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Tanzania Secondary School Science Teachers Perception and Reaction to Gender Difference in Performance in Science

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Introduction

For some time now, the Advanced Certificate of Secondary Education Examination (ACSEE) results have revealed that the average percentage of girls failing in the science subjects was about 6% higher than that of boys (Physics, Maths and Chemistry). Poor enrolment of girls in science subjects at the University of Dar es Salaam and Sokoine University has also been cause for concern. Girls have continued to account for only about 10.0% of the total admission in science. The ratio of girls to boys enrolled in science or technical areas in tertiary institutions has also continued to be very low.

A study was conducted in 1995 which intended to give a careful description of gender difference in performance in science from the perspective of secondary school science teachers' views. The relevance of teachers' perception stems from their pivotal influence on girls' self-image, motivation, and attitudes to science. The study sought to suggest ways in which girls learning outcome and enrolment could be improved, i.e., by minimising gender-related barriers to girls' successful learning and performance in science. The study also sought to reduce the gap on research in the University of Dar es Salaam directed to this particular area.

The Background

Gender studies in education have drawn a substantial attention by different educators world-wide (Fennema, E. & J.A. Sherman, 1977; Duncan, 1989; Linda, 1986). In Tanzania, professional women gathered in the late 1980, to form a special organ—Women, Education and Development (WED). Gender equity in education has been one of the central goals of WED. Equity in this sense should be three-fold: enrolment, performance, and number professionals in science.

Explanation on gender difference in the above areas was sought from secondary school science teachers banking on their true classroom and life experiences. The teachers came from diverse ethnic minorities so they also had

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different traditional/cultural experiences and orientations to gender treatment. This was a great advantage as their views on the subject would be demographically well spread.

The Problem

A pilot analysis of the ACSSE results for the years 1983 to 1992 revealed a significant gender difference in performance in science. The average percentage of girl failures in the three subjects Physics, Chemistry and Maths (PCM) ranged between 5% to 8% higher than the corresponding percentage of boy failures (United Republic of Tanzania, National Examination Council, (NECTA), 1993). This is relatively insignificant when compared to differences in performance cited in Mbilinyi and Mbughuni (1990). The authors gauge the primary school girls performance as "being continuously lower than that of boys in all subjects including language."

On enrolment, data from primary schools between 1979 and 1991 revealed that boy's had an average enrolment of 1% higher than that of the corresponding girls in the 13 years (range = 3%) (Tanzania Bureau of Statistics, 1992).

Enrolment at non-technical secondary level both private and public showed a significant gender difference for the years 1978 and 1991. In these 14 years, boy's average enrolment in percentage of the total was 12.5% higher than that of girls (range = 18.4%) (op. cit:23). The gender difference here is very significant when compared with the primary school figures. On the other hand, technical secondary schools put boys at an average of 83% of the total enrolment in the years 1984 and 1986 respectively (The United Republic of Tanzania 1992)

The higher up you go in the academic ladder the higher the gender difference in enrolment becomes in the sciences in the same direction. For example, girl's average enrolment in percentage of the total number enrolled in both Sokoine University of Agriculture and the University of Dar es Salaam (science and engineering) did not exceed 14% in the years 1988 and 1990 respectively (*op. cit*: 30).

The above gender differences in the enrolment and performance are assumed to be very closely related especially when enrolment to a higher level of education is based on selection examination as in the case of Tanzania.

The Purpose

The purpose of the study which is discussed in this article was threefold. First, the aim was to find out if Tanzania secondary school science teachers were

Only one teacher did not respond to have come across gender issues during her teaching. But this same teacher agreed that there was a significant gender difference in performance in science in her classes. Fifteen teachers said that they were aware of gender differences in general while four did not see the differences. On performance, 17 teachers agreed to have experienced a significant gender difference between boys and girls, while three responded the opposite and one gave a No response. All Yes and No responses were accompanied by explanations categorised below; with exception of three teachers who gave no explanation.

One teacher said that girls perform well in continuous assessment tests but fail at O-Level because "*Wanapoteza hamu ya kusoma*" ("They loose the interest to study") at Form IV. Note that the number of responses do not tally to 18 because some teachers gave more than one explanation. Further more, full explanations were included in the questionnaire items which required teachers to give explanation on the possible causes of gender difference in performance. Their responses on this will be discussed later. One interesting explanation however reads: "*Wavulana wanaona aibu kupitwa na wasichana, hivyo huongeza bidii zaidi.*" ("Boys feel shy to be out-performed in class by girls and so put a lot of effort"). One teacher said, "girls don't like science".

Male Teacher's Background

There were 38 returns from male science teachers questionnaire from the six Tanzania regions. Their background information was analysed as presented Table 13.

Table 13: Information on Male Teachers Background

Number of Science Teachers	Subjects and No. of Teachers Teaching	Teaching Experience in Years	Responses on Gender Awareness		Response on Significant Gender Difference		Level Of Teaching In Forms.
			Y	N	Y	N	
6 2 8 8 14	Ph = 4 Ph + Mt = 9 Ph + Ch = 1 Ph, Ch, Mt = 2 Ch = 4 Ch + Mt = 3 Mt = 7 BI = 6 BI + Ch = 26	< 1 1-2 2-4 5-7 >7	24	8	27	5	I = IV = 15 III—1V = 14 IV - VI = 9

girls as future wives tightened girls security within a home bound environment under close watch by parents and the extended family.

As a result most of the times, girls were engaged in indoor activities or play. Restrictive environments to girls is not only a practice in one region. This is typical of practices by most ethnic communities in Tanzania. In Kilimanjaro for example, the Chagga reinforce this gender differentiation in treatment even through a literal translation of a proverb saying *"Ichumia ni auyo na iramia numba ni womoo"* (Going out is your father and staying indoor is your mother.) This implies that boys should refrain from indoor activities while their counter part girls should accept this as a given.

Boys, unlike girls, were expected to be future fathers and so family bread earners. These were relatively free and could engage in distant outdoor activities such as cattle herding. The activities made boys more independent and oriented away from home. Role differentiation between boys and girls is a national problem rather than a problem of a few people in Tanzania.

The Learning Theories and Boys Advantage

Clark (1983), Teyler (1987) and Braun and Linder (1975) from their research findings on a similar problem advocate that difference in environment in which boys and girls are subjected is among the factors which contribute to gender differences in performance.

Some theories in educational psychology (i.e., Piagetian and Constructivist) also hold that the environment can either nurture or hamper development of certain skills among children. Experience to support this was revealed in one Tanzanian local news paper (*Mfanyakazi*) in the mid-1980s. One boy lived in a Ugandan forest with monkeys for about a decade. This boy developed skills of jumping from one tree branch to another and when rescued failed to speak. By implication, the boy could not develop language skills. The environment denied him opportunity to develop language skills as monkeys had no "human" verbal communication. Arguing parallel to the above event, boys' free interaction with the world around them is likely to enhance the development of certain important skills in the learning of science. Curiosity, investigation, observation, confidence and design are likely to be developed faster in boys than girls. There are therefore likely chances for boys to relate school science to experiences in everyday life and slimmer chances for girls to do so.

The Constructivist View and Boys Advantage

Assuming a Constructivist view of learning, i.e., learning can take place if it starts from the learners own experience, an ideal Constructivist teacher would

therefore start her/his lesson by probing into what her/his learners already know. Caught in this situation, girls would have experience in cooking, laundry, collecting firewood, and a few indoor games. On the other hand, boys would have broad experiences as a result of their different environment exposure, different games, activities and freedom which allows them to get into even more risky activities than girls. Conclusively, under ideal Constructivist approaches to teaching, boys are likely to relate more of their school science concepts to more relevant personal experience hence having a differentiated rate of accommodation and understanding during the teaching-learning.

Parent And Gender Difference in Treatment

Parents handle girls differently from boys. Girls are perceived as delicate and more susceptible to more evils from the society than boys when both are subjected to the same environment. Orientation of parent's expectations about a girl also differ significantly to the same parent's expectation to a boy in the same family. As a result of the above gender differences in perception and orientation, families draw clear distinctions between girls and boys in terms of roles in everyday life activities, children's behaviour, reward system and relationship to the parents and among peers in general. Conscious and unconscious, parents often label their children using gender-biased framework.

Experience related to parents reactions towards educational pursuits among girls and boys reveal a demotivation practice on the side of girls but rarely on the boys. For example, in Tanzania, most school girls would be asked to stay home in cases where their mothers are either sick or absent from home. Girls are in most cases expected to act as a direct substitution to the mother in almost all family roles especially in event of problems. At the same time, they are a hand to the mother, unlike the boys in the eyes of both the mother and the father. It would be interesting to find out if families without 'a girl child' treat boys in the same manner.

Who is Responsible?

Experience in child treatment from most working and non-working families in Tanzania indicate a high gender discrimination by parents. If both father and mother arrive home after work (i.e., at 4.00 p.m.), the father would in most cases drop the wife and drive away. In similar occasions, the father would sit, pull his newspaper and start reading. Corollary to this, a father would dodge his family who has been farming together in a village, to go to a local pub while the mother goes to attend family chores. The mother would rush to the

kitchen, prepare something for the father first if not for the whole family. The two parents would also encourage their boy to play, stay idle or study while their daughter would be busy helping the mother or cooking for the family in an event where the two have just come from school. A similar experience from Burkina Faso reveals that the workload of girls is so great that females have little time to pursue education.

