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CHALLENGES FOR SCIENCE TEACHERS IN NURTURING SCIENTISTS IN TANZANIA; A CASE OF SECONDARY SCHOOLS IN MOROGORO MUNICIPALITY.

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ABSTRACT

The paper assess challenge of nurturing youth scientists in Tanzania. The study was conducted in Morogoro municipality whereby a cross section research design was used. The study employed questionnaires, focus group discussions and structured interviews for data collection, and data were analyzed using frequency and percentage. The study revealed that scarcity of science teachers, performance, attitude towards science subjects and laboratory equipments are among the big challenges in nurturing scientists. Therefore the paper recommends the government and other stakeholders to address the challenges so as to achieve the National Development Vision 2025.

Keywords: Scientists, nurturing, Development Vision 2025, challenges

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1.0 INTRODUCTION

Basic education Statistics in Tanzania (BEST, 2007) shows smaller Teacher Pupil Ratio especially in science subjects compared to arts subjects in which the standard ratio was 1:40 and 1:120 to arts and science subjects respectively. This indicates the shortage of secondary school teachers for science subjects (to include Physics, Chemistry, Biology and Mathematics) compared to arts subjects (to include English Language, Kiswahili, Civics, History and Geography).

Most of the teachers who have been working in public and private secondary school in Tanzania have been trained by the government. The government incurs the cost of training them by expecting some returns in terms of services they provide in the schools in order to ensure efficiency and quality output in the education system. Nevertheless, efficient and quality education seems difficult to realize if there is a shortage of teachers since teachers are not only important in the teaching and learning process but also as instrument for social, political and economic change. Nyerere (1968) states that, teachers are more than a single group of people who shape the ideas and aspirations of a nation, and to neglect their power has been one of the biggest fallacies of our society.

The teachers shortage is mainly remarked in science subjects, and to some extent in arts subjects, which lead into failure to achieve a fundamental education objectives stipulated in the Education and Training Policy (1998), that is to prepare students for tertiary, higher education, vocational, technical and professional training.

According to Education and Training Policy (1995) science and technology is an essential components of education and training in the whole education and training system. Application of science and technology helps people to interact with the environment for survival and it is important for socio-economic development in the underdeveloped countries like Tanzania. The Ministry of Education and Vocational Training (MoEVT) emphasize on the teaching of Mathematics, Science and Technical subjects such as computer studies in secondary schools in order to promote technical and scientific development. This fundamental objective can only be achieved by having a sufficient quantity and quality of science subjects teachers in secondary

schools. Still there is a remarked shortage of science subjects' teachers in secondary schools which is a challenge towards achievement of the education objectives of preparing students for tertiary, higher education, vocational training technical and professional development (Education and Training Policy, 1995).

With all the government to increase the number of teachers so as to enhance sustainability of nurturing of scientists at different stages, industrialization (national transformation from low to middle economy, still the situation has not improved. This paper was set to assess the challenges facing teachers in nurturing the young scientists for ensuring industrial transformation in achieving the national development vision 2025.

2. METHODOLOGY

The study was conducted in Morogoro municipal whereby the area was selected to represent other areas in the country (being municipals, town and rural areas). A cross section research design was used to ensure high viability and flexibility in data collection and analysis.

Sample size and Sampling techniques

A multistage sampling procedure was used by the study to select the respondents. At first study Morogoro Municipal was selected from the seven district councils of Morogoro region. At send stage 8 secondary schools were selected out of 22 public secondary schools in Morogoro Municipal Council namely Kilakala, Morogoro, Sumaye, Lupanga, Kihonda, Kayenzi, Uluguru and Mji Mpya. At third stage 88 respondents were selected randomly from the selected schools whereby 11 respondents from each school. Apart from these two key informants [Regional Education Officer (REO) and District Education Officer (DEO)] were included in the study. The sampling unit was teachers.

Data collection and analysis

Data collection techniques included interviews, questionnaires and focus group discussions. Meanwhile, quantitative data were entered in MS-Excel and analysed using descriptive statistics where frequency and percentage were used and results were presented by charts and tables. Moreover, secondary data were collected from head of schools DEO and REO.

