UNIVERSITY OF CAMBRIDGE
Faculty of Education

REAL
Research for Equitable Access and Learning

laterite
DATA | RESEARCH | ADVISORY

Growing enrolment, static resources: Changes in school resources and infrastructure in relation to enrolment trends in Rwandan secondary schools

Leaders in Teaching Research and Policy Series

December 2020

mastercard foundation
Leaders in Teaching

Authors

Zia Khan and Phil Leonard of Laterite carried out primary data analysis and drafting of this report. Professor Ricardo Sabates of the REAL Centre provided detailed review and input to the final draft.

Acknowledgements

This work was carried out in partnership with the Mastercard Foundation as part of the Leaders in Teaching initiative. Leaders in Teaching supports teachers throughout their careers and prepares them to deliver high-quality education through a variety of interventions, with a focus on STEM subjects in secondary education in Rwanda. The REAL Centre and Laterite are learning partners on the Leaders in Teaching initiative, responsible for generating evidence on improved teacher performance and student learning in Rwandan secondary schools.

About Laterite and the REAL Centre

Laterite is a data, research and advisory firm dedicated to bringing high-quality research services to the most underserved markets. Based in East Africa, the firm strives to carry out impactful research that helps 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.

Suggested citation

Khan, Z., Leonard, P. and Sabates, R. (2020). *Growing enrolment, static resources: Changes in school resources and infrastructure in relation to enrolment trends in Rwandan secondary schools*. Leaders in Teaching Research and Policy Series, December 2020. Laterite, Rwanda and REAL Centre, University of Cambridge.

Approval to disseminate this work was granted from the National Institute of Statistics Rwanda (NISR) on 31 May 2021.
Approval No: 0174/2021/10/NISR
Study name: The Leaders in Teaching Quantitative Baseline Study

Introduction

Context

In Rwanda, both the government and donor organisations view school infrastructure and resources as an important pathway to positively impact secondary education outcomes. For example, the Government of Rwanda's Education Sector Strategic Plan 2018-2024 (Ministry of Education (MINEDUC), 2019a) mentions the following targets related to school characteristics and infrastructure:

- **Strengthening** science, technology, engineering and mathematics (**STEM) and ICT education across all levels of education:** improving laboratory facilities, equipping schools with smart classes, and training teachers in the use of ICT equipment like computers;
- **Increased access to secondary education:** expanding enrolment at the secondary education level by targeting a Gross Enrolment Ratio of 55% in 2020, compared to 45% in 2017, at the lower secondary level and a Gross Enrolment Ratio of 42% in 2020, compared to 31% in 2017, at the upper secondary level; and
- **Strengthening modern school infrastructure and facilities across all levels of education in Rwanda:** equipping secondary schools to meet minimum standards for infrastructure, including for electricity, water, toilets and hand-washing facilities.

For this reason, donor and programming organisations invest heavily in improving school infrastructure and physical and human resources. The Mastercard Foundation's Leaders in Teaching initiative, which supports teachers throughout their careers and prepares them to deliver high-quality, relevant education in Rwandan secondary schools, is an example of this.

For example, Leaders in Teaching implementing partner the African Institute of Mathematical Sciences (AIMS) aims to set up smart classrooms across various secondary schools and plans to distribute science kits to schools in order to orient STEM teaching towards learner-centred pedagogy. Fellow implementing partner Inspire Educate and Empower Rwanda runs a teacher assistantship program for high school graduates with the aim of increasing future recruitment of teachers.

The study

This brief analyses a panel dataset of 358 secondary schools in the 14 districts of Rwanda where the Leaders in Teaching initiative is taking place.[1] The aim of this brief is to understand whether secondary school resources and access to infrastructure in

districts where Leaders in Teaching interventions are taking place have increased between 2017 and 2020. The brief provides insights which will be important to account for when making decisions regarding future investments in resources and infrastructure. It will also inform policy-makers and implementing partners about how they can adapt their current programs and better design future ones based on the latest trends and relationships identified in the data.

Data for this study was created by combining two datasets which capture information about school resources and infrastructure at different points in time: (i) data collected in Rwanda in February/March 2020 by Laterite and the Research for Equitable Access and Learning (REAL) Centre at the University of Cambridge as learning partners on the Mastercard Foundation's Leaders in Teaching initiative; and (ii) data collected by Laterite in 2017 for a situational analysis of secondary schools in Rwanda for AIMS, MINEDUC and the Mastercard Foundation. More information about the data analysed for this brief is included in the methodology section.