Tanzanian girls are faced with similar treatment. Some parents would be heard scolding their sons by saying "usisome masomo ya kike", (i.e. don't specialise in female subjects), "Utafeli vipi hesabu kama wanawake?" ("How can you fail in Maths like women?").

A follow-up discussion with some school girls doing science revealed that some parents would accept failure grade in Maths from their daughters, but not from their sons. Mbilinyi and Mbughuni report that girls are able to score first division in ACSEE (p. 39). Most parents will get surprised where girls performance is high because it is contrary to their expectation. As a result, they will push their daughters to put more effort in the arts subjects led by a belief that it is a discipline suited to girls. The boys would be asked to work hard to become engineers, doctors, pilots, etc.

The great concern here is that the above mentioned gender discriminations are practised by almost everyone in the society, including the educated professionals and non-professionals, the lumpens, the old and the young and in the eyes of mothers and fathers. Worse still, some ethnic minorities (Coast and Mtwara) practice early "sexual ritual" to girls which in most tendencies put them out of school completely. Along the same lines, some parents in some regions (Mwanza, Shinyanga and Mara regions) take their girls out of school early before they complete their education level for the purpose of getting dowry (interview data). This results in discouraging girls from continuing to higher education, hence affecting the number of girls who might join/specialise in science at a tertiary level. A net effect of all of these subjective treatments to girls manifests itself in more occasions for girls to perform poorly in the sciences compared to the boys. This also affects the children's own perception of their own self image and the world as they tend to think of every phenomenon in terms of "a man" or a "woman".

Sekwao reported some of the findings of a study conducted by a research unit in her Ministry. She said it was very alarming to find out that "most of our children have been damaged to extent that they cannot believe to see some jobs taken by women". For example, in a questionnaire which required primary school pupils to complete some statement, children gave the following responses.

Questionnaire statement:
Andika Mwanamume au Mwanamke katika sehemu iliyoachwa wazi. (Fill in Male or Female in the blank space).

1. Asha anaendesha trekta; Asha ni mwanamume. (Asha is driving a tractor; Asha is a male).

Asha is a very common female name. But children's perception of the world of work could not imagine a female tractor driver.

It is also common to find a father or mother with his/her children staring at a woman plumber, bus driver, engineer, and the like with an astonishment, "look, it is a 'she' driver", etc. Parents are therefore in a way responsible to their girls dislike of some science oriented jobs.

Teachers and Gender Differentiation in Treatment

Teachers were mentioned by some studies as reinforces of stereotype behaviour and gender roles among school children. Tobias (1978), Shonborn (1975), Cain (1980) and Whyte (1986) have similar views that some teachers would tend to encourage girls to conform to feminine subjects such as Domestic Science or languages. Teachers were also reported to treat boys and girls differently in which boys receive more attention than girls regardless of the teacher's sex (Mbunda 1990-1992, Mbilinyi and Mbughuni *op. cit.*). A live experience from observation made in a Physics class of "teachers to be" at a tertiary learning institution quoted this from the teacher, "Is there any girl in my class? How would you expect a girl to study and pass Physics?" This was rather an uncomfortable experience which needed ascertaining from the student's side. Interview data from a few students who have had a course with this same teacher revealed out that this was a common treatment to all Physics students who happened to be taught by the teacher. "He naturally dislike girls in Physics", the students added. What damage to girls in Physics has this individual teacher done? His practice might have far reaching effects than what is merely represented here. It was an experience which this class of student teachers should have not been exposed to! Worries were therefore born in mind that our practising science teachers might not be free from such perceptions towards girls.

Blaming or praising students, offering reward and punishment can either improve or lower pupils self-esteem. Less attention to girls would motivate them in general learning. However, the degree of teacher negative treatment required to produce a negative effect on students is not known. Teachers unconsciously reinforce and validate pupil's perception of gender related behaviour (Duncan, 1989; Herbert, 1985). This behaviour is likely to be practised by Tanzanian parents and teachers.

The School Science and the Curriculum

The school curriculum is said to be full of "male models" showing men in active dynamic roles. Women are presented in passive and often domestic roles. Observation of textbooks in Tanzania revealed that girls are depicted playing the mother/wife roles such as carrying water, cooking, etc; while boys are depicted playing father/husband roles such as farming, returning from office, boy herding cattle, etc. (Mbilinyi and Mbughuni). Sekwao (1989) raises a concern on lack of "female" models in most of the science education materials. She mentioned examples of "sexist" books one of which being Secondary Maths Book One. Sekwao said, 80% of the word problems depict men using names like Juma, John, etc. The remaining percentage reinforced women stereotype problems such as buying onions, going to market, etc. It was also a parallel finding by this study that less than 10% of all of the scientific photographs in the only Physics textbook (by Abbot) which has dominated more than four decades of the school Physics in Tanzania represent women. This would have built up the image that "Physics is a men's subject" to most of the Physics learners.

Girls and Boys Self Image

In most societies many girls would put femininity as a priority in most of the task they undertake. And so, even if a husband and wife get a tyre burst when driving a car, it is seldom that the wife would attempt changing a tyre. This "feminine" image of girls has penetrated through many people in the society just like simple repair and maintenance jobs in a family home are for 'men', washing and cleaning are for 'women'. Teachers alike have images of "rough" boys and the "soft" girls, with images of being "dirty" for boys "clean" and "tidy" for girls.

Children's perception of science has been unfortunately "masculine" in most reported studies and science "makes people dirty and rough" and so not feminine. This might explain why there are such few girls in technical jobs, engineering or as "car mechanics". Girls' dislike of science might somehow be rooted in this perception. Boys unlike girls get prepared for future "masculine" jobs and so opt for sciences. Liking for the science might be a motivation in working hard leading to success. Based on this assumption boys would therefore tend to perform better in science than their counter part girls.

Biological Differences Between Sexes

Halpern (1986) studied gender difference from a different perspective. The author tends to raise concern on misinterpretation on some research findings.

For example, although there would be differences in activities undertaken by men and women, the difference should not necessarily be considered as a reflection of sex-related differences in cognitive abilities (p. 4). From the research reports revisited there was no evidence of a sex-related biological mechanism which has been reported to affect boys or girls differently. However, some test differences on gender performance reported between 1980's and 1990's were based on measures on "what one does in fact" which is achievement and not what "each of the sexes can do", which is ability. It can not therefore be generalised that there are some types of cognitive abilities that vary on the average as a function of sex.

Later effect of such variation on cognitive processes is however unknown. Using some theories such as the genetic theory, the Freudian, social modelling, learning and cognitive theories, sex-differences in boys and girls have been explained as a result of psycho-social variables than biological ones. And so, it is nature and nurture which must jointly operate in the development of cognitive abilities. This supports the discussion effect of gender differences in environment in which boys and girls are subjected. The world (nurture) has been acknowledged in most literature in education as the source of sex-differences between girls and boys rather than biological. In general most if not all the researchers revisited do not relate sex-differences to biological phenomena.

If sex-differences in performance were due to inept/inborn characteristics, it would be difficult to have women excelling equally in almost all types of jobs in this world. We have women pilots, engineers, doctors and in almost every profession. And in several cases women excel equally as men. This refutes a possibility of explaining difference in performance in science between girls and boys using biological factors. The above framework was very useful in the next task of this research paper, data analysis. It formed concrete areas in which teachers responses were analysed, discarding some of their vague responses.

Methodology

Area of Study

The research was conducted in 10 co-education schools from six regions in Tanzania. The regions participating in the study were: Dar es Salaam (2 schools), Iringa (2), Kilimanjaro (1), Mbeya (1), Morogoro (2) and Zanzibar (2). A non-probability sampling of schools was employed.

The number of schools under study were determined by travel logistics, student's activities by the time of visiting, easiness in processing permit to visit the schools while in the region and financial constraints.

Since teachers in most schools came from all over Tanzania, the field changes had no influence to the generalisation of the results.

Sample Population

Experience from supervision of the University of Dar es Salaam Physics student teachers in Tanzania revealed that there is an acute shortage of science teachers. Most of the O-Level schools would at most have between two and three science teachers. A good number of these schools also offer co-education streams. Therefore the study deliberately decided to involve all of the science teachers from co-education schools. However, the strategy was adopted because of the problem faced by most researchers in determining the size of the sample necessary to fulfil the purpose of any planned research. Use of largest sample was therefore the rule of the thumb adapted by the study to reduce the chances of obtaining negative results or failure to reject the null hypothesis (Kerlinger 1964, Gibbon and Morris 1987, Borg and Gall 1989).

Instruments

The study adapted structured questionnaire with open ended questions as main tools for primary data collection. A few close ended questions (yes/no) preceded some of the open ended format to elicit free response. The questionnaire was designed in Swahili language to enhance clarity in views given by teachers responses. The questions centred on different themes discussed under the conception framework. The instrument format was chosen following the fact that "little research on the relative merits" of the opened-end or closed-end questionnaire had been reported (Borg and Gall op cit). Secondary data was collected from documentary review of continuous assessment marks from the school on gender basis. This however depended on the availability of science students performance records. Lack of photocopying services made it impossible for the researchers to do a hand copying of all of the students continuous assessment science scores. Some representative scores were therefore used to reveal whether or not the difference existed.

Data collection

To ensure a good return and independence of response, the research instruments were administered personally and in an agreed time between the researcher and the participant science teachers. To make this possible, a pre-arrangement with the different Heads of the respective sample schools was made. The science teachers were organised to sit and fill in the questionnaire in one convenient place and at the same time in the presence of the researcher. This approach facilitated in resolving what would be teachers' problems in understanding some of the question statements.

