Policy brief
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Harnessing the potential of ICT for education in Rwanda

In brief

- The Government of Rwanda's Education Sector Strategic Plan describes the use of information and communications technology (ICT) in general as "fundamental" to achieving the socio-economic development outlined in Vision 2050, and its use in education as "critical".
- Technology in education has significant potential to increase equality of access to and use of education materials, but it is important that investments in ICT do not inadvertently worsen inequality.
- It is also important not only to bring technology to the schools that have infrastructure, but to also invest in basic infrastructure in the schools that do not have it, so that they can also benefit from educational technology.
- Research shows that to have an impact on learning outcomes, ICT interventions also need to be tied to the curriculum and to be well integrated by teachers into classroom instruction.
- This policy note describes evidence of strategies to optimise the impact of ICT on learning outcomes.

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Background: Aspirations and challenges for the use of ICT in education in Rwanda

How can the Rwandan education system use information and communications technology (ICT) to optimally and equitably enhance learning outcomes?

The Government of Rwanda's Education Sector Strategic Plan for 2018/2019 to 2023/24 (ESSP)[1] describes the use of ICT in general as "fundamental" to achieving the socio-economic development outlined in Vision 2050, and its use in education as "critical".

An important feature of the Rwandan context is the One Laptop Per Child policy espoused in the previous ESSP, which comprised a significant investment in access to ICT. However, to its credit **the Government of Rwanda recognises that access to hardware is not enough to improve learning outcomes, and has to be complemented** with teaching skills to use ICT as a learning tool, as well as the provision of basic infrastructure; evidence supports this convincingly, for example in Peru[2][3] and in India[4]. Data from 2016 show that just 32% of primary and 51% of secondary schools are connected to the electrical grid, and only 19% of secondary schools have an internet connection.[5]

The current ESSP intends to build on the One Laptop Per Child policy by ensuring that primary and secondary schools have "smart classrooms" incorporating computers, a projector, digitised content, and internet connectivity. The strategy also intends to develop teachers' ability to use ICT as a tool for learning, and also to provide digital content for pre-primary, primary, and secondary education, enabling multi-mode approaches to education including online and distance learning.

Technology in education has significant potential to increase equality of access to and use of education materials. It can enable educational content to be **pitched at the right level for each individual student,** an important educational principle that is shown by research to be highly effective, and provide better content to children in poor areas than available teachers could provide; it can also **help less experienced or less competent teachers perform** by providing them with teaching materials and tools that can help them deliver better learning outcomes.

1. MINEDUC (2017) Kigali: Republic of Rwanda.
2. Cristia et al (2014), Does Technology in Schools Affect Repetition, Dropout and Enrollment? Evidence from Peru
3. (Germán et al 2014) The Effects of Shared School Technology Access on Students' Digital Skills in Peru
4. Toyama 2015, Geek Heresy: Rescuing Social Change from the Cult of Technology, Public Affairs
5. MINEDUC (2016b). Education Statistical Yearbook. Kigali: Republic of Rwanda. http://mineduc.gov.rw/fileadmin/user_upload/pdf_files/2016_Education_Statistical_Yearbook.pdf

However, given that technology has the most impact on learning outcomes in schools with good teachers and good infrastructure, **it is important that investments in ICT do not inadvertently worsen inequality.** Whilst it may be most cost effective to focus investments in technology, especially planned investments in hardware, in schools that are best equipped to use it effectively, only doing this risks worsening educational inequality in Rwanda. It is important not only to bring technology to the schools that have infrastructure, but to also **invest in basic infrastructure in the schools that do not have it, so that they can also benefit from educational technology.**

Research shows that to have an impact on learning outcomes, ICT interventions also need to be tied to the curriculum and be well integrated by teachers into classroom instruction.[6]

This policy note describes evidence on options for strategies to optimise the impact of ICT on learning outcomes according to the principles described above.

