary schools the students seen to be slow in covering the subject matter in these subjects.

Also, the results in table 1 show that, among the effects of shortage of science and mathematics in covering the syllabus is that, students are overdosed due to a lot of assignments and home works as 90(88%) of secondary school students and 37(77%) of secondary school teachers agreed to the statement to make a total of 127 (85%) of respondents while 15% of respondents were contrary to the statement. The majority of respondents (85%) of respondents reported that, due to the shortage of science and mathematics teachers in secondary schools in Karatu district, the teachers put more efforts in syllabus coverage and therefore the student are provided with a lot of assignments at schools and home works while at home. The findings indicated that, students are coming to school in the weekends and also the are extra hours in the evening for the science and mathematics subjects and this make the students to be overloaded with a lot of assignments whereby most of dislike teachers together with science and mathematics subjects.

The findings are in line with the study by Chuwa (2014) on the determinants of Mathematics and science career choices among secondary school female students in Ilala District Dar es Salaam Region. The major findings revealed that, science and mathematics teachers use tuitions, extra hours and weekends to assist students in those respective subjects although the majority of parents assist their female students in mathematics and science in

doing their homework thus encouraging them to do science and mathematics subjects, the home environments continue to follow the traditional gender roles that leave household duties to females hence impeding them from concentrating on school work and make them dislike the subjects.

Furthermore, the results in table 1 show that, due to shortage of science and mathematics teacher there is poor preparation of lesson plans and scheme of works as 97(95%) of secondary school students and 40(44%) of secondary school teachers agreed to the statement to make a total of 137(91%) of respondents while 9% of respondents were contrary to the statement. This majority of respondents (91%) reported that, due to shortage of teachers the preparation of lesson plans and scheme of works are not improved rather most of science and mathematics teachers are using outdated lesson plans and scheme of works which is caused by the presence of many sessions per one teacher. The findings indicated that, due to shortage of science and mathematics teachers there is

#### 4.2 Effects of Shortage of Science and Mathematics Teachers on Students' Learning Behaviour in Secondary Schools in Karatu district

no improved teaching methodology and there is cooperative instructional methods among teachers rather they use the same methods often.

The findings are in agreement with Maina (2009) who revealed that the characteristics of instructional theory were not implemented in the classroom and among the factors which contributed to this were: teachers' poor methodology; lack of teaching aids; inadequate number of books; language and different ability of learners. Maina suggested that there was a need to strengthen teachers teaching colleges and demonstration schools in term of facilities, to improve teachers' motivation, to employ laboratory technicians and also the revision of the current syllabus. Therefore, from the findings, it implies that, shortage of science and mathematics teachers, results to poor methods in teaching, poor preparation of teaching aids and poor preparation of lesson plans which results to poor implementation of classroom instructions.

Objective two of this current study was set to assess the effects of shortage of science and mathematics teachers on students' learning behaviour in secondary schools in Karatu district. Table 2 presents the summary of the respondents' responses and the results of quantitative findings through questionnaires on the effects of shortage of science and mathematics teachers on students' learning behaviour in secondary schools in Karatu district.

**Table 2: Quantitative Findings on the Effects of Shortage of Science and Mathematics Teachers on Students' Learning Behaviour in Secondary Schools**

<b>Effects of Shortage of Science and Mathematics Teachers on Students' Learning Behaviour in Secondary Schools</b>	<b>Students n=102 f(%)</b>	<b>Teachers n=48 f(%)</b>	<b>Total n=150 f(%)</b>
De-motivates the habits of students to learn science and mathematics.	97(95)	41(85)	138(92)
Developing negative attitudes towards science and mathematics that are tough subjects	101(99)	46(95)	147(98)
Shortage of teachers lead to poor class attendance in science and mathematics	91(89)	38(79)	129(86)
Shortage of science and mathematics teachers makes students to ignore the subjects	93(91)	40(44)	133(87)
Shortage of science and mathematics teachers makes students fail to learn on their own	83(81)	29(60)	112(75)
Shortage of science and mathematics teachers makes students to dislike the subjects	98(96)	42(88)	140(93)

f = frequency, % = percentages, values in brackets are percentage of students who agreed with the statement. Those with contrary opinion to the statement are implied.