Data Presentation

The data collected were categorised under five major subject tittles: raw score and gender, teacher awareness, attributes to gender and teacher remedial strategies and amplification. Each major theme had sub-themes to avoid duplication of the findings. Categorisation of the data was made to enhance analyses and testing of the hypothesis using Chi-square(χ^2). Chi-square was chosen as it is best suited for categorical data. For descriptive purposes all responses were treated statistically using different statistical indices.

Data Analysis

One of the hypothesis of the study was that no significant gender difference in performance in science existed in the analysis of the classroom evaluative test scores. Data from continuous assessment marks were collected. A correlation approach was used to analyse these data. Using Pearson's moment of correlation, the raw scores were tested for correlation between the boys and girls. This was preceded by computation of statistical description values in terms of gender (the mean range and variability index, the standard deviations) from the tests raw score data. A frequency distribution of scores on gender basis was also done. Each set of scores from one class and school was analysed separately.

It was however found out that the number of boys in all science classes was significantly higher than the corresponding number of girls. For example, there were only eight girls specialising in science in one Form III class (1993) at Kigurunyembe (Morogoro) while the number of boys was 50. For research purposes, eight boys were randomly picked from the 50 (every 7th student from the alphabetical list of boys, i.e., 1st, 8th, 15th, 22nd, 29th, 36th, 43rd and the 50th). A similar approach was used throughout the study. The total number of participants in this particular exercise was therefore 127 girls and 127 boys. Had it not been the poor ratio of girls to boys (about 1:3) in most of the science classes, the sample would have been very large given that the number of boys in the list was 412. So, the study was forced to drop 285 boys and make a random selection of the 127 to equalise with the number of participant girls. It was however evident that the number of girls opting for science was significantly lower compared to that of boys.

In some cases, only two girls were present in a class of 18 science students (Meta, Form V, Physics, Chemistry and Maths Stream, 1993). It was a difficult decision to compare scores from two girls and two boys only. However, the girl's average scores were 45 (Physics) and 40.5 (Maths). The corresponding average scores for boys were 52.5 (Physics) and 52.5 (Maths).

Some schools provided two lists of raw scores for each student; one for course work marks and the second for examination scores. The two were averaged to get a single score for each student. Each school's results were analysed subject wise. This helped in establishing a fair conclusion of the gender differences in performance in terms of single subjects (Note here that we are comparing students scores not abilities/achievement. Note also that all of the data presented in all Tables 1-10—unless otherwise stated—were collected from different schools academic records files.)

Table 1: Raw Scores in Maths Kigurunyernbe, Form IIIs)

									x	S	R
Girls	69.9	43.5	62.0	42.5	24.5	59.5	64.5	73.0	54.9	15.5	48.5
Boys	49.5	55.0	77.5	71.5	58.0	69.0	62.0	55.0	62.2	9.0	28.0

The Results

From Table 1, the variability value from the girls raw scores showed that five girls had a percentile raw score of around 60.0. The remaining had scores around 40.0 (2) and around 25.0 (1). The later three raw scores contributed to the lower mean in the girls scores (54.9) compared to the higher mean (62.2) in the boys scores. The main reason is that all boy's raw scores are around 50.0. On comparison, boys raw scores unlike the girls raw scores are more close to one another. However, this alone could not be used to generalise that boys performance was higher than that of the girls because of the small size of the sample population. But the mean score values in the two distributions can be used as indicators in predicting the direction of the possible gender difference in performance in the sciences. So, by gender analysis of several such raw score distributions (see Table 2-10), it was possible to predict the existence and direction of the gender difference in performance between boys and girls.

Table 2: Raw Scores in Physics, Chemistry and Biology (Form IIIs, 1993)

Girls			Boys		
Biology x =33.6	S = 11.4	R = 37.0	Biology x =44.0	S = 14.7	R = 52.5
Physics x =37.2	S = 6.2	R = 19.5	Physics x =-42.	S = 15.4	R = 53.0
Chem. x = 56.1	S = 10.1	R = 32.0	Chem. x =55.25	S = 16.0	R = 53.5

Table 3: Raw Scores for Form IV Kigurunyembe (1993)

Girls			Boys		
Maths x = 47.2	S = 12.4	R = 47	Maths x = 61.8	S = 10.8	R = 29.5
Biology x = 60.9	S = 19.5	R = 62.5	Biology x = 59.2	S = 14.6	R = 47.5
Physics X= 28.0	S = 10.3	R = 28.5	Physics = 40.2	S = 10.4	R = 30.5
Chem. x = 36.5	S = 7.6	R = 23.5	Chem. X = 41.0	S = 8.1	R = 23.0

Table 4: Raw Scores for Form III, Meta.(1991)

Girls			Boys		
Maths x 39.7	S = 7.3	R = 28.0	Maths x = 47.3	S = 13.1	R = 38.0
Biology x 37.0	S = 16.0	R = 54.0	Biology x = 29.8	S = 7.5	R =28.0
Physics x 39.9	S = 12.4	R = 37.0	Physics x = 20.75	S = 12.2	R = 47.0
Chem. x = 16.9	S = 12.4	R = 37.0	Chem x = 20.75	S = 12.2	R = 47.0

Table No. 5: Raw Scores for Meta Form IIIs (1992)

Girls			Boys		
Maths x =16.4	S = 16.5	R= 62.0	Maths x:= 20.6	S = 12.6	R = 39.0
Biology x =23.3	S = 7.8	R = 28.0	Biology = 27.8	S = 12.0	R = 45.0
Physics x =36.1	S 18.1	R = 68.0	Physics = 38.4	S = 17.9	R = 73.0
Chem. x =26.4	S 13.1	R = 44.0	Chem. x = 30.5	S = 13.6	R = 42.0

Table 6: Raw Scores Meta Form IIIs (1993)

Girls			Boys		
Maths x = 73.0	S = 10.6	R = 26.0	Maths x = 70.6	S = 9.01	R = 28.0
Biology x = 37.8	S = 113	R = 36.0	Biology x = 50.3	S = 12.9	R = 49.0
Physics x = 38.4	S = 13.6	R = 44.0	Physics x = 1.2	S = 13.6	R = 55.0
Chem. x = 32.9	S= 11.6	R = 37.0	Chem. x = 38.95	S = 13.6	R = 47.0

Table 7: Raw Scores Meta Form IIIs (1993).

Girls			Boys		
Maths x = 4 3. 2	S = 6.7	R = 19.0	Maths x = 48. 2	S = 9.5	R = 32.0
Biology x = 44.5	S = 12.1	R = 19.0	Biology x = 52.0	S = 8.6	R = 22.0
Physics x = 2.9	S = 6.8	R = 20.0	Physics x = 32.5	S = 9.3	R = 31.0
Chem. x = 27.1	S = 9.1	R = 33.0	Chem. x= 35.5	S = 9.0	R = 25.0

Table 8: Raw Score for Meta Form IV (1993). First Term.

Girls			Boys		
Maths x = 16.3	S = 11.9	R = 45.0	Maths x = 23.0	S = 13.23	R = 53.0
Biology x = 29.6	S = 17.2	R = 62.0	Biology x = 41.1	S = 14.5	R = 52.0
Physics x = 16.8	S = 14.2	R = 50.0	Physics x = 25.9	S = 15.6	R = 48.0
Chem. x = 19.9	S = 13.4	R = 55.0	Chem. x = 23.0	S = 10. 1	R = 39.0

Table 9: Raw Score for Mkwawa Form V (1991/92).

Girls			Boys		
Maths x = 33.5	S = 12.0	R = 45.0	Maths x = 36.7	S = 9.4	R = 36.0
Biology x = 43.7	S = 7.8	R = 35.0	Biology x = 47.3	S = 8.1	R = 30.0
Physics x = 42.4	S = 13.6	R = 55.5	Physics x = 42.6	S = 15.1	R = 53.0
Chem. x = 41.5	S = 10.2	R = 46.5	Chem. x = 46.65	S = 12.2	R = 61.0

Note: In this class, Chemistry combination had 48 girls and 105 boys, Physics 27 girls 99 boys (27 out of 126 students) Maths (Adv.) 34 girls (I incomplete course work) and 94 boys.

Table 10: Raw Scores for Mkwawa Form VI (1992/93)

Girls			Boys		
Maths x = 38.8	S =14.0	R = 44.0	Maths x = 44.0	S = 19.6	R = 90.0
Biology x = 37.0	S = 9.2	R = 1.0	Biology x = 49.7	S = 10.9	R = 53.0
Physics x = 53.2	S = 15.1	R = 50.0	Physics x = 55.1	S = 16.4	R = 55.0
Chem. x = 38.9	S = 8.5	R = 35.0	Chem. x = 45.0	S = 10.9	R = 49.0

Gender Difference and the Course Work Scores

The results from Tables 2-10 were summarised based on each table first followed by a frequency distribution of the mean scores indicating the leading sex in each case.

From Table 2, boy's mean scores in Physics and Biology are significantly higher than the corresponding girl's average scores in the two subjects. There is no significant gender difference between boy's average score in Chemistry and the girl's average score in the same subject. However, boys have a significantly higher score range and variability values in all subjects than the girls. There is no significant gender difference in the Biology mean score in Table 3. But the boy's average scores in Physics, Chemistry and Maths are significantly higher than those of the girls. Girls' raw score distribution in Maths and Biology vary more than those of boys.

