



Assessment of the Approaches Used in Teaching and Its Influence on Selection of Science Subjects among Female Students in Public Secondary Schools in Arusha District

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Abstract: *Teaching approaches and its influence on selection of science subjects among female students in public secondary schools in Arusha District Council, Tanzania was investigated. Objectives were to; highlight approaches used in teaching of science subjects in public secondary schools and determine how teaching approaches influence female students' choice of science subjects in public secondary schools. Active Learning theory guided the study. Convergent mixed methods design suitable to collect data through questionnaires, documentary analysis and interview guide was adopted. Sample size of 132 respondents; 80 students & 44 teachers selected by simple and stratified random sampling techniques while 8 school heads were purposively selected. Validity was established through expert judgment. Reliability was determined and reliability index, QS , $r=0.914$ and QT , $r=0.912$ was obtained. Qualitative data were analyzed thematically alongside research questions and presented in narrative forms while quantitative data were analyzed using descriptive statistics in the SPSS and results were presented in charts and tables. The study revealed that student centred, experimental and outdoor teaching/learning approaches attract more girls in taking science subjects. In conclusion, schools with adequate staffing of science teachers and laboratory materials are likely to adopt student centred, experimental and outdoor teaching/learning approaches which encourage female students in selecting science subjects. It is recommended that, since Tanzania is emphasizing industrialization as a backbone for economic development, science education for female students in all levels should be given a special attention in terms of proper infrastructures, human resources and funding that will enable teachers to adopt the right teaching approaches.*

Keywords: *Approaches, Teaching, Science, Subjects, Arusha*

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1. Introduction

Science is the heart of technological development and without science there can be no meaningful development. Consequently, there is a need for more graduates of science in developing countries. Also, there is a great need for more female graduates in different fields such as medicine, engineering, piloting and radiography. This can only be achieved if more female students are encouraged to choose science subjects (Githaiga, 2018). However, in actual sense, more male students are selecting science subjects compared to female students in secondary schools. It is the concern of stakeholders in education to establish whether teaching approaches employed by teachers in secondary schools could be a contributing factor to few female students selecting science subjects.

Teaching approaches are the methods and techniques used by the teacher in organizing the learning process. There are various approaches which are used in teaching and learning process. The main approaches of teaching and learning include: teacher centred approach, learner centred approach, evaluation approach or Bloom's approach, inductive and deductive approaches (Kabote et al., 2014). According to Dahms (2017), there are five approaches used to teach science subjects which are constructivist approach, collaborative approach, integrative approach, inquiry approach and reflective approach. In teaching female student science subjects, the approaches suggested will be applied. Learners centred approaches (sometimes referred to as discovery learning, inductive learning, or inquiry learning) place a much stronger emphasis on the learner's role in the learning process. Inquiry based teaching encouraging learners to ask a lot of questions. The choice of teaching approaches depends on what is being taught. It is very important that teachers first understand what they are going to teach before choosing the right approach.

Students' selection of science subjects all over the world is minimal compared to other fields of education and specifically for girl students (Lavigne, 2017). As such, the overall proportion of girls doing science subjects decrease at advanced level compared to male students in the United States of America. For example, in Chemistry subject 48% were females while 52% were males. In Physics, only 21% were females and 79% were males and in Biology subject 52% were males and 48% females. In Mathematics, 69% males participated (Kusum & Gill, 2017).

Githaiga (2018) conducted a study in Kenya on factors influencing form two boys' and girls' choice of Kenya Certificate of Secondary Education (KCSE) subjects. The study asserts that, the ratio of students who registered for

Biology in 2019 were 35.15% females and 49.08% males, Physics 29.93% females and 51.88% were male students, and Chemistry 37.56% females and 50.43% males. In 2020, Biology was 46.99% females, 51.24% males, and Physics 43.46% females 55.46% males, and Chemistry 42.80% females & 56.62% males.

Dahms (2017), stated that over 54,000 who got form five slots in public schools in Tanzania, 14, 826 (65%) were male students selected to pursue science while 7,859 (35%) were females selected for science as well. Although the ratio between boys and girls opting for science subjects still differs in developed nations, the same applies in developing nations where few female students engage in selecting science subjects. The statistics clearly show that women are underrepresented in science careers and view that this starts from secondary schools where there are insufficient number of young women enrolled in science subjects. It is therefore necessary to carry out a study to probe the contribution of teaching approaches towards representation of women in science subjects in public secondary schools.

1.1 Research Questions

The following research questions guided the study:

- i) What are the approaches used in teaching science subjects in public secondary schools in Arusha District?
- ii) How do teaching approaches influence female student's choice of science subject in public secondary schools in Arusha District?

2. Literature Review

The empirical studies were reviewed with reference to research objectives. The study was anchored on Active Learning Theory by John Dewey.

2.1 Theoretical Review

This study is guided by Active Learning Theory by John Dewey as cited by AL-Rawi (2018). The theory postulates that effective learning takes place when learners actively take part in learning process. Active learning is a set of strategies that posits the responsibility for learning with the students actively participating in discovery, problem solving, performing experiments and making inquiry. The theory puts emphasis on many activities during teaching that are learner driven. According to AL-Rawi (2018), active learning can be achieved through cooperative learning, group projects and student's presentations. Likewise, problem-based

learning, experiential learning and inquiry-based instruction contribute towards active learning. The theory proposed active learning principle as progressive education by allowing students to be more active in their learning. Therefore, this theory supports student centred approach in teaching fundamentally because learners are given room to explore and learn by actively participating in making errors and finding their solution them.

