

**Understanding
factors which support
students' learning and
motivation in STEM
subjects in Rwandan
secondary schools**

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About Laterite and the REAL Centre:

Laterite is a data, research and analytics firm specialised in research for social impact. Founded in East Africa, the firm uses rigorous techniques to provide context-relevant evidence. Laterite's aim is to help decision-makers find solutions to complex development problems.

The REAL Centre at the University of Cambridge pioneers research into overcoming barriers to education, such as poverty, gender, ethnicity, language and disability, and promotes education as an engine for inclusive growth and sustainable development.

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Introduction

Context

This study explores the perceptions of Rwandan secondary school students on factors which support their learning and engagement in STEM, why they value learning maths and sciences, and their future aspirations. It is based upon data collected via individual booklets from 409 students (197 boys; 210 girls) at 12 secondary schools exposed to interventions provided by Leaders in Teaching implementing partners.

Key findings

- This study has revealed that internal and external factors impact upon students' learning and motivation in STEM. Key themes raised by pupils included the importance of school community members, especially positive teacher-student relationships. Classroom resources were also found to facilitate pupils' understanding and engagement along with students' own discipline and positive feelings, especially motivation, towards STEM subjects.
- Students expressed that they highly value learning about STEM. Pupils linked achievement in these subjects with personal success as well as more broadly, to contributions to Rwanda's development as a country.
- Students shared recommendations for improving their educational experiences in STEM. These were largely focused on the greater need for STEM resources, including ICT equipment, higher quality teaching and more qualified teachers.
- Students communicated a desire to pursue both professional and vocational career paths. Their aspirations were also closely linked to a vision to actively contribute to Rwanda's advancement, notably by becoming doctors, government officials or teachers.

Key implications

- Enhance teaching training on the affective dimension of pedagogy to help educators develop strategies for cultivating rapport and positive learning relationships with students.
- Invest in creating enriching educational environments which support students' academically and affectively.
- Strengthen efforts to promote the importance of STEM amongst students and ensure that access to career guidance is available in secondary schools to support their future aspirations.
- Provide more opportunities and pathways in schools for students to give feedback on how to improve teaching in STEM.

Setting the context

The Leaders in Teaching programme, funded by the Mastercard Foundation, is a comprehensive initiative spanning five years with the goal of enhancing the quality of education in Rwandan secondary schools, particularly in STEM subjects. This initiative was established in 2018 across 14 districts of Rwanda and is built upon four core pillars:

- **Recruit:** Identifying and enlisting bright and dedicated individuals into the teaching profession.
- **Train:** Enhancing the quality of teaching and learning through robust teacher training and ongoing professional development.
- **Lead:** Strengthening educational leadership within the teaching community.
- **Motivate:** Encouraging and elevating the teaching profession and inspiring teachers through recognition and public engagement.

The objective of Leaders in Teaching is to equip educators with the necessary skills and knowledge to deliver high-quality and relevant education. This is accomplished through collaborative efforts with six implementing partners: the African Institute for Mathematical Sciences (AIMS), the University of Rwanda-College of Education (URCE), the Flemish Association for Development Cooperation and Technical Assistance programme (VVOB), Inspire, Educate and Empower (IEE) Rwanda, UNICEF, and Carnegie Mellon University-Africa. Research and learning is an integral part of this initiative.

This policy paper draws upon data collected in November 2021 from 409 secondary school pupils in Rwanda who completed, through written descriptions, student-friendly booklets focused on understanding perceptions of factors which support their learning, thoughts regarding learning maths and sciences and their aspirations for the future.

Research participants

Out of all the educational institutions offering lower secondary education within 14 out of the total 30 districts where the Leaders in Teaching programme was active, 360 schools have been involved in data collection activities to date. From this broader sample, 12 schools were purposely selected based on the degree of Leaders in Teaching training received, location (rural/urban) and school type ('Schools of Excellence' and regular schools). In **Table 1** the various districts and locations of the 12 selected schools are detailed. We engaged with a total of 409 students across 12 purposively selected schools, comprising 197 boys, 210 girls, and two students for whom gender information was not available.