3. RESULTS AND DISCUSSIONS

The study involved teachers (48.5%), students (45.5%), Head of schools (4.8%), Regional Education Officer (0.6%) and District Education Officer (0.6%) as indicated in Table 1.

Table 1: Distribution of respondents

Respondents	**Frequency**	**Percentage**
Secondary schools arts and science teachers:	80	48.5
Secondary schools arts and science students:	75	45.5
Regional Education Officer	1	0.6
District Education Officer	1	0.6
Head of schools	8	4.8
Total	**165**	**100**

3.1 Scarcity of science teachers

When each school was visited for this information, all head teachers accepted that there are fewer science teachers than required. Although the total number of science teachers required is less than that of Arts teachers as indicated in Table 2 below, there are fewer children who are taking science compared to arts subjects.

Table 2: Analysis of actual and required arts and science teachers in secondary schools

s/no	**Name**	**Required**		**Actual**		**Deficit or surplus**	
		Arts	**Science**	**Arts**	**Science**	**Arts**	**Science**
1.	Kilakala	50	25	44	15	+ 6	10
2.	Morogoro.	50	35	56	20	5	15
3.	Sumaye	36	24	27	16	9	8
4.	Mji Mpya	12	10	9	4	3	6
5.	Kayenzi	16	9	10	5	6	4
6.	Lupanga	20	10	13	3	7	7
7.	Kihonda	50	25	55	15	5	10
8.	Uluguru	40	20	40	16	0	4
	Total	**274**	**158**	**254**	**94**	**20**	**64**

Note - mean deficit and + surplus

Table 2 shows that there is a 254 and 94 teachers of arts and science respective while 274 arts teachers and 154 science teachers were required when the study was conducted. Thus there was a deficit of 20 arts but 64 science teachers. Therefore the results implied that there is a problem of science secondary teachers than arts teachers in Morogoro municipal.

A detailed analysis revealed that Morogoro secondary school had the highest number of teachers required (35 teachers) while Kayenzi secondary school had few number of science teachers required (9 teachers). This is to say that arts teachers are to increase by 107% in order to meet the demand of arts teachers in Morogoro. However for science subjects, there are only 94 science teachers, while the demand is 158 science teachers, which indicate that in order to meet the demand the number of teachers has to increase by 168%. This indicates that although there are more arts teachers than science teachers, science teachers are far less than required. In order to meet the demand for science and arts teachers, the current number of arts teachers has to be increased by 107% while the current number of science teachers has to be increased by 168%. The study also involved the analysis of actual and required number of science teachers across all eight secondary schools involved in this study. It was revealed that, all eight secondary schools had fewer science subjects' teachers than required.