Table 4 reveals significant gender differences in the Physics and Biology mean scores putting girls higher than the boys, while the average score in Maths and Chemistry put boys higher than the girls. There is a high variation in the girls raw score in Biology

From Table 5, there is no significant gender difference in the mean score in Physics but in the three other subjects, that of boys' is higher than the girls'. Variability of the raw scores is inconsistency in both girls and boys distributions.

Table 6 shows that girls mean scores in Maths and Physics are significantly higher than the corresponding boys' scores, while the scores in Chemistry and

Biology reveal the vice versa. There is no significant difference in the variation of the raw scores between boys and girls.

The mean scores in the three subjects except Physics in Table 7 show a significant gender difference, that of boys being higher than the corresponding girls' scores. The average scores in Physics show no significant gender difference while variability in both girls' and boys' raw scores are inconsistent but relatively low.

Table 8 shows a significant gender difference in the mean scores in all four subjects, girls' scores being lower than those of boys. Variation in the raw scores for both cases is unstable. The boys' mean scores in the three subjects Maths, Chemistry and Biology are significantly higher than those of girls as revealed in Table 9. The average score in Physics and the raw score variations show no significant gender difference between boys and girls. Table 10 shows a significant gender difference in the average scores in all of the four subjects in favour of boys.

The Gender Difference: Mean Score and Frequency Distribution

The summary given above might not give a clear line direction of gender difference in performance. An attempt was therefore made to make a summary of the summary using a more straight forward instrument, the frequency distribution. This shows how frequent each of the two gender being addressed here led in terms of the mean score in each subject. The abbreviations used were- B = boys, G = girls and N = no significant gender difference between boys' and girls' mean scores in the respective subjects.

Table 11: Frequency Distribution of Performance

				Frequency Distribution		
Physics	Chemistry	Maths	Biology	B	G	N
B	N	B	B	3	0	1
B	B	B	N	3	0	1
G	B	B	G	2	2	0
N	B	B	B	3	0	1
G	B	G	B	2	2	0
N	B	B	B	3	0	1
B	B	B	B	4	0	0
N	B	B	B	3	0	1
B	B	B	B	4	0	0
Total				31	4	5

The above results indicate that boys' mean scores in all course work marks from the four different schools were higher than the corresponding girl's scores

in 31 events. Girls' mean scores were on the lead for only 4 times out of the 40 events which were analysed. There were only five events of mean scores in which no significant gender difference between girls and boys was revealed. Although there is a clear lead from the boys' side, it has been difficult to make a declarative statement to generalise the findings on gender difference in performance in favour of one sex. This is because, continuous assessment tests are teacher made tests. They cannot be considered as standard instruments and so conclusions made are limited to the sample instruments used. In this context, gender differences in performance between girls and boys have greater chances of occurring in the secondary school science student continuous assessment marks. Boys' chances to perform better than girls are significantly higher than those of girls. However, there was a significant gender difference in performance in science between boys and girls measured by mean scores in the continuous assessment marks from ten different streams analysed in this study.

Findings from the above analysis were used to test the secondary schools science teachers' awareness of gender difference in performance in science between boys and girls.

Girls are Capable

There is evidence from the above discussion that gender difference in performance could have two directions: One is boys performing better than girls while the second is girls' performing better than boys. The analysis of course work raw marks for Form III 1991 (Meta) and 1992 (Kigurunyembe and Meta) and 1993 (Meta) indicated that girl's mean score in Chemistry (1992) was 0.9 points higher than that of boys. In 1991, girls' mean scores in Biology went higher than that of boys by 7.2 points, which is a significantly difference. In 1993, girls' means score in Maths was 2.4 higher than that of boys (III Meta); while in Physics, it was 0.4 points higher (III, Meta).

Gender: Teacher's Awareness

The following information on teachers was extracted by the questionnaire.

(a) Teacher's sex
(b) Teaching experience
(c) Subjects taught and level (Form I-VI).

The response on teachers background were used to support whether the participating teachers were the actual representative sample of the Tanzanian science teachers, i.e., had adequate experience and taught science at levels in which specialisation in science begins (Form II-IV).

Female Teachers Background

There were 21 female teachers respondents. Their teaching experience varied in the following way.

Table 12: Female teachers background

Number of Teachers	Subjects Taught		Experience in Years
1	Biology (single)	6	Below 1 year
1	Maths (single)	2	Between I & 2 years
6	Chemistry (single)	I	Between 2 & 4 years
4	Physics (single)	3	Between 5 & 7 years
9	Two (of the above)	8	Above 7 years
	Home Economics	1	

Level of teaching

Between Form III and IV -- 16 teachers.
Form I to 11 -- 5 teachers.

The above data indicates that 90% of the female teachers had an experience ranging from 2-7 years in teaching science, while 60% had experience of about five years and a above. They all taught either one or two science subject. For the single subject teachers, Biology accounted for 30% of all the teachers. The teachers background data was however adequate to warrant the use of teachers as a representative sample of Tanzania female science teachers except for the Home Economics teacher and the one with less than one year experience in teaching. This left only 19 female science teacher's responses as useful to the study's purpose. The two were discarded to eliminate the amount of guess responses.

Female Teachers and Gender Differences Awareness

The main items in the questionnaire required teachers to reflect on their teaching experience and find out if they were aware or have ever come across any gender related issues, i.e., performance. Also teachers were asked to respond yes or no to the statement that; there was a significant gender difference in performance in science between boys and girls measured by their continuous assessment test scores, terminal examinations scores and annual/national examination scores. Responses from the two categories were analysed, and the results are presented below.

Only one teacher did not respond to have come across gender issues during her teaching. But this same teacher agreed that there was a significant gender difference in performance in science in her classes. Fifteen teachers said that they were aware of gender differences in general while four did not see the differences. On performance, 17 teachers agreed to have experienced a significant gender difference between boys and girls, while three responded the opposite and one gave a No response. All Yes and No responses were accompanied by explanations categorised below; with exception of three teachers who gave no explanation.

One teacher said that girls perform well in continuous assessment tests but fail at O-Level because "*Wanapoteza hamu ya kusoma*" ("They loose the interest to study") at Form IV. Note that the number of responses do not tally to 18 because some teachers gave more than one explanation. Further more, full explanations were included in the questionnaire items which required teachers to give explanation on the possible causes of gender difference in performance. Their responses on this will be discussed later. One interesting explanation however reads: "*Wavulana wanaona aibu kupitwa na wasichana, hivyo huongeza bidii zaidi.*" ("Boys feel shy to be out-performed in class by girls and so put a lot of effort"). One teacher said, "girls don't like science".

Male Teacher's Background

There were 38 returns from male science teachers questionnaire from the six Tanzania regions. Their background information was analysed as presented Table 13.

Table 13: Information on Male Teachers Background

Number of Science Teachers	Subjects and No. of Teachers Teaching	Teaching Experience in Years	Responses on Gender Awareness		Response on Significant Gender Difference		Level Of Teaching In Forms.
			Y	N	Y	N	
6 2 8 8 14	Ph = 4 Ph + Mt = 9 Ph + Ch = 1 Ph, Ch, Mt = 2 Ch = 4 Ch + Mt = 3 Mt = 7 BI = 6 BI + Ch = 26	< 1 1-2 2-4 5-7 >7	24	8	27	5	I = IV = 15 III—1V = 14 IV - VI = 9

From the 38 respondents, 6 teachers had a teaching experience of less than one year performance (<1). Questionnaires from these teachers were abandoned. Of these six, three teachers taught Ph and Mt, 2-Mt and 1 Ch and Mt between Form I and IV. The remaining 32 teacher respondents, 30 (93.7%), indicated to have a teaching experience of between 2-7 years, which was considered relatively adequate for such teachers to have some experience about the gender issues. The remaining two had a teaching experience varying between one to two years. In terms of levels of teaching, 23 teachers indicated to have been teaching between Form III-IV (14) and IV-VI (9). The remaining 9 were teaching in Form I-IV level. This implies that more than 72% of the respondents had been teaching science specialised streams (Form III-VI) and about 25% in the general science streams (Form I-II).

Gender Awareness

Twenty four of the male teachers (75%) said they were aware of gender issues. The remaining eight (25%) were unaware of gender issues. It was interesting to note that all the eight male teachers who denied to have heard of any gender related issues were Biology specialists (6 taught Biology only, 2 Biology and Chemistry). However, 27 teachers (84.4%) agreed that there was a significant gender difference in performance in the course work assessment marks between boys and girls. Five teachers(15.6%), disagreed that there was a significant gender difference in performance in terms of their course work assessment marks. Of the five teachers who disagreed in this way two were Biology specialists, two Chemistry and one Physics specialist.

Responses on Gender Difference

Most teachers who agreed on the gender difference in performance in the course work assessment marks came up with an explanation that girls usually score lower marks than boys (13) or boys occupy higher ranks than girls (3). Some teachers quoted some examples from national examination results saying; "In the 1992 examination results, out of 29 division zero grades, 25 belonged to girls".

The examination referred to here was the Certificate of Secondary Education Examination, (CSEE); sometimes called O-Level Examination.

The CSEE results are usually presented in grade norms such as A = excellent (1 point), B = good (2 points), C = satisfactory (3 points), D = pass (4 points) and F = failure (zero points). The fewer the points the higher the division. A student specialising in seven subjects with grade C in all subjects would score 21 points in total. Such a candidate is likely to be categorised in

Division II. While if s/he could score 19 points or less, the same candidate could be categorised in Division I. Using this criteria, division zero candidates must be failure cases scoring F in most subjects if not all.

