Teaching Methods for Motivating Girls to Learn Science Subjects in Community Secondary Schools in Mbeya, Tanzania

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Abstract

This qualitative study investigated effective teaching methods that motivate girls to learn science subjects in community secondary schools in Mbeya, Tanzania. It focused on participants' perspectives on these methods and the challenges teachers face in the teaching process. Data were collected from 40 participants across four community secondary schools using observations, interviews, and focus group discussions. The findings revealed that teachers used both teacher-centred and learner-centred approaches to motivate girls to learn science subjects. However, challenges such as overcrowded classrooms, inadequate teaching resources, and poor infrastructure hindered teachers' efforts to motivate girls to learn science. The study recommends improving the learning environment and resource availability to enhance girls' motivation and engagement in science subsects within community secondary schools.

Keywords: *teaching methods, motivation, gender gap, learner-centred approaches, under-representation*

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Introduction

The use of effective teaching methods by teachers plays a significant role in motivating learners to learn Science, Technology, Engineering and Mathematics (STEM) subjects (Lyanga & Chen, 2020). Teaching methods act as a bridge between learners and teachers in the process of communicating scientific concepts and principles in schools (Shana & Abulibdeh, 2020). Therefore, motivating learners and enhancing their understanding of concepts rely heavily on the use of appropriate teaching methods (Mkimbili, 2018). STEM knowledge contributes to

the generation of innovators, problem solvers, and great thinkers in society (Huruma, 2015). Those people are needed not only to solve global challenges but also to combat the issues related to sustainable development (United Nations Educational Scientific and Cultural Organization [UNESCO], 2020). Therefore, it is important to have scientifically literate men and women in efforts to attain socio-economic development of the nations (Kerenge, 2014; Rachmatullah et al., 2018). Moreover, the importance of careers related to STEM fields in this competitive and globalised era is critical for a more academic tone globally (Kant et al., 2018).

Although scientific knowledge is important for socio -economic development and human survival, girls' motivation to pursue science subjects remains a global challenge (Robinson, 2018; Sya'bandari et al., 2021). Some studies have noted that the attitude of students, interests and motivation towards science learning, especially girls tend to decline throughout their school years (Roberts, 2014). Since women account for half of the world's population, girls' underrepresentation in STEM affects their participation in future careers in STEM fields (Robinson, 2018). In Europe, women represent 35 per cent of all STEM graduates; this situation is similar in Japan and the United States of America (Schumck, 2017). However, the participation of women in STEM can be improved when teachers play their role of motivating students, particularly female students, to develop positive attitudes towards science subjects (URT, 2014; Sukor et al., 2017).

Factors contributing to the underrepresentation of girls in science include societal misconceptions that girls are different from boys in terms of abilities and interest in science (Robinson, 2018; Sya'bandari et al., 2021), considering science subjects more masculine than feminine (Mukhwana et al., 2020), girls perceiving science subjects to be harder than arts subjects (Moss-Racusin et al., 2021) and educational or class environment factors, including the use of poor teaching methods by teachers (Husse´nius, 2014). Moreover, studies reveal that the use of the traditional teacher-centred approach is among the major factors that pull away learners, especially girls, from science and mathematics (Kelana & Suwarma, 2024; Clawson, 2019; Mkimbili, 2018).

Different initiatives have been taken globally to improve girls' participation in science subjects in schools. For instance, the US government realised that the competitive nature of the economy in the globalised world depends much on the knowledge and skills gained from STEM regardless of gender (Roberts et al., 2018). Therefore, the US government advocates STEM for all in policies enacted and practices to eliminate the challenge of girls' under-representation (Kocabas et al., 2020). For example, one of the broad goals of science education, according to

the National Research Council (2011), is 'to increase STEM literacy for all students, including those who do not pursue STEM-related careers or additional study in the STEM-related disciplines (National Research council, 2011). Similarly, in Australia, different policies have been made to improve the situation of girls' underrepresentation in science, with the government establishing several organisations and programmes that work to raise the profile of science among girls (Chapman & Vivian, 2016). Thus, attention was placed on teacher quality, including the quality of teaching science and mathematics using innovative inquiry-based approaches (Timms et al., 2018). However, the underrepresentation of girls and women in STEM persists regardless of the efforts (Kinyota, 2021).

