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Strategic initiatives for girls' interest to learn science subjects in rural Tanzanian secondary schools

Rider Ems, Mary Allay and Syliverster Buyobe

The University of Dodoma, 1 Benjamin Mkapa Rd., 41218 Iyumbu, Dodoma, Tanzania

Abstract. This study examined the strategic initiatives employed to promote girls' interest in learning science subjects in Tanzanian secondary schools. A case study research design was employed to gain insight into the participants' experiences. The data collected through interviews and focus group discussions were analysed, and themes and sub-themes emerged. It was found that educators used various strategies to motivate girls to learn science subjects, including. The study concludes that the availability of proper learning materials, study tours, guidance, and counselling may motivate girls to develop an interest in learning science subjects in ordinary secondary schools. For further study, the study recommends that a similar study be conducted with female pupils in primary schools in rural areas.

Keywords: science, girls, interest, initiatives

1. Introduction

The advancement of science and technology requires people to adapt to and follow global changes in order to remain competitive in the global market. This is particularly essential for girls during their school life and in their future life situations. The United Republic of Tanzania (URT) prepared its educational policy in 2014 and revised it in 2023. The policy insists on gender balance between males and females at all levels of education [26]. This was done to give girls a chance that may help them in their everyday lives. In this manner, girls are encouraged to take science subjects so that they can pursue careers as doctors, engineers, mechanics, and technicians. Therefore, the study assumed that initiatives and sustainable strategies are needed to improve girls' interest in science subjects in rural ordinary secondary schools in Tanzania, particularly in the Arusha Region.

1.1. An overview of initiatives used to promote interests in girls to learn science subjects in ordinary secondary schools

Worldwide, female students have been given a special opportunity in the academic arena to enhance their abilities and competencies, which enables them to compete in their socio-economic lives [25, 27]. A study conducted by Amunga and Musasia [2] found that science subjects help girls pursue a variety of careers, including those in medicine, engineering, mechanics, and technology. Through the science subject, girls may benefit in their everyday life [21]. It makes sense that science subjects are essential for girls in ordinary secondary schools. Through science subjects, there is a possible increase in girls' job opportunities in their daily life situation, rather than in social science. This suggests that there is a need to encourage female students to pursue science subjects, not only to meet their personal needs but also to support national interests.

0000-0003-4612-9347 (M. Allay); 0009-0001-4642-0815 (S. Buyobe)
riderems112@gmail.com (R. Ems); allaymary@gmail.com (M. Allay); sylivester.john@udom.ac.tz (S. Buyobe)

A study conducted in Australia by Timms et al. [23] found that girls in ordinary secondary schools face numerous challenges that discourage them from taking science subjects. The study by Iroaganachi, Babalola and Soyemi [8] reported that girls' interest and motivation facilitated their opting for science subjects in ordinary secondary schools. In contrast, a study conducted by Papadakis [17] found that teachers' pedagogical practices while teaching science subjects affect girls. A study conducted by Aina [1] found that low interest in science among girls was one of the factors affecting female students' decisions to opt for science subjects. This suggests that girls' interests and teachers' pedagogical practices are crucial for enhancing their readiness to choose science subjects in ordinary secondary schools. This study identified a need to explore strategic initiatives that could support girls in choosing science subjects in rural secondary schools.

Furthermore, a study conducted by Mwakabenga and Komba [13] reported that socio-economic status is among the factors that influence girls' decisions to opt for science subjects in ordinary secondary schools. A study conducted by Papadakis [16] found that there is an inequality between women and men throughout their entire lives. Additionally, a study conducted by Timms et al. [23] found that a shortage of funds and a misperception were among the reasons that deterred girls from being interested in science subjects. These highlight the imbalance in the number of females and males in science subjects in secondary schools. Through that situation, it was doubtful.

Moreover, poor family status, care of siblings, and household chores at home affect girl students in ordinary secondary schools [4]. A study conducted by Mhagama [12] in Tanzania found that girl students hesitate to opt for science subjects due to low motivation and a lack of counselling. Additionally, a study conducted in Zimbabwe by Vurayai [28] found that low confidence and underachievement in the combined science curriculum were affecting girls in rural ordinary secondary schools. This suggests that these factors are among the influences on girls' decisions to choose science subjects. Through these issues, special initiatives were needed to motivate girls to choose science subjects in rural, ordinary secondary schools.