Other explanations on gender differences in performance in science between boys and girls by number of respondents were:

(a) Girls misconception of science as a difficult subject (or and so are boys subject) – 10.
(b) Girl's have low ability to pursue science especially (Ph and Mt) than boys – 2.
(c) Girls do most of the home duties unlike boys and have little or no time to study – 2.
(d) Some girls perform very good just like some boys do – 3.
(e) Girls do better in Biology than boys – 2.

It was further elaborated by some of the above respondents, i.e., on girls misconception of science as a difficult subject that girls were worrisome and not confident when it comes to science or, girls could not persevere. For example, one teacher was quoted saying; "sayansi inahitaji muda wa kutosha wa kufikiri" "science demands more time to think". This teacher indicated that despite the fact that they have a lot of duties binding them at home which take a lot of their time, they still spend most of their time in beautifying themselves especially in hair dressing, nail varnishing, etc. Consequently, they spend little time in science or end up copying homework from boys: "Wasichana wangu hutegemea kunakili" "taping" homework kutoka kwa wavulana". ("My girls depend on taping homework from boys"). It was however only one teacher who came up with such experience in girls and this cannot be generalised. It was interesting to find out that there was no significant difference between female and male teachers on their perception of gender difference in performance in science.

Testing the Gender Awareness Hypothesis

The findings from the above discussion were adequate to test the first Null hypothesis that there was no significant awareness by Tanzanian secondary school science teachers on gender differences in performance in the science subjects. Firstly, using the mean score performance in the course work marks between boys and girls, it was found out by this study that boys had generally higher scores in all of the science subjects than girls. It was only a few cases in which the girls' mean scores in the course work marks in science were higher than those of their counter part boys. Secondly, out of the 19 female science teachers' responses, 17 (80.4%) agreed to have experienced a significant

gender difference in performance in science between boys and girls. The remaining two disagreed. Thirdly, 27 male teachers (84.4%) agreed that there was a significant gender difference in performance in science between boys and girls, five teachers disagreed. Both female and male teachers referred to their experience in the science coursework marks as primary evidence, and national examination results as a secondary source. They all indicated that boys perform better than girls in science in most cases. A few teachers indicated that it is only in Biology where girls tend to perform better than boys.

Using two out of the three set of evidences above, Chi-square (χ^2) was used to test the difference between the observed results and expected or theoretical results. The results were therefore grouped into three categories as seen below:

1. The χ^2 formula:

$$\chi^2 = \sum \frac{(o_f - E_f)^2}{E}$$

Where, 0 = observed frequency in each category
E = expected frequency in each category
Σ = the sum of

2. The Chi-square χ^2 was calculated using the formula:

$$\chi^2 = \sum \frac{(o_f - E_f)^2}{E}$$

3. Values in figure five were obtained from

$$\chi^2 = \sum \frac{(o_s - E_s)^2}{E_s} = \frac{(22 - 23.39)^2}{23.39} = 0.083.$$

4. χ^2 was obtained by summing the:

$$\chi^2 = \sum \frac{(o_f - E_f)^2}{E}$$

ie. 0.083 + 0.080 + 0.408 + 0.0027 + 0.013 = 1.0127.

The first category is that of score distributions. There were 7 set of course work marks in which 4 subjects appeared in each set (Bi, Ch, Mt and Ph). This made the distributions (or events) to be 28 in total. Out of these, girl's mean score were higher than those of boys in only 6 distributions. This form the first row. And so, 22 events showed a gender difference in performance (favouring boys) and the 6 disagreed the gender difference in performance. This formed the first row. The second row is formed by the female and male responses on significant gender difference (see Table 14).

Table 14: Observed frequencies

	Group 1: *Agree To Significant Gender Difference*	Group 2: *Disagree, No Significant Gender Difference*	Row Total
Score Distribution	22	6	28
Female Responses	17	2	19
Male Responses	27	5	32
Column Total	66	13	79 (Grand Total)

A table of expected frequency for each cell total was calculated by multiplying the column and raw total for that cell and dividing by the grand total (N)., i.e., = column total/grand total x row. For example, for Group 1, (Agree results)

Table 15: Expected Frequency for the Six Cells

	Agreed	Disagreed
Score distribution	23.39	4.60
Female responses	15.87	3.13
Female responses	26.73	5.26

Further processing of the data was done by squaring the difference between the values of the observed frequency and corresponding expected frequency in each cell and dividing by respective expected frequency.

Figure16: Values From the Above Process

	Group 1	Group 2	
Scores distribution	0.083	0.426	0.509
Female responses	0.080	0.4.08	0.488
Male responses	o.0027	0.013	0.0157
Sum of the cell values	0.1657	0.847	1.0127

From the above figure,/the value of calculated chi-square ($\chi^2 c$) = 1.0127.

Before we determine the significance of Chi-square χ^2, the degree of freedom was calculated from the formula:

$$df = (r-1)(c-1)$$

Where r = raw = 3

c = columns = 2

$2df$ = (3-1)(2-1) = 2

A table of χ^2 distribution was consulted at $df = 2$. (Appendix 2 in Cohen and Holliday, (1979:243). For significance at the 0.05 level. This gave a $\chi^2 t = 5.99$. Since our obtained (calculated) value of Chi-square ($\chi^2 c = 1.0127$) fails to reach this, we accept the null hypothesis that no difference exists between teachers' perception on gender difference in performance in science subjects, and the gender difference in performance based on the mean course work assessment marks in the science subjects. Both instruments revealed that boys scored higher than girls in the science subjects. The teachers perception that boys perform better than girls was revealed by the difference in the science coursework marks in which the boys mean scores in science were generally higher than those of girls in the subjects measured.

A cautionary note is however given here that none of the findings held that boys had a "higher ability" than girls. It was the difference in performance" or "achievement" between boys and girls which was found out and not "difference in ability." This is because, coursework test in the continuous assessment process usually measured "what students do based on different teaching approaches and content taught and not what "student can do". Teachers constructs test using different format and types. Seemingly, we expect a significant difference in difficulty level between a test constructed by one teacher and another on the same content. The same is expected for tests across subjects. And so, since such tests are not standardised, they cannot be simply accepted as measuring "ability" but achievement.

Gender and Competence in the General School Subjects

The first task of measuring the teachers perceptions on gender difference in performance in science was followed by a "subject competence" in task. This required teachers to give their views on subjects in which boys excel and those in which girls excel. The objective was to find out if the results on the conception would be reinforced or rejected by the science teachers view on "subjects competence" between boys and girls. It was assumed that teachers would associate boys' competence with Physics and Maths and girls' competence with Biology and any other arts subjects (especially languages).

Teachers Perceptions of Subjects Competence by Gender

Science teachers were asked to write in ranking order, three subjects in which the two, boys and girls are most competent. The results were analysed on gender basis. All of the male science teachers' responses associated boys competence with science subjects (Biology excluded) and girls with Biology, language (Swahili) and others (History, Geography, Domestic Science, or

Civics). Similar responses were found from female teachers on the case of boys but different with girls. Most female teachers ranked Biology as the first subject in which girls are most competent. The results were however analysed as presented below.

On the subject competence by gender, 37.5% of male teachers and 36.8% of female teachers ranked Physics as the first subjects in which boys are most competent. In the case of girls in Physics, none of the male teachers consider them as competent and only 5.2% of the female teachers ranked them No 1. (1 teacher out of the 19). Thirty-seven and half per cent of the male teachers ranked Maths No I in terms of boys competence while the percentage of female teachers was 26.31%. Those who ranked Chemistry as No. 1 best for boys were 6.25% male and 5.2% of the female science teachers. The ratio of male to female teachers who ranked Physics, Maths and Chemistry as second in boys competence were: 25%:31.5% (PH); 25%:10.5% (MT), and 28.1%:15.8% (CH) respectively. The percentage on the side of girls was: 3.1%:0% (PH) 3.I%:0% (MT), and 6.25%:15.8% (CH). Ranking of boys competence as third in the subjects was: 18.7%:0% (PH), 15.6%:15.0% (MT) and 34.4%:26.5% (CH).

The trend above suggests that both male and female science teachers categorise science subjects like Physics, Chemistry, and Maths (PCM) as boys subjects. Seemingly both male and female science teachers consider Maths and Physics as boys' subjects. Out of the 32 male science teachers for example only 2 (6.2%) teachers mentioned subjects other than science (PCM) as boys subjects. These two mentioned History and Geography; other 2 mentioned Biology and Geography 1st and 2nd in boys competence (this was 3.1 % of all males science teachers).

Analysis of views on girls competence revealed that 43.75% of the male science teachers and 47.36% of the female ones ranked Biology as a number one girls' subject. This implies that there was no significant gender difference between male and female teachers' perception on Biology as a girls' subjects (and not a boys' subjects). On Chemistry, 6.25% of the male teachers ranked it as one in which girls had competence as 2nd in rank, while 18.75% ranked them as 3rd respectively. The percentage of the female teachers with the same view were 15.8% and 5.2% respectively showing no significant gender difference in the overall perception.

The perception on girls competence in Maths was the poorest from both male and female teachers. Those who ranked Maths as 2nd and 3rd in the girls' competence were 3.1 % and 12.5% of the males science teachers respectively. The female science teachers with the same ranking were in the ratio 0% and 15.8% respectively. The small percentage in the number of both female and

male teachers on girls and the competence in Maths suggest that the male and female science teachers perceive Maths as "a male" or masculine and not a girl's subject. Instead, girls' competence was considered to be high in the languages where they were ranked the second. For example, between 15.0% and 22% of the male science teachers ranked language between 1st and 3rd in girls competence. Other subjects mentioned in the same ranking were Civics, Geography and History (or Arts). Female teachers perception also ranked girls as second competent in languages (between 5.0% to % 21%). Others associated girls competence and commercial subjects, Civics, Domestic Science, History or Geography.