2.1.1 Application of the Theory to the Current Study

The theory put emphasis on teaching approach such as student centred, constructivist and learning by inquiry which has significant effect on the type of learning achieved by the students, particularly girls. According to Active Learning Theory, the availability of competent and qualified teachers has a significant influence on the choice of science subjects among female students. Similarly, the availability of laboratory equipment/apparatus and practical science activities emphasized by the theory has an influence on the choice of science subjects among female students.

2.1. Empirical Review

The researcher reviewed empirical studies under the following study objectives: to highlight approaches used in teaching science subjects in public secondary schools and to determine how teaching approaches influence female students' choice of science subjects in public secondary schools in Arusha District Council.

2.2.1 Approaches Used in Teaching Science Subjects in Public Secondary Schools

Berry (2008) conducted a study on “elementary school students’ attitudes towards science and related variables” in Pakistan. The author asserts that the major concern of science education is to develop a positive attitude towards science, regardless of individual differences. In fact, the attitude of the learners to science subject dictates their choices. The study also revealed that a great number of students, particularly girls, have negative feeling and approaches towards science that depresses them from lasting with scientific inquiries. Henriksen et al., (2015) in a study conducted in the U.S.A argues that many girls seem to conclude that boys do not like smart, aggressive, or competitive girls. It is possible that girls who do better in science and mathematics stifle their skills so that they do not look too smart in those areas, making them seem more attractive to boys. Similarly, the approaches of teaching equally determine girls’ choice of science

subjects. The findings revealed that student centred and inquiry approaches attract more students and particularly girls in taking science subjects.

There are different teaching methods employed in science education in Nigerian tertiary institutions. Miles (2015) asserted that it is expected of a teacher to implement a range of instructional strategies that will bring academic success to all the science students. For any method to be able to bring good results in the present age, it should be a method that promotes maximum social interaction. Social interaction between students and between teachers and student plays a crucial role in learning (Nguyen and Williams, 2016). These authors further stressed the need for the students to be provided with a supportive, open and interactive environment as this could help them discover knowledge. The teaching methods commonly used in science education classes are lecture and demonstration methods. Lecture method is often used to deliver a large amount of information to the students in a short period (Berry, 2008). According to Aina and Langenhoven (2015), lectures are designed to deliver new information to a large group of students. This method is known to be effective in dealing with a large class. However, it could also be used for a small class. On the other hand, demonstration teaching method is a useful method of teaching because it improves students' understanding and retention (Maricic et al., 2019). According to Ruatta (2013), the demonstration is effective in teaching skills of using tools and laboratory experiment in science. However, study found that the time available to perform this demonstration is very limited in a classroom setting. Therefore, a demonstration is often designed to allow students to make observations rather than through hands-on laboratory activities (Maricic et al., 2019).

According to Kamwendo (2014), many communities in Tanzania give more priority for boys than girls to take science subjects believing that science subjects are difficult, therefore girls cannot manage to take them; which are wrong concepts because girls and boys are equal in education sphere. Socio-cultural factors are important in parental and family decision on whether to invest on girls’ education or not because the community always favour boys over girls on education and promote different educational opportunities for boys compared to girls. Kihwele (2014) notes that men dominate, and women/girls lag behind in science subjects.

2.2.2 How Teaching Approaches Influence Female Students' Choice of Science Subjects in Public Secondary Schools

In Dallas Texas, U.S.A, Miles (2015) researched on students' perception of science subjects. The study revealed that the learning and teaching science subjects was less practical than theoretical and experimental based. The study only identified experimental based approach in teaching as the only approach that influence girl's choice of science subjects. Henriksen et al., (2017) on a study of "You'd be good at that: Gender patterns in parent child" reported about selection of science courses in Denmark. The author revealed that students are likely to enrol in science classes if they talk with their parents first, which means that parents do influence their decisions. Generally, parents encourage their children to take science subjects where they assume they can be able.

Report from Euro-Barometer in Luxembourg by Semali (2020) revealed the reason why youth in schools are currently not interested in taking science subjects. The reason is that it is complex, something that requires students to engage in collaborative learning, problem solving, and conducting laboratory practical experiments. Naugah (2019) noted that currently, students learn through memorization of facts where it becomes difficult to exercise discovery of knowledge. The findings indicated that science education in Africa did not take into account the intellectual and cultural environment of children that cause the decline of interest in science subjects among girl students. Due to evaluation that the science subjects are less relevant to students' daily life, the availability of enough science teachers, teaching & learning materials and availability of well-equipped laboratories was also found to arouse the interest of girl students to choose science subjects.

AL-Rawi (2018) conducted a study on factors directly responsible for the choice of science subjects among female students in selected school in Jigawa metropolis, Nigeria. The study revealed that the choice of science subjects among female students is influenced by sex of the students, peer group influence, motivation, the choice of future career and teaching approaches. The teaching approaches identified in the study are teacher-centred, learner-centred, subject-mattered centred, teacher dominated interactive "banking" approach constructivist, disciplinal integrated, individualistic, collaborative indirect and guided direct approach. Additionally, the study carried out by Itika (2021) in Ghana found that since young age girls are taught to be supportive and helpful whereas boys are given more opportunities to be independent, assertive and in charge. Hence more boys than girls chose science subjects. A related study was

conducted by Naugah (2019) on factors affecting the choice of science subjects among girls in Mauritius. The study acknowledged that parents perceived science as more important for boys than girls and expected boys to do better in science.