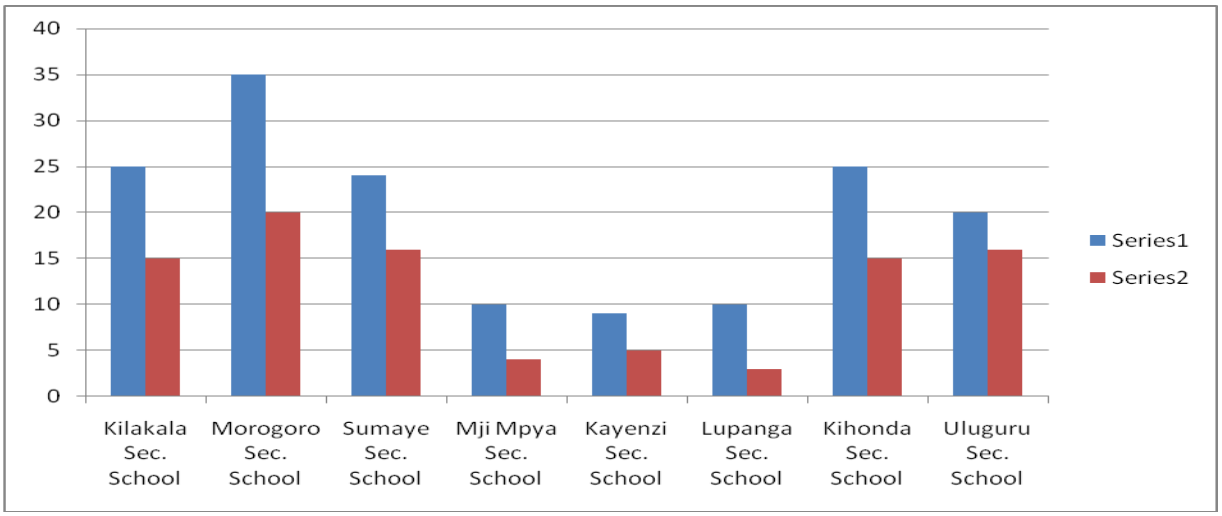

Figure 1: Comparison of actual and required science teachers in secondary schools

Science teachers are trained by other science teachers. If there is scarcity of science teachers in schools and colleges, chances are that there will be few science students. If the schools and

colleges decide to recruit many students while they have fewer teachers, the chances are that the students will not perform well because they will not get good support from their teachers.

3.2 Challenges

a) Lack of good teaching and learning environment and facilities

Both teachers and students have indicated that there are few science teachers because there are few people who are studying science subjects, and that this is highly contributed by lack of both good teaching and learning environment for both science teachers and science students. Although almost 91% of students have indicated that there is a laboratory for science subjects in their schools, the quality of these laboratories is of major concern.

Table 3 Schools with laboratory buildings, materials and equipment

No	Name of school	Presence of Laboratory Buildings	Presence of laboratory materials and equipments
1.	Kilakala Sec. School	√	Present but not enough
2.	Morogoro Sec. School	√	Not enough and are outdated
3.	Sumaye Sec. School	x	x
4.	Mji Mpya Sec. School	x	x
5.	Uluguru Sec. School	x	x
6.	Kihonda Sec. School	x	x
7.	Kayenzi Sec. School	x	x
8.	Lupanga Sec. School	x	x

It was revealed that it is mandatory for schools with science subjects to have a laboratory, and therefore each school, especially with high level science classes has a science laboratory. However, in some schools, laboratories do not meet the required standards. They do not have enough equipment to enable students to learn or teacher to teach properly. As indicated in the figure below, 95% of the schools do not have enough equipment and materials for practical

science experiments. There is lack of chemicals or reagents for chemistry experiments, and they lack most of the equipment they need for physics, chemistry and biology experiments.

However, although internal review in 2000 in secondary schools in Tanzania showed that while science textbooks and laboratory facilities has been improved in some schools under the Science Education in Secondary school Projects (SESS), classroom practice had changed very little (Osaki, 2000) because of lack of good science teachers, it is difficult to bring expected changes in secondary schools' science subjects.

Lack of equipment for teaching and learning has forced students to depend much on tuition classes when the schools have closed for holidays. Some teachers confirmed that they use their small budget to buy equipment and reagents for students to facilitate practical sessions during practical examinations. Some students see these things for the first time during examinations, but they are being taught theories in classes. Moreover, seminars and workshops were not conducted to science teachers in Morogoro District and there were lack of science equipment and books in schools so as to update the teachers with new techniques in teaching the subjects. Such findings concur with a study conducted by Bandeke (1983) who examined of teaching and learning science in colleges of National Education, who found that the tutors were not competent enough to handle various sections of the science syllabus properly; shortage of equipments and chemicals as well as teaching materials in the colleges and the student teachers had a poor science background which made it difficult for them to cope with science studies at the colleges.

Apart from questionnaires that were administered to include a question whether a school has laboratory science or not, the researcher visited each school to confirm some of the findings. It was surprising to find out that only two schools (Kilakala and Morogoro Secondary schools) had science laboratories. The rest did not have laboratory buildings, and therefore they used their normal classrooms when they wanted to do some practical sessions on science related experiments.

As indicated in Table 3 above, there is no school with laboratory building and good or enough laboratory equipment. Even the two schools with laboratory buildings, they do not have enough

science materials and equipment. This indicates a big gap between the current situations in schools and the standard set by the Ministry of Education and Vocational Training.