In summary, there was a general perception of girls that they were not competent in Physics and Maths. Instead, girls were considered to be very competent in Biology and on average had little competence in Chemistry. The girls' second competence was mainly in language followed by other arts subjects. Such views were held by both male and female science teachers. On the other hand, boys were considered as very competent in Physics and Maths by both male and female science teachers. The boys' competence in Chemistry was considered average. Very few science teachers associated boys with any other subjects than the three, Physics, Chemistry and Maths. What reasons then did the Tanzanian science teachers gave on the observed gender difference in performance and competence in the school subjects between girls and boys? Why should Physics and Maths be highly perceived as "boys" subjects and Biology as "girls" subject by these teachers?

Attributes to Gender Differences

It was found out that society has negatively influenced girls' confidence and motivation to pursue science. For example, three female teachers observed that girls have grown in an environment that believes "wanawake ni watu wa kupokea amri", i.e., "women are people to receive orders". This was reinforced by five male teachers who said, society expects very little from women since they "look down on them". The teachers further blamed the society's perception of girls that "wao ni watu wa jikoni na kazi zao ni za kupika "they are the kitchen people and their work is to cock" (5 male responses). This view was considered by the science teachers as a demotivation to girls to pursue science better. Another two male teachers and one female said, parents with these views lead girls into early marriage.

Societal pressure and tighter "security" on girls also render them not confident, and thus with unequal participation chances in most outdoor work setting. As a result, girls cannot go freely away from home to places such as the library or to friends/classmates for group study purposes. This type of

culture was described by five male teachers and two female teachers that "Our culture does not appreciate creative girls" (*wasichana watundu*), instead, girls are told "to receive orders and obey". These teachers further pointed out the effect of such culture on girls' classroom learning that: "girls perceive themselves as poor in ability, (*hujiona wanyonge*) and do not even attempt to answer questions in class".

Generally, most teacher respondents raised a concern that some cultural practices, and specifically some ethnic rituals had led girls to develop a false perception that they cannot perform at boys level in most things including the science subjects. For example, six male respondents felt that girls feel that some courses or subjects are for men. These science teachers observed that the Tanzania economic structure has clear demonstrations between "men's" job and "women's job". Consequently two male responses quote girls as saying that "after all it does not help struggling with Physics and Maths. Who is to do the heavy duty jobs that they lead to?"

There were six female and four male science teachers who did not say anything on cultural influence on gender difference in performance. However, there was enough evidence from most of both male and female science teachers that some cultural practices and beliefs on girls have a negative effect. Either, they demotivate them to pursue science or mislead them in choosing science as a future career. This was evidenced by the job structure in Tanzania. Most men occupy the engineering or manufacturing sector while women are in the services sector. Job stratification and sex stereotyping was also reinforced by some of the Radio Tanzania advertisement programmes. For example, advertisements to do with secretarial jobs or courses, washing, house cleaning, or poor decisions in home or economic position were all associated with women. The situation was made worse by drama plays (*mchezo wa wiki*), a play of the week. Women were always either subjected to stressful poor home environment, beaten, blamed for not cooking, etc. Although composers of such plays would claim that their objective is to discourage the above treatment to women, experience reveals that the targeted audience hardly get such massages. This is because, either the play's messages was not well connected/logically presented, or different parts were given different reinforcements which in most cases ended up giving men a superior status than the women. This directly affects girls perception of their own self-image and development from early childhood.

The School Environment

Among the 19 female teachers, fifteen (78.9%) did not perceive the school environment as a contributing factor to gender difference in performance in

science. The remaining four teachers had varying views in which one of then said that some teachers favour boys more than girls. Another teacher saw "school culture or orientation" in science subjects as an influencing factor. For example, the teacher mentioned her school as the one in which commercial subjects have taken the lead in being liked by students, with most students disliking the science. Therefore students and especially girls go for commercial subjects. Love affairs between school girls and boys was mentioned by one female teacher to affect girls more than boys. "Girls forget themselves and fall dependent of boys" in almost all subjects once boys and girls become lovers.

Some male science teachers (15.6%) felt that the school curriculum and subjects specialisation directly made two different paths for boys and girls. These said, streaming of "girls" in subjects such as cookery or Domestic Science, home economics, typing reinforces gender differences. This also promotes girls perception of some subjects as "special for girls" and others as "special for boys". As a results a few girls do not opt for science subjects. There was only one male science teachers who mentioned that some teachers discourage girls from taking science.

Girls were also affected more than boys in the "double session system of schooling". Two teachers expressed their concern that most girls in the afternoon session come to school looking very tired. This is because they are given a lot of work to do at home before they come to school.

The school students organisational structure also was mentioned as a factor that discriminated girls from leadership posts. Teachers who raised this as an issue (3) said that girls are seldom involved in the school leadership compared to boys. Another teacher (1) mentioned that school also discourages girls and boys cooperation when it comes to working together. This is because, most teachers would scold girls who frequent boy's dormitories or who are most of the time in boy's company. Such association is misinterpreted as "prostitution". The sitting arrangement in most science classes perpetuated the gap between boys and girls. In most of the schools visited, few girls were found sharing, one desk with boys.

The sports and games taken by girls were also different from those taken by the boys. When it came to dances (local or traditional) girls would occupy special "feminine" places and style of dancing, one teacher remarked. There was only two teachers who said that school did not perpetuate any gender differences. Other seven (21.8%) male science teachers did not give any response.

Community and Gender

About 50% of all male and female science teachers made clear explanations on the communities influence to gender difference. The remaining percentage

either gave no response (31.25% male and 57.78% female) or gave unrelated responses (18.7% males, 5.2% female). The community was also blamed by its clear distinction of jobs between men and women (18.7% male 15.8% female). Some teachers observe that: "a female carpenter would be the talk of a village" and most parents would not accept their daughters to become mechanics, etc. Another 18.78% of male teachers and 10.5% of female teachers lamented that generally the community does not promote girls in science or science vocations. They said, the community does not appreciate the contribution of women to the society. A typical quotation from the one teacher's response written in Kiswahili reads. *"Jamii haithamini shughuli za wanawake zinazofanana na zile za wanaume"*. This means, "the community does not value activities by women which are similar to those taken by men".

It is common for most people to look down at work done by women saying *"Ah, imefanywa na mwanamke"* (Ah, it has been done by a woman"), another teacher remarked. Such a remark implies that a woman's job would in most cases be perceived as of "poor" or "low quality". A similar work done by man will not receive such comments, even if it was inferior to a similar job done by a woman. Along this line another 6.2% of the male teachers observed in mixed languages that "Watoto wa kike wanaofanya vizuri hasa katika core sciences, *huonekana* 'queer' *au "tishio'*." Meaning that girls who perform better in science are perceived as queer or a threat." Generally, this observation blames the community's misconception of science as a boys subject. Another 6.2% of female teachers also blamed the continuing practice by most communities of engaging girls only in doing almost all "home activities" and leaving boys to play around or do the least in the home. There was also a concern by one teacher (male) that some "parents" from the community engage in love affairs with school girls. These either end up marrying the girls or make them pregnant with the community doing nothing about this. The teacher put it this way, "psychologically, *hii inadhalilisha sana wasichana"*, i.e., "psychologically this undermines girls a lot". And so, the girls feel that it is beyond them to do anything about such community practices and other taboos that directly discriminate them.

To summarise, the community as an attribute to gender difference was blamed by the science teachers for its engendering the misconception of science and science related careers as special for men and not for women. The teachers also saw the community as accepting practices that put women at a lower position than men and women as "men's labourers". Women have therefore been made to be subservient to men. It is these practices which affect girls' chances of choosing science as a future career and also chances of devoting more time in studying the science subjects. The above practices directly affect

girls performance in science and hence, promote gender' difference in school performance, putting boys at a lead in most subjects.

Gender and Biological Differences

A good number of the male secondary school science teachers had a misconception that there were biological difference between boys and girls leading to gender difference in performance. Evidence from their responses indicated that about 60% of the male science teachers held a belief that girls were biologically born either weaker or more delicate than boys and cannot cope with "masculine" related jobs. From the female science teachers, only two (10.5%) of them had the same misconception as the male teachers. The remaining 68.4% of the female teachers did not give any response while 5.21% gave unclear explanations. The percentage of males who did not give any response on this was 25.5% while 15.6% of them came up with vague responses. Of those who believed in biological differences, three male teachers (15.7%) had a perception that girls are born with a different intelligence quotient (IQ) to boys. These did not however specify if girls' IQ was higher or lower than that of boys. But they put their arguments this way: "*Tofauti ya kijinsia huonyesha kama wasichana wanapungukiwa na kitu*", i.e., "gender difference make girls appear as if they are lacking something." Another 12.5% of male teachers saw maturation as having a greater effect on girls than it has on boys. One of the teachers wrote that "*wasichana hufuatwafuatwa na wanaurne kiasi cha kuwapotezea muda*", i.e., "girls are frequently approached/seduced by men to the extent of wasting the girls time".