Various initiatives have been undertaken by the government and individual scholars from diverse countries to encourage girls to pursue science subjects. For example, a study conducted by Papadakis [18] reported that using smart and mobile devices, as well as mobile applications (apps) in a STEM learning approach, influences learning achievement in pre-primary and primary schools. The United Republic of Tanzania equalises girls and boys through the curriculum, as stipulated in the Education Policy 2014 [26]. The study conducted by Sumra [22] emphasises the implementation of the 2014 curriculum, which identifies the need to study science subjects for both boys and girls. On its part, STEM has been protesting against gender imbalance between male and female students [19]. However, female students in rural ordinary secondary schools still lack confidence and are hesitant to opt for science subjects. This suggests that there is a need to implement initiatives that encourage girls to choose science subjects in rural ordinary secondary schools. Therefore, the study focused on exploring the initiatives that motivate girls to opt for science subjects. It is assumed that this study will contribute to increasing the awareness of girl students, thereby enhancing their interest and confidence in pursuing science subjects, and making them more competitive in the global economy.

1.2. Research objective

To explore strategic initiatives that are used to promote the interests of girls to learn science subjects in the selected ordinary secondary schools in rural Tanzania.

2. Theoretical framework

This study was guided by Liberal feminist theory developed in the 1950s and 1960s by Betty Friedan [3]. The liberal feminists emphasise equal opportunities for all people, believing that every person deserves an equal chance to develop their rational and moral capacities in order to realise their personhood [6]. The liberal feminists further acknowledge that girls and women should be given equitable educational opportunities, including science education, as men and boys are, because all are human beings by nature [3]. The key arguments of liberal feminism are equal opportunity, individualistic focus, and formal equality. *Liberal feminists* maintain the view that both men and women are equal; therefore, women should be treated equally as men [14, 20]. With regard to gender labels, liberal feminists contend that girls' views towards particular fields, such as science, might be influenced by society's expectations and traditional gender stereotypes [15]. The usefulness of this theory to this study lies in its insistence on equal opportunities for females and males. Second, the theory involves girls in all activities during the teaching and learning process. Third, this theory provides girls with the opportunity to participate in all activities and be treated equally in the classroom setting.

In this study, the liberal feminist offers gender inclusiveness and participation in educational matters. Liberal feminism advocates for inclusion and gender sensitive pedagogy in classrooms to advance equity in the learning process [9]. It is, therefore, important to adopt the liberal feminist theory because it advocates for fair treatment of both men and women, who should be given equal opportunities in access and participation in education, particularly in science education. Girls have to think about their personhood in terms of self-fulfilment, individual autonomy, and rationality, which are characteristics of all people regardless of gender.

3. Methodology

3.1. Research approach and research design

This study employed a qualitative research approach embedded within the case study research method. The qualitative approach was used to gather participants' views and feelings about initiatives that motivate girls to choose science subjects in ordinary secondary schools. The case study research design allowed the researcher to investigate the issue in a natural setting [5]. Additionally, the case study provided the researcher with detailed information about the girls in secondary schools' perceptions of how to choose science subjects in their day-to-day activities.

3.2. Research instruments and participants

The study involved 30 participants: two heads of schools (one from each of the selected schools), eight teachers (four from each of the selected schools), and twenty (20) students, that is, ten (10) art students and ten (10) science students from each of the two selected schools. Head of schools and teachers were used because they are responsible for guiding and counselling girls to opt for science subjects. Additionally, they are leaders and have the authority to support girls' students in obtaining teaching and learning materials. Moreover, they are responsible for motivating and inspiring girls to excel in science subjects at their respective schools. The students were involved because they are the primary agents in choosing science subjects.

The semi-structured interviews were administered to the heads of schools and science subject teachers. The selected students were grouped into four groups (five students in each group). The interview and focus group discussion sessions lasted between 30 and 60 minutes, depending on the available time and the participants' ability to articulate their thoughts. The data were recorded using an Android smartphone

and a notebook. These help the researcher to become familiar with the results. Both FGDs and interviews were conducted using an interview guide prepared in English, but participants were allowed to respond in either English or Kiswahili. Lastly, a professional translator from the University of Dodoma, Department of Linguistics, translated the findings clearly.

