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Inconspicuous practices affecting students' enrolment and continuation in STEM in Ordinary Level secondary schools: Analysis of teachers' and students' experiences

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Abstract

STEM is vital to industrialisation, technological advancement and scientific innovations. Despite the importance of STEM education, in Tanzania, there is a decline in the number of students taking Chemistry and Physics subjects, poor performance, and the fact that these subjects are often optional in many schools. This study examined the subtle practices that discourage students from taking Physics and Chemistry subjects as part of STEM in ordinary-level secondary schools. This phenomenological study purposively selected and interviewed 25 participants from 12 secondary schools in Mvomero, Mbeya, Tabora, and Nzega districts in Tanzania, all of whom consented to participate. The authors used the content analysis method to analyse the data and presented it in themes, supported by direct quotations. The findings indicate that schools use standard seven and FTNA results to stream students. In contrast, teachers tend to regard higher achievers as more suited to science subjects and low achievers as less suited, regardless of their interests. The low achiever streams hardly receive additional support in STEM because teachers consider them unfit. Schools force higher achievers who are uninterested in science to study Physics and Chemistry while denying interested low achievers a chance to study them. Although teachers believe streaming motivates students to work hard, it does not help students improve their performance as it neglects the needs and interests of students. The study recommends that the government make Chemistry and Physics subjects compulsory and ensure adequate school resources. Schools should encourage teachers to devise appropriate learning support for students to enrol and succeed in STEM subjects.

Key words: *Learning achievement; Secondary schools; STEM; Streaming;*

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Introduction

Global economic prosperity depends highly on Science, Technology, Engineering, and Mathematics (STEM) knowledge and skills (McDonald, 2016). Unfortunately, the number of students enrolling in STEM fields is declining (Khan *et al.*, 2023), which puts global economic prosperity at risk of stagnation and creates a dependency on a few nations that have invested heavily in STEM. The competencies brought by STEM subjects are critical in contributing to industrialisation, technological advancement and scientific innovations that drive the global economy at all levels. Policymakers consider STEM education pivotal for transforming societies beyond the Fourth Industrial Revolution (4IR) in creating decent jobs for most youths (UN, 2024). STEM also contributes to the fight against hunger by ensuring food security in production and preservation (UN, 2017). Despite the importance of STEM in individual, national, and global economic development, the performance and the number of students are dropping to the point of raising concerns among experts in the field. The situation necessitates an investigation to uncover practices that lead to enrolment decline in STEM. Therefore, this study explored inconspicuous practices in secondary schools that discourage students' enrolment in Chemistry and Physics as part of STEM subjects. Specifically, the study aimed to answer the following question: What school-based practices are responsible for the decline in enrollment in Chemistry and Physics? What are teachers' and students' perceptions of factors for declining Chemistry and Physics enrolment?

Globally, studies have reported a decline in student enrollment in STEM subjects across all educational levels (Semali and Mahta, 2012; Matete, 2022; Khan *et al.*, 2023; Kihwele and Mkomwa, 2023; Ismail and Yusof, 2023). The decline is attributed to implicit biases, a lack of support, and inadequate resources, which affect students' perceptions and engagement with STEM (Roberts *et al.*, 2018; Hughes *et al.*, 2020; Li *et al.*, 2020; Gülhan, 2023). In this context, girls are disproportionately affected by their underrepresentation in STEM education (UNICEF, 2020), which hinders the attainment of SDG4, specifically in terms of inclusive and equitable quality education.

In Tanzania, STEM subjects, such as Mathematics and Biology, are compulsory at ordinary secondary school levels, while Chemistry and Physics are optional. According to statistics from the National Examination Council of Tanzania (NECTA), many students choose to drop these optional subjects, and less than 30% of all students pursue them to the final grade, yet they perform poorly. Declining STEM enrolment jeopardises the attainment of the current national industrialisation policy and Vision 2050 (Mwaisakila and Matemani, 2021; URT, 2025). Form Two National Assessment (FTNA) results indicate a decline in performance in both subjects, despite an increase in the number of students. Additionally, the results of the Form Four National Examination (Certificate of Secondary Education Examination [CSEE]) for the past five years, from 2019 to 2023, indicate poor performance in Chemistry and Physics subjects, with a yearly decrease in the number of students.