Table 1. Overview of participants

School	District	Location	School Type	Total students	Boys	Girls	Missing
A	Gisagara	Rural	Regular school	30	12	16	2
B	Karongi	Rural	School of Excellence	26	5	21	
C	Kamonyi	Rural	School of Excellence	55	17	38	
D	Ngororero	Rural	Regular school	32	19	13	
E	Gicumbi	Rural	Regular school	18	10	8	
F	Gicumbi	Rural	Regular school	32	19	13	
G	Gicumbi	Rural	Regular school	43	16	27	
H	Gisagara	Rural	Regular school	47	36	11	
I	Musanze	Urban	Regular school	28	19	9	
J	Gicumbi	Rural	Regular school	25	7	18	
K	Gisagara	Rural	Regular school	36	14	22	
L	Musanze	Rural	Regular school	37	23	14	

Research instrument and process

The students received booklets entitled “About me..” that included six topics (see **Table 2**) designed to encourage them to express, over a two day period, their thoughts regarding their learning and future goal. While they were also encouraged to convey their ideas visually, all students ultimately communicated through written responses. For the scope of this policy brief, we centre on students’ responses to three specific topics, denoted by grey highlighting in **Table 2**. These comprise: ‘*Things which help me learn in school*,’ ‘*Thoughts about learning maths and science*’ and ‘*When I grow up I want to be*’. While the original structure of the booklet was retained during data collection, our decision to focus upon these three sections within the present study was influenced by the extent of crossover between themes identified for questions 1, 2 and 5. We therefore focus upon presenting data for question 2 due to this finding, in addition to 4 and 6.

Table 2: Outline of student booklets

1) My favourite things about school
2) Things which help me learn in school
3) Things stop me from learning and enjoying schools
4) Thoughts about learning maths and science
5) Things which motivate me to attend school
6) When I grow up, I want to be

Process for gaining ethical consent

The study received ethical approval from the Rwandan National Ethics Committee (RNEC), the National Commission for Science and Technology (NCST), Rwanda Basic Education Board (REB), and the relevant district offices. Internal ethical approval was granted by the ethics committee at the Faculty of Education, University of Cambridge, UK. Within schools, written consent was obtained from headteachers or Directors of Studies prior to pupils' involvement. Students were clearly informed of the research purpose, processes, and how their booklets would be used for analysis and reporting. Students were also made aware of the purpose of the booklet which was to encourage a breadth of responses (long and short, depending on how students felt) and allow for diversity of engagement with the research from a student's perspective. Students' confidentiality was also ensured, through being clear that all content from the booklets would be anonymous.

Verbal consent was sought from students before commencing work on their booklets and they were given the option to opt-out of the activity any time. No adults from school management or staff were present in the classroom when booklets were administered and students were also permitted to take their booklets home to work on, if preferred. All activities related to obtaining consent from school leaders and students were conducted using the language of Kinyarwanda.

Analytical approach

This study used a constant comparison analytical approach which involved comparing each unique finding and interpretation as they emerge with earlier examples from the student booklet data (Lewis-Beck et al., 2004). Via the use of NVivo 12 software, data were coded, annotated, developed into themes and sub-themes, and subsequently analysed. The overarching aim of this approach was to cluster students' responses in relation to each topic into themes and sub-themes through three stages: 1) Open coding (arranging data into relevant

and clearly labelled clusters); Axial coding (arranging clusters into similar categories or codes); Selective coding (pooling and refining codes) (Glaser, 1965). Classical content analysis which refers to developing numerical descriptions of specific aspects of data that is analysed (Bauer, 2000), was further applied during the analytical process to determine the salience of themes and sub-themes in relation to each key topic from the booklet.

Results

1. Things which help me learn in school

For the dimension *Things which help me learn in school*, five key themes emerged from students' booklets (see **Table 3**). These included **school community members, school facilities and resources, school activities, school discipline and behaviours**, and having a **positive feeling while at school**.