Source: Field Data (2022)

In table 2 the results show that among the effects of shortage of science and mathematics teachers on students' learning behaviour is that it de-motivates the students to learn the respective subjects as 97(95%) of secondary school students and 41(85%) of respondents agreed to the statement to make a total of 138(92%) of respondents who were in agreement with the statement while 8% of

respondents were contrary to the statement. The majority of respondents (92%) indicated that, for students to learn it needs adequate and qualified teachers to facilitate teaching and learning. Also, the findings indicated that, psychologically the students should be motivated to learn especially in science and mathematics subjects which are seemed to be with some sort of complexity. Further, the

majority of respondents reported that, students' learning behaviour in science and mathematics subjects should be acquitted with enough teachers to cooperate as a team work and provide motivation to students to learn, contrary if there is inadequate science and mathematics teachers the students lose their passion to learn in these subjects.

The findings are in agreement with the report of García & Weiss (2019) on the teacher shortage is real, large and growing, and worse than we thought. The findings revealed that, shortage of teachers harms students, teachers, and the public education system as a whole. Lack of sufficient, qualified teachers and staff instability threaten students' ability to learn and reduce teachers' effectiveness, and high teacher turnover consumes economic resources that could be better deployed elsewhere. The teacher shortage makes it more difficult to build a solid reputation for teaching and to professionalize it, which further contributes to perpetuating the shortage..

The results in table 2 show that, 101(99%) of secondary school students and 41(85%) of secondary school teachers agreed to the statement that, shortage of science and mathematics teachers develops negative attitudes towards science and mathematics subjects that, are very complex subjects. This made a total of 147(98%) of respondents who were in agreement with the statement while 2% of respondents were contrary to the statement. The majority of respondents (98%) reported that, it is the fact that arts subjects' teachers are exceeding science and mathematics teachers in secondary schools in Karatu district. Therefore, this develops negative attitudes towards science and mathematics subjects that are very complex subjects. The findings reported that, although science and mathematics subjects have some sort of complexity but the shortage of science and mathematics teachers strengthen this attitude among students and this makes the students to take arts subjects over science and mathematics.

The findings are supported by the study of Masele (2018) on Efficacy of Information Provision Strategies for Promoting Mathematics Education in Tanzania: A Case of Selected Secondary Schools in Dar es Salaam. Findings revealed limited use of various sources of information in promoting mathematics education and there is no specific session which discusses the importance of mathematics importance for career development. Dependable sources of information for students are mainly teachers, parents and peer groups. There was poor usage of media and the internet in promoting mathematics. The study urges the need to harness the Web and available media in the publicising mathematics education information. Information professionals are urged to liaise with policy makers to rally together in influencing other practitioners in mathematics education to promote this subject. Therefore, from the findings, it implies that, the shortage of science and mathematics teachers, results to the stereotype among students that science and mathematics subjects are difficult.

Also, the results in table 2 show that, shortage of science and mathematics teachers bring effects on students' learning behaviour in secondary schools such that, it leads to poor class attendance in science and mathematics sessions as 91(89%) of secondary school students and 38(79%) of secondary school teachers agreed to the statement which made a total of 129(86%) of respondents who agreed to the statement while 14% of respondents were contrary to the statement. This mass of respondents (89%) indicated that, most of students tend to dodge science and mathematics sessions due to shortage of science and mathematics teachers as one teacher fail to manage the large class and many streams thus the students avoid the science and mathematics sessions which limits their learning in these subjects.

Moreover, the results in table 2 show that, shortage of science and mathematics teachers makes students to ignore the subjects and take over on arts subjects as 93(91%) of secondary school students and 40(44%) of secondary school teachers were in agreement to the statement which made a total of 133(87%) of respondents who agreed to the statement while 13% of respondents were contrary to the statement. The majority of respondents (87%) indicated that, most of secondary schools' students tend to ignore science and mathematics subjects due to the shortage of teachers and it is also due to poor coverage of the topics whereby most of the students take arts subjects over science and mathematics subjects. The findings reported that, most of students are feeling doubt about few number of science and mathematics teachers, if they would succeed in teaching all the topics for these subjects, hence from this doubt the students ignore science subjects and basing on arts or business subjects.