This alarming trend severely affects national industrialisation and economic growth targets, requiring a workforce in science, technology and engineering. For example, comparing enrollment with those pursuing STEM subjects shows a significant drop from 33.6% in 2019 to 25.9% in 2022 in chemistry and from 26.7% in 2019 to 19.1% in 2022 in Physics, as shown in Table 1.

Table 1

STEM enrolment and performance in Form Two National Assessment (FTNA) and their corresponding Certificate of Secondary Education Examination (CSEE)

FTNA			CSEE			Dropout rate from FTNA to CSEE
Year	**Sat for Exam**	**% Passed**	**Year**	**Sat for Exam**	**% Passed**	
Chemistry						
2021	602,347	42.37	2023	162,652	96.14	73.0
2020	598,386	42.85	2022	155,007	93.68	74.1
2019	505,230	47.60	2021	152,105	92.02	69.9
2018	485,494	32.00	2020	154,881	87.09	68.1
2017	485,133	51.98	2019	162,777	76.76	66.4
Physics						
2021	600,229	31.03	2023	122,102	71.85	79.7
2020	598,386	22.57	2022	114,472	68.34	80.9
2019	568,305	50.28	2021	116,610	55.33	79.5
2018	503,875	48.01	2020	120,856	48.87	76.0
2017	483,693	36.74	2019	129,275	48.38	73.3

Source: NECTA

On average, 77.9% of the candidates who sat for Physics and 70.3% in Chemistry in FTNA did not proceed to study them up to CSEE, crippling national efforts to industrialisation and economic growth. The situation affects efforts towards industrialisation and economic growth by supplying a small number of STEM graduates to meet high demand.

Studies have indicated that streaming students based on performance, also known as tracking or ability grouping, is one of the strategies that help promote motivation and can significantly impact their engagement and success in STEM (Johnston and Wildy, 2016; Mahende, 2021). This contradicts the findings of Hughes *et al*. (2020) and Roberts *et al*. (2018), who found that high achievers might benefit at the expense of low achievers. There is a significant positive relationship between ability streaming and feelings of academic inferiority, as well as motivation and affect, which influence students' career choices (Limangura *et al*., 2018; Baidoo-Anu, 2022; Li *et al*., 2020; Mogaka *et al*., 2021). Streaming can enable tailored instruction, challenging higher-achieving students with advanced material and providing additional support for those who need to grasp foundational concepts (Roberts *et al*., 2018). Kihwele (2014) reflects on students' attitudes towards science subjects in secondary schools, where students are often forced to study science due to their performance expectations but lack intrinsic motivation. Many students find STEM subjects challenging due to their complex nature, including calculations, practical experiments, and terminology, which can lead to a lack of confidence and poor performance. This negative perception can cause students to develop a defeatist attitude towards science, reinforcing the belief that success in these subjects is unattainable. Teachers' perceptions of streaming based on ability significantly influence students' engagement and success in science subjects. Teachers' growth mindset practices, expectations, and instruction quality play crucial roles in shaping students' perceptions of science. Hughes *et al*. (2020) highlighted a disparity in the quality of instruction between different streams. Teachers assigned to lower streams may not be as experienced or have lower expectations, which can hinder students' academic growth. This

disparity can negatively impact students' perceptions of their abilities and interest in STEM subjects.

Lyanga and Chen (2020) contend that the teaching and learning of science in Tanzanian secondary schools are affected by both students' and teachers' perceptions. In many public schools, students believe they cannot pursue science topics because teachers discourage them (Kihwele, 2014). This belief, combined with the perception that science subjects are complex, makes it harder for students to engage with them. Gimba *et al*. (2018) recommended comprehensive training programs for teachers to enhance their teaching skills, implement improved teaching methodologies, and address issues such as overcrowded classrooms and a scarcity of instructional materials. These actions aim to elevate the quality of science and technology education, recognising its importance for academic and national development.

Teachers may inadvertently contribute to negative perceptions of science by suggesting that it is only for brilliant students, discouraging others from pursuing it and directing them towards subjects perceived as easier, like Kiswahili and civics (Kihwele, 2014). Nzunda and Mayeka (2023) suggest that Tanzania could learn from the success of countries like Japan, South Korea, Germany, and Sweden. These countries have cultivated an education culture that values innovation and leverages the latest technologies and best practices worldwide. Adopting such strategies could improve the quality of science education in Tanzania. Teachers' perceptions and practices shape students' attitudes towards science. Addressing disparities in instruction quality, providing professional development for teachers, learning from international success, and creating an inclusive educational environment are essential steps to improving STEM education in Tanzania.