Similarly, Tanzania has implemented various strategies to address gender disparities in STEM education. This is evident in educational policies such as the Development Vision 2025, which promotes the provision of science and technology for all by stating that education systems must cultivate a science and technology culture from the lowest levels, giving a high standard of education to all children aged 6-15 (URT, 2000). Moreover, the government reviewed its curriculum in 2005, considering the significance of teaching methods for science. The government also transformed the teaching and learning orientation from a knowledge-based curriculum (KBC) to a competency-based curriculum (CBC), which emphasises the practical application of what is learned to solve real-life problems (Mkimbili, 2018).

The new curriculum, therefore, plays a great role in changing the role of teachers from being knowledge transmitters to knowledge facilitators by supporting learners in constructing knowledge (Mabula, 2012). Mkimbili (2018) and Clawson (2019) observe that science teachers are required to adopt learner-centred approaches in actual classroom teaching. In this, teaching methods such as discussion methods, project-based methods, and simulation methods should be used to motivate learners to learn science and mathematics and connect their knowledge with the real world (Titilayo, 2015). These kinds of methods arouse learners to actively participate in the teaching and learning processes through different activities. Formally, science teachers preferred traditional teacher-centred methods of teaching to contemporary competence-based methods in classrooms (Mkimbili, 2018). The traditional teaching methods, particularly the predominant use of the chalk-and-talk or lecture approach, had significant implications. This method made teaching more demanding and often limited learners' opportunities to actively engage in the learning process, particularly in the context of explaining scientific abstractions, concepts, and principles (Muneja, 2015). Consequently, this approach contributed to low learner motivation, especially among girls, in science subjects (Mkimbili,

2018). Regardless of the efforts made to encourage girls to take science subjects in secondary schools, the number of girls majoring in science subjects continues to decline when compared to the number of boys (Kasembe & Mashauri, 2011).

Gender disparities in science subjects in secondary schools

The gender gap in science subjects is vivid, with the number of girls being lower than the number of boys. In addition to the low number of girls, it is interesting to know that girls perform poorly when compared to boys in science subjects in secondary schools. Gender disparity in science subjects in the Certificate of Secondary Education Examinations (SCEE) is illustrated in Table 1.

Table 1

Number of Students in Science Subjects in O-Level Secondary Schools between 2019 and 2020

SECONDARY EDUCATION										
CERTIFICATE OF SECONDARY EXAMINATION(CSEE)										
Results by subjects for school candidates 2019-2020										
Subject	**Year**	**Candidate sat**			**Candidate passed**					
		Boys	Girls	Total	Boys	%	Girls	%	Total	% of total
Biology	2019	201510	220052	421562	125808	62.4	107152	48.7	232960	55.3
	2020	208792	226628	435420	128421	61.5	111864	49.4	240285	55.2
Basic	2019	201859	220473	422332	49868	24.7	34710	15.7	84578	20.0
Mathematics	2020	208732	226613	435345	50897	24.4	36685	16.2	87582	20.1
Physics	2019	69877	58567	128444	39746	56.9	22396	38.2	62142	48.4
	2020	66365	53977	120342	37759	56.9	21049	39.0	58808	48,9
Chemistry	2019	86116	76661	162777	70168	81.5	54784	71,5	124952	76.8
	2020	82626	71517	154143	74290	89.9	59989	83.9	134249	87.1

Source: NECTA-CSEE Results of 2019-2020 (URT, 2021)

Table 1 highlights a higher enrolment of girls compared to boys in both years, as evidenced by the numbers of girls and boys who sat for compulsory subjects, i.e., biology and mathematics. However, participation and performance in physics and chemistry subjects remain disproportionately lower on the side of girls, reflecting low motivation and systematic challenges to take these subjects. Thus, this suggests that girls exhibit lower motivation in science, as reflected in their participation and performance (Robinson, 2018).

The underrepresentation of girls in STEM-related subjects has become a growing concern of the gender gap, noting the fact that the women's population is growing fast (Roberts et al., 2018). Thus, any form of underrepresentation is significant as it informs their representation in workplaces (Robinson, 2018). While previous studies

(see, for example, Itika et al., 2017; Matete, 2022; Kinyota, 2021) have addressed girls' science education in Tanzania, the studies on effective teaching methods to motivate girls in community secondary schools are relegated. In that regard, the researchers were prompted to conduct a study on teaching methods that inspire girls to learn science subjects in community secondary schools. The failure to address girls' challenges in science subjects denies girls access to STEM education and career opportunities (Aciksoz et al., 2020), thus placing girls into a marginal status that is against human rights and the promotion of equality in the world. In 2015, the United Nations adopted the Sustainable Development Agenda with goals to be achieved by 2030. Goal number five of the Sustainable Development Goals (SDGs) required the member states to achieve gender equality and empower all women and girls devoid of discrimination (UNESCO, 2020). One of the ways to empower girls and end discrimination against them is through increasing their participation in STEM subjects.