Table 3. Things which help me learn in school

Themes	M %	F %	All %	Sub-themes	Examples	M %	F %	All %
School community members	91	93	92	Teachers	<i>Teaching practice (110); teacher characteristics (45); positive teacher-student relationship (32)</i>	76	79	78
				Peers	<i>Collaborative learning (138); positive relations (18)</i>	54	60	57
				School leaders	<i>Giving students advice (15)</i>	23	21	21
School facilities and resources	81	82	82	Learning-related	<i>Library and reading materials (186); ICT facilities (120); classroom (116); stationary (38); laboratory (30); visual materials (15); school building (12)</i>	73	73	73
				Well-being-related	<i>Food (107); garden (32); hygiene-related (30); playground (10)</i>	36	37	36
School activities	48	46	48	Academic activities	<i>Preparation-revision (124); active participation in learning (20)</i>	35	37	37
				Extra-curricular activities	<i>Playing sports games (26); entertainment (16)</i>	9	11	9

Student related factors	28	26	27	Student behaviours	<i>Student routines (20); maintaining hygiene (11); punctuality (11)</i>	22	17	20
				Student feelings	<i>Self-motivation (26); experiencing success (12)</i>	11	14	13

1.1 School community members

As seen in **Table 3**, almost all the students considered **school community members** as a crucial factor that helped them learn in school. A key dimension of this theme, not surprisingly, was **teachers**, referred to by over three quarters of students. The most cited example of this sub-theme was *teaching practice* which was explained as checking and enhancing students' understanding. As one male student shared: 'Teachers try their best to help us. They answer the questions we ask them. They help us understand much better. Thus, we increase our skills and knowledge' (School C). Students also felt other teaching practices were beneficial for their learning including fulfilling their potential and linking theories to real life. Additionally, students commented on the importance of *teacher characteristics* such as being humble, skilled, and speaking 'nicely without being too harsh' (School J). Furthermore, students expressed the benefits of having a *positive teacher-student relationship* to their learning. This was associated with 'being comfortable around teachers' (School H) and 'loving and respecting teachers' (School I).

Approximately half of the students reported **peers** as another sub-theme that facilitated their learning in school, with *collaborative learning* as the most cited response. One female student noted: 'Things that help me in learning in this school are doing exercises in groups and working together. When we work in groups we share ideas, hence we benefit from each other's knowledge and skills due to the group work' (School J). Moreover, *positive relations* among students were noted as helping participants learn successfully, through the advice and support provided to one another. Finally, around a quarter of students regarded **school leaders** as helpful for their learning by *giving students advice*. As pointed out by one male student: 'Our leaders advise us. As we have caring leaders, I feel like I have to put my efforts in developing my country' (School G).

1.2 School facilities and resources

School facilities and resources-raised by over three quarters of students-was another key theme associated with things that help students learn in school. Here **learning-related** school facilities and resources were most prominent, with *library and reading materials* being most valued.

As articulated by one female student: 'The library helps us to gain knowledge and understand better what we studied in class.' (School F). In addition, students appreciated the significance of *ICT facilities*. One female student reported: 'The ICT room helps me in my learning because I use it to make research on questions I failed to answer. Again, it helps us to acquire computer skills' (School C). Also, *classrooms* which 'shield' students 'from rain and sun', and had 'sufficient seating places and desks' were perceived as a comfortable environment for study (one male student, School H). Similarly, other examples concerned with useful learning-related school facilities and resources included *stationary* such as notebooks and pens, a *laboratory*, *visual materials* such as drawings on classroom walls and a *school building*.

On the other hand, ***well-being-related*** school facilities and resources were considered by 147 students as contributing to their learning. *Food* was raised as the most cited example, with one male student sharing, 'having lunch at school gives me energy to help me study' (School H). Furthermore, a *school garden* was communicated as providing students with fresh air and made them 'love' their school more (School E). Moreover, students valued *hygiene-related* school facilities and resources. For instance, one female student mentioned: 'Having clean water at school. When I am exhausted from studying, I go and wash my head with water or even drink it as to refresh my mind' (School G). Lastly, a *playground* was reported as helping students 'relax' and 'think straight', thus supporting their learning (School H).