A combination of teacher and student self-influences, as well as external factors, shapes students' perceptions of school science. Students are more inclined to choose careers in STEM-based disciplines, particularly STEM activities. However, various factors influence students' career choices, including personal interest, social factors, trends, self-perceptions, high income, ability, and prestige (Kinyota, 2013; Ozkan and Topsakal, 2023). Self-efficacy in science, combined with the availability of motivated teachers, laboratories, and learning materials, was a crucial factor. Mapolisa and Tshabalala (2014) found that secondary school students with high academic performance believe in collaborative learning, strive for excellence, and achieve good grades. However, some students still believe science subjects are more suitable for boys and more demanding than arts subjects (Laraba *et al*., 2024). These gendered perceptions within STEM fields are changing, with students recognising equal success potential for both males and females.

Kaur *et al*. (2022) highlighted the complex interplay of factors influencing students' difficulties and unpleasant experiences of transitioning from primary to secondary school in mathematics and science that lead to learning hurdles and disengagement. Gimba *et al*. (2018) found that students usually lack a solid scientific foundation, show disinterest, and encounter substandard teaching methods. Kaur *et al*. (2022) proposed greater curricular and pedagogical continuity between primary and secondary education, interventions focusing on social elements such as peer interactions and family influences, and additional research on integrated learning approaches in mathematics and science to support smoother transitions and foster student interest. Students' experiences, interests, social factors, and the quality of instruction influence their perceptions of enrolling in STEM streams. While high-performing students may benefit from streaming, those in lower streams often face adverse treatment and disengagement, such as feeling mistreated, being labelled dull and neglected. Addressing these disparities requires interventions focused on curricular continuity, social support, and equitable teaching practices to ensure all students succeed and develop a positive perception of their abilities in STEM-related disciplines.

Vygotsky's theory emphasises the significance of social interaction in cognitive development, suggesting that individuals are born with innate mental functions, including attention, sensation, perception, and memory (Vygotsky, 1978). Through social interaction, especially within the Zone of Proximal Development (ZPD), learners

can acquire higher cognitive functions with the help of more knowledgeable others. In Tanzanian secondary schools, informal practices hinder students from engaging effectively with STEM subjects, despite the curriculum aligning with students' age and intellectual capacities. The streamlining of students based on their prior science performance is particularly evident, as it can limit their opportunities for learning through social interactions. Those inclined towards the arts often find science subjects challenging and frequently lack appropriate teacher support, which negatively impacts their learning outcomes (Johnston and Wildy, 2016). According to Vygotsky's theory, teachers must offer tailored support to students to foster cognitive development in science, enabling them to learn skills beyond their current abilities (Adebisi, 2024; Smagorinsky, 2018). Differentiated classrooms that promote social learning interactions could enhance students' logical memory, retention, and attitudes towards science (Chen *et al*., 2016). Thus, aligning teaching practices with Vygotsky's principles could bridge the gap in STEM learning by leveraging social interactions to support cognitive growth. This theory advocates for allowing students to choose any subject, regardless of their performance, and for teachers to provide differentiated instruction based on individual learning needs, rather than grouping them by ability.

Materials and methods

Study Design

Phenomenological design studies individuals' lived experiences to better understand their meaning. They further assert that phenomenology research studies the experience of any human phenomenon that affects their life without taking a stand on the subject, whether it is actual, authentic, or misleading. The design enables the analysis of significant statements, where the meaning of units is constructed and the essence of their description is developed. This research employed a phenomenological design to understand the lived experiences of teachers and students regarding inconspicuous practices that affect students' enrollment and continuation in STEM fields in secondary schools. The design effectively addressed the study's focus by collecting information on the participants' lived experiences.

Participants

The study involved twenty-five (25) sample, eleven (11) STEM teachers, and fifteen (15) students from twelve (12) selected ordinary level secondary schools in four districts: Mbeya, Mvomero, Nzega and Tabora. Researchers purposively selected the schools due to their practices in streaming students based on their performance. The participants were purposively selected based on their teaching and learning experience in schools implementing performance-based streaming classes. The inclusion criteria for teachers were those who taught chemistry and physics subjects, and for students, monitors from both science and non-science streams.