The data collected in this study were analysed using thematic analysis through five steps as suggested by Creswell and Creswell [5]. The first step involved familiarisation with the data, transcription, translation, reading, and re-reading of the data. The second step was to establish initial codes. The third step involved assembling relevant codes into the identified themes. The fourth stage involved revising the theme and sub-themes, which entails modifying the themes. The fifth step was naming and defining themes. Lastly, the sixth step was writing up the report.

3.3. Trustworthiness

To ensure credibility, which is the confidence placed in the truth of the study's findings, the study employed the following elements: triangulation of data sources, including non-participant classroom observations, face-to-face semi-structured interviews, and document reviews. The study also employed multiple data collection methods (triangulation), including interviews and focus group discussions. Applying triangulation in the methods and sources of data collection helps ensure the credibility of the study [5]. To ensure transferability, the study findings depend on readers; that is, if they notice contextual similarities between their own contexts and those of the study, then they can decide to apply the study findings in their own context. To ensure conformity in this study, the researcher conducted cross-checks to verify whether the respondents' ideas, experiences, and opinions aligned with the study's findings. To ensure dependability, the study involved different participants from different contexts. This was important because it was expected to help the researcher collect various views about girls' perceptions of opting for science subjects in ordinary secondary schools in Arusha rural areas.

3.4. Ethical considerations

The researcher adhered to all ethical guidelines throughout the study. Firstly, the researcher obtained research clearance from The University of Dodoma and subsequently requested approval to conduct the study from all relevant authorities, including the Ministry of Education, Science, and Technology, as well as regional and District authorities, and all relevant governmental institutions. The research ethics were adhered to throughout the study, including respecting the respondents' privacy and confidentiality, and maintaining their anonymity. Additionally, since some respondents were expected to be under 18 years of age, the researcher sought the parents' consent for the respective pupils to participate in the study.

4. Findings and discussions

The study examined strategic initiatives aimed at promoting girls' interest in learning science subjects in selected ordinary secondary schools in rural Tanzania. The results from the informants during interviews and FGDs show that major strategic initiatives were being made in rural schools to motivate girls to take an interest in science subjects. The following initiatives were made to motivate girls to take an interest in science subjects in rural, ordinary secondary schools.

4.1. Establishment of science clubs

The results from informants revealed that in rural areas, ordinary secondary schools had science clubs that dealt with science activities. These were found to motivate

girls to opt for science subjects. The participants elaborated that science clubs were among the factors motivating girls to choose science subjects. In this regard, one of the science teachers reported:

> Some teachers use clubs that involve both males and females gender. Through the clubs, girls try to be competent and confident in their learning activities. Also, through clubs, girls increase their readiness to opt for science subjects like boys. (Interview with Science Teacher 6 from School B, January 2025)

In a similar vein, students from school B added that:

> In fact, within the clubs, we improve confidence and readiness to learn science subjects. For me, I think clubs gave me the ability to compete with boys without fear. (Focus group discussion with science students from School B, January 2025)

The above quotes reveal that the establishment of science clubs in rural, ordinary secondary schools was found to facilitate girls' choices of science subjects in their everyday life situations. These findings align with the study conducted by Whyte [29], which revealed that clubs provide girls with the opportunity to compete against boys. This increases their learning capacity and ability. The study found that science clubs were among the initiatives that motivated girls to learn science subjects in rural, ordinary secondary schools. However, the lack of teaching and learning materials in science subjects demotivates girls from being involved in science subjects. The study found that girls' readiness and effective supervision of clubs during teaching and learning increase girls' interest in science subjects.

4.2. Inviting professional and former scientists

The findings generated from the participants show that some rural ordinary secondary schools were using professional and former scientists to motivate girls to opt for science subjects. The participants reported that inviting professional and former scientists was motivating girls to engage more in science subjects. In connection with this, one of the science teachers added:

> We use a variety of strategies to inspire and support female students in their pursuit of science subjects. One of our key initiatives is to invite former students who graduated from our school and have progressed to higher levels of education to return and share their experiences. These alumni play a crucial role in changing the girls' mindset that science subjects are only for boys; instead, science subjects are for both boys and girls. Hearing directly from peers who have successfully studied science helps current female students to believe in their own potential. (Interview with Science Teacher 6 from School B, January 2025)

The statement above suggests that involving former scientists was one way to motivate girls to become engaged and interested in science subjects. They added that science subjects were preparing learners to be engineers, medical doctors, mechanics and pilots, which are important careers in the contemporary world of science and technology. These findings relate to the study conducted in Tanzania by Mbuta [11], which reported that professional teachers were motivating students during teaching and learning in secondary schools. In contrast, a study conducted by Vurayai [28] found that low confidence and low participation were affecting the motivation of girl

students during the learning process. However, this study found that visits from professional or former scientists in rural secondary schools were motivating girls to opt for science subjects. Additionally, a study found that low teachers' pedagogical competence in science subjects is among the challenges that demotivate girls from opting for science subjects in ordinary secondary schools.