3. Methodology

This research used mixed methods approach under convergent mixed methods design which enabled the researcher to converge or merge qualitative and quantitative data in order to provide comprehensive analysis of the research problem (Creswell & Creswell, 2018). In this approach both qualitative and quantitative data were obtained differently, analyzed separately and the findings were later integrated to complement each other. The target population for this study was 1273 from 33 public secondary schools comprising of 33 heads of schools, 440 teachers of science subjects and 800 form three students who have selected science subjects (MoEST, 2022). Gay and Airasian (2009) observed that a sample of 10% to 30% of the target population is representative enough for a research study. Therefore, 25% of schools/school heads and 10% of the targeted respondents were sampled. Sample size of 132 respondents; 80 students and 44 teachers were selected by simple and stratified random sampling techniques while 8 school heads were purposively selected. For students, the researcher selected 10 from each school where five boys and five girls were selected while six teachers from seven schools each and two from one school were selected as the respondents in the study. In schools where the number of students who have selected science subjects couldn't reach 10, other students were considered as respondents for the study. Gender was considered as the strata in the current study. Data was collected through questionnaires, documentary analysis and an interview guide. Content validity of research instruments was determined by expert judgment by two specialists in pedagogy and education matters in Tanzania. The reliability was ascertained through test-retest technique in pilot study using 10% of the population not necessarily under the study and reliability index, QS, $r=0.914$ and QT, $r=0.912$, was obtained. Qualitative data were analyzed thematically alongside the research questions and presented in narrative forms (Braun & Clarke, 2017). While quantitative data were analyzed using descriptive statistics in the SPSS version 23 and results were presented in charts, & tables. Documentary review enabled the researcher to obtain the number of female students who have selected science subjects and related information about reasons for female students' choice of science subjects.

4. Results and Discussion

The first research question investigated the approaches used in teaching science subjects in public secondary schools in Arusha District Council. Questionnaires were administered to students who were required to agree or disagree with the items which were in the questionnaire. To address this question, students were provided with 14 approaches used in teaching science subjects in public

secondary schools and they were requested to indicate whether they strongly agree with the approach that is mostly applied or strongly disagree. Percentage responses for each statement were computed and their corresponding mean scores were also calculated. In calculating the mean scores, 1 score was given for strongly disagree (SD), 2 for disagree (D), 3 for undecided (U), 4 for agree (A) and 5 for strongly agree (SA). The percentages and mean scores from students have been summarized in table 1.

Table 1: Students' Responses on the Approaches used in Teaching of Science Subjects in Public Secondary Schools (n=80)

Statements	SD		D		U		A		SA		Mean score
	f	%	f	%	f	%	f	%	f	%	
Teacher centred approach	0	0	10	13	4	5	38	48	28	35	4.2925
Evaluation approach or bloom's approach	6	8	5	6	0	0	56	70	13	16	4.2825
Outdoor teaching/learning approach	0	0	0	0	15	19	44	55	21	26	4.2725
Experimental approach	0	0	0	0	0	0	39	49	41	51	4.2625
Inductive approach.	5	6	0	0	0	0	44	55	31	39	4.2000
Insightful approach	0	0	0	0	0	0	20	37	34	63	4.1875
Student centered approach	0	0	0	0	5	6	56	70	19	24	4.1875
Integrative approach	0	0	0	0	0	0	25	46	29	54	4.1750
Constructivist approach	0	0	0	0	0	0	25	46	29	54	4.0750
Deductive approach.	0	0	7	9	0	0	38	48	35	44	4.0500
Collaborative approach.	0	0	17	21	0	0	32	40	31	39	3.9625
Reflective approach	0	0	10	13	4	5	51	64	15	19	3.8875
Grand mean score											3.28

Source: field data (2023)

Data in table 1 show that teacher centred approach is mostly used in public secondary schools in Arusha district council. This approach had a mean score of 4.2925 which was relatively higher than the grand mean score of 3.28 (neutral point). This implies that teachers consider teacher centred approach in curriculum implementation. They argue that the syllabus is wide and it is examination oriented. Therefore, teachers are required to prepare students to compete with others from other schools. However, they easily forget that the approach does not encourage slow learners to learn by individual practice. Consequently, the approach does not persuade girls to select science subjects, putting in mind that science subjects require personal and individual efforts through

practice with minimal guidance if necessary. This finding is contrary to Constructivism Theory by Piaget as cited in Dahms et al, (2017). According to the theory, a constructivist teacher is a facilitator who encourages students to discover principles and construct new knowledge within a given framework or structure. Therefore, the theory discourages the teacher centred approach in teaching because it denies learners room for self-discovery. Due to the shortage of laboratories especially in Africa and Tanzania, teachers tend to teach theories rather than using practical (Bipa, 2020). It has been also reported by Simtowe (2021) that in Tanzania there is a serious shortage of laboratories in government secondary schools by more than 49 percent which

negatively affects teaching and learning in Chemistry, Biology, and Physics subjects.