1.3 School activities

Based on the theme ***school activities***, the importance of ***academic activities*** and ***extra-curricular activities*** was discussed among nearly half of students. With regards to the former *preparation-revision* was the most cited example. As indicated by one male student: 'The time reserved for self-study in the morning and evening helps my learning because I have enough time to revise my lessons' (School B). Another academic activity raised was *active participation in learning*, described by students as 'asking teachers questions to get clarification' (School J), 'following what the teachers say' (School I) and 'doing preparation in front of the whole class' (School A). For the latter theme, extra-curricular activities including *playing sports games* and *entertainment* were expressed as helping refresh students' minds and therefore supporting their learning. As shared by one female student: 'Watching movies also help me because it helps me to recover from the stress that I get during the week. It helps me to relax' (School B).

1.4 Student related factors

More than one quarter of participants reported **student related factors** as another pivotal theme. First, approximately a quarter highlighted **student behaviours** as a key factor that boosted their engagement in study. Good *student routines* we also indicated as helpful for the establishment of effective timetables for facilitating learning. As commented by one male student: ‘I wake up early and arrive in the classroom at 5:30 am to revise what I learned. Again, we also do self-study in the evening’ (School C). Moreover, students’ *maintaining hygiene* and *punctuality* were perceived as factors which supported learning. **Student feelings** were additionally revealed as a sub-theme linked to student related factors among 52 students, with the most reported example being *self-motivation*. As stated by one female student, ‘The fact that we can prepare and know who we will become in the future will help us achieve our goals’ (School E). Another salient example was *experiencing success*, which was associated with ‘having good marks’ and achieving ‘excellence in terms of academic performance’ (one male student from School D). Other feelings that assisted students’ study incorporated calmness, courage, curiosity about exploring different things and having a fresh mind.

Gender differences

In focusing on data from all-male and all-female groups for the dimension *Things which help me learn in school* (See **Table 3**), general similarity was observed in terms of the proportions who mentioned each theme and sub-theme.

2. Thoughts about learning maths and science

With regards to *Thoughts about learning maths and science*, findings were clustered under two key themes: **importance of learning maths and science** and **recommendations for improving maths and science learning**. Table 4 provides a summary of key sub-themes and examples under each.

Table 4. Thoughts about learning maths and science

Themes	M %	F %	All %	Sub-themes	Examples	M %	F %	All %
Importance of learning maths and science	5 7	76	67	Personal development	<i>Knowledge applicable to daily life (215); developing thinking skills (12)</i>	5 0	5 9	55
				Becoming a good citizen	<i>Personal success (126); contribution to country development (22)</i>	2 9	4 0	35

Recommendations for improving maths and science learning (156)	44	33	38	Availing learning-related resources and facilities at school	<i>ICT facilities (83); laboratory (57); library and books (37)</i>	33	19	26
				Improving teaching and learning practice	<i>Enhancing student understanding (57); restructuring school programmes (55)</i>	27	20	24
				Improving availability of qualified teachers	<i>Having qualification and expertise (49); teacher training (22)</i>	26	15	21
				Encouraging students	N/A	5	5	5

2.1 Importance of learning maths and science

For the theme of **importance of learning maths and science**, as noted by nearly three-quarters of students, two major sub-themes were identified. The benefits of learning maths and science to one's **personal development** received the most attention, as highlighted within over half of student booklets. The most cited response in respect to this sub-theme was *knowledge applicable to daily life*, which was associated with four aspects. First, learning how to use ICT was noted as helping students seek information, network and with their communication. One female student shared: 'ICT helps to know the trending news from other parts of the world. It also helps us in communications like telephone, radio, television, and others' (School G). Second, learning science was acknowledged as helping students understand more about living organisms, including in relation to disease prevention and treatment. In addition, it was noted as helping students understand 'how to take care of our own bodies and others' (Female student, School H). As pointed out by another female student: 'although sciences are difficult, they are helpful. For instance, learning Biology helps you to know yourself and to know the characteristics of other living things' (School A). Third, students reported that learning maths helped them to know how to count well, how to manage money, and how to 'do business' (Female student, School L). Lastly, students emphasised the importance of learning science in a bid to 'protect the environment' (Male student, School J). The other attribute related to the sub-theme, **personal development**, concerned *developing thinking skills*. Students commented that 'learning math and science helps people open their mind and think outside the box' (Female student, School K), as well as think critically and solve problems better.