Key findings

School characteristics and infrastructure have shown mixed improvements over the last three years in the 14 districts where Leaders in Teaching programs are underway. Large increases in secondary enrolment along with inequality in the distribution of resources across different types of schools have increased the burden on school infrastructure and resources, especially in small, rural schools.

- **Secondary school enrolment has increased by 26% between 2017 and 2020:** Secondary enrolment has expanded substantially in recent years, representing substantial progress towards a key government target of higher gross and net enrolment rates at the secondary education level. Increased enrolment in small, mostly rural schools – where enrolment increased by 49% between 2017 and 2020, compared to 24% at large, urban schools - has driven the increase. This increase comes with challenges, such as higher pupil to STEM teacher ratios, and an increase in the enrolment gap between boys and girls – on average, there are 5 girls for every 4 boys in secondary education.
- **Access to infrastructure and resources has improved in secondary schools:** There have been significant improvements in the access to facilities like internet (access increased from 37% to 56% of schools) and electricity (from 81% to 92.5% of schools).
- **Small, rural schools have seen the highest increases in enrolment but tend to have the least infrastructure and resources:** These types of schools started off with less infrastructure than other schools and are still lagging behind.

- **Classroom infrastructure and resources have remained largely unchanged over the last three years, while class sizes have increased:** High levels of overall school infrastructure do not translate to equally high levels of facilities at the classroom level. At the same time, higher enrolment (as much as 49% higher in rural schools from 2017 to 2020) and class sizes (from an average of 32 to 40 for small rural schools from 2017 to 2020) have led to greater pressure on existing infrastructure, especially within the classroom.
- **Schools face fewer barriers to integrating ICT resources, especially when it comes to budget and finance:** The proportion of school leaders that mentioned having insufficient budget to buy ICT hardware as a barrier to integrating ICT into their classrooms decreased from 83% in 2017 to 60% in 2020.
- **There have not been significant improvements in ICT and STEM infrastructure between 2017 and 2020:** ICT and STEM resources like availability of laptops and access to science labs have not significantly improved. At the same time, higher enrolment levels have put pressure on existing ICT and STEM infrastructure.

Methodology

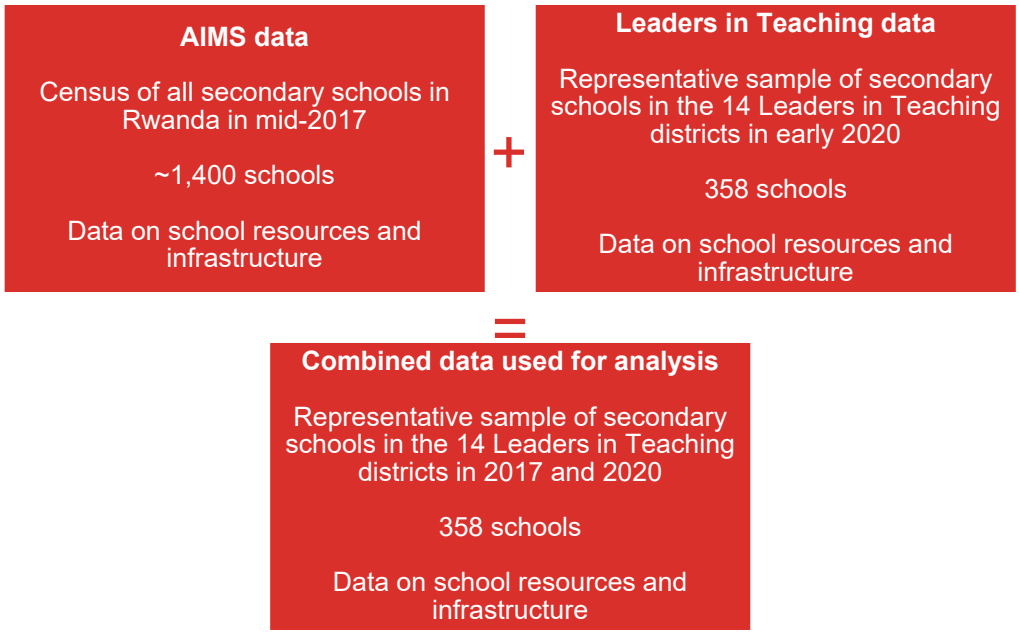
Data for this study was created by combining two datasets, (i) data collected in Rwanda in February/March 2020 by Laterite and the Research for Equitable Access and Learning (REAL) Centre at the University of Cambridge as learning partners on the Mastercard Foundation's Leaders in Teaching initiative; and (ii) data collected by Laterite in 2017 for a situational analysis of secondary schools in Rwanda for AIMS, MINEDUC and the Mastercard Foundation.