In addition, evaluation approach or bloom's approach had a mean score of 4.2825 which is above the neutral mean score of 3.28. There was a general feeling among students that teaching for a long while has taken the dimension of Benjamin Bloom's Taxonomy of education where teachers try to examine different levels such as synthesis, application, knowledge and evaluation in education. The findings show that this approach is influenced by education system in developing countries and particularly Tanzania that is examination oriented. Henriksen et al., (2015) argues that evaluation approach or bloom's approach discourages learners from choosing some subjects which they find a little bit difficult. Instead, the study supports student centred and inquiry approaches which attract more students and particularly girls in taking science subjects.

The researchers established that outdoor teaching/learning approach (OT/LA), with a mean score of 4.2725, is not frequently used in public secondary schools. In their responses, students pointed out that most teachers prefer teaching inside classes instead of teaching outside. This is contrary to the findings by Waite et al., (2017) who proposed a pathway model by suggesting that learning in natural environment (outdoor) lead to academic benefits such as increased engagement, self-regulation and raised attainment. Therefore, OT/LA provides learners with the opportunity to experience nature which promotes learning, and it enables learners to be more physically active during the lesson.

The experimental approach had a mean score of 4.2625, which was relatively higher than the grand mean score of 3.28 (neutral point). From table 1 on students' responses on the approaches used in teaching of science subjects in public secondary schools, experimental approach is only used by teachers mostly during demonstrations. However, the majority of teachers prefer lecture methods even where experiments should be done. The researchers found that inadequate apparatus and chemicals compel teachers to adopt a demonstration approach in teaching science subjects.

Moreover, the inductive approach as a method of teaching in public secondary schools had a mean score of 4.2000. The students noted that the induction given by teachers in most cases is not adequate to enable them explore science subjects to their satisfaction. According to students in their responses in open ended questions, teachers quite often are in a hurry to complete syllabus coverage. Therefore, they give little attention to inductive approach during teaching and learning of science subjects. In this regard, Miles (2015) asserted that it is expected of a teacher to implement a range of instructional strategies

that will bring academic success to all students taking science subjects. Further, the study revealed that for any method to be able to bring good result in the present age, it should be a method that promotes maximum social interaction. Social interaction between students and between teachers and student plays a crucial role in learning.

The study established that student centred approach (SCA), with a mean score of 4.1875, is the most preferred approach among students in secondary schools. However, in the views of students, most teachers use this approach and this could contribute towards few girls selecting science subjects and mathematics. Lending credence to this finding, Nguyen and Williams (2016) further stressed the need for the students to be provided with a supportive, open and interactive environment as this could help them discover knowledge. The study found out that teaching methods commonly used in science education classes in developing countries are lecture and demonstration methods. Teacher-lead approaches to teaching practical science should be preceded by demonstration in the classroom before allowing students to perform the practical themselves. According to Ruatta (2013), demonstration is effective in teaching skills using tools and laboratory experiments in science. However, the current study found that the time available to perform this demonstration is very limited in a classroom setting. Therefore, a demonstration is often designed to allow students to make observations rather than through hands-on laboratory activities.

In attempting the question on why few girls select science subjects, head of school B remarked as follows:

Some girls lack confidence in themselves. Consequently, they feel inferior when it comes to selection of science subjects. Similarly, most girls face premature sexual activities when at schools resulting in early pregnancies which hamper their learning goals. Therefore, besides teaching approaches employed by teachers, school management and parents should find ways of protecting girls against weird society members who exploit them for personal gain (personal interview on 4th May, 2023).

The response from head of school B suggests that lack of confidence among girls lowers their self esteem in pursuing science subjects. Consequently, besides teaching approaches such as outdoor, learner centred, experimental, and teacher centred employed by teachers, school management and parents should find ways of encouraging girls to have confidence in themselves. Moreover, girls should be protected from strangers with sinister motives that are detrimental towards their education.

From documentary review the study found that percentage of girl students taking Physics, Biology, Chemistry and Computer are below boys except in secondary schools where sciences are compulsory. The study also established that effective learning of science subjects that require adequate time to internalize knowledge is not achieved. This is due to inadequate science learning facilities (textbooks, laboratories, library, ICT) available in most secondary schools that have employ experimental and OT/LA approaches.

Similarly, in order to address first objective, teachers were provided with 14 approaches used in teaching science subjects in public secondary schools and they were requested to indicate whether they strongly agree with the approach that is mostly applied or strongly disagree. Percentage responses for each approach were computed and their corresponding mean scores were also calculated. In calculating the mean scores, 1 score was given for strongly disagree (SD), 2 for disagree (D), 3 for undecided (U), 4 for agree (A) and 5 for strongly agree (SA). The percentages and mean scores from students have been summarized in table 2.