The findings are in agreement with a report by MoEVT (2012) whereby it has been reported pass rates in physics was 26.3% in 2008 and dropped to 13.7% in 2011, while that of chemistry was 32.9% in 2008 and dropped to 15.8% in 2011. A similar trend can be observed in biology and mathematics. For stance, the pass rate for biology dropped from 15.1% in 2008 to 9.4% in 2011, while that of mathematics dropped from 9.2% in 2008 to 5.8% in 2011. The report revealed that, those pass rate are caused by the science and mathematics education in secondary education in Tanzania to be faced with several challenges which is associated with shortage of science and mathematics teachers, as a result, the failure rates and lack of interest among students in science and mathematics in secondary schools is becoming a serious problem. Therefore, from the findings, it implies that, shortage of science and mathematics teachers results to the poor pass rate which is caused by lack of interest to take science and mathematics subjects among secondary school students.

Furthermore, the results in table 2 show that, shortage of science and mathematics teachers makes students to learn

on their own as 83(81%) of secondary school students and 29(60%) of secondary school teachers agreed to the statement to make a total of 112(75%) of respondents who were agreed to the statement while 25% of respondents were contrary to the statement. The majority of respondents (75%) indicated that, the shortage of science and mathematics teachers in secondary schools reduce the passion to learn on their own pace among students. This is due to the lack of teaching and learning materials in science and mathematics subjects and lack of guidelines from the teachers as there is shortage of teachers. The findings reported that, due to the fact that, science and mathematics subjects need to be facilitated by the teachers, there should be with enough teachers in secondary schools especially in these subjects and if there is shortage of science and mathematics teachers it makes students failing to learn on their own pace.

The findings are in agreement with Mazana, Montero & Casmir (2020) on assessing students' performance in mathematics in Tanzania: the teacher's perspective. The findings revealed that, Poor background is a hindrance to acquiring higher order mathematics skill in higher levels. Poor background in mathematics can be attributed to characteristics such as lack of content knowledge, and poor instructional strategies and this limit the students to learn on their own pace. Also, the quality and quantity of instructions were among the evident factors in their data. The quantity of instruction in their study was indicated by less contact hours due to teacher absenteeism leading to poor coverage of the syllabus or high pace of instruction that had an impact on students' grade. Such results are supported by Michael (2015) on Factors Leading to Poor Performance in Mathematics Subject in Kibaha Secondary Schools 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 which also results to lack of individual learning strategies especially learning on their own pace in science and mathematics subjects.

With regard to the Effects of Shortage of Science and Mathematics Teachers on Syllabus Coverage in Secondary Schools in Karatu district, the study discovered that there are Effects of Shortage of Science and Mathematics Teachers on Syllabus Coverage in Secondary Schools in Karatu district as the DEOs commented that:

DEO 1 commented that:

*Shortage of science and mathematics teachers limits the effective teaching & learning and syllabus coverage. Teachers revolve around directives from school administrators to finish the syllabus at an earlier date. The limiting of 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. The authority instructs the teachers to complete the syllabus within a short period of time that is the first offense; therefore shortage of science and mathematics teachers could affect content coverage among students as the teachers have been given a time limit for completing the syllabus. (Personal Interview, 26<sup>th</sup> April, 2022).*

DEO 2 reported that:

*There are shortage of science and mathematics teachers in secondary schools in Karatu district and syllabus coverage has become a challenge in these subjects such that, there are poor preparation of scheme of work and lesson plans and the schemes and plans are outdated and this is caused by science and mathematics teachers to have many sessions with many streams (Personal Interview, 26<sup>th</sup> April, 2022).*

Also, one among school heads commented that:

*Shortage of science and mathematics teachers in secondary schools affects the early coverage of syllabus, such that, few present science and mathematics teachers trying their level best in covering the topics but some of the topics are not finished and some of topics are not covered at all. Also, since teachers are instructed to finish syllabus at a given time they put more efforts on syllabus coverage while most of content matter are left without being taught (Personal Interview, 27<sup>th</sup> April, 2022).*

The findings concur with a study by Project (2013) on the shortage of teacher's on implementation of the Curriculum. The major findings revealed in this research were as follows: the shortage of teachers seemed to be a major factor hindering the implementation of Curriculum such that, the few present teachers were trying their level best to cover the syllabus and some subjects were taught effectively while other not taught at all, the shortage resulted into student indiscipline behaviour where most of the time spent without teachers in classes is misused by student involving themselves in immoral behaviours such as love affairs. The researcher found that, the school administration used various strategies to alleviate the shortage of teachers such as the use of form six-leavers, part time teachers and remedial classes to reduce the

problem. From the findings, it implies that, although few science and mathematics teachers in secondary schools in Karatu district are putting more efforts in syllabus coverage especially in science and mathematics subject still some of the subjects were not covered or taught at all due to the shortage of science and mathematics teachers.