Table 2

Characteristics of Key Informants

S/N	Pseudonym	Gender	Work experience/ Year of study	Subject/ Stream	Nature of school	Streaming status
	In-service Teachers					
1.	Teacher 1	F	12	Chemistry	Public	Yes; From two
2.	Teacher 2	M	13	Physics	Public	Yes; Form two
3.	Teacher 3	F	11	Chemistry	Public	No
4.	Teacher 4	F	15	Chemistry	Public	Yes: Form one
5.	Teacher 5	M	14	Physics	Public	Yes; Form two
6.	Teacher 6	M	3	Physics	Public	Yes; Form two

7.	Teacher 7	M	6	Chemistry	Public	Yes; Form one
8.	Teacher 8	F	18	Physics	Private	Yes; Form one
9.	Teacher 9	M	9	Chemistry	Private	No
10.	Teacher 10	M	16	Chemistry	Private	No
11.	Teacher 11	M	22	Chemistry	Private	Yes; Form one
	Students					
1.	Student 1	M	4	Science	Private	Yes
2.	Student 2	M	4	Science	Public	Yes
3.	Student 3	F	4	Art	Public	Yes
4.	Student 4	F	4	Science	Public	No
5.	Student 5	M	4	Art	Public	No
6.	Student 6	F	4	Art	Public	Yes
7.	Student 7	F	3	Science	Public	Yes
8.	Student 8	M	3	Science	Public	Yes
9.	Student 9	M	3	Science	Public	No
10.	Student 10	M	3	Art	Public	Yes
11.	Student 11	F	3	Science	Public	Yes
12.	Student 12	M	3	Art	Private	Yes
13.	Student 13	M	3	Science	Private	No
14.	Student 14	F	3	Art	Private	No

Data collection method

The data collection process employed in-depth interviews with structured questions, followed by probing questions to elicit deeper insights from the lived experiences of respondents. In-depth interviews collected data on performance-based streaming in schools, factors motivating such practices, and how teachers and students perceive these practices. The interview questions were: *How do you stream your students in streams? What are the factors behind such streaming? How do you perceive these streaming practices?*

Data analysis

The phenomenology design analyses data thematically to extract meaning and essential insights from participants' information. The thematic analysis involved coding, categorising codes, and developing and interpreting those themes. The process retained respondents' original voices with support from quotations from interviews. The sense-making process from the collected data enabled researchers to analyse the data critically and present it clearly to inform state-of-the-art practices, ideal practices, and policy interventions.

Ethical considerations

Researchers adhered to research ethics, including obtaining respondents' consent to participate in the study, informing them of the study objectives, ensuring there was no physical or psychological harm, and providing the freedom to withdraw during the study process. They also maintained the confidentiality and privacy of respondents' identities and the information they shared. In presenting the findings, the study has used pseudonyms to hide respondents' identities and maintain confidentiality.

Results

The study explored practices in ordinary secondary schools that discourage enrolment in STEM subjects, specifically chemistry and physics. The driving force behind this study is the decline in the number of students pursuing STEM fields and their underperformance in secondary schools. The study found that informal practices in many schools have a long-term impact on students' enrollment in chemistry and physics subjects. These include streaming, forcing students in or

out of science subjects, condoning subject dropping to avoid division zero and the challenge of inadequate science learning resources. Teachers and students agreed that the policy allows some science subjects, such as chemistry and physics, to be elective. Students, by nature, prefer fewer subjects that result in a smaller study load. Some teachers support this practice, citing that science is "difficult" and only the cleverest students can study it.

Streaming students at entry in Form one

We asked in-service teachers why there are few students in science streams. Their responses indicated that the streaming practice was one of the reasons few students enrolled in science subjects. Four out of eleven teachers admitted to implementing streaming practices starting from form one in their schools. Some secondary schools use primary school leaving examination results to categorise students in streams. Teachers place students with higher performance in Stream A and continue grouping others based on their performance, up to Stream E or beyond. Teaching practices in these streamed classes regard those in streams A and B as capable of studying chemistry and physics; they emphasise other streams to study business and arts. Teacher 9 supported the finding, saying, "*Students with good performance study science better than others. Think of students who fail civics or language subjects they cannot perform physics or chemistry*". Also, Teacher 2, a Physics teacher in one of the schools, added:

> In our school, we place students according to their performance in the PSLE, and when they sit for terminal and annual examinations, we stream them based on their performance. This can range from form one to four and is intentionally designed for easy teaching and performance control (Teacher 2).