Table 2: Teachers’ Responses on the Approaches used in Teaching of Science Subjects in Public Secondary Schools (n=44)

Statements	SD		D		U		A		SA		Mean score
	f	%	f	%	f	%	f	%	f	%	
Teacher centred approach.	0	0	0	0	0	0	27	61	17	39	4.725
Evaluation approach or bloom’s approach	0	0	0	0	9	21	22	50	13	30	4.77
Inductive approach.	0	0	0	0	1	2	27	61	16	36	4.67
Reflective approach	0	0	4	9	0	0	27	61	13	30	4.63
Student centred approach	0	0	0	0	4	7	17	32	33	61	4.60
Outdoor teaching/learning approach	3	7	0	0	0	0	29	66	12	27	4.54
Experimental approach	0	0	4	9	1	2	26	59	13	30	4.54
Constructivist approach	3	7	1	3	8	18	16	36	16	36	4.54
Deductive approach.	1	2	4	9	0	0	22	50	17	39	4.52
Collaborative approach.	0	0	10	23	1	2	22	50	11	25	4.52
Integrative approach	0	0	7	16	1	2	28	64	8	18	4.22
Grand mean score											4.38

Source: field data (2023)

Data in table 2 show that teacher centred approach is mostly used in public secondary schools in Arusha district council. This approach had a mean score of 4.725 which was relatively higher than the grand mean score of 4.38 (neutral point). Teachers explained that due to inadequate science facilities in most schools and inadequate staffing coupled with overwhelming workload, they are compelled to adopt this approach in curriculum implementation in order to cover the wide syllabus. The study established that most teachers are aware that the approach does not encourage slow learners to learn by individual practice. However, for reasons beyond their control, they are compelled to espouse it. One consequence of this

approach is that it does not encourage girls to select science subjects, putting in mind that for effective learning to take place teaching should be enjoyable and learner centred. The finding in this study is supported by Bipa (2020) who asserted that due to the shortage of laboratories, teachers tend to teach theories rather than using practical. It has been also reported by Simtowe (2021) that in Tanzania there is a serious shortage of laboratories in government secondary schools by more than 49 percent, which affects teaching and learning in Chemistry, Biology, and Physics subjects.

Additionally, data in table 2 indicate that integrative approach had a mean score of 4.22, which is slightly above the neutral mean score of 4.38. This implies that the more activities given during the lesson the more learners concentrate and enjoy the lesson. This mean score was also above the neutral point a clear indicator that teachers value integrative approach because it makes their lessons joyful to learners. It should be noted that learners should be allowed to discuss ideas and ask questions as they work towards finding a solution.

Moreover, outdoor teaching/learning approach as a method of teaching in public secondary schools received a mean score of 4.54. Outdoor teaching/learning enables learners to develop better critical thinking and problem-solving skills. According to teachers in their responses to open ended questions, outdoor teaching/learning provides learners with the opportunity to experience nature which promotes learning. In this regard, Miles (2015) asserted that outdoor teaching/learning enables the learner to be more physically active during the lesson. For any method to be able to bring good results in the present age, it should be a method that promotes maximum social interaction. Therefore, teachers should identify the best environment to teach knowledge & skills as indicated in lesson objectives.

In this study, experimental approach had a mean score of 4.54. The study found out that students are not given adequate time to reflect on the knowledge disseminated in class before attending another lesson. While giving affirmative report, Mogale (2018) argued that teachers who preferred to use both hands-on and minds-on skills, described practical science as an activity that combines the use of equipment as well as problem-solving, and engaging in scientific methods in order to understand how science works.

On the same theme on approaches used in teaching of science subjects in public secondary schools, another school head observed that:

Outdoor teaching/learning approach connects the classroom knowledge to real life situation in the field. Through this approach, teaching and learning activities make the lesson enjoyable to learners as seen in students' activities. Similarly, it enhances higher order thinking among learners due to learning through exploration. This also applies to student centred teaching approach to a greater extent (Personal Interview, 5th May 2023).

The observations by the school head clearly offer a challenge to science teachers to make their lessons enjoyable to learners. Therefore, teachers should select teaching approaches that will help them achieve this. Itika (2021) noted that many students describe sciences as boring subjects and they drop in interest and performance between grade 4 and 8. Similarly, their low participation indicates that there may be influences outside the education system that negatively impact on the choice made by the students in their courses of study.

The second objective of the study determined how teaching approaches influence female students' choice of science subjects in public secondary schools in Arusha District Council. First, the respondents identified the teaching approaches that influence female students' choice of science subjects in public secondary schools as shown in figure 1. Secondly, the respondents rated and explained how the teaching approaches influence female students' choice of science subjects in public secondary schools as presented in figure 2.