This study was, therefore, necessary to be carried out because its findings are expected to add to the existing body of knowledge, improve teaching and learning practices and inform different key educational stakeholders on issues related to effective use of teaching methods and motivating girls to learn science subjects in community secondary schools (Creswell, 2012). The curriculum development institution and policymakers might also draw experiences from the findings of the study and devise syllabi that are inclined to foster means through which science teachers are motivated to teach and encourage girls' education. Furthermore, the study is expected to improve teachers' teaching practice as they gain more understanding of the factors that contribute to the under-representation of girls in STEM. Therefore, this study sought to answer the following questions:

i. What are participants' views on the teaching methods used by teachers to motivate girls to learn science subjects?
ii. What are the challenges that teachers experience in motivating girls to learn science subjects?

Theoretical Framework

The study was guided by the Expectancy Value Theory of motivation, which was proposed by Eccles et al. (1983). The theory explains how students' expectations for completing a task or reaching a goal relate to the importance of doing so. It is one of the theoretical constructs of motivation that describes the nature of achievement (Day, 2021). The theory posits that learners' motivation and performance are influenced by their expectations of success and the value they assign to tasks. The Expectancy Value Theory was adopted in this study because it contains components necessary in the process of motivating learners, especially girls, in their choices, persistence, and performance in learning. It helps teachers effectively use teaching methods to motivate girls to learn science and mathematics

because of the beliefs and expectations that they develop for STEM-related fields, as well as the expectations they have for their students.

Methodology

Research approach and design

This study employed a qualitative approach because it allowed the researchers to obtain crucial information needed to address research questions (Huberman et al., 2014). The research adopted a phenomenological research design, which focuses on understanding the different ways people experience, conceptualise, interpret, and make sense of phenomena within their environment (Bogdan & Biklen, 2007). This design was useful for the study as it enabled a deeper exploration of teachers' and students' lived experiences regarding teaching methods and their impact on motivating girls to learn science subjects. This way, the study provided rich insights into both the practices and challenges of girls' engagement in science subjects within secondary schools.

Sample and sampling procedures

Four community secondary schools in Mbeya Region were purposively selected to take part in this study. Two (2) of the chosen schools had good performance, while the other two (2) had poor performance in the 2022 Certificate of Secondary Education Examinations (CSEE); that is, from four National Examinations Council of Tanzania results. The researchers expected that the two categories of schools would provide different perspectives when looking at the issue of the performance of girls in science subjects in community secondary schools. The focus on performance was important since it is one of the constructs that can be used to portray student motivation in the learning process (Roberts et al., 2018). The study had 40 participants who were purposively selected to take part in the study. There were 16 science teachers, four (4) teachers from each school, 24 students, six (6) from each school under study. The participants in this study were Form Three students specialising in science subjects. It should be noted that students are supposed to decide on their subject streams – science, art, or business, in form three. Ndalichako and Komba (2014) indicate that it is in form three that students' future in academics, whether or not to join science, art, or business streams, can be determined.

Location of the study

This study was carried out in the Mbeya Region. The region was chosen due to high secondary school enrolment rates, with notable gender disparities in science performance (Kihombo, 2017). The researchers were interested in community secondary schools because these schools were specifically introduced to achieve

the goal of Education for All (Dakar, 2000). Education for All was a resolution under the auspices of the Dakar Framework for Action adopted by the World Education Forum as a collective commitment of nation-states to reaffirm the vision of the World Declaration on Education for All that was adopted in 1990 (Dakar, 2000; Okkolin et al., 2010). Moreover, the enrolment in these schools was higher than in other public secondary schools, which enrol students with the highest performance (Assey, Malingumu & Babyegeya, 2022).

Methods of data collection

The study employed different methods of data collection, including the classroom observation method, which is the most reliable tool for data collection in gathering first-hand field information as the participants engage in actions and experiences in their natural settings (Gama & Alves, 2021; Pesambili & Novelli, 2021). Four observations were possible for each school, meaning that each form three science teacher was observed. This method was also useful in collecting information that could not be obtained through other tools. Therefore, non-participatory observation allowed the researchers to observe teachers' practices without direct involvement.