4.3. Providing counselling services to female students

The informants revealed that providing counselling services to female students in rural ordinary schools was among the strategies that motivated girls to opt for science subjects. Through counselling, students gain knowledge and skills that are more important as they become interested in science subjects. Regarding this, one science teacher commented:

> I also work closely with our science teachers to provide ongoing counselling to students, emphasising the long-term advantages of studying science subjects. We often hold joint counselling sessions where we discuss the relevance of science in daily life and encourage students to approach these subjects with seriousness and determination. (Interview with Science Teacher 6 from School B, January 2025)

In addition to that, one student from school A had viewed:

> Sometimes, our school invites professional women who have excelled in their careers after studying science subjects. These women engage with our students, highlighting the importance of studying science and the opportunities it can provide, such as careers in medicine, engineering, mechanics, and aviation. Their stories serve as powerful motivation, showing our students that science can indeed lead to a successful and fulfilling career. (Focus group discussion with Student 2 from School A, January 2025)

The quotes above demonstrate that counselling is essential for motivating girls to engage in science subjects in ordinary secondary schools. The respondents added that during counselling sessions, girl students were made aware of the importance of taking science subjects, which therefore made them more inclined towards these subjects. The findings of this study concur with those of a study conducted by Chauhan and Kumar [4], who reported that providing proper guidance and counselling to illiterate parents encourages girls to opt for science subjects. The study found that counselling girl students was among the initiatives that may motivate girl students to be interested in and motivated to opt for science subjects in rural ordinary secondary schools in Tanzania. However, the study found that a lack of guidance and counselling affects girls' decisions to opt for science subjects in ordinary secondary schools.

4.4. Competitions among learners for girls' motivation

Through the interview, the participants reported that competition was one possible initiative that could encourage girls in rural areas to opt for science subjects. This is important because it facilitates learners' readiness to compete with their fellow students. Reacting to this, one female science teacher said:

> In fact, we organise competitive examinations between male and female students. These competitions help identify and reward high achievers in science, with prizes given and recognition made to both boys and girls who excel, thus promoting a spirit of achievement and competition. (Interview with Science Teacher 6 from School B, January 2025)

However, students from art subjects commented that:

> In our school, some teachers prepare competitions from one class to another class or from one group versus another group. The purpose is to motivate girls in their classroom interaction. (Focus group discussion with students from School A, January 2025)

The above quotes suggest that competition is essential for motivating girls to compete with boys or other girls. This increases their intrinsic motivation, making them more likely to enjoy and engage with science subjects. The findings of this study relate to the study conducted by Madara and Cherotich [10], which reported that girls had lower participation rates compared to boys. A study by Iroaganachi, Babalola and Soyemi [8] found that girls in secondary schools have a lower interest in opting for science subjects than boys. The study found that competition was one of the initiatives to motivate girls to take science and social science subjects in ordinary rural secondary schools. The lack of motivation for girls affects their involvement in science subjects. The study concluded that competitions should be viewed as strategies for motivating girls to opt for science subjects in ordinary secondary schools in rural areas.

4.5. Study tours for girls' learning

Regarding study tours as encouraging elements to make girls students like opting for science subjects, one of the respondents revealed:

> We organise visits to schools like Ilboru Secondary School, where students have a strong commitment to studying science subjects. During these visits, our students spend the entire day interacting with their peers, exchanging ideas, and learning from the success strategies employed by the students in those schools. The goal of these visits is to understand what contributes to their superior performance, whether it be their level of commitment, the facilities available to them, or other factors – and to implement these practices in our own school. (Interview with Science Teacher 6 from School B, January 2025)

The statement above indicates that study tours in various contexts motivate girls' students to engage in science subjects in rural secondary schools. Additionally, the informants noted that study tours were found to make students more creative and motivated in learning science subjects, as they were exposed to real-world examples that served as raw materials for their studies. This experience motivated them to pursue studies in science subjects. These findings contrast with those of Prieto-Rodriguez, Sincock and Blackmore [19] and Whyte [29] who reported that a visit to a school discouraged girls from continuing with science subjects. In contrast, the current study found that study tours motivated girls in rural ordinary secondary schools to take science subjects.