The second key sub-theme identified in reference to the importance of learning maths and science was the benefit of **becoming a good citizen**, as raised by over one third of students. Students expressed a preference for *personal success*, which related to employment and further study opportunities, and fulfilling future aspirations. One male student reported: 'mathematics and science help you reach your desired goals like that of becoming a medical doctor' (School L). The possibility of *contribution to country development* was identified as another factor. As one female student stated, 'learning maths, science and technology is important because people who study those are considered to be important as they contribute to the economy of the country' (School B).

2.2 Recommendations for improving maths and science learning

Recommendations for improving maths and science learning was additionally raised as key theme associated with thoughts about learning maths and science. This arose in over a third of students' booklets and was supported by four sub-themes. **Availing learning-related resources and facilities at school** was suggested by over a quarter of students with the most cited examples constituting *ICT facilities, laboratory, library and books*. For instance, one female student expressed: 'we want a laboratory because there are lots of things that we were supposed to be learning from laboratories, but we are not because we don't have one, and this causes a lot of students to be less interested in learning sciences' (School F). **Improving teaching and learning practice** was further identified as a sub-theme by close to a quarter of students, incorporating examples such as *enhancing student understanding* and *restructuring school programmes*. Concerning the former, most students wished that teachers would give them more exercises and 'make sure that every student understands what he or she is taught' (Male student, School H). For the latter, students indicated that 'there should be an increase in the time allocated to science courses' (one male student from School G) and ICT learning in the syllabus so that the students could 'understand them better' (Male student, School K).

Another sub-theme related with recommendations that was noted by a fifth of students as enhancing maths and science learning was **improving availability of qualified teachers**, as exemplified through teachers' *having qualification and expertise* and *teacher training*. On the one hand, students described the necessity of 'qualified and motivated teachers' so that they could 'go to an advanced level having skills in it' (Female student, School B). On the other hand, students discussed the significance of 'recruiting or training teachers so that they teach what they understand. Therefore, every student will like science and ICT' (Female student, School B). Furthermore, teachers' **encouraging students** was advised in relation to this theme, albeit by a small proportion of

students. For instance, one female student shared that ‘girls should be encouraged to learn math and science in order to get what it takes to prepare for a better future’ (School G). Also, it was recommended by students that the government, school leaders, and teachers should invest greater effort into public advocacy to ‘raise awareness of the importance of learning maths and science’ (Female student, School C).

Gender differences

Concerning the data from all-male and all-female groups for the dimension *Thoughts about learning maths and science* (See **Table 4**), substantial differences were found for the theme the **importance of learning maths of science**, which was acknowledged by a larger proportion of girls (76%) compared to boys (57%). At a sub-theme level, more girls (40%) also raised how studying these subjects helped **them to become a good citizen**, compared to boys (29%). On the other hand, more boys (44%) indicated **recommendations for improving maths and science learning**, compared to girls (33%), a pattern also observed for the related sub-themes **availing learning related resources and facilities at school** (males=33%; females=19%) and **improving availability of qualified teachers** (males=26%; females=15%)

3. When I grow up, I want to be

Themes which arose under the dimension of *When I grow up, I want to be* (i.e. the future goals of the students) included **career paths** and **becoming a good citizen**. These are summarised in **Table 5**.