Both of these datasets captured the following information related to school characteristics and infrastructure:

1. **School enrolment and STEM teaching staff size** – This includes information about both overall enrolment and enrolment dis-aggregated across gender and also the level of teaching: O-level/A-level;
2. **Physical infrastructure –** This includes information about utilities: electricity, internet, water, toilets, as well as classroom infrastructure;
3. **ICT and STEM Infrastructure** – This includes data on accessibility of computing devices, information on the types of barriers schools face in ICT, and availability and infrastructure of science labs.

The analysis presented in this brief is representative of all lower secondary schools in 14 of the 30 districts in Rwanda where Leaders in Teaching initiatives are taking place.[1]

Figure 1: Overview of the data and how it was created



Findings

Secondary school enrolment has increased between 2017 and 2020

Overall enrolment in secondary schools has increased by 26% in the 14 districts where Leaders in Teaching interventions are taking place between 2017 and 2020.[2] This increase aligns with trends in Rwandan government administrative data: between 2016 and 2018, secondary enrolment increased by 19% (MINEDUC, 2019b). Further, Laterite's Markov chains model predicts that secondary enrolment in Rwanda will almost double in the next five years (Laterite, 2020).

The increase in enrolment is mainly driven by growth at the lower secondary level: O-Level (lower secondary) enrolment has increased by 30%, while A-level (upper secondary) enrolment has gone up by 7%. We also find that schools which were small[3] in 2017 had the largest increase in enrolment, growing by 48% over the three years. This was followed by large schools growing by 28% and very large schools by 11%, compared to 2017 levels.

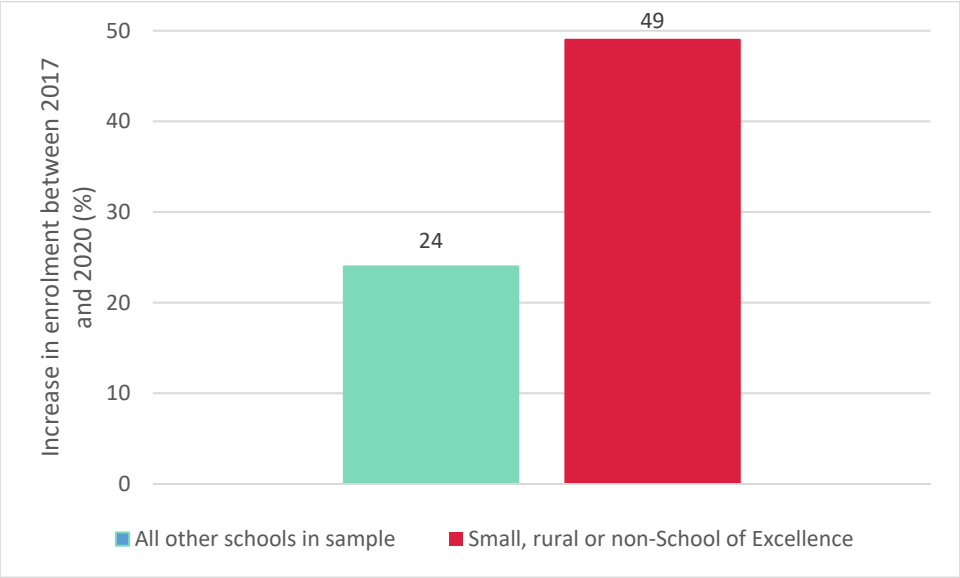
In line with this finding, **the types of schools that have experienced the greatest increases in enrolment have been small, rural schools**. By contrast, the schools showing the slowest growth were very large, urban schools and schools of excellence, as shown in Figure 1.[4]

When looking at enrolment disaggregated across gender, we observe a higher increase in female enrolment (27%) compared to male enrolment (23%). This has exacerbated the gap in enrolment between boys and girls in secondary schools: average female enrolment at the start of 2020 was 26% higher than male enrolment, meaning there are 5 girls for every 4 boys in secondary education.[5]

The increase in enrolment has also negatively impacted pupil to teacher ratios because the recruitment of new teachers has not kept pace with enrolment. While the average number of secondary STEM teachers per school has increased from 5.6 teachers to 5.9 teachers per school, we observe an increase in the ratio of pupils to STEM teachers from 70 pupils per teacher to 83 pupils per teacher due to the large increases in enrolment.