The teachers observed further that the tendency of men/boys to seduce girls "hinders girls from making free interactions" with boys (5.3% male). Another 5.3% of the male science teachers claimed that "naturally, girls should appear humble, lenient, loving and calm in front of boys" ready to receive a loving response. This usually happened to girls after Form II level (maturation), the teachers further commented. It is at this time when girls start beautifying and behaving very feminine, responded 9.4% of the male teachers while 5.2% of the female teachers had a perception that biologically girls cannot cope with science related jobs. Another 9.4% of the male and 5.2% of the female science teachers had a concern on girls menstruation as affecting the girls study behaviour. These teachers had a belief on girls that: "*wakati wa kuwa katika hedhi hawana uwezo wa kufikiri kimakini zaidi—walio wengi sio wote*", i.e., "most girls fail to think properly during their menstruation period". It was therefore expected of girls by the science teachers not to perform equally to boys in the science subjects.

It was only 9.4% of the male science teachers against 21.0% of the female

science teachers who clearly said that "kutokana na maumbile wasichana na wavulana ni sawa", i.e., "biologically, boys and girls are equal". The teachers compliment their perception of "no biological difference" between boys and girls by citing examples where girls had performed equal/or better than boys in terms of scores in the science subjects.

Teachers, Parents and Gender

Out of the 19 female and 32 male science teachers, 57.8% of the female and 18.7% of the male teachers gave no response on how teachers or parents could influence gender differences. Only 3.1% of the male teachers said, "teachers do not influence" while 28.1% of them generally agreed that teachers negatively influence girls performance in science. None of the female science teachers mentioned teachers as being responsible to gender differences. The male teachers gave different respondents such as, "some teachers threaten girls that science is difficult" (12.5%), and "some teachers discourage girls to cooperate with boys" (9.4%). A quotation from one of the male teachers on how teachers openly discriminate girls from boys reads-, *"ubaguzi wa wazi mfano, "yaani" wanaume mnashindwa na "wanawake" kwa nini?"*, i.e., "a direct discrimination e.g. "how is it possible" that "women" are leading or doing better than men?" The literal translation here might have not carried the weight portrayed by the above quotation. The quotation implies that it was a big surprise by the teachers to have girls leading which is carried by the word "yaani". Even the way the word "wanawake" has been used infers to a "low status". Another teacher complained that some male science teachers scare girls from seeking more help from them because the teachers tend to seduce the girls. Boys also have a tendency "to keep an eye" *("kuwa macho")* on girls who are close to teachers and tend to "ridicule" them.

Parents were held responsible for girls' under performance in science by 56.2% of the male teachers and 36.8% of the female teachers. Out of these, 25% of the male and 10.5% of the female teachers perceived parents as giving more priority to boys and pushing the boys to choose their careers on science. The remaining 31.2% of the male and 26.6% of the female science teachers condemn parents for not liberating or setting free their girls from heavy loads of work in their homes. "The whole family looks at a girl as a co-mother" one teacher observed. Both the female and male science teachers felt that most girls are put in very tight security from both parents. This holds them up within defined "home boundary" and tends to make girls feel "insecure" and "worrisome" when they are in other environments. This further minimises the girls chance of seeking educational help or materials unlike the boys. This of course affects girls confidence in general and so their decision making power which might get perpetuated to affect performance in science negatively.

Gender and self-image

There was 42.1% of the female and 31.2% of the male teachers who had no opinion on the influence of girls' or boys' self-image to gender difference in performance in science. Only one (3.1%) of the male teachers perceived the self-image to have no influence to gender differences while 18.75% either misinterpreted the meaning of the word self-image or confused it with biological factors. These gave responses related to other areas such as "girls involve themselves in love affairs soon as they mature", etc. Such responses were considered as worthless to this study and so counted off.

The remaining majority of both male and female teachers portrayed "girls misconception of themselves as weaker than that of boys" and "girls misconception of science as difficult or a boys' discipline". These responses were in the ratio of 40.6% -male and 42.1% female teachers. Other teachers lamented further that "some boys discourage girls from doing science". Negative influence was also mentioned specifically coming from girls in the art stream. These were mentioned to disapprove and laugh at those girls who were studying science by 21.0% of the female and 6.2% of the male teachers. These again portrayed that girls had a "masculine image" of science.

Other Influencing Factors

Most teachers (57.8% female and 40.6% male) did not come up with other factors contributing tc gender difference in performance than the ones already mentioned. The remaining majority of the teachers respondents were a repetition of the girls' misconception of science (10.5% female and 6.2% male). Others said girls have a lower value of education in general (9.4% male) and so spend most of the time in keeping themselves beautiful (10.5% female). Absence of "women models" in the science discipline was mentioned by 6.25% of the male teachers. Lack of teaching-learning material which led to a poor teaching-learning process was also a factor which was mentioned by 25.0% of the male science teachers. The remaining teachers mentioned girls as having a higher drop out rate than boys (5.2% female, 33% male) and child upbringing practices (33% male) and "most girls seeking for marriage" as a priority (6.25% male).

Testing The Second and Third Hypotheses, Science Teachers Reaction

1. Strategies in Eliminating Gender Difference

There was a major strategy that was mentioned by the majority of the 51 science teachers towards elimination of gender difference. This was "gender sensitisation" of the public, i.e., the parents, teachers, girls and boys. About

76.5% of all teachers mentioned "gender education" as the best strategy as portrayed by a quotation below:

> "Ni swala la jamii nzima ya Tanzania kuanzia mzazi mpaka walimu waelimishwe kwamba jinsia zote ni sawa. Ni swala ambalo litachukua muda mrefu kama lilivyoishi". ("It is a task to all Tanzanian community starting from parents to teachers to be educated that all sexes are equal. This task will take a long time as that lived by the gender difference.")

From the above general strategy to gender sensitisation of the Tanzanian public, the respondents mentioned different areas of concentration in varying percentage of responses as presented below in female to male ratios.

(a) Parents sensitisation on gender equality (31.6%:28.1 %)
(b) Girls sensitisation on their gender misconception (15.7%:21.8%)
(c) Gender education to both girls and boys (0%:18.7%)
(d) Teachers sensitisation on gender issues (5.3%:18.7%)
(e) Community sensitisation on gender issues (10.5%:21.0%)

Responses related to sensitisation on gender equality wanted girls to be liberated from "heavy load of work at home" (31.5%: 15.7%). These however did not propose engaging boys or using boys to relieve girls from home activities where applicable. Other strategies mentioned were as presented below with the percentage of respondents in female: male ratios in bracket.

(a) Positive discrimination and motivation of girls (21.0%:34.3%)
(b) Increasing girls single sex science specialised schools (10.5%:31.2%)

The reason given in adapting the above strategies were almost similar from both female and male responses. In sensitisation of girls on their misconception on science, the teachers reasons were typical of the quotation below that:

> "Kuondoa hisia ya ugumu wa masomo fulani kwao na kuwa upo uwezekano wa kufanya vizuri hata kupita wanaume." ("To remedy perception on the difficulty of some subjects and ascertain the possibility of them performing even better than men.")

On the girls positive discrimination, some teachers suggested that girls could be allowed to proceed in science even when their performance did not reach the required cut-off point or division for admission. On motivation, some suggested that women scientists should come in as models to carry the gender education and career counselling to girls. This would start at primary schools where children could be advised to start their specialisation in the sciences.

Gender education to the public and specifically parents was mentioned as a vehicle towards liberating girls from the type of treatment they currently

receive as a result of either misconceptions, traditional practices or parent expectations. The strategy was also directed towards opening more career opportunities to girls unlike the current practice. It was revealed that most "science-related" jobs advertisements would specify "sex" and this was "male" in most cases (with an exception of the medical field). One female teacher narrated her own experience when she appeared for an interview only to be confronted by a "female boss" who told her that; "I did not know that you were a woman. Unfortunately we do not employ women. They have a lot of problems" (personal interview with a University of Dar es Salaam MA (Ed) female graduate, Sept. 1993). It was sad for the female graduate to hear that from her fellow female officer. And so, it is necessary that gender sensitisation should cut across all Tanzanians starting from the family, primary school up to the higher levels of the services and production sectors.

To reinforce this, one teacher narrated the following:

> "Watoto waandikiwe kutokea shule za msingi masomo wanayomudu na mambo ya jinsia. Hii ni muhimu ili watoto wakue na hiyo hisia ya jinsia" ("Children to be prepared from primary school in subjects they feel comfortable and on gender issues. This is important so that children develop with gender awareness.")

There were also other recommendation which were mentioned by one or two teachers as follows:

(a) Science should be a compulsory to all students (2-male)
(b) Sitting arrangements should encourage girl/boy interaction and cooperation (female)
(c) Eliminate "gender streaming" in school, i.e., Domestic Science, home economics is for girls and not for boys (2-female)
(d) Teaching in science should be improved and this should start from primary school to encourage more children in science (female). This will reduce the misconception of science as a difficult subject.
(e) Stop boys from "bull-dozing girls" (kuburuza wasichana) when it comes to science learning (3-male). They should give girls a chance to practice science.
(f) Special career counselling to girls on the importance of science to them as major contributors to the Tanzanian economic growth (1 -female).

The above suggestions, although they attracted small numbers of respondents does not mean that they rank lower than those which received majority of responses in terms of their importance. It is important to note that although the strategies have been mentioned as independent entities, in practice they are dependent and influence one another. For example, to achieve girls

motivation in science, career counselling and guidance from "female scientist" as models would play a relatively successful role than from a "male scientist" model. Moreover, if there is a success to have more girls opting for science, there must be vacancies for them to pursue science education further (more A-Level girls science schools) and science careers as well (A quota for women employment in science careers). This would suggest that employers must be ready to provide an "equal employment" opportunity to both "men" and "women" and where applicable, positive discrimination of women could be practised, giving women more priorities than men where applicants tie in qualification as a motivation to girls in science. This implies that "gender issues" should be approached using a "process model" which is not significantly different from Tuguta's (1993) suggestion in which every body/thing should be "gender-sensitised".