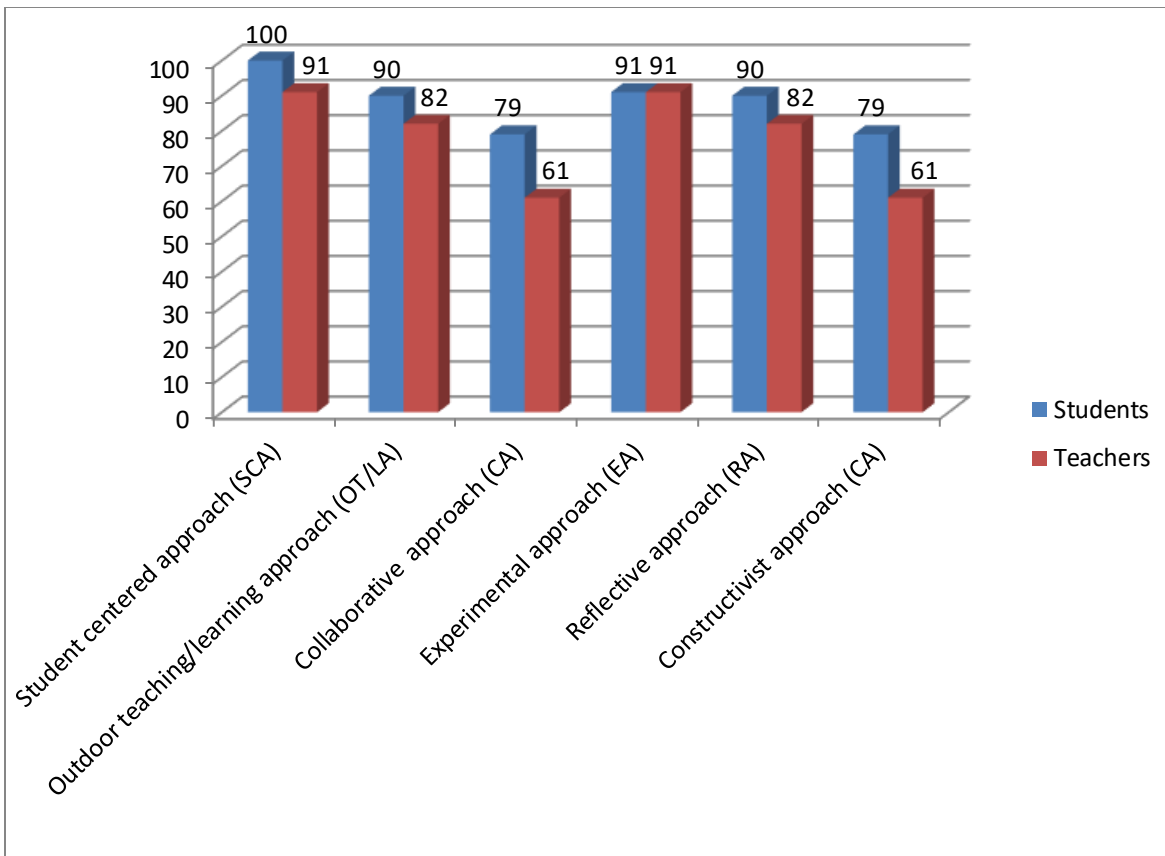


Figure 1: The Approaches that Influence Female Students' Choice of Science Subjects

Source: Field Data (2023)

Figure 1 presents the summary of the respondents' responses on the teaching approaches that influence female students' choice of science subjects in public secondary schools in Arusha District Council. In this regard, 100% students and 91% teachers identified student centred approach (SCA), 90% students and 82% teachers mentioned outdoor teaching/learning approach (OT/LA) while 79% students and 61% teachers recognized collaborative approach (CA) as the teaching approaches that mostly influence female students' choice of science subjects in public secondary schools. Moreover, 91% students and 91% teachers revealed that experimental approach (EA), 90% students and 82% teachers sighted reflective approach (RA) while 79% students and 61% teachers acknowledged that constructivist approach (CA) is instrumental in influencing female students' choice of science subjects in public secondary schools in Arusha District Council.

During the interviews on how the teaching approaches influence female students' choice of science subjects, the head of school A noted that:

Teachers who involve students in their lessons through practical and hands-on activities normally attract the interest of students in science subjects. However, teachers who adopt lecture methods do not appeal so much to the interest of students in science subjects. Therefore, it is indeed true that teaching approaches influence female students' choice of science subjects (personal interview on 4th May 2023).

From the interview excerpt, the study establishes that lessons that involve practical work/observations enhance learner's problem-solving skills. Whenever students are fully involved in learning through exploration and practical work, effective learning occurs. The views from the school head are corroborated in the study conducted by Olaitan (2021) to investigate science teachers' views on practical science subjects. The study revealed that teachers who preferred to use hands-on skills only tended to refer to knowledge gaining by carrying out experiments or activities involving equipment. Kihwele (2020) noted

that hands-on learning requires students to handle and use equipment, which in turn encouraged self-discovery.

When asked to suggest ways that can encourage girls to select science subjects, one head of school put forth the views that:

There is need for teachers to adopt good teaching approaches that are popular among students and particularly girls. Similarly, there should be a national conference advocating for science subject for girls. Such conferences should be graced by women scientist and role models in the country who would play a significant role in encouraging girls to select science subjects. Besides, there is need for the government and parents to invest on facilities

and favourable conditions for girls' education (personal interview on 4th May 2023).

In this regard, the researcher established that indeed teaching approaches influence choice of science subject among female students. Therefore, teachers should select teaching approaches that are popular among students in order to influence girls' choice of science subjects. A related study by Cairns and Dickson (2021) intimated that resources needed to effectively teach science subjects should be adequate in order to motivate both teachers and students. The availability of adequate resources will enable teachers to adopted teaching approaches such as student centred, outdoor and experimental that will enhance hands on activities among students. Moreover, more female science teachers should be recruited after training so as to encourage more girls to select science subjects.