We also observe that small rural schools experienced the largest increase in the pupil-to-STEM-teacher ratio: from 51.5 to 74.5 pupils for every STEM teacher, a 45% increase. In contrast, other schools saw an increase from 78 to 87 pupils per STEM teacher, a 12% increase.

Figure 2: Percentage increase in secondary enrolment in small, rural, and non-School of Excellence schools compared to the rest of the schools

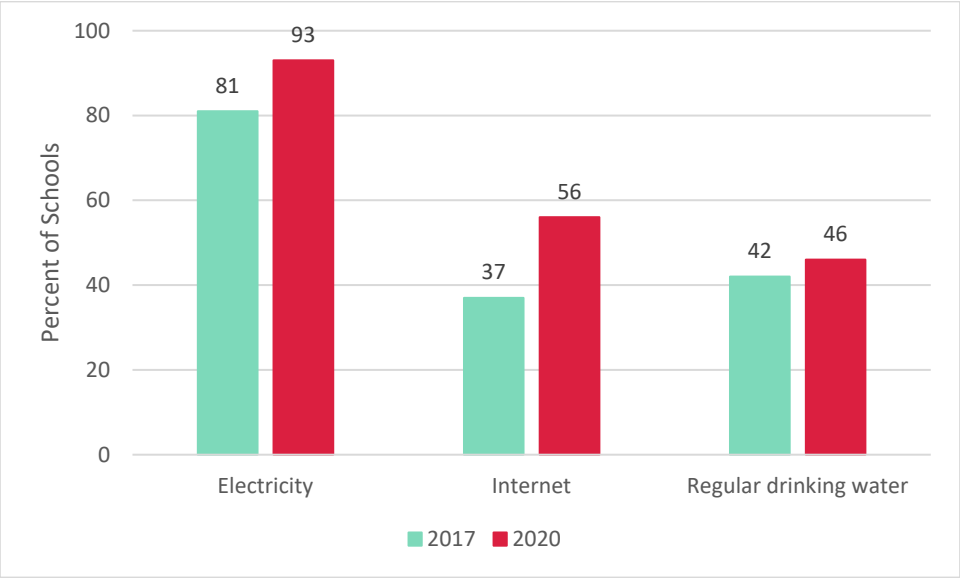


At the overall school level, access to basic infrastructure and resources has improved

There have been significant improvements in access to facilities like internet and electricity. Between 2017 and 2020, as shown in Figure 2, the proportion of schools with access to internet increased from 37% to 56% of schools, and the proportion of schools with access to electricity increased from 81% to 92.5%.

There was no significant change in the percentage of schools with access to regular, safe, drinking water for students, which remained around 42%. However, urban schools did experience a significant increase in access: in 2020, 80% of urban schools could provide regular drinking water to students compared to 65% of urban schools in 2017, an increase of 15 percentage points.[6] In addition, 96% of schools in 2017 and 98% in 2020 had access to toilets separated by gender.

Figure 3: Percentage of schools with access to electricity, internet, and regular safe drinking water.



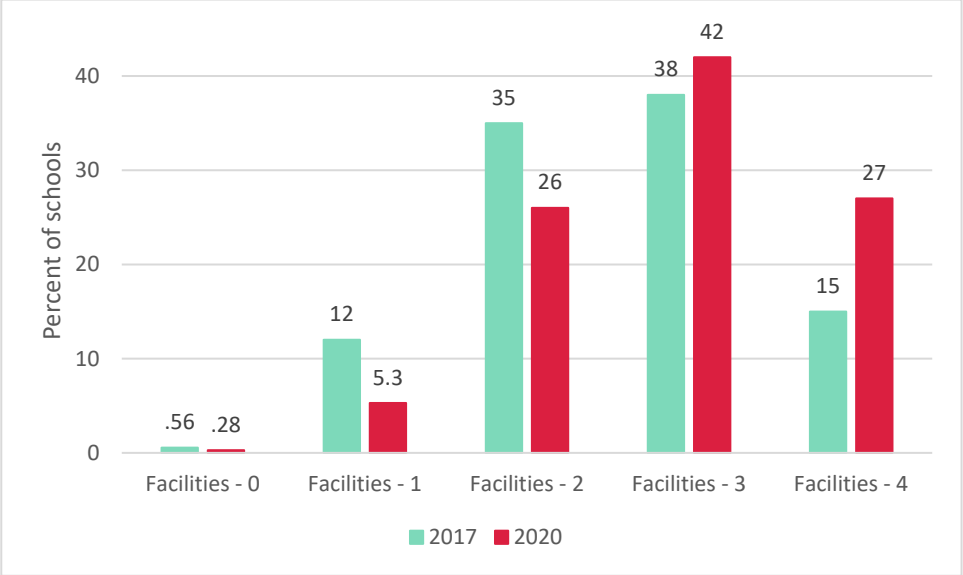
To understand trends in physical infrastructure more generally, we created an indicator which reflects overall access to physical infrastructure. The indicator is a simple sum of all the facilities that a school has access to out of the following – internet, safe drinking water, electricity, and toilets for boys and girls. Therefore, the minimum score for a school is 0 and the maximum score is 4.