The same practice is common to other schools; however, they are flexible in allowing students to move from one stream to another once they improve their performance in terminal examinations. A chemistry teacher, Teacher 11, confirmed this claim by saying, "*We keep them that way, but once they improve in the terminal examination, we move them to where they fit*". This practice puts students at risk of failing more as they transition from science to non-science classes, where they lack a firm foundation in the subjects due to frequent changes.

Streaming students in form three

Streaming based on FTNA results

Teachers and students in most schools agreed that their schools stream students based on FTNA results. Eight of the eleven (11) teachers acknowledged streaming their students; four teachers said they conducted it at Form One, and four at Form Two (See Table 2). Teachers who conduct streaming at Form One also continue streaming them after FTNA results and transfer students with low grades to non-science streams. On the other side, nine (9) out of fourteen (14) students admitted that their schools have streaming practices. Teachers believe that streaming students motivates them to study hard to reach their dreams and also to improve the school's overall performance. In an interview with Teacher 5, he said, "*We make students aware from when they join our school that there is streaming ahead, so if you want science, you must work hard. So, we use Form Two national assessment results as the basis for streaming*". The findings confirm schools' reasons for streaming, which are to promote their performance profiles. However, the findings also noted that some students who passed the FTNA did not wish to continue in the science stream, while others had failed in the national assessment and wished to study science subjects.

Students pass but do not like to enrol in science streams.

After the FTNA results are released, teachers categorise students into streams based on their performance. The findings revealed three groups of categorising students. These categories include i) students who pass chemistry and physics and continue in the same stream, ii) those who pass and do not enrol in chemistry and physics and iii) those who failed in FTNA but wish to enrol in chemistry and physics.

Teachers said they encourage those learners who perform well in science but don't wish to continue with chemistry and physics. Sometimes, they are forced into science streams because they can do better. A physics teacher from one of the schools said,

> After FTNA results, schools stream those who scored division one and two to take physics and chemistry subjects. The rest will go to arts and other subjects. If a student with a division one or two GPA doesn't want to take physics or chemistry,

> we try to guide, counsel, and encourage them. Sometimes, we call parents to encourage them to take those subjects because they have the ability and science is a marketable field (Teacher 6).

Also, when students are reluctant, teachers involve parents in advising their children on the importance of Chemistry and Physics in their careers. However, the approach is less fruitful as few students enrol in Chemistry and Physics streams. Teacher 10, a chemistry teacher, clarified this finding, saying, "*We advise students who have good performance and want to drop either physics or chemistry or both subjects; sometimes parents are engaged. But if they are not ready, they can drop those subjects*".

Again, during the interview with students, we asked them to share their experiences with the forced decision to enrol in Chemistry and Physics subjects. Findings indicate that some schools provide guidance to students, while others require it. Student 6, a student from one school who studies the Chemistry and Physics stream, said, "*After FTNA, if you pass and you don't like science subjects, we are advised to take them because of the benefits of those subjects in the current world, and we are free to take or not to take*". Similar findings were obtained from Students 1, 7, 8, 11, and 13 regarding advice to enrol in science streams, highlighting their importance for the future.

Denying Students who have failed but are interested in science

The findings reveal that some students failed in Chemistry and Physics in FTNA, but were eager to study science subjects. In many schools, these students are not allowed to enrol in science streams as the schools fear they will fail in their Form Four national examinations. In some schools, teachers say they advise students and sometimes force them to drop science subjects. A physics teacher confirmed the situation in her school, revealing that:

> Students are streamed according to their performance. A student with lower performance, for instance, those with a grade of D, may request to study chemistry or physics. They are capable of performing well under certain conditions. If they perform poorly in some exams, we require them to drop those subjects because they may fail future national examinations (Teacher 8).

Another teacher from a different school also admitted to a similar experience, saying,

> We don't allow students with lower performance to opt for science subjects, even though it's their interest, because we have experienced that most students who force themselves to opt for science subjects (Physics and Chemistry) in form three end up scoring F in the CSEE exams (Teacher 3).