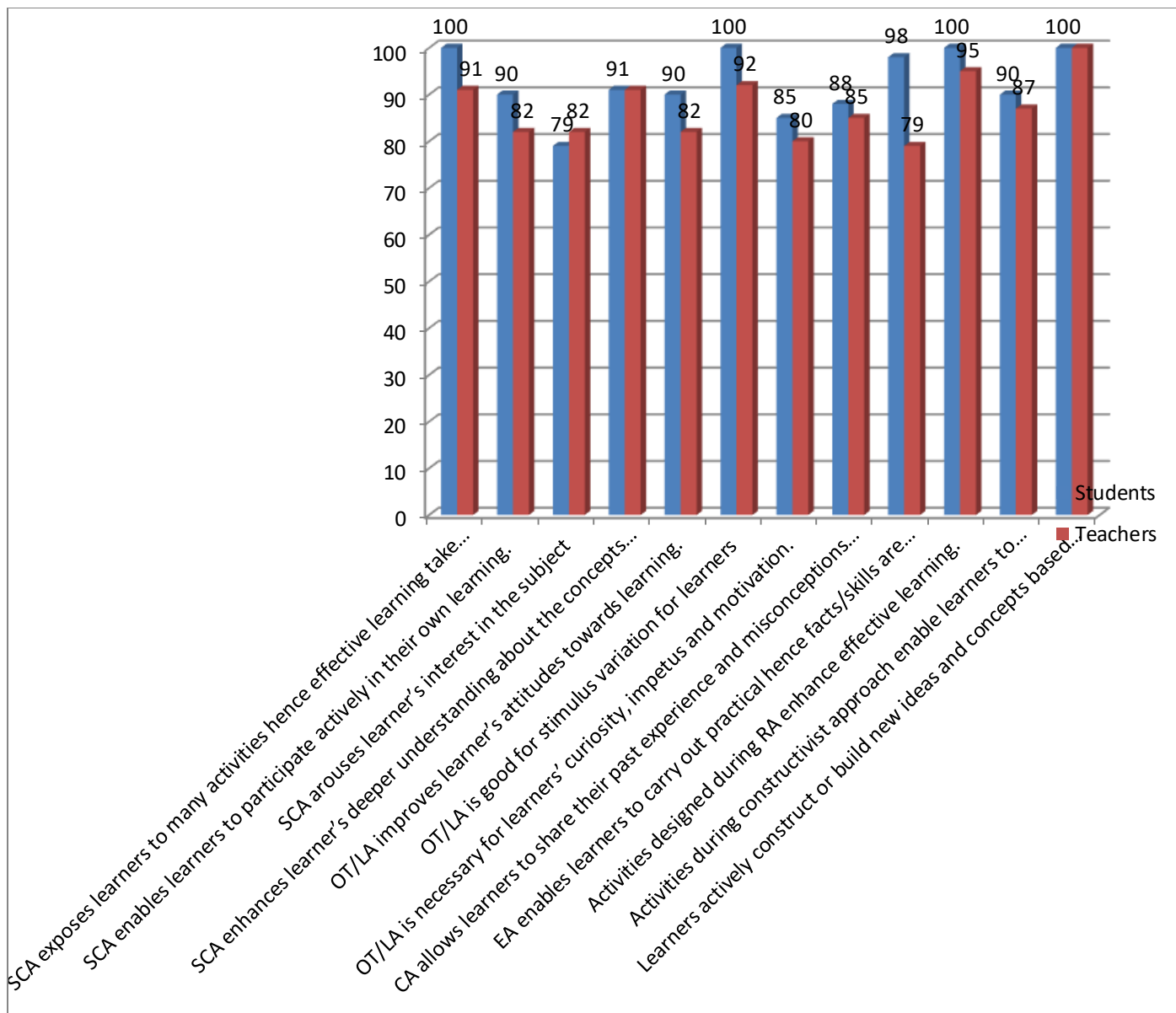


Figure 2: How Teaching Approaches Influence Female Students' Choice of Science Subjects

Source: Field Data (2023)

Figure 2 show that students acknowledged that SCA enables learners to participate actively in their own learning by 100%rating while teachers mentioned that SCA enables learners to participate actively in learning by 91%. On the same breath, when asked to rate and explain how the teaching approaches influence female students' choice of science subjects in public secondary schools, students revealed that SCA arouses learner's interest in science subjects by 90% and teachers concurred that the approach arouses learner's interest in science subjects by 82%. Furthermore, both students and teachers mentioned that SCA enhances learner's deeper understanding about

the concepts being taught by 91%. The researcher established that when learners interest is aroused, many students, particularly female ones, will select science subjects hence the objectives of the current study will be achieved. To reinforce these findings, Active Learning Theory supports student centred approach in teaching fundamentally because learners are given room to explore and learn by actively participating in making errors and finding their solution to them. Similarly, Waite et al., (2018) noted that SCA increased students' engagement with and understanding nature by 94%, increased

students' acquisition of life skills by 93% and increased students' enjoyment of lessons by 95%. In addition, students observed that OT/LA improves learner's attitudes towards learning by 90% while teachers posit that it improves learner's attitudes towards learning by 82%. Still on OT/LA, students agreed that OT/LA is good for stimulus variation for learners by 100% while teachers mentioned that it is good for stimulus variation for learners by 92%. On further investigation, students opined that OT/LA is necessary for learners' curiosity, impetus and motivation by 85% while teachers noted that it is essential for learners' curiosity, impetus and motivation by 80% as indicated in figure 2. In order to support this finding, Waite et al., (2017) asserted that OT/LA increased students' engagement with learning by 92%, learners' attainment by 57%, behavior by 85% and social skills by 93%.