In this study, semi-structured interviews and focus group discussions (FGDs) served as the primary methods of data collection. The researchers prepared interview guides that comprised open-ended questions. According to Cohen et al. (2018), open-ended questions provide researchers with room to probe more into the answers in order to collect detailed information. Kivunja et al. (2017) point out that, unlike other data collection tools, interviews enable researchers to collect in-depth data from respondents. In addition, Patton (1999) observes that interviews are helpful in generating rich qualitative data due to their flexibility, focus and time effectiveness. Researchers organised interviews in natural settings in schools without disrupting school timetables and ongoing classes. Gunawan (2015) points out that interviews should not take a long time to avoid boredom. Thus, all interview sessions in this study lasted between 45 minutes and one hour.

Focus group discussions (FGDs) were conducted for students. During FGDs, participants had time to share experiences, ideas and expressions of beliefs, meanings and values to arrive at a collective understanding of their perspectives on common teaching methods that teachers used to motivate girls to learn science and mathematics. The details from both interview responses and FGDs were noted down and organised before a thorough analysis was done. (Creswell, 2014) notes that field data should be subjected to comprehensive, in-depth examination to remove all kinds of nuances that might destabilise the results. Thus, data collected from the field were subjected to critical analysis to generate valid findings.

Data analysis

Data analysis followed Braun and Clarke's six-stage thematic approach for analysing qualitative data (Dawadi, 2020). The stages include data familiarisation, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing a research report. All transcripts and audio recordings were organised and coded to fit the study's purpose. Analysis to develop the story was based on themes in relation to the research questions to ensure there was not much overlap between themes. Extracts from interviews and FGDs supported key themes in reporting the findings of the study.

Ethical considerations

Ethical considerations for this study included securing research clearance from the University of Dodoma. The researchers also secured a permit from the Mbeya Regional Administrative Secretary as well as the District Administrative Secretary to conduct the study in four different schools. The researchers also ensured that participation in this study was voluntary. Participants were briefed on the study's purpose, assured of confidentiality and granted anonymity before they were invited to participate in interviews and FGDs (Creswell, 2014).

Findings of the Study

The study's findings are represented based on the themes extracted from field data, as follows:

Teaching methods used by teachers to motivate learners in science subjects

The study revealed that both teacher-centred and learner-centred teaching methods were adopted indiscriminately by teachers to teach science subjects for both girls and boys. However, since teachers were well aware that girls were less represented in science subjects, they made deliberate efforts to motivate them to learn science subjects.

Lecture method

The findings revealed that teachers, especially in schools A and B, preferred the lecture method of teaching. The technique involves teachers explaining concepts while learners listen attentively most of the time during classroom sessions. It is a traditional way of teaching based on a teacher-centred approach, which does not promote critical thinking, and it rarely engages learners in the process of teaching and learning. One Biology teacher had the following to say during interviews:

> I think what makes girls find these subjects to be hard is learning the concepts theoretically using the lecture method. We sometimes teach

> theoretically by the use of the lecture method. As a result, remembering abstract concepts becomes hard, leading to low motivation. However, practical methods make children see what they learn, which motivates them and helps them remember (Interview 16, 26th July 2023, Mbeya).

In classrooms, researchers observed some teachers teaching using the lecture method. The Physics teacher in school B, on 16th November 2023, used the lecture method to teach the effect of electricity current. Again, on 28th July 2023, the biology teacher in school D was seen using the lecture method when teaching the endocrine system in the Coordination topic.

Discussion method of teaching

Recognising the limitations of the traditional methods, teachers employed more interactive approaches, such as group discussions, to address the gender gap. This was achieved by deliberately providing girls with active roles during discussions and the presentation of findings. This method was used during the review stage of the lesson development to arouse students to review what was learned before. Moreover, it was also used to perform several other functions, including attracting active involvement and participation, evaluating learning and arousing student interest in the subject. Teachers explained that this method was mostly used during teaching because it helped to make girls confident and improve their motivation to learn science subjects, as described by one physics teacher from School A.

> I usually organise group work, and in those groups, I try to mix boys and girls. I make sure that there are more girls, and I assign them some leadership roles. Even during presentations, I make them participate so as to build their confidence because sometimes they are not confident enough to speak before boys (Interview 16, 26th July 2023, Mbeya).