Policy proposals and rationale

Evidence shows that a range of ICT interventions can have positive impacts on student learning outcomes, especially the use of ICT to disseminate specific software and information. This note focuses on two types of ICT interventions that can improve learning outcomes: those intended for use by 1) students, and 2) teachers. Some of these interventions have proven effective at improving a range of education sector outcomes, and some have been ineffective; a comprehensive review here is beyond the scope of this paper but an excellent review is available in a paper titled "Education Technology: An Evidence Based Review" by Escueta et al (2017)[7]. Here we outline some interventions that were shown to be successful elsewhere, which the Ministry of Education (MINEDUC) might consider piloting and evaluating.

1. Using technology to match instruction to learning level

Teaching at the Right Level (TaRL) is an evidence-informed approach pioneered by the Indian NGO Pratham that assesses the skill level of each child, then groups and teaches them according to their skill level using level-appropriate materials and engaging activities.[8] Technology may be particularly good at matching instruction to skill level; moreover, it may be able to do this not only among groups of children but at the individual level, as well as having the potential to improve learning outcomes for underprivileged children.

6. Evans & Popova, 2016; Cristia et al. 2012; He, Linden, and MacLeod 2008; Malamud and Pop-Eleches 2011; Barrera-Osorio and Linden 2009; Beuermann et al. 2013 ; Murnane and Ganimian 2014
7. "Education Technology: An Evidence Based Review" by Escueta et al (2017)
8. https://www.povertyactionlab.org/scale-ups/remedial-education

Mindspark is an interesting case of this; it is an educational software developed over ten years by an Indian company that provides personalised instruction to students using games, videos, and activities. The software uses a database of over 45,000 questions to test students, providing explanations and feedback that facilitate their learning. Mindspark is designed to deliver content that is carefully customised to the level of the individual student, catering to the wide variation of learning levels within any given grade in a way that would be hard for any individual teacher. A second notable feature is that Mindspark identifies patterns of errors that students commit, and targets content to correct these errors in a dynamic individualised way that, again, would be hard for a classroom teacher to identify or address to such a tailored degree.

Singh et al (2017) examined the impact of Mindspark on learning outcomes in an experiment in which students in grades six to nine in government-run secondary schools in low-income neighbourhoods, used the programme for 45 minutes, 6 days per week, for 4.5 months; this was combined with supervised instructor-led group-based study. The researchers found that Mindspark significantly improved learning outcomes in mathematics and in Hindi, and especially among lower performing students[9]. Students who participated in the programme improved in mathematics twice as much as students in the comparison group in the same period (4.5 months); students also improved 2.5 times as much in Hindi. At school, test scores in Hindi improved, but scores in mathematics did not; the researchers hypothesise that this is because the students who used Mindspark were several years behind in mathematics, and the school exams would still be beyond their learning level even given the progress they made.

Mindspark is just one, albeit particularly successful and prominent, example of a pedagogical intervention that matches teaching to students' learning level. In a review of what works to improve learning in developing countries, Evans & Popova (2016) found that many studies of education interventions in Africa agree on the high learning impact of pedagogical interventions that match teaching to students' learning, including through technology.

The Government of Rwanda might consider piloting and testing an educational software intervention with this property, taking into account the supervision and management needs; if this works, it would likely be a cost-effective and scaleable way to improve learning outcomes, which does not depend on teacher skill level. The Government might also assess any existing or proposed software interventions to see if they match instruction to students' learning level.

9. Muralidharan, Singh & Ganimian (2017) Disrupting education? Experimental evidence on technology-aided instruction in india. NBER working paper series. Available here http://www.nber.org/papers/w22923.pdf Accessed 26 June 2018

2. Combining lesson plans or scripted lessons with coaching

Dissemination of quality lesson plans to teachers using technology that teachers can then use in the classroom, may have promising and cost-effective potential to significantly improve student learning outcomes, especially when combined with teacher training or coaching. This broad approach is supported by seven studies from five countries:[10] South Africa, Liberia, Kenya, Uganda, and the US, covering reading outcomes and mathematics outcomes.

Cilliers and Taylor (2017) find in South Africa that frequent coaching in the form of monthly visits are more effective than twice-yearly training, to support scripted lesson plan delivery. They find that the effects on student scores are far higher in urban schools than in rural schools. However, Jackson & Makarin (2017) find in the US that benefits to student scores were higher for weaker teachers, suggesting that there could also be an inequality-reducing effect because lower-skilled teachers compensate for skill deficiencies by substituting the lessons for their own efforts; this also gave teachers more time for other tasks.