It was clear that if schools do not have science laboratories or science equipment and materials, in most cases students will either not be motivated to study science, or those who will select science will not perform well due to poor preparations. Science practical examinations contribute 30-40% of overall performance of students, therefore if there are no good laboratories and good equipment and enough materials for experiments, students are being prepared to fail examinations, and distort their future career in science related subjects.

b) Percentage of students taking science subjects

The study also assessed the extent at which students are selecting science subjects. Questions related to selection of science and arts subjects were applied to students, head teachers and District Education Officer. They all confirmed that they are experiencing a situation whereby there are less science students than there are arts students in all secondary schools involved in the study. In all schools, the percentage of students who are taking science subjects is very low. It was found that in the schools assessed, only 22% of students are taking science subjects, and about 29% of students have average of 21-40% of students taking science subjects. There was no school with more than 40% of students taking science subjects. That means, the majority of students are taking arts subjects.

The Head teachers of all eight schools were requested to provide actual number of students taking science and those taking arts. The following data were collected from only form three and form four students in all eight schools in this study. Table 4 shows that only 22% of students in form three and form four are taking science subjects, with the lowest percentage at Kihonda Secondary school, which has only 14% of students in taking science subjects. The highest percentage is at Kilakala Secondary school, which has 42% of students in science subjects, followed by Morogoro Secondary School with 33% students in science subjects.

Table 4 Distribution of arts and science students in form III and form IV

Names of Secondary Schools	Number of students taking Arts (Form III and IV)	Number of Arts Teachers	Number of students taking Science (Form III & IV)	Number of Science Teachers	Teacher Student Ratio (Arts)	Teacher Student Ratio (Science)
Kilakala	157	44	113	15	1:4	1:7
Morogoro	496	56	242	20	1:8	1:12
Sumaye	344	27	97	16	1:12	1:6
Mji Mpya	300	9	72	4	1:33	1:18
Uluguru	425	10	76	5	1:43	1:15
Kihonda	678	13	110	3	1:52	1:37
Kayenzi	395	55	92	15	1:7	1:6
Lupanga	439	40	105	16	1:11	1:7
TOTAL	**3234**	**254**	**907**	**94**	**1:12**	**1:9**

The fact that there is only 22% of students taking science subjects indicates the important to explore why only few students are deciding to choose science. The study concentrated in form three and form four students because most of the schools provide an opportunity for students to choose either science or arts subjects when they have completed form two, therefore, form three and form four students represents a true picture of students' choices, and the schools cannot easily interfere these choices. However, students in form five and form six are responding on the combinations of subjects that each school is teaching. This means that, if the school is teaching only arts combination, there will be all arts subjects. However, for form three and form four students, it is mandatory to teach all science and arts subjects, so that students can have an opportunity to select their choices accordingly.