The testimonial above means that teachers make efforts to engage and motivate girls in the teaching and learning processes using group work. The respondent indicates that girls are involved in group discussions and are given leadership roles so as to increase their motivation and participation in science subjects. One student in School B made the following comment.

> The most commonly used method for teaching science in our school is group discussion. Many teachers do leave assignments; we discuss them in groups, and then when we bring the assignments back, they choose anyone to present the findings, especially girls (FGD D, 18th October 2023, Mbeya).

This means that the discussion method is a positive strategy by teachers to arouse and motivate girls in science subjects. This means that the discussion method is commonplace in schools, and teachers use the method as a way of mitigating gender disparity in secondary schools. This was achieved through asking and answering questions, listening, and responding to the views of other students in their respective groups.

Question-and-answer method

This study found that teachers use questions and answer cues as a method of teaching science subjects. The findings show that most teachers made use of questions and answer cues during the review or introduction stage of a lesson. This is the stage at which teachers attempt to determine what learners know before they begin teaching a new topic or sub-topic via brainstorming using quick oral questions and answer cues. Some teachers argued that they use this method as a means of building confidence in learners, especially girls, as well as motivating them to learn their particular subjects. One of the respondents made the following comment during the interviews:

> We always find methods that motivate learners, mostly girls. For example, when we teach, we may be pointing at girls so as to encourage them to attempt the questions we ask. We engage them to make them realise that they are also capable of answering questions (Interviewee 13, 18th July 2023, Mbeya).

Another respondent who taught Physics in school A had the following to say:

> One of the methods that I use all the time is the question-and-answer method. I use this whenever I discover that the responses for the learners are inadequate; I mean poor responses. In this method, I ask questions and point at any girl to answer the questions, and I reward whoever supplies correct answers. This really helps in raising the motivation of girls in secondary schools (Interviewee 5, 17th July 2023, Mbeya).

The respondent asserts that questions and answer cues are used to build confidence. One aspect of confidence is to be able to express oneself without feeling shy or fearful. Respondents had a view that the questions and answers method serves to motivate learners to continue learning. It was further noted that the process was used alongside the motivating technique of providing awards to those who provided correct answers.

The use of practical laboratory experiments

Science subjects rely heavily on empirical findings and sensory observation. Learners are expected to observe, explore, analyse, and report on their findings. Most scientific innovations occur in laboratories, where practical activities help students grasp scientific concepts. This study found that science teachers utilise laboratories and practical sessions to enhance learners' understanding of science topics and scientific procedures. Respondents highlighted that practical activities not only build knowledge and skills but also motivate students, particularly girls, to pursue science streams in secondary schools. Laboratory sessions, where teachers facilitate experiments and demonstrations, provide valuable hands-on learning opportunities for girls in schools. A respondent in the Chemistry department had the following to say.

> When teaching about reaction rates, I take students to the laboratory to demonstrate the processes. For example, I illustrate reversible and irreversible reactions. I show them an irreversible reaction using magnesium and hydrochloric acid, explaining that the reaction cannot be reversed. Students observe magnesium dissolving in the acid, confirming the theory with practice. They become excited when they see theoretical concepts validated through practical experiments (Interview 16, 26th July 2023).

However, the researchers observed that schools A and B had no science laboratories for practical experiments. Teachers in these schools did all experiments in normal classrooms, which were not designed for practical use. This situation posed a challenge in engaging girls in practical activities and motivating them to learn science subjects.

Hands-on activities

The study found that teaching science involves making students learn by doing with their hands; that is, the process of touching and seeing what was done in the actual learning process. Hands-on activities motivate learners to learn and gain skills needed for socioeconomic development. Cognitive and competency skills are enhanced through the use of empirical evidence when learners get involved using real activities. One Chemistry teacher in School D made the following comment.

> Hands-on activities motivate learners in unique ways. For example, in teaching acid-base, I ask students to mix the acid, base and salt and determine indicators on their own. The following day, I ask them to observe and test colour changes when mixing acids, bases, and salts. Such activities serve to motivate and engage students in the learning process (Interview 6, 17th July 2023, Mbeya).

The study found that hands-on activities enhance the recall of information. Learners reported that these activities made it easier to remember concepts during examinations. They noted that this method was especially beneficial in exams, as it improved performance and motivated them to engage in learning. However, the researchers observed overcrowded classrooms in school C and D, which hindered teachers' ability to engage with female students effectively.