On the students' side, they confirm what teachers reported: those who show low abilities but like the subject are either given a chance to improve or advised to take business or arts subjects instead of science subjects. Student 9, a student in the science stream, said, "*For students with lower performance in FTNA and they like science subjects, they are advised not to take those subjects; instead, they have to concentrate on subjects where they get good grades for their future performance*".

Dropping STEM subjects to avoid division zero

In an interview with a student in one school, she revealed that students who seem weak in academics are encouraged to concentrate on two to four subjects. Teachers believe that in so doing, students are likely to obtain at least a D grade, thereby avoiding a division zero. So, out of seven compulsory subjects, they take a few subjects and leave behind others perceived to be difficult, including Chemistry and Physics. Student 14, a student from one of the schools visited, confirmed this, saying, "*Wanaogopa kufelisha sana, wanasisitiza wale wenye uwezo mdogo kuweka nguvu kwenye masomo mawili hadi manne tu ili wakipata D hawapatapa ziro [They avoid massive failure, they insist those with low abilities to take between two to four subjects, they will avoid getting zero because they will get grade D]"*. Similar responses were received from Student 4, 5, 10 and 12. The motive behind the practice is the political slogan of eradicating failure in secondary school. We received similar responses from teachers that support this finding.

A teacher said,

> We have a target to attain in terms of performance, especially abolishing zero in our school. If we allow all students to take science subjects, they will likely fail, and we will not reach that target. We grade them, at least for weak students. They can

> study two subjects, Kiswahili and Civics, and get two D's (Teacher 1).

Science teaching and learning environments

Teachers admitted that the enrolment decline in chemistry and physics subjects results from the teaching and learning environment. Inadequate resources such as teachers, learning materials, and laboratory facilities, threaten students who wish to enrol in science streams. In some schools, learning assistance is limited to a few Chemistry and Physics teachers with a large teacher-student ratio. Inadequate Chemistry and Physics teachers necessitate that schools implement streaming to have a few students taking science subjects and thereby lessen the teaching load. Teacher 7, the only Chemistry teacher in his school, admitted, "*It's difficult for one teacher to handle and advise all students in all streams they teach Physics or Chemistry in school. A teacher will choose to teach only stream A from form one to four to teach those subjects*". The response implies that students outside of stream A (a science stream) will not take chemistry and physics subjects. In the same vein, responses from students indicate that once you enrol in the science stream, your parents need to find private tutoring (private tuition) during the holidays. Students believe enrolling in Chemistry and Physics subjects without private teaching will lead to failure in the final examinations.

Teachers' perceptions

Most teachers support these practices, believing that training a few students who can excel in Chemistry and Physics subjects is better than forcing all students to fail. Therefore, teachers believe that streaming students according to their performance enables schools to attain their performance targets. Teacher 4, a teacher from one of the schools, revealed that,

> All students have no option to take all subjects; they will decide on combinations after form four. Last year, we attempted to allow our students with low performance in the FTNA physics subject to drop the subject in Form Three. Surprisingly, in this year's CSEE results, most students who dropped Physics scored divisions three and four, while those who studied Physics scored divisions one and two. Students with fewer subjects tend to relax (Teacher 4).

Additionally, allowing options can create laziness among students; many of them drop those optional subjects, thereby reducing the number of subjects they have to study. Teacher 5, a Physics teacher, acknowledged this finding as he said, "*Students who pass sometimes don't like to study science subjects, especially girls, even though they are advised on the potential benefits of those subjects, they drop them because they feel science subjects are highly demanding*."

Students' perceptions

The study found a mixed perception of the streaming practices and enrolment in science subjects. While some students perceived it positively, as it allowed students with high achievement in science to continue studying those subjects, others felt that the streaming system denied them a chance to study those subjects and meet their life dreams and career aspirations. During the interview session with Student 2, a student from one public school, he said,

> After the Form Two [national] assessment results in my school, there is another school-based interview to determine who will join the science stream. You might pass the national assessment and fail the interview or vice versa. Then, after every term, students who score below average are transferred to non-science streams. I think this is beneficial because the school aims to improve students' performance in science, but it also provides an opportunity for those who failed the national assessment but are interested in science to try again, and if they perform well, to proceed with their science studies (Student 2).