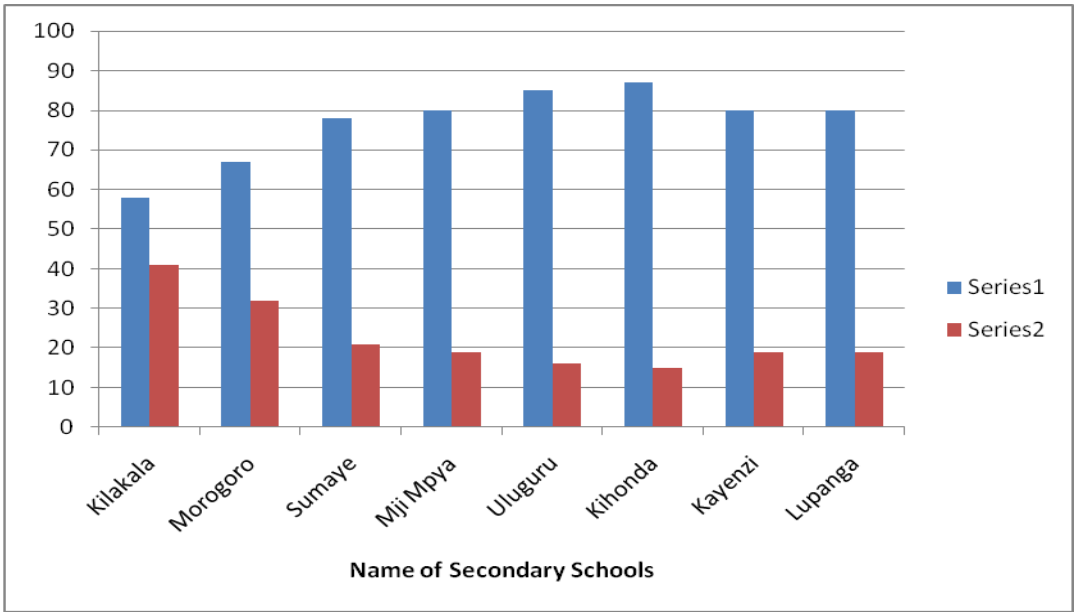

Fig. 2: Percentage of Arts and science students in form III and form IV

As indicated in Fig. 2 above, the gap between science and arts students is highly viewed at Kihonda and Uluguru secondary schools, while the smallest gap is at Kilakala Secondary school. The smallest gap at Kilakala secondary school is contributed by the fact that the school is one of the special government schools, which were given priority by the government because they were sending students who had appeared to have performed very high , and therefore the government had to ensure they have enough qualified teachers to teach these students.

It is very difficult to have fewer science students and expect to have many science teachers. Therefore, one of the reasons for fewer science teachers could be the fact that there are few science students in secondary schools. The reason foe fewer science students are explained in this study.

c) Poor performance of science students in examinations

In Tanzania there are many teachers who are selected from group of students who have not performed well in their examinations. Teachers' colleges have reduced their entry requirements in order to attract a bigger number of students because those who have not performed well in their examinations do not choose teaching career. Despite this effort, most science students have been performing worse to the extent that it was hard for teaching colleges to enroll them. Poor

performance of science students in form four and form six has contributed in having few science students in teaching colleges. The results are similar with that of Lubondo (1993) who found that science teachers were not competent as 31% are form four in Morogoro rural district.

d) Frequency changing of career or schools by science teachers

The fact that science teachers are in demand has resulted infrequent movement of science teachers across schools. Teachers are not staying in the same school for a long period of time. They move from one school to another because of different reasons. These reasons include searching for better salaries, looking for better working conditions(good relation with other teachers, better accommodation, places with good transport and accommodation, schools with good equipment, water, electricity etc).

Other teachers have changed their career as teachers and began to do other jobs. It was reported by school teachers that some teachers have decided to establish their businesses and are now entrepreneurs in non-education businesses. Some have secured opportunities for further studies, but in areas that are not related with teaching, and are enjoying better income from non-teaching profession. With this findings, it can be concluded that there is a perception that teaching is not a good profession, and that teachers are meant to live average life, therefore for a person who wants to earn good life he/should think of changing career to another career that will pay him or her good money.

One teacher who joined business was approached to offer his experience in his new career. He indicated that he is now earning four times more than he used to earn as a chemistry teacher at an ordinary level secondary school. Another teacher who was the researcher's physics teacher also confirmed he is now earning six times he used to earn as a physics teacher after he went for a Master Degree and now working in a telecommunication company in Dar-es-salaam. He was able to say:-

"I am earning six times I used to get as a teacher, and I do not have to spend a lot of time marking exams or students' work"

Such comments indicate how important it is for teachers to receive a decent compensation that is relevant to the amount of work they do. Although there is no exception in teaching, it is important that the government and other entrepreneurs in education to realize that teachers have a special and unique role in shaping people's career. If they are well compensated, and supported to do their work well. Most teachers will value their work and will not leave their career to join other careers.

e) Difficulties in science subjects in schools

During the interview with science teachers, they all had a consensus on the fact that lack of enough science teachers is also contributed to by the fact that science subjects are more difficult than arts subjects. Traditionally, science is regarded as a difficult subject and most of the students who appear to be very bright in classes have ended up taking science subjects. This means, when there are few science students, chances are that there will also be few people who will be able to opt for science, in the long run, there will be few science teachers.