It was however unfortunate that none of the teachers who participated in the study mentioned about having a national policy towards gender equality. None of them mentioned the mounting of a "women" or "girls" movements, societies or clubs which would deliberate on issues. This would act as a forum in which (girls could be educated on their misconceptions and other behaviour which promote gender difference in performance between them and boys.

Gender and Science Teachers Specific Tasks

The science teacher respondents were required to suggest ways in which they could eliminate the gender difference using their "specific science teaching" role. It was however found out that most teachers gave suggestion which were beyond their capability, i.e., increase the number of only-girls science schools. Teachers who gave suggestion which were relatively within their reach were found repeating most of the strategies mentioned earlier such as motivation for girls (34.3)% male and 2.1 % female) or, arrest girls misconception of inequality to boys in ability to pursue science (21.0% female, 15.6% male).

Those who came up with different suggestions had this to say (in the ratio of female and male responses):

(a) Give girls extra time to study science (26.3%:40.6%)
(b) Start science competition between boys and girls (0%:2.5%
(c) Appreciate girls work (0%:6.2%)
(d) Give equal opportunity to girls especially in answering questions (10.5%:21.8%)
(e) Use examples of girls who have excelled in science and science careers as models in teaching (10.5%:9.3%)
(f) Avoid any language that label girls as weak in science and boys as the

able group (15.7%: 21.8%).

(g) Form science study groups and give girls leadership posts (0%:6.2%) A few teachers did not give any response on this (31.5%:12.5%). There was only 2 male. science teachers who said that they do not know what to do.

The two science teachers expressed their inability to help saying:

> "Sielewi nitawasaidiaje kwani swala hill ni wao wenyewe wanajlonaje "self-awareness" Ila ye yote atakeyependa msaada niko tayari kuwapa" ("I do not know how to help them because the problem is on how they perceive themselves "self awareness". But I will be ready to give help to any who wants it".)

There was also an argument which was further aired by one of the teacher that: "mimi siwezi ila serikali...." ("Personally I cannot but the government can...")

2. Implications of the "Specific Science Teachers" Suggestions

Suggestion made by the science teachers as "their specific roles" in remedying gender difference in performance fell into three different groups. The first one was a strategy that will still reinforce perceptions on gender difference (31.5% female and 37.5% males), i.e., give girls extra time to study science. Girls, once given this special attention different from boys, will continue to perceive themselves weaker than their counterpart boys. The suggestion also implies that some teachers believe strongly that boys learn science faster than girls. This follows from the finding that only two science teachers out of the 51 respondents clearly said-, "boys and girls are biological equal" in terms of mental ability. The perception of boys being better than girls was also held by a significant number of female science teachers.

The second category of the suggestions was from teachers who mentioned strategies which were difficult to measure or implement. For example, "appreciate girls work" or "use of good language" on the side of science teachers when communicating with girls. The question to be answered here is, how would science teachers appreciate girls work in science? A criteria for appreciation was necessary mentioning. For example, giving similar comments on girls work as well as the boys or avoidance in treating girls work differently to that of boys. The suggestion "to give equal opportunity to girls as boys" could encompass a lot of other suggestions. It is important to observe that the major concern is to "eliminate" gender difference. Anything taken as a remedy to the observed gender difference should not again "put girls in a misconception" (or boys to feel) that they are being favourable because they are different to boys. This makes the whole issue complex.

The third group of suggestions builds on the complex of the gender issue. Two science teachers expressed their worries that "they don't know how to solve the problem." This is because, "it was girl's own perception problem". But one of the teachers unknowingly mentioned "girls self-awareness". This is the central problem and it may bring some success if girls "self-awareness" could be brought to a "neutral position" in terms of boys status. It may be that girls were "unconsciously behaving" in a way that portrayed a significant gender difference in science classrooms. Or, to the girls it was "ideal" to them the way they behaved. If their ideal behaviour has put them to be misconceived as "they don't want to work hard" in science, they should first be made aware that their behaviour is misconceived. Once girls "self-awareness" is brought to believe in equal status of the two sexes, a later strategy could now be employed. This would depend on the initial reaction and girls performance level. Teachers must have a common frame work in conducting the gender counselling and guidance mission. This might be an area of future research which would find out "appropriate" approaches of dealing with gender issues in different contextual settings. The contexts would include the family, traditional villages or ethnic minorities, work places, schools, and other public institutions and the individual girl or boy.

Summary and Conclusion

This study had intended to find out what were the Tanzanian secondary school science teachers perceptions and reaction on gender difference in performance in science between boys and girls. Thirty-two male and 19 female teachers were involved in the study.

The study was led by three hypotheses. The null hypothesis was used to test the difference between the teachers perception and the statistical findings from the students coursework assessment raw scores. The null hypothesis was tested using χ^2 method ($df = 2$) and a significance level of 0.05. This was accepted that there was no significant difference between the Tanzanian science teachers perception on gender difference in performance in science based on the mean course work assessment marks in science. Most teachers perceived that boys had higher scores than girls (or lead girls) in most of the science subjects. This was established from the analysed course work marks.

The second and third alternative hypothesis were based on an assumption that teachers perceptions on the attributes to gender difference in performance in science would centre on parents, teachers, community, culture and students self-image and biological factors.

Findings from the science teachers responses were used to test the two hypothesis. It was found out that most of the teachers explained gender difference in performance in science in terms of the above factors. It was only

teachers in each of the cases below who clearly stated that teachers, students self-image and biological factors do not influence gender differences in performance in science. This number was very insignificant.

On biological factors, there was a significant difference between female and male science teachers who perceived boys to be biologically different from girls (60% of the male and 30% of the female science teachers).

Both male and female science teachers' reaction to gender difference centred on educating the entire Tanzania people on gender issues. Some of the suggestions, however would directly continue to perpetuate students and teachers gender perception that girls have a slower speed in the learning of science than boys or girls learn science differently from boys because they are different from boys. This is to say, the suggestion given were gender stereotyping. It was therefore observed that teachers reaction just gave a highlight on possible alternatives towards approaching the gender issue in Tanzania. They were however limited in scope because some perpetuated gender difference while others were not practical. The science teachers failed to take into account the complexity of the issue.

Where Do We Move From Here?

Building on one of the possible reactions by teachers, one major remedy to the misconceptions on gender differences between girls and boys or men and women would be:

> Educating the entire Tanzanian public on the current people's perception on gender and their damaging effect on girls and women in general. The effects should however not be treated in a unidirectional way. This is because gender perceptions have greatly influenced the public especially boys or men's behaviour towards girls or women which has penetrated in many places in Tanzania, i.e., the learning institutions, religion institutions, work places, learning materials, radio programmes, daily language, and even the "thinking" in almost everybody "men" and "women".

In short the education programme should take into consideration that perceptions on gender difference is a complex and delicate issue. It affects almost everybody and if not handled carefully, it may have very damaging effects in several institutions, the family being one of these.

How Do We Do It?

Teachers should be our central focus. The Tanzanian government has in most cases used her teachers towards successful implementation of her policies. To mention a few, whatever success was reached in the Adult Education should be attributed primarily to the teachers' efforts. Education for self-reliance,

mass-politicisation through school children's songs and plays, health campaigns and other activities have well been promoted by Tanzanian teachers from different institutional levels.

Are The Teachers Ripe nn Gender Issues?

Findings from this study revealed that more than 75% of all female and male science teachers involved in this, study believed in gender difference. These misconceived boys as being better than girls in almost everything. Majority believed further that such differences were biological and not nurtured. Evidently, we cannot make an instant use of the teachers in any way to educate our people without doing something to their perceptions. "Should teacher's workshop on gender" be our first move? Teachers might also brainstorm on the modalities of conducting the mass-education on gender.

Child Development and Gender

Children learn better through imitation. The child's immediate environment and experience therefore is the best source of child's behaviour towards others. If we relatively need to make a sound success in mass education on gender, the growing children should be among our sensitive target group. This should run parallel with parents because parents are likely to undo whatever children learn on gender unless it is in compromise with his/her belief. Does this suggest that the primary school children should be our first target group? Should gender education form the core or extra curricular activity of the primary school curriculum?

Gender? It is Everybody's Task.

Looking at the way gender-stereotyped behaviour has spread across textbooks, radio programmes, newspapers, and other communication media, everybody need to be gender conscientised. Book publishers, the journalists, and everyone else fall in this category. Should they became "gender-conscious" before they communicate anything to the public.

This would suggest that we need an instrument that will guide "gender equity" in treatment in Tanzania social-economic culture. It is therefore important to the Tanzanian Government to safeguard women equal rights to employment, education, public opinion and treatment, etc. Should a gender policy be instituted or special circular on gender?

May be we would adapt the Value Belief Model (VBM) suggested by Tuguta (1993) which treat gender issues as human made thus suggest that it solve them. The model as presented in its three elaborates: (i) Perceived susceptibility, (ii) Perceived severity, and (iii) Perceived costs and benefits.

Some of the suggestions by the science teachers in a way compliment this -model, i.e., the model believes that the gender issue is expensive, complex and involves everyone in the society. On the other hand, one of the suggestions from teachers said, "solving the gender problem will take as long time as it has itself lived". So, suggestions from this study, complimented by other approaches/models form within and outside Tanzania would need to be thoroughly evaluated for possible adaptation.

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