Table 5. When I grow up, I want to be

Themes	M %	F %	All %	Sub-themes	Examples	M %	F %	All %
Career paths	95	95	95	Professional	<i>Medical doctor (173); government jobs (104); teacher (75); journalist (22); businessperson (20); IT specialist (20); lawyer (15); researcher (10)</i>	76	84	80
				Vocational	<i>Transport industry (57); engineer (19); mechanic (10)</i>	28	17	22
				Arts and entertainment	<i>Musician (17); artist (16); athlete (12)</i>	15	13	14

Becoming a good citizen	34	39	38	Personal success	<i>Attributes of greatness (65); values and discipline (40); being rich (14)</i>	26	24	25
				Supporting vulnerable groups	N/A	9	14	12

3.1 Career paths

As illustrated in **Table 5**, rich discussion around **career paths** was evident and reported by nearly all students. This theme could be divided into three specific sub-themes. First, over three-quarters of students indicated their preference for **professional** jobs, with many examples reflecting a strong desire to contribute to the development of Rwanda as a society. The most cited response with respect to this sub-theme was *medical doctor*, with different types noted including surgeons and ophthalmologists. As one female student shared: 'I want to be a neurosurgeon so that I (can) help everyone who has brain diseases because we don't have many neurologists in Rwanda. That is the reason why the number of people who are killed by brain diseases keeps on increasing. So, I want to save those Rwandans' (School B). Other commonly cited professional jobs noted by students included *government jobs* and becoming a *teacher*. One male student expressed the wish to be 'a police officer who will be sent on peace mission locally and globally. He articulated: 'I will protect and defend my country by ensuring that it has security' (School H). Other professional jobs that were raised, albeit by far fewer students, incorporated *journalist*, *businessperson*, *IT specialist*, *lawyer*, and *researcher*. For instance, one male student exclaimed: 'I want to serve in the IT field. I want to make special robots in Rwanda. I took this direction because technology is not yet developed in Rwanda. Therefore, I want to work in the IT field so that I make many robots that are recognised on an international level' (School C).

In addition, almost a quarter of students referred to **vocational** jobs as their future career goals, with the most cited example being workers in *transport industry*, as well as *engineer* and *mechanic*. As commented by one female student: 'I want to be a pilot when I grow up because I like it very much. It can be important to me. When I hear a pilot talking about its importance, I make it my goal to achieve it. For example, my uncle does so. Therefore, I want to be like him' (School C). Furthermore, occupations in **arts and entertainment** such as *musician*, *artist*, and *athlete* were discussed among 57 students. One female student reported: 'when I grow up, I wish to be an artist because I like it very much. So, I strive to study well so that I can achieve my goal set' (School J).

3.2 *Becoming a good citizen*

Becoming a good citizen-raised by approximately 150 students-was the second key theme associated with the future goals of the student. On the one hand, the majority of responses, as shared by over one-quarter of students, referred to **personal success** which was associated with three examples. The most prevalent of these was *attributes of greatness*, primarily explained in relation to students wishing to become ‘a great person who will be important for the country’ when they grow up (Male student, School H). Moreover, students articulated their hopes of being someone with *values and discipline* such as honesty and patriotism. To give an example, one female student stated: ‘I want to be a disciplined person who has a good behaviour. In the future, I wish to be a patriot’ (School G). Another highlighted aspect about personal success concerned *being rich*, with one male student sharing, ‘I want to be a billionaire’ (School B). On the other hand, the wish of **supporting vulnerable groups** was indicated by 49 students as the other sub-theme of becoming a good citizen when they grow up. As pointed out by one female student: ‘I want to be a doctor who will be treating and taking care of people with disabilities by advising them and welcoming them without discrimination as well as treating them well’ (School A), which linked back to the students’ ideal careers which was described in Section 3.1

Gender differences

As shown in **Table 5**, though no substantial gender differences were seen at a thematic level for the dimension *When I grow up, I want to be*, at a sub-theme level, a higher proportion of boys (28%) expressed a desire to undertake a **vocational** work role following school compared to girls (17%).

Conclusion

In drawing from data from 409 students across 12 Rwandan schools, this study has illuminated valuable insights into the factors that profoundly influence adolescents’ learning in school. Additionally, it has shed light on students’ perceptions of learning math and science, and their aspirations for the future.