By using the overall access score, **we found that the average number of facilities that secondary schools in the Leaders in Teaching districts have access to has increased from 2.5 to 2.9 facilities between 2017 and 2020.** Figure 3 shows that the percentage of schools that have 2 or less facilities has decreased between 2017 and 2020, while the percentage of schools with 3 or 4 facilities has increased.

Very large schools showed the largest increase in access – from 2.8 to 3.3 facilities. This was followed by large schools – 2.6 to 3 – and finally, small schools – 2.3 in 2017 and 2.6 in 2020. Very large schools also had the highest base level of access to facilities, followed by large and small schools in that order.

Urban and rural schools both showed similar increases in the number of facilities: both increased by 0.35 between 2017 and 2020. However, despite the increase being the same, urban schools have much higher access to facilities compared to rural schools – 3.5 facilities compared to 2.9, respectively.

Figure 4: Distribution of schools with access to various levels of facilities.



Note: "Facilities - 0" refers to schools with no basic facilities, “Facilities – 1” refers to only 1 of the basic facilities, and so forth.

Small, rural schools have seen the highest increases in enrolment but tend to have the least infrastructure and resources

Small, rural schools – about 43% of all secondary schools in the 14 Leaders in Teaching districts – have experienced the largest increases in enrolment: a 49% increase between 2017 and 2020. These schools also tend to have the lowest access to infrastructure.

Overall access to physical infrastructure facilities for small, rural schools improved from 2.3 facilities to 2.6 facilities between 2017 and 2020. The other schools also improved by a similar amount but started off with a higher level of resources: such schools improved from 2.7 to 3.1 facilities between 2017 and 2020.

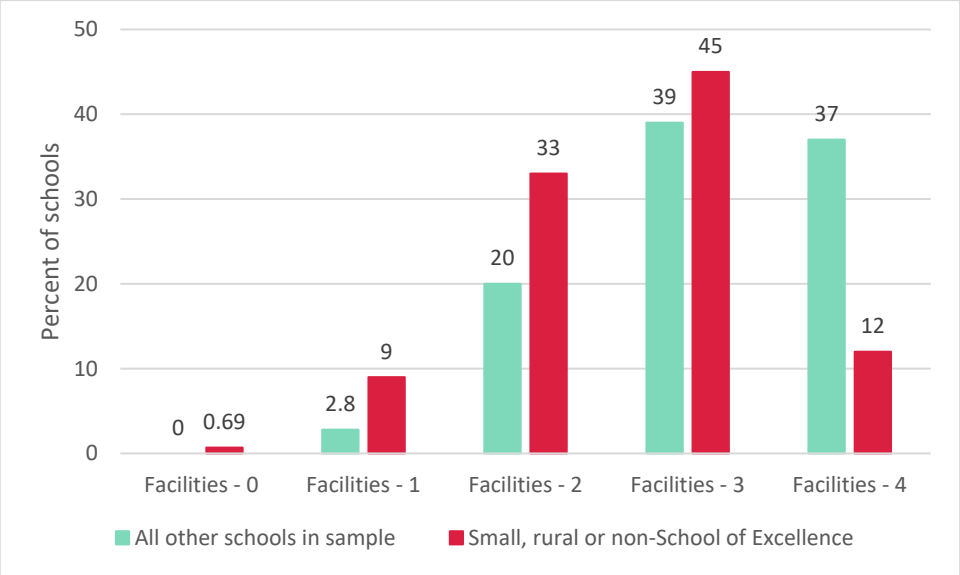
We observe the same trend when we break down overall infrastructure into its constituent elements. Electricity access for small, rural schools increased from 70% to 88% from 2017 to 2020. This increase is larger than the increase for other schools – 90% to 96%, however, these schools also started off at a much higher level.