With regard to the Effects of Shortage of Science and Mathematics Teachers on Students' Learning Behaviour in Secondary Schools in Karatu district, the study discovered that there are Effects of Shortage of Science and Mathematics Teachers on Students' Learning Behaviour in Secondary Schools in Karatu district as the DEO 1 commented that:

*The shortage of science and mathematics teachers affects students' learning behaviour in secondary schools; firstly students' lose the passion to learn science and mathematics and decide to take arts subjects over science subjects. Secondly, due to the shortage of science and mathematics teachers, students develop negative attitudes towards science and mathematics subjects that are difficult subjects and the students decide to leave the subjects (Personal Interview, 28<sup>th</sup> April 2022).*

Also, one among HSs reported that,

*The shortage of science and mathematics teachers affects students' learning behaviour in secondary schools such that, especially to girls students whereby students develops the stereotype belief that mathematics and science subjects is difficult for women but easy for men, a situation which discourages girls to participate fully in mathematics and science education (Personal Interview, 28<sup>th</sup> April 2022).*

The findings supported by the study of Masele (2018) on Efficacy of Information Provision Strategies for Promoting Mathematics Education in Tanzania: A Case of Selected Secondary Schools in Dar es Salaam. Findings revealed limited use of various sources of information in promoting mathematics education and there is no specific session which discusses the importance of mathematics importance for career development. Dependable sources of information for students are mainly teachers, parents and peer groups. There was poor usage of media and the internet in promoting mathematics. Challenges related to mathematics subject improvements include motivational, technical, managerial and financial. Furthermore the stereotype belief that mathematics and science subjects is difficult for women but easy men, a situation which

discourages girls to participate fully in mathematics education. Efficient use of media is emphasised for mathematics education promotion. The study urges the need to harness the Web and available media in the publicising mathematics education information. Information professionals are urged to liaise with policy makers to rally together in influencing other practitioners in mathematics education to promote this subject. Therefore, from the findings, it implies that, the shortage of science and mathematics teachers, results to the stereotype among students that science and mathematics subjects are difficult which affects their passion to learn on their own.

## 5. Conclusion and Recommendations

### 5.1 Conclusion

From the findings this study concludes that, there is shortage of science and mathematics teachers in all the visited public secondary schools compared with the requirement. There was an acute shortage of teachers, particularly in science and mathematics subjects in public secondary schools in Karatu district. In this situation, it was very difficult for school curricula to be implemented accordingly. In order for subjects to be taught effectively, enough number of qualified science and mathematics teachers should be available in Schools. In all the visited schools, school curricula were not being implemented effectively is required due the shortage of science and mathematics teachers.

Also, this study concludes that, the shortage of science and mathematics teachers is a growing problem in secondary schools not only in Karatu district but also beyond the district and for the growing teacher shortage it affects students' achievement, such that, few science and mathematics teachers in public secondary schools in Karatu district put more efforts in syllabus coverage rather than content coverage among students. This is because the school administrators provide a limited time for teachers to cover the syllabus at a given time. Therefore, the few science and mathematics teachers focus on syllabus coverage rather than content-coverage among students and this result to poor academic performance in secondary schools.

### 5.2 Recommendations

1. In order to mitigate the shortage of science and mathematics teachers, the government should introduce new systems to recruit, support, and retain teachers. Recruiting new science and mathematics teachers would address the problem of shortage of science and mathematics teachers in secondary schools and those recruited teachers should be deployed immediately after finishing their studies.

2. To school administrators, there should be a cordial relationship between head of schools and science and mathematics teachers such that since science and mathematics teachers are few they could not be given a limited time to cover syllabus but should be given a time to master content in the subjects. Also, availability of teaching and learning materials should be adequate such as enough text books and reference books, teaching models in order to simplify the work of teaching science mathematics and create attractive working environment and hence job satisfaction to science mathematics teachers in performing their work comfortably and focusing on content mastering among students.
3. There is a need for the government, through the Ministry of Education and Vocational Training, to encourage more young Tanzanians to join teachers' training in science programme so as to produce enough and competent science and mathematics teachers.
4. Moreover, the shortage of science and mathematics teachers sometime can be caused by geographical factors for example the peripheral districts. Science and mathematics teachers in the peripheral districts should be given hardship allowances so as to be encouraged and attracted remain in those areas.

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