4.6. Providing learning materials to female students

The results suggest that learning materials play a crucial role in motivating secondary school girls in rural areas to pursue science subjects. In the context of the current study, it was found that teachers were providing learning materials, such as books and digital resources like laptops and tablets, to girls. These learning materials were found to support them and motivate them in taking science subjects in rural secondary schools. Elaborating on this, one of the science teachers said:

> We also supply essential learning materials, such as textbooks and, where available, tablets, to support students' engagement with science. The use of

> digital resources, including educational videos and audio materials, complements traditional teaching methods and enriches the learning experience. (Interview with Science Teacher 6 from School B, January 2025)

In a similar view, one student from social science subjects claimed that:

> In fact, many teachers insist on using videos and digital materials in science subjects rather than social science subjects. This encouraged us (girl students) to opt for science subjects because learning through digital materials motivates and increases our interest during the teaching and learning process. (Focus group discussion with social science students from School A, January 2025)

The above quotes demonstrate that learning materials are crucial for motivating girls in rural secondary schools to pursue science subjects. It was noted that digital materials, such as laptops and tablets, supported them in their search for notes and other important information. The findings of this study relate to a study conducted by Toto, Mngarah and Bwagilo [24], who found that the availability of teaching and learning materials is important for improving students' learning abilities in secondary schools. In contrast, the study by Mbuta [11] found that secondary schools were facing inadequate teaching and learning materials. However, this study found that the availability of teaching and learning materials motivated girls in rural areas to engage in science subjects.

4.7. Reinforcement to girls (rewards and gifts)

The results from the respondents showed that reinforcement (rewards and gifts to girls is important for motivating girls to opt for science subjects in secondary schools. Additionally, they noted that if female students were given rewards upon passing their examinations, it would increase their motivation to learn. On this, one science teacher said:

> For those students who perform well in science subjects, we also provide them with tangible support such as exercise books, pens, shoes, and accommodation, recognising that many of them come from financially disadvantaged backgrounds. I motivate the girl students to opt for science subjects by providing gifts to students who do better in a test or an examination, such as an exercise book, a pen, or a rubber. When other students see those gifts to their fellows, they get the motivation to study science subjects. (Interview with a Science Teacher 6 from School B, January 2025)

Similarly, the head of school B had this to say:

> We collaborate with the school board to identify and implement effective strategies for supporting female students pursuing science. This includes providing them free lunch as an incentive. (Interview with the head of School B, January 2025)

The quotes above reveal that reinforcement is important for motivating girls in ordinary secondary schools in rural areas. Additionally, the informants noted that funding and lunch were found to motivate girls in their learning. These findings relate to those of a study conducted by Gor [7], which found a difference in gender among female and male students in secondary schools, but rewards were motivating them to study science subjects. The study by Prieto-Rodriguez, Sincock and Blackmore [19]

reported that girls who performed well in their examinations were motivated in science subjects. The study found that the reinforcement of rewards and gifts, such as funds, lunch, and others, motivated female students in secondary schools to study science subjects.

5. Conclusions and recommendations

Based on the findings above, the study concludes that the availability of proper learning materials is among the strategies that can motivate girls to study science subjects in rural secondary schools. Additionally, this study concludes that proper strategies and guidelines are needed to motivate girls to participate in science subjects. Moreover, the study concludes that collaboration is necessary between the government and other educational stakeholders to train school heads and teachers on how to encourage girls to choose science subjects. In addition, the study concludes that the government, through the Ministry of Education, should encourage secondary schools to be more creative in motivating female students to engage in science subjects rather than art subjects, thereby enhancing their competitiveness in the global market. Additionally, the study recommends that teaching and learning materials should be made available to all secondary schools, both urban and rural, to motivate girls to engage in science subjects. For further study, the study recommends that a similar study focus on girls in primary schools in rural areas to gauge their interest in studying science subjects. Lastly, a similar study should investigate pedagogical practices that motivate girls in ordinary secondary schools in rural areas.

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