On the other hand, some students expressed dissatisfaction with streaming, citing the impact of denying students the opportunity to study science. Students believe such practices diminish their life choices and hinder their pursuit of careers they dream of. During an interview with students, they believed that some students might start poorly in science but gain momentum as they continue studying, and that teachers' support is crucial; therefore, deciding they cannot study is unfair to them. Student 3, a student in the Art stream, confirmed these findings, saying,

> I think this is not fair. We dream of becoming doctors or engineers only because you have failed form two national assessments. They kill your dreams, believing you are incapable. If they want to help students, why don't they provide more support? It is so discouraging(Student 3).

Despite the mixed perceptions, the findings imply that the streaming focuses on improving schools' performance in national examinations rather than considering the needs and interests of individual students and providing appropriate scaffolding.

Discussion

The study explored ordinary practices in secondary schools that discourage students' enrollment in Chemistry and Physics subjects. It specifically intended to identify common practices and how teachers and students perceive them concerning science subject enrolment. The study found that streaming based on academic performance is the main factor in decreasing science enrolment. Other practices include limited support for low achievers in science subjects and students lacking motivation, forcing them to drop Chemistry and Physics subjects to avoid mass failure (division zero). Additionally, the existence of policies that make Chemistry and Physics subjects elective (optional) in ordinary-level secondary schools, combined with the perception that science subjects are difficult, affects enrollment.

The present study found that secondary schools sort students and stream them based on their performance in primary school leaving examinations (PSLE) and the FTNA results. The finding aligns with Gupta *et al*. (2023) and Hughes *et al*. (2020), who reported that sorting students as per their prior performance has been a custom in many schools. The study found that schools enrol high performers in science subjects and those with low performance in non-science subjects. This finding aligns with studies by Gülhan (2023) and Roberts *et al*. (2018), who report that teachers advise students to avoid non-science subjects in some schools, as teachers believe they cannot enrol in science subjects. Streaming students creates a self-fulfilling belief against STEM, as Kaleva *et al*. (2019) reported that choosing or rejecting subjects results from perceptions towards them and future career prospects. Streaming limits students' study options, indirectly reinforcing harmful stereotypes and discouraging students with potential. The findings reveal that students can move between streams based on later performance. This practice weakens their science foundation, as the movement to and from science class might disconnect their learning experiences. This approach denies students the opportunity to explore their potential, develop a passion for science subjects, and build a solid foundation, thereby increasing their risk of failure. Therefore, schools should recognise the importance of foundational skills in various subjects as they can benefit STEM learning. Schools should enhance the mechanism of providing students with the necessary support to foster their potential without limiting them based on their past performance.

The study again found that schools are pressured to improve performance metrics, especially in national standardised assessments and examinations. Teachers reported that they have a target to eliminate zero grades in schools, so in some cases, they ask students to drop chemistry and physics subjects and remain with fewer subjects to avoid failing. This practice discourages students from taking science subjects despite their interest and efforts. Students who obtain low grades are then encouraged to take non-science subjects, which are considered easier than potentially failing a broader range of subjects, including chemistry and physics, similar to what Kihwele (2014) reported. This finding suggests that schools are prioritising avoiding failing grades over promoting long-term knowledge and career development in their students. These findings contradict the quantitative study of Gupta *et al*. (2023), suggesting that dropping subjects has less importance on students' academic performance. Therefore, this practice may improve schools' performance statistics but limits students' options and exposure to science subjects, potentially contributing to a decline in STEM enrollment.

Science teaching and learning environments, including instructional approaches, perceptions towards science subjects, and inadequate human and material resources, also contribute to low enrolment rates in these subjects. This study

found that the instructional approach and limited resources, including the number of teachers and functional science labs, hinder chemistry and physics subjects, forcing students to drop them. Science teachers in most public secondary schools are overloaded and struggle to support all students, especially those with lower grades. This situation forces teachers to consider providing subject content to students in lower grades rather than teaching them and teaching those deemed bright to upper grades. The findings align with Shirazi (2017), who found that recommended STEM subjects need more lab experiments to increase student interest in science subjects.