On collaborative approach (CA) in teaching, students observed that CA allows learners to share their past experience and acquire new knowledge necessary in addressing misconceptions by 88% while teachers believed that CA play the same role by 85%. When the misconception such as science in hard and can only be done by boys or boys will not associate with girls taking science and mathematics are addressed, many girls will select science subjects in public secondary schools in Arusha district council. According to Seymour (2017), learning occurs particularly well when people are engaged in constructive learning that addresses misconceptions. There is the importance of helping students connect with prior knowledge and experiences as new information is presented in order to help them dispense misconceptions and build a correct understanding.

With respect to Experimental approach (EA), students noted that EA enables learners to carry out practical hence facts/skills are registered in long term memory by 98% while teachers acknowledged that it enables learners to carry out practical hence facts/skills are registered in long term memory by 79%. Another teaching/learning method mention was Reflective Approach (RA). In this case, students reported that activities designed during RA enhance effective learning by 100% while teachers asserted that activities designed during RA enhance effective learning by 95%. The finding is in line with Active Learning Theory that guided the study. The theory puts emphasis on many activities during teaching that are learner driven (AL-Rawi, 2018).

Constructivist approach (CA) was also mentioned as another teaching/learning method that influences female students' choice of science subjects in public secondary schools. Activities during constructivist approach enable learners to concentrate & enjoy the lesson by 90% as

reported by students while teachers concurred that it will enable learners to concentrate & enjoy the lesson by 87%. The same approach enable learners to actively construct or build new ideas and concepts based upon prior knowledge and new information. These findings are in concurrence with the Constructivism Theory which is a learning theory particularly applicable to the teaching and learning of science subjects. Piaget suggested that through accommodation and assimilation, individuals construct new knowledge from their past experiences (Dahms et al, 2017).

Furthermore, during interviews, majority of heads of school commented that students have poor participation in about science subjects while in class due to challenges they encounter in school. One head of school maintained that:

Outdoor teaching requires adequate preparation which is a challenge to most teachers as reported by Head of Department (HOD). The teacher's role should be to coach, facilitate and guide the learning process during outdoor teaching. All these require adequate time for preparation both for teachers and students. Furthermore, outdoor teaching nurtures creativity of learners thereby improving learner's attitude towards learning. Similarly, OT/LA encourages informal learning of the hidden curriculum (Source: Field Interview, 4th May 2023).

In this respect, teachers observed that outdoor teaching stimulate, inspire and improve learner's motivation; consequently, learners make self-discovery of subject concepts and students get the opportunity to see the world in action hence they are encouraged to learn through exploration. However, the study through the respondents established that for effective OT/LA to take place adequate preparation is necessary.

5. Conclusion and Recommendations

5.1 Conclusion

Based on the findings of the current study, the following conclusions were drawn:

The result of the study on the first objective revealed that some approaches used in teaching influence female students' choice of science subjects. For instance, schools with adequate staffing of science teachers and laboratory materials are likely to adopt student centred approach, experimental approach and outdoor teaching/learning

approaches, which encourage female students from selecting science subjects in public secondary schools in Arusha District Council. Therefore, education stakeholders should provide conducive teaching/learning environment that will encourage female to select science subjects. It is argued in this study that there shall be no single bullet as a solution to make sure that female students take a stage in science related subjects. Thus, there is a need to have collaborative efforts among policy makers and other educational stakeholders including parents and communities to work together if more female students are to take up science subjects in public secondary schools.

Students' centred approach, experimental approach and outdoor teaching/learning approaches enable students to carry out numerous activities during teaching/learning process. Therefore, both teachers and students have a strong feeling that when learners are exposed to numerous activities during teaching/learning process, it will arouse their interest in science subjects thus they will be able to develop better critical thinking and problem-solving skills. In addition, the respondents noted that the more activities during the lesson enable learners to concentrate & enjoy the lesson. This implies that the Government needs to place more investment in laboratories in secondary schools so that students practice what they learn in the classrooms to build a sense of confidence upon them that they can do it. This includes the improvement of girls' access to scientific and technological related studies and careers in early ages especially at primary school levels. In addition, training programs on gender relations and equality among men and women and how they are implicated in their daily lives are equally important.

5.2 Recommendation

Based on the study findings the following recommendations were made:

1. Since Tanzania is emphasizing on the industrialization as a backbone for economic development, science education for females in all levels should be given a special attention in terms of proper infrastructures, human resources and funding that will enable teachers to adopt the right teaching approaches. There should also be appropriate measures that address the sustainability efforts by female students in secondary schools so as to have female scientists in higher levels who can render skills to the nation.

2. Increasing the number of science teachers is equally important if the Government wants to improve the female graduates in science and later join the universities with the area of science specialization. Similarly, there is a need as well to have sensitization programs that target girls, families and society at its totality so that to build confidence and assertiveness among girls to take part in science subjects. Indeed, if the African countries and Tanzania in particular want to improve female students' choice of science subjects, then information on the women's positions in the society and their contributions towards country' economy has to be well thought about.
3. Furthermore, parents and relatives should support female students to perform their homework by providing them with moral and social support. Lastly, there is need to introduce exclusive scholarship schemes for girls to encourage female students to select science subjects at secondary schools.

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