Access to drinking water has not improved for small, rural schools and has instead decreased by a statistically insignificant amount to 36% from 29%. At the same time, access has improved significantly from 44% to 53% for other schools.

Lastly, the number of small, rural schools with access to internet improved from 26% in 2017 to 40% in 2020. Over the same period, the other secondary schools saw larger gains in internet access – from 45% to 68%.

In summary, secondary schools have made significant improvements in the area of school level physical infrastructure between 2017 and 2020. These improvements have been seen by all types of schools – urban as well as rural, small as well as large.
However, we notice that schools which had started off with lower levels of infrastructure – specifically small, rural schools – have not been able to improve at a quick enough rate to catch up with schools with higher resource endowments. They will need more time and investment to catch up.

Figure 5: Distribution of schools with access to basic facilities in 2020 across small rural schools which are not schools of excellence compared to other schools.



Classroom infrastructure and resources have remained largely unchanged between 2017 and 2020, while class sizes have increased

The average number of secondary classrooms in schools increased from 11 classrooms in 2017 to 12 in 2020. This signals that schools are not only growing in terms of student enrolment but also in terms of physical size to accommodate higher levels of enrolment.

Despite facing different levels of increases in enrolment, all schools showed the same increase in the number of classrooms: small rural schools grew from 6 classrooms to 7 between 2017 and 2020, while other schools grew from 14 to 15 classrooms.
This is further reflected in the finding that small rural schools had smaller class sizes in 2017 – 32 pupils per class – compared to larger, urban schools – 40 pupils per class. Despite this, they ended up almost with the same class sizes in 2020 – 41 pupils per classroom in small rural schools and 43 pupils per classroom in all other schools. Overall, the average class size for secondary schools in the 14 Leaders in Teaching

districts increased from 36 pupils per secondary classroom in 2017 to 42 pupils in 2020.

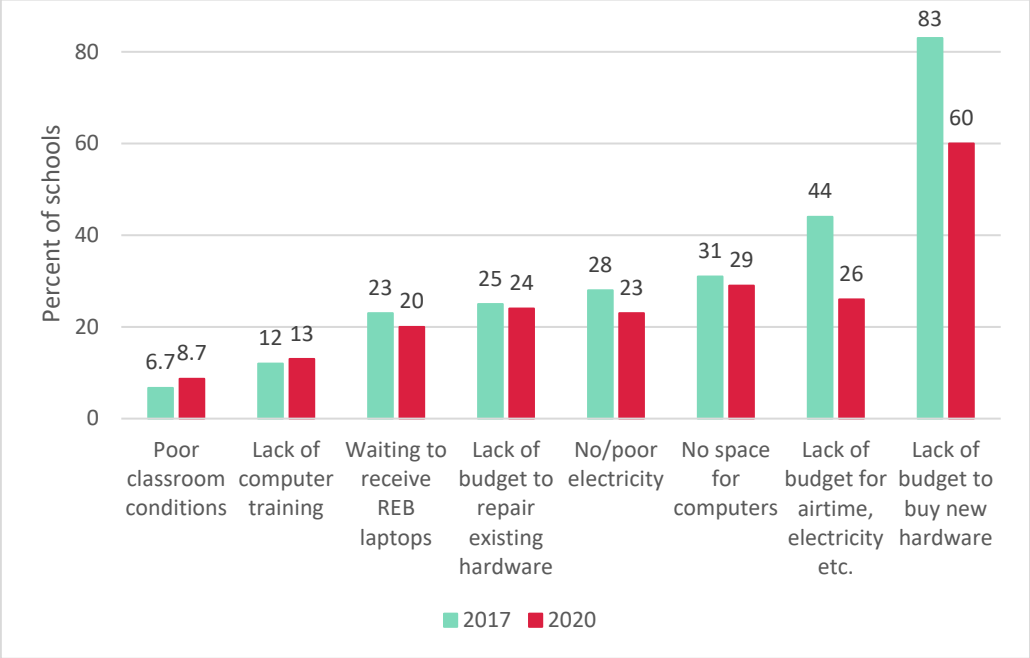
In relation to classroom infrastructure, we find that, on average, **30% of classes in secondary schools require repairs according to school leaders.** This percentage has not changed by a statistically significant level between 2017 and 2020. **The number of schools where no class required repairs also remained unchanged, remaining at 45% of all schools.** There were no statistically significant differences in this area between small rural schools and all other schools.