Demonstration

It was observed during this study that teachers used the demonstration method as a way of communicating ideas to learners. Teachers performed different activities so that the girls could observe how they should be done in order to help them transfer theory into practical realities as a means of motivating girls to learn (Smith et al., 2015). Teachers said that they used visual aids such as flip charts, posters, PowerPoint presentations and videos to demonstrate ideas. One Chemistry respondent in School D had the following to say.

> We sometimes use videos. Now, I am teaching about "hormonal coordination", and because these are things that cannot be seen because they are in the body, we went to the staffroom, and I played a video to demonstrate to them how they function (Interview 12, 18th July 2023, Mbeya).

A student from school A further made the following comment during one Focus Group Discussion session: *"Other teachers use drawings to show us pictures of real objects"* (FGD, A, 31st July 2023, Mbeya).

The narrations above are clear illustrations of how girls can be helped to understand and enjoy the topics being taught. Respondents revealed they used the demonstration method to make learners understand and motivate them to learn.

Field trips

Teachers revealed that another common technique used to break the gender gap in school is organising field trips (study tours). In this method, girls may visit other institutions to witness, for instance, the use of innovative technologies and available future career opportunities in science and mathematics subjects. These trips, according to the respondents, help to inspire learners and help them make useful decisions in pursuing career paths in science-related subjects. They also reported that during such trips, girls can meet successful women who might inspire them to make the right career choices in future. A teacher in school D noted that:

> Last year, we managed to take to science camps with some of the girls from our school who were doing well in physics and mathematics. The

> camps were organised in the University of Dar-es-salaam. During the camps, girls had the opportunity to meet with other students from other schools and learn different things. This really motivated and inspired them to continue studying science. (Interview 17, 26th July 2023, Mbeya).

These findings concur with (Behrendt & Franklin, 2014), who pointed out that the participation of students in field trips helped to generate positive attitudes towards science subjects among students. They further added that field trips help to provide first-hand information that cannot easily be found in classroom contexts.

Project method

This study found that teachers used project-based teaching methods to motivate girls in science subjects. In this method, students work in groups as teams that are useful in building relationships, goal setting, developing existing skills, acquiring new skills, and creating learning outcomes that have a clear benefit to the community (Nkundabakura et al., 2023). According to the respondents, project-based teaching enhances the girls' ability to work with fellow students using the time and available resources (Tufail & Mahmood, 2020). One respondent in School D remarked that:

> I prefer using project -based methods to motivate girls to learn. Thus, there are some topics which require learners to do some projects. I guide them on what should be done and ask them to do the projects cooperatively. When learners work jointly together, they enjoy teamwork and get motivated to learn (Interview 15, 26th July 2023, Mbeya).

This indicates that science teachers assign learners project-based activities as a means of arousing their interest in studying science subjects.

Challenges teachers face in motivating girls in science subjects

Overcrowded classes

The respondents said they faced different challenges in motivating girls, specifically in situations where classrooms were overcrowded. Responding to the issue of motivating girls in crowded classrooms, one Physics teacher in School A noted that:

> We have a problem with too large classrooms, specially Form ones and twos where the number is between 200 students and 300 students in a class. Thus, we cannot effectively reach all the students during the teaching and learning processes. Even if these classes are not the classes when learners are supposed to opt for science, the situation

> affects their choice of what to learn, and, in turn, it affects their decision to join science subjects, which are perceived to be harder than other subjects. Thus, as a result, only a few girls agree to pursue science in form three (Interview 13, 18th July 2023, Mbeya).

The biology teacher in School B had the following to say.

> The biggest challenge I see is that teachers are not motivated to teach in large classes even though science subjects are important to all. This is a problem because even if students are willing to study, effective learning cannot be attained when the classes are too large, and teachers are not motivated. (Interview 18, 26th July 2023, Mbeya).

Inadequate teaching resources

This study found that inadequate teaching facilities significantly reduced learners' motivation to study science in community schools. Respondents highlighted that effective science teaching was often hindered by a lack of resources, particularly textbooks. One teacher from School B stated, "*We experience challenges during teaching due to the unavailability of books. Books are generally not sufficient*" (Interview 14, 26th July 2023, Mbeya). This highlights the struggles science teachers face in motivating girls to engage with science subjects in the absence of sufficient learning materials. In such a situation, it was not easy for teachers to motivate girls to learn science.