Figure 3 shows 67% strongly agreed that science subjects are more difficult, while 19% they only agreed, meanwhile only 10% disagreed that science subjects being difficult. Therefore the results imply that the students had negative attitude towards the science subjects.

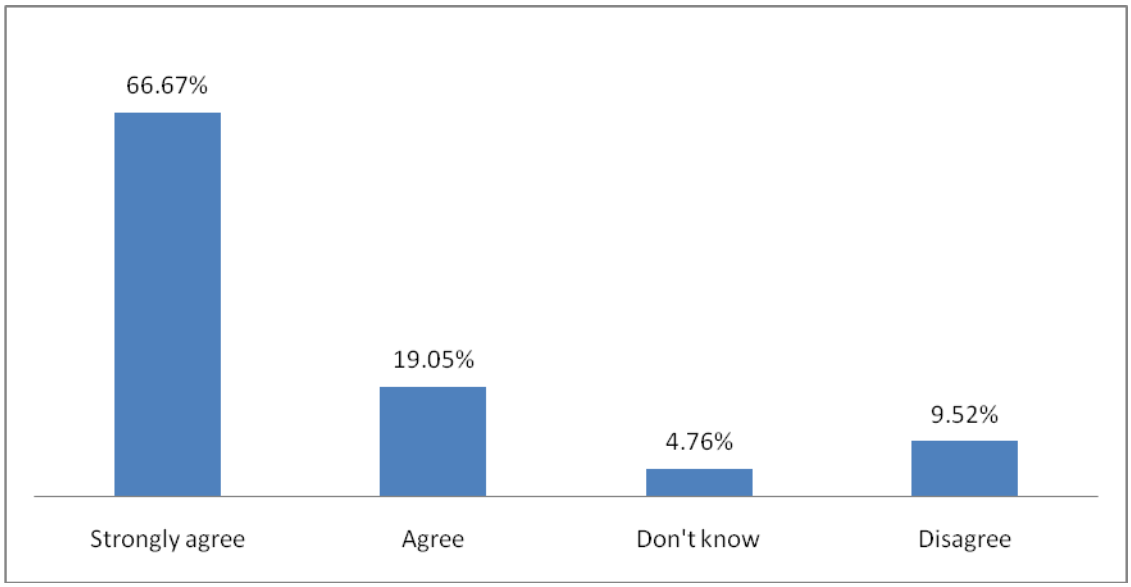

Fig.3 Opinion on science subjects more difficult than arts subject

The study also assesses that whether it is true that science subjects are more difficult or more challenging than arts subjects in secondary schools. It was evident that in most secondary schools, students and teachers indicated that science subjects are more difficult than arts subjects and therefore many students who are performing at an average level opt for arts than science. This contributes in having more arts than science students. Teachers agreed with this fact during interviews, and students also mentioned that science subjects are very difficult compared to arts subjects as indicated in Figure 3. This study has therefore assumed that if science subjects are more difficult, there will be fewer students who are taking science subjects, and this will contribute in having fewer science teachers on these subjects.

f) Uncompensated risk

During the interview with teachers, science teachers have claimed that being science teachers they are exposed to a lot of challenges, including health risks associated with chemicals (especially for chemistry and biology teachers). In most schools, the laboratories are not equipped with safety equipment to reduce some health risks, and therefore some teachers have ended up getting lifetime health complications resulting from e.g. fumes from chemicals and chalk dust. Despite such risks, they have a feeling that their salaries and other benefits do not indicate any consideration on such risks.

Generally, teachers are paid low. In terms of salaries, the diploma holder are paid 244,000/= per month and degree holders are paid 347,000/=per month, while a degree holder pharmacist is paid 814,500/= per month and an engineer is paid 720,000/= per month. A diploma holder in scientific and vocational professions is paid 471,830/= per month. In terms of housing/ water supply, health services and electricity (i.e. working condition), was found only in Kilakala Secondary School, and the houses were not enough to all teachers. Training and development opportunities are not clear to science teachers, depends on the number of science teachers available in the school.