Infrastructure at the classroom level lags behind overall school level infrastructure. The average proportion of schools with at least one classroom with access to internet increased from 3% in 2017 to 28% in 2020, a 25 percentage point increase. At the school level, the picture is quite different, with the proportion of schools reporting access to internet increasing from 37% in 2017 to 56% in 2020. Additionally, the percentage of secondary classrooms in a given school with access to electricity did not change at all between 2017 and 2020, remaining at 33%. Lastly, 53% of schools are unable to provide electricity in any of their classrooms, even though more than 90% of schools have some access to electricity in 2020.

Schools face fewer barriers to integrating ICT into the classroom, especially when it comes to budget and finance

Figure 5 highlights the barriers that schools face in further integrating ICT in their classrooms. We see that the biggest barriers have decreased the most. A lack of budget to buy new hardware decreased by 23 percentage points from 83% to 60% - while a lack of budget to pay for ICT associated costs like airtime, electricity, etc. decreased by 18 percentage points from 44% to 26.

Figure 6: Barriers to ICT over 2017 and 2020



Note: REB refers to the Rwanda Basic Education Board.

There have not been significant improvements in access to ICT and STEM infrastructure between 2017 and 2020

Access to ICT and STEM resources like laptops and access to science labs has not significantly improved. At the same time, similar to how increased enrolment has put pressure on classroom infrastructure, ICT and STEM infrastructure are also under stress due to higher enrolment.

The number of laptops available for use by school administration and teachers increased significantly, but not for students. For school administration, the average number of laptops increased from 2 to 6 per school. For teachers, the number of laptops per school increased from an average of 3 to 4.5. However, laptops intended for student use did not increase significantly and remained unchanged at an average of 137 laptops per school.

The proportion of schools that do not have access to any laptops for students decreased from 33% in 2017 to 29% in 2020. Access to laptops at small rural schools did not change: 43% of these schools do not have access to a single student laptop. On the other hand, this figure improved at all other schools – in 2017, 26% of these schools did not have any student laptops, while this number dropped to 19% in 2020.

The limited increase in access to laptops along with the increase in enrolment means the number of laptops per pupil has decreased from 0.42 to 0.32 laptops per pupil (or from 2.4 to 3.1 students for each available laptop) between 2017

and 2020. This is the case even for schools that have access to at least one laptop: the ratio has decreased from 0.65 to 0.45 laptops per pupil (or from 1.5 to 2.2 students for each available laptop) in these schools.

The proportion of schools with access to science kits increased from 75% to 78%. Again, we observe that small rural schools have less access to science kits at 65% in 2017, which did not change significantly in 2020. On the other hand, larger/urban schools saw improved access to science kits from 82% in 2017 to 88% in 2020.

The proportion of schools that have science labs stayed at 19% between 2017 and 2020. Further, we do not observe a change in the frequency of lab usage between 2017 and 2020: 10% of schools use their science lab sometimes (5-10 times per term), 50% of schools often use their science labs often (1-4 times a week), and 38% of schools use their science labs every day.

Policy takeaways

The data provides insights related to school characteristics and infrastructure with the potential to guide current and future programming and policy. Three policy takeaways follow:

- **When making decisions about resource allocation, take into account that small rural schools lag behind the rest**

The data shows that small, rural secondary schools have seen the largest proportion of increase in enrolment compared to other schools – a 48% increase over three years. This has caused these schools to experience the largest increases in class sizes relative to other schools. At the same time, these schools tend to have the lowest levels of infrastructure access compared to other schools, lagging behind in areas like access to electricity, drinking water, and access to internet. They have poorer access to facilities and resources like science kits, science labs, and student laptops.

Policy-makers and programming organisations may wish to take this information into account when looking to maximise the impact of decisions about resource allocation.

- **Account for the impact of increasing enrolment that is expected to continue in the future**

We observe a large (26%) increase in secondary school enrolment between 2017 and 2020 in the 14 Leaders in Teaching districts. For per capita access to school resources and facilities to remain stable or improve, facilities which can only be used by a limited number of pupils at a time – laptops, classrooms, science labs, etc. – need to increase in proportion with enrolment.

Future programs and policies will need to account for the resource needs relating to the increases in enrolment at the secondary level which are expected to occur in the coming years (Laterite, 2020; MINEDUC, 2019a). Otherwise, even if investments improve the absolute availability of infrastructure and facilities, access might still go down on a relative, per capita level. This is already happening in relation to some resources - for example, between 2017 and 2020 we observe an increase in class sizes and a decrease in the per capita availability of student laptops even though the absolute number of available laptops in schools has not changed.