Poor infrastructure

The study found poor infrastructure as another challenge to motivating girls to participate actively in science subjects. During interviews in School A, one respondent made the following remark.

> Motivating girls to learn science subjects is hard here, given the fact that we have an unfavourable environment. You can see in our school that the water, toilets, and laboratories are not that conducive. Girls face challenges, especially during the menstrual flow, due to lack of enough water and poor toilets for washing and changing. This makes some of the girls skip school for a while. You have to know that the laboratories that we are using are mainly classrooms, which are just used in the place of laboratories (Interviewee 2, 21st July 2023, Mbeya).

The quote highlights that poor infrastructure, including inadequate water, toilets, and makeshift laboratories, creates a challenging environment that discourages girls from participating in science subjects. Specifically, the lack of proper facilities, such as water and appropriate toilets during menstrual flow, contributes to girls

missing school and feeling less motivated to engage in science learning. This suggests that it is not easy to teach and motivate girls who are not comfortable and confident due to the poor learning environment.

Discussion of Findings

Our findings revealed that there were no specific teaching methods used exclusively for motivating girls. Rather, teaching methods based on teacher-centred and learner-centred approaches were used for both boys and girls, with extra efforts made by teachers to improve the situation of girls. It was found that the lecture method was used despite the fact that it deprives learners of opportunities to take an active role in the teaching and learning processes. This aligns with Lyanga and Chen (2020), who revealed that the lecture method of teaching was among the methods that science teachers in community secondary schools mostly used for teaching science subjects in Tanzania. The method does not promote critical thinking, contrary to the philosophy that guides the provision of education in the country (URT, 2014). It is, therefore, necessary for teachers to rely more on the learner-centred method of teaching, which helps in the active participation of learners in learning and improves their motivation (Jatau et al., 2021).

The study also found that teachers adopted various learner-centred teaching methods, including discussion, demonstration, questions and answers, practical laboratory experiments, field trips and project methods. When using this method, teachers deliberately provided special treatment to girls as a strategy to motivate them to learn science subjects. Since these methods were participatory, learners were actively engaged in the teaching and learning process, resulting in their motivation. These findings concur with those of other studies that emphasise the effective use of teaching methods based on a learner-centred approach to motivating learners to learn. According to (Tufail & Mahmood, 2020), group discussions help girls gain confidence and motivation due to leadership roles assigned to them by teachers during discussions. Lee and Sulaiman (2018) further point out that students' positive attitude towards a lesson is enhanced through the use of practical work. Laboratory experiments, which are given to learners, are important ingredients in raising their motivation to learn because learners can verify abstract concepts through the use of empirical evidence based on a sense of organs used in the process (Colibaba et al., 2014). The development of a student as a whole in terms of all the domains, cognitive, affective and psychomotor, is possible through the use of practical science work, inquiry teaching and the use of hands-on activities (Shana & Abulibdeh, 2020). The Tanzania government emphasises teachers' use of the learner-centred teaching approaches that promote

the development of inquiry mind in learners, making them competent and developing skills in solving real-life situations (URT, 2014).

Notwithstanding the existing efforts, the study found that teachers encountered several challenges, including overcrowded classrooms, scarcity of teaching materials and poor infrastructure. This finding concurs with (Matete, 2022), who revealed that science and mathematics teachers in Tanzania teach more theoretically rather than practically due to the lack of enough laboratories in public secondary schools. The Tanzania government acknowledges the importance of a conducive environment for girls' science learning. Thus, it continues its effort to promote the construction and equip secondary schools with laboratories for practical science work (Abdallah, 2015).

Conclusion and Recommendations

Motivating learners, particularly girls, to learn science subjects requires creativity on the part of teachers to use effective methods so as to attain the desired results. The appropriate use of a learner-centred approach in teaching is essential in improving girls' motivation. However, the study findings have revealed that the teacher-centred approach is still in use due to some challenges that teachers face during teaching. The study, therefore, recommends that the government must improve the teaching and learning environment, particularly for teaching science subjects. Furthermore, the study suggests that more studies be carried out on using teaching methods for motivating girls in inclusive classrooms. The findings of the study cannot be generalised to indicate a clear picture of the country because it was limited to a narrow area of four community secondary schools with a sample size of 40 participants only in the Mbeya Region. It is recommended that a larger sample be used to cover a wider range of areas in the country. The researchers suggest that another study could be undertaken involving both public and private secondary schools.

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