Art teachers are paid just like other teachers at school, therefore their risk are not compensated. At the same time, the government does not have a health insurance scheme for them, so if they

get problems at work it is hard for them to get treatment they need through their low salary. One of the teachers at Mji Mpya Secondary School said:-

"We are taking a big risk but we are not paid well. A friend of mine, whom we went to teaching college together, has lost his sense of smell because of smelling dangerous fumes when he was preparing a chemistry experiment for his form six students. He was not supported well by the government. If I get another job I would prefer to leave teaching chemistry".

This has made some of teachers who are very keen to either change their career or seek for some private secondary schools that pay more or that has worked well in reducing such health risks at work.

Generally, science teachers are not happy with how they are compensated (in relation to salary and other benefits such as risk allowances, medical or health insurance etc). They find themselves as being exposed to risks, which can ruin their life at any time. That is why most of them prefer to do something else, but they are retained to work as teachers because they do not have some other better alternatives.

g) Fear of failure

Interview with teachers and students at Sumaye Secondary school revealed that one of the reasons for few science teachers is that there are few science students. This is also contributed by the fact that most of the students who are studying science fail exams. The percentage of science students who pass to go for further studies (like those who join universities) is low compared to arts science. Therefore, choosing science is like choosing to fail. This has demoralized many students to take science subjects. With the situation found in eight secondary schools, where science subjects has no enough teachers and schools have neither laboratory sciences nor enough science equipment and materials, it is not surprising that students fear of taking the risk of choosing science subjects.

h) Difficulties in changing career

Both student and teachers have indicated that science teachers are facing a lot of challenges in changing their career when they want to do so. They indicated that few companies or institutions are likely to hire a science teacher to do anything else compared to art teachers. Teachers indicated that they have been trying to find even some part time jobs when they are in holidays but it has been difficult. The only available opportunity for science teachers is to conduct some tuition classes for students who are challenged by science. However, they indicated that arts teachers are hired to do some other jobs, including facilitating in different community projects, working as counselors or advisors and many other jobs in offices. Even when they want to change their career, there are many organizations that can either accept them directly or require them to take some short courses to find into their job openings. However, it was mentioned that science teachers cannot easily move to other careers, and this has made people to have a perception that choosing to be a science teacher is a big risk.

Students who are taking arts subjects were also asked why they did not decide to study science subjects. They have several reasons, among them included that science is very difficult, some were not sure if they will end up getting a good job by studying science subjects. Others indicated that they were pressurized by their parents to take arts subjects although they liked to take science. The majority were not sure if they would get good teachers to support them if they had chosen science subjects because they are seeing how science students are suffering from lack of enough teachers, and they have to depend on tuition classes. Others had already defined their career, and they could see themselves studying arts subjects that contribute or that will lead them to get their dream career, and they mentioned careers such as arts teachers, accountants, lawyers and administrators.

It was surprising to find that students can make such an analysis, which is almost similar to what teachers themselves find. Although some students have not received career counseling, they can still assess the situation of teachers at their schools and be able to decide whether they would like to be teachers or not. This means, when teachers are seen to be performing poorly financially, it is very possible that this will discourage even students to select that career.

Students were asked if they like to be science teachers and it was surprising to find out that only 5% indicated that they can consider being science teachers, while 71% were straight to say they would not like to be science teachers, leaving 23% who do know yet whether they have would like to be science teachers (Figure 5).