- **Instead of targeting change at the overall school level, aim to impact classrooms directly**

At the overall school level, secondary schools have shown significant and large improvements over the period of 2017 to 2020. However, this progress has not always translated to the same extent of improvements at the classroom level where most of a pupil's learning takes place. For example, we observe that electricity is accessible to more than 90% of secondary schools in Leaders in Teaching districts, but 53% of schools still do not have electricity in any of their classrooms.

This finding highlights that investments to improve access to infrastructure might not be focusing on the quality or breadth of the access. The electricity example clearly shows that even though most schools have access to electricity, the quality of access is not high, as having electricity in the school is likely insufficient if it is available in each classroom.
To overcome this issue, if the aim of programs and policies is to improve the learning environment of students, then targeting classroom-level indicators can provide a more accurate picture of the impact of resource allocations on teaching and learning compared to targeting school level indicators.

References

CIA. (2020). World Fact Book – Rwanda. Available at: https://www.cia.gov/the-world-factbook/countries/rwanda. Accessed: 10/08/2021

Laterite. (2017). *A situational analysis of STEM and ICT in general secondary education in Rwanda.* Kigali, Rwanda.

Laterite. (2020). *Using Markov Chains to predict trends in Rwanda's school system.* Kigali, Rwanda. Available at: https://4det8y3z1n391t76me8rfynx-wpengine.netdna-ssl.com/wp-content/uploads/2020/05/Proof-of-Concept-Markov-Chains-Education-System-Rwanda.pdf. Accessed: 10/08/2021.

MINEDUC, Rwanda. (2019a). *Education Sector Strategic Plan 2018/19 to 2023/24.* Kigali, Rwanda. Available at: https://planipolis.iiep.unesco.org/en/2019/education-sector-strategic-plan-201819-202324-6812. Accessed: 10/08/2021.

MINEDUC, Rwanda. (2019b). 2019 Education Statistics. Kigali, Rwanda. Available at: https://www.statistics.gov.rw/publication/statistical-yearbook-2019. Accessed: 10/08/2021.

CIA. (2020). World Fact Book – Rwanda. Available at: https://www.cia.gov/the-world-factbook/countries/rwanda. Accessed: 10/08/2021

Endnotes

[1] Leaders in Teaching districts – Musanze, Gicumbi, Kayonza, Rwamagana, Nyabihu, Ngororero, Rusizi, Nyamasheke, Karongi, Rubavu, Gisagara, Nyaruguru, Nyanza, Kamonyi.

[2] The 2017 data was collected in September, while the 2020 data in January. Therefore, our calculations for the 2020 data do not account for the drop out of students as the school year progresses. This means that the effective enrolment – enrolment after accounting for drop out – might be slightly lightly lower.

[3] We have characterised school sizes in the following manner: small schools (< 300 total pupils), large schools (300 < total pupils < 600), and very large schools (> 600 pupils). School enrolment size also reflects the school's physical size since small schools tend to have approximately half the number of classrooms – 6 classrooms, on average –compared to large schools, while large schools, at 12 classrooms on average, have half the number of classrooms compared to very large schools which have 24 classrooms on average.

[4] Schools of excellence are schools selected by MINEDUC to have high-quality infrastructure (like science labs). There are around a hundred schools of excellence in Rwanda. In the Rwanda schooling system, students can choose which schools they want to apply for and their final selection depends on their academic performance. This means that schools of excellence will have high performing students, assuming that they will appear to be more attractive to admission seekers.

[5] According to the CIA World Fact book (CIA, 2020), the population distribution of girls and boys in the age group of 0-24 years is roughly the same with a slightly higher number of boys.

[6] The increase in urban schools' access is not reflected in the overall access to drinking water because urban schools form a small proportion of total schools and thus contribute less to the overall effect.

REAL Centre
Faculty of Education
University of Cambridge
184 Hills Road, Cambridge,
CB2 8PQ, UK
@REAL_Centre
www.educ.cam.ac.uk/centres/real
Email: realcentre@educ.cam.ac.uk

Laterite
Amy's House, Plot 1563,
KG 12 Avenue,
Gaculiro, Kinyinya,
Kigali, Rwanda

@Laterite_Africa
www.laterite.com

All details correct at the time of going to print, September 2021.