Teachers' perceptions indicate their preference for making some science subjects, such as physics and chemistry, electives, as they believe students have different intellectual abilities, needs, and interests. This finding aligns with Zhang *et al*. (2022) and Mwadzaangati and Kazima (2021), who found that academic performance and the perceived usefulness of STEM in one's future career determine the number of elective subjects to take. While some teachers support this due to the perceived difficulty of science, it creates a barrier for students who might be interested in STEM but lack self-confidence (Shirazi, 2017). The elective system could limit exposure to crucial STEM fields and discourage future generations from pursuing them, as they may perceive them as less important. There is a need to manage the study load more effectively and cater to diverse learning styles while ensuring a solid foundation in STEM education. The current policy framework needs a review to make Chemistry and Physics subjects compulsory. Treating some science subjects as optional, regardless of their potential, jeopardises the efforts in promoting and driving the global economy through the industrial revolution and technological advancement. Therefore, the government should recruit sufficient science teachers and provide them with adequate resources and facilities to enhance STEM learning.

Students indicate their preference for elective subjects is to have a lighter study load and hence opt for them. Moreover, the study found that students perceive ability and success in Chemistry and Physics subjects to depend on private tutoring, which further discourages science enrolment for those who cannot afford it. The findings align with the study by Kaleva *et al*. (2019), which suggested that STEM ability and performance are crucial in choosing or rejecting these subjects. Although some teachers collaborate with parents to advise students to enrol in science subjects, the study findings suggest that few students will join Chemistry and Physics in poorly resourced learning environments. This calls for schools to motivate teachers to support students struggling to study science subjects by organising remedial classes.

Findings suggest that a few female students are interested in science, a finding similar to those of Bonnette *et al*. (2019) and Appiah-Castel *et al*. (2020). The study further suggests that most female students do not find science subjects interesting because they are perceived as too demanding, masculine, and requiring more time to study. During the interview, the responses showed that students who pass sometimes dislike studying science subjects, especially girls, despite being advised of their potential career benefits, a finding similar to those of Adolphus (2020) and He *et al*. (2020). However, these findings contradict those of Kennedy *et al.* (2018), who found that male students are biased in STEM subjects. Also, the finding suggests that girls' attitude toward science triggers teachers to stream a few capable students for Chemistry and Physics subjects to avoid "all students failing". However, this perspective has limitations, as some teachers perceive streaming disregards the potential of students in lower streams who might thrive with better support. The belief that all students would fail without streaming is a myth. Offering guidance instead of eliminating options can help teachers address concerns about female students' perspectives on science subjects. There's also a need to challenge gender stereotypes associated with science subjects. Teachers' desire for student success is commendable. A more balanced approach that combines a strong foundation for all with targeted support for high performers is likely more effective.

Conclusion

The study explored ordinary practices in secondary schools that discourage students' enrollment and continued studying of science subjects. Findings indicate the existence of practices, such as streaming and forcing students in or out of science subjects based on their

academic performance, making Chemistry and Physics optional subjects, condoning subject dropping to avoid a division zero, and the challenge of inadequate science resources, which contribute to a decreased enrollment. Schools often place higher-performing students in separate classes from those with lower academic performance. Teachers tend to encourage students who excel in Chemistry and Physics to continue studying science subjects, even though they are on the verge of dropping them. Conversely, those who struggle in Chemistry and Physics subjects but wish to continue are discouraged or forced to drop them due to fears of poor performance in national exams. Teachers consider these practices crucial in promoting school performance while disregarding the future of individual learners. The study findings demonstrate that teachers and students in most schools prefer to make certain science subjects, such as physics and chemistry, electives, citing their perceived usefulness and lighter workload.

The study findings suggest that inconspicuous practices employed by teachers to enhance school performance lead to decreased enrolment in science subjects. There is a dichotomy between education guidelines and the actual practices in schools. While science subjects are optional for students, some schools prevent them from pursuing subjects that interest them. Additionally, the findings indicate that streaming practices could jeopardise the development of future science experts, particularly in light of the national industrialisation policy aimed at enhancing agriculture, a critical sector for the national economy that relies heavily on investment in STEM.

Recommendations

The study recommends that teachers discourage streaming students based on their academic performance and devise mechanisms, such as differentiated instruction, to provide appropriate support tailored to learners' needs and interests, thereby elevating their STEM competencies. Schools must ensure the availability and adequacy of human and material resources to promote students' interest and participation in STEM subjects. Consequently, the study suggests revising policies that make science subjects elective, eliminating streaming practices, and enhancing teacher professional development to support student learning better.

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