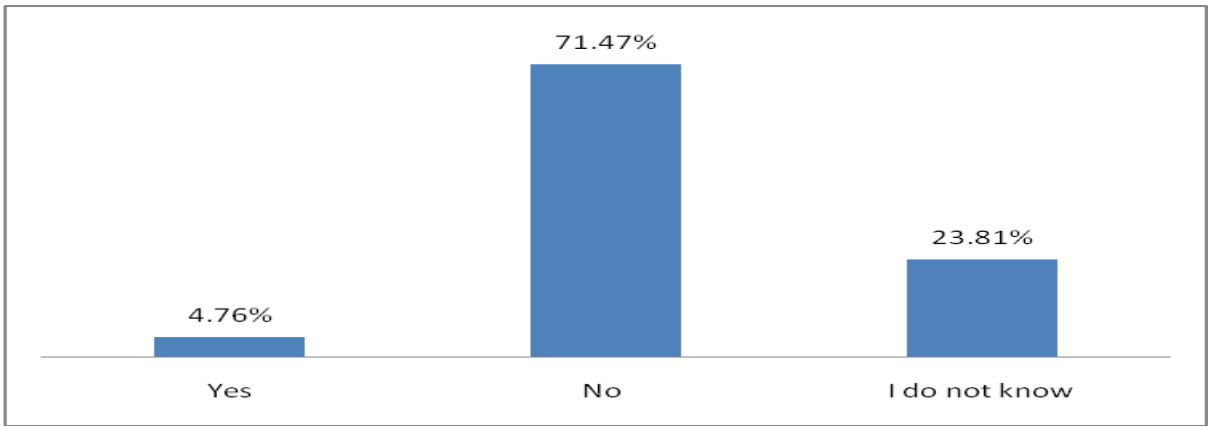

Fig 5: Students with interest in becoming science teachers

Figure 5 shows that almost 24% of students do now know whether they would like to be science teachers indicates that many students need career advice. It is expected that at secondary school level, students should be in a position to know their dream career, and take courses that contributes in shaping their career dreams. Chances are that, some of these students will end up choosing whatever comes first. It is out of this group that they will choose teaching profession after they have not performed well in their final national examinations.

i) Rate of teachers to quit teaching or change their career

The study assesses the rate at which teachers quit teaching career or change their career from teaching to other non-teaching careers. This helped to provide a picture of whether most teachers quit after they have joined their teaching career, or whether only few people opt for teaching career.

In order to assess this situation head teachers of all eight schools involved in this assessment were asked the extent at which science teachers in their schools leave the school to join other non-teaching career in the last 3 years. It was noted that all eight schools have lost some teachers in the last two years.

As indicated in Table 5 below, almost 57% of all schools have lost 4-7 teachers within two years, while 22% have lost 0-3 teachers, and the same percentage has lost 8-10 teachers. However, no school has lost more than ten teachers.

Table 5: Rate of teachers to quit teaching or change career

Name of schools	**No. of teachers studying**	**Teachers taking education**	**Teachers taking other fields**	**Proportion (%) Education**	**Proportion (%) for other fields**
Morogoro	39	29	10	74.4	25.6
Kilakala	9	6	3	66.7	33.3
Mji Mpya	9	5	4	55.6	44.4
Kayenzi	15	8	7	53.3	46.7
Sumaye	7	6	1	85.7	14.3
Kihonda	15	9	6	60	40
Uluguru	6	4	2	66.7	33.3
Lupanga	11	8	3	72.7	27.3
	111	**75**	**36**	**67.6**	**32.4**

The fact that no school has lost more than 10 teachers indicates that due to scarcity of science teachers it is hard for the school to have such a big change in science teachers within period of only 2 years.

These results can be concluded that schools have fewer teachers not only because few teachers join schools, but also because many teachers leave these schools to join other schools or change teaching career after they have joined their teaching career because of different reasons. Interview and discussion with ex-teachers indicated that some teachers change their career when they are dissatisfied by the conditions at the school leave schools or who move to other career do so after they are dissatisfied by the prevailing situation in the school.

4. CONCLUSION AND RECOMMENDATION

Lack of enough science teachers is a critical issue that needs immediate attention. It is obvious that students can hardly perform better than their teachers, therefore if there are no enough qualified science teachers, the country will not be able to have good scientists. Although students have not demanded with loud voice, discussing with them reveals that they are in great need of science teachers, and that they are highly affected by lack of these teachers.

Lack of appropriate methods to address lack of science teachers is likely to continue the cycle of problems, where lack of teachers results in lack of science students which in turn leads to lack of teachers and so on. The cycle has to be stopped by an intervention at any point (at the teachers or students). Interventions can target teachers themselves, students, policies or materials etc. The paper recommends that the government has to take special interventions on these challenges so as we can achieve the objectives set in Development Vision 2025.

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