This **evidence suggests that the provision of lesson plans combined with coaching, could be a cost-effective, quite scalable activity,** especially for urban schools, as long as teachers are able and willing to use these plans.

A distinction worthy of note is between the provision of model lesson plans that teachers are free to adapt, and the provision of more scripted lessons. According to USAID, scripted lessons, also known as direct instruction, involve highly sequenced instruction, clear and concise directions, teacher guidance and active student participation, and support of student learning at all levels. They do not rule out the development of higher order skills but can help develop them by getting the basics right. Scripting is not uncontroversial but there is some evidence for its effectiveness[11]. For example, Piper and Kora (2011) assess a programme called "Early Grade Reading Assessment Plus" in Liberia, and conclude that "scripted lesson plans can be a part of an effective program for reading improvement".[12] The increased rates of learning between the midterm and final assessment show

10. Cilliers & Taylor 2017 Monitoring Teachers and Changing Teaching Practice: Evidence from a Field Experiment Piper, B. & Korda, M. (2011), 'Egra plus: Liberia. program evaluation report.', RTI International . Piper, B., Zuilkowski, S. S. & Mugenda, A. (2014), 'Improving reading outcomes in Kenya: First-year effects of the PRIMR initiative', International Journal of Educational Development 37, 11–21. Lucas, A. M., McEwan, P. J., Ngware, M. & Oketch, M. (2014), 'Improving early-grade literacy in east africa: Experimental evidence from kenya and uganda', Journal of Policy Analysis and Management 33(4), 950–976. Kerwin, J. T., Thornton, R. et al. (2015), 'Making the grade: Understanding what works for teaching literacy in rural Uganda', Unpublished manuscript. University of Illinois, Urbana, IL . Jackson, C. K. & Makarin, A. (2016), Simplifying teaching: A field experiment with online" off-the-shelf" lessons, Technical report, National Bureau of Economic Research. Romero et al, 2017. Can Outsourcing Improve Liberia's Schools? Center for Global Development Working Paper 462
11. Davidson (2015, Scripted reading lessons and evidence for their efficacy. 2015 Global Education Summit. Available here https://www.usaid.gov/sites/default/files/documents/1865/Davidson.pdf
12. Piper, B. & Korda, M. (2011), 'Egra plus: Liberia. program evaluation report.', RTI International .

that while there was some initial resistance to such methods, the creation of and support for lesson plans for teachers has a high likelihood of continuing to be effective in Liberia."

Therefore, **MINEDUC might consider piloting and testing the scripted lesson approach in the Rwandan context and comparing it to the use of less sequenced lesson plans.**

Conclusions & recommendations

Using technology to match instruction to students' learning level, and using technology to help teachers deliver better lessons, can improve teaching and learning outcomes. The use of technology can increase equity in the education sector if its effective use is implemented in less privileged schools and only if complementary investments are also made in teaching skills and basic infrastructure.

Technology can enhance learning outcomes; this note focuses on two channels through which it can do so.

- First, it can directly enhance learning outcomes through content delivered to students; certain types of educational software can tailor instruction to the individual level of the student.
- Second, technology can enhance learning outcomes by improving teaching through lesson plans and coaching, and possibly through scripted lessons.

Technology is effective when teachers integrate it well into lessons in a way that is relevant to the curriculum.

While it is not inevitable, technology could be a force for equity in the Rwandan education sector, particularly by providing underprivileged students access to individualised instruction of high quality, and by increasing the quality of lessons taught by lower-skilled teachers. However, complementary investments in teaching skill and basic infrastructure, including electricity, are important if Rwanda is to realise the educational potential of technology.

Should MINEDUC wish to explore any or all of these policy options further, a natural next step would be a corresponding scoping study. The IGC would be pleased to undertake this work under its Learning Evidence Advisory Panel (LEAP) facility for providing evidence to education policymakers.

Following such a scoping study, a full-scale pilot, using government systems and adapting designs to suit the policymaking context, would be a natural next step. IGC-affiliated researchers could play a role in both informing the design of these at-scale trials and in analysing their results.