Concerning factors which support learning, this study has demonstrated the importance of both external and internal variables on students’ experience in school. In respect to the former example, school community members, facilities and resources, activities and discipline and behaviours were found to play a pivotal role. Teachers, in particular, were celebrated for helping students enhance their comprehension, implementing effective teaching practices, and

embodying qualities such as humility and effective communication. Furthermore, positive teacher-student relationships were highlighted as integral to fostering a conducive learning atmosphere. The availability of school facilities and resources emerged as another critical dimension with students emphasising the importance of having access to science laboratories and accessible ICT facilities when learning STEM as well as resources which supported their well-being. Student-related factors, while discussed to a lesser extent, mostly included including having effective behaviours for facilitating learning such as established routines, and importantly, positive feelings about learning, especially self-motivation.

Students' perspectives on the value of learning math and science further uncovered multifaceted implications for personal growth and responsible citizenship. Specifically, students, especially girls, recognised how studying these subjects could help bring about personal success and potential contributions to Rwanda's development. In the context of this topic, students also expressed a number of recommendations for improving STEM education which were centred around the need for more resources and facilities, higher quality teaching and learning and more qualified teachers. Interestingly, more boys were found to provide explicit recommendations for improving STEM, relative to girls in our sample.

In considering pupils' future career aspirations, students revealed a desire to pursue diverse professional and vocational paths, however data revealed they were more focused upon the former. They further exhibited a vision to actively participate in Rwanda's advancement, particularly be becoming medical doctors, working within government or by becoming teachers. For vocational careers, most students and particularly boys, expressed interest in working within the transportation sector. Interestingly, students also articulated the importance of becoming good citizens, a theme primarily marked by qualities of greatness and having values and discipline.

Policy implications

These findings provide important learnings concerning the factors and conditions that can best support and motivate learners within secondary STEM contexts in Rwanda. Below we summarise the pertinent implications for education policies and practices which have been identified from the data:

- **Enhance training on the affective dimension of teaching within professional development initiatives**

Our findings shed light on the criticality of teachers to pupils' learning and engagement. This includes their dispositional characteristics such as humility and kindness and positive relationships with students which were acknowledged as helping pupils feel at ease in the classroom and inspired to learn. These dimensions should therefore be considered in teacher professional development initiatives, alongside a focus on teaching practices, to help educators develop traits and strategies for cultivating rapport and positive connections with their students.

- **Invest in creating enriching educational environments which support students' academically and affectively**

This entails investments in well-maintained facilities which encourage academic development *and* well-being, comprehensive resource accessibility including laboratories and ICT equipment, and support for extracurricular activities and collaborative learning to holistically enhance students' educational experiences.

- **Intensify efforts promoting the importance of STEM**

While approximately a half of students recognised the importance of learning maths and science education, this finding also suggests that efforts emphasising the relevance and utility of STEM subjects should be intensified. This may involve curriculum adjustments to allocate more time to these subjects, teacher training to enhance teaching quality within these disciplines, and advocacy campaigns to pique students' interest in STEM.

- **Ensure access to career guidance and counselling is in place to support secondary students' diverse future aspirations**

Given that most pupils expressed clear future goals, many of which were directly related to STEM, secondary schools should ensure that comprehensive career guidance and counselling is in place to assist students in exploring and pursuing their varied career aspirations effectively. Based upon our findings, both professional and vocational career paths should be supported.

- **Integrate values and citizenship education within STEM curricula**

Our study has revealed the importance of values and citizenship to Rwandan students' learning in STEM and future aspirations. These themes should therefore be integrated where possible into STEM curricula in order to allow students to cultivate these attributes within the contexts of these disciplines.

- **Provide more opportunities and pathways in schools for students to share their views on learning and enhancing teaching in STEM**

Finally, this study has shown the immense value that can be gained from listening to students' voices. Students clearly articulated a number of highly relevant recommendations for improving teaching and learning in STEM which have strong potential for boosting their achievement and motivation in these subject areas. This study has also suggested that girls, in particular, may benefit from increased encouragement for communicating their views. Given the underrepresentation of girls in STEM at the secondary school as well as tertiary level in Rwanda [Rwandan Ministry of Education (MINEDUC), 2021], their first-hand recommendations could help bring about enhancements in girls' self-efficacy and learning experiences in maths and sciences, changes which may also impact their future career decisions.

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