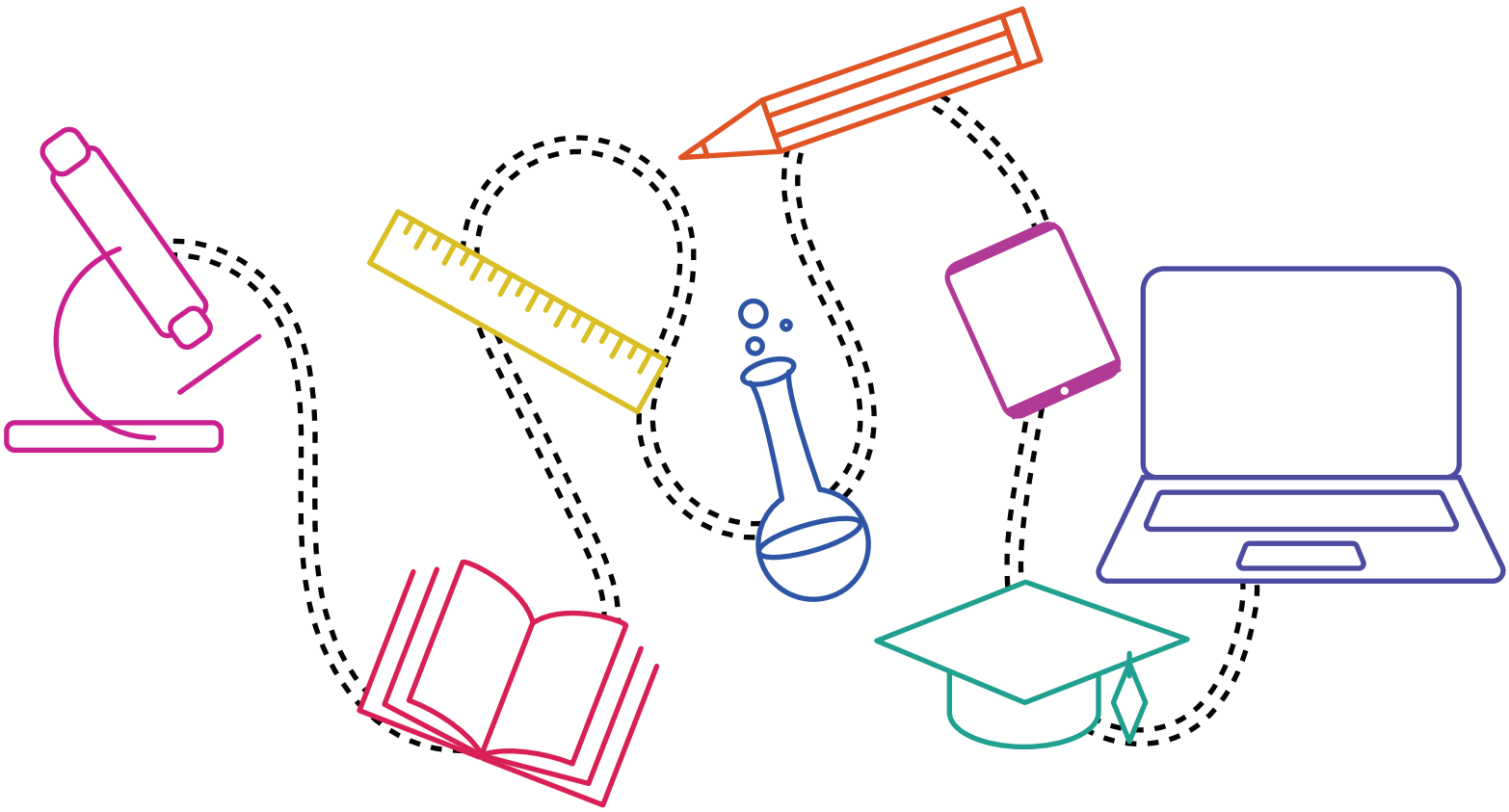
Education Technology for Effective Teachers

David K. Evans (Center for Global Development)
Teachers Thematic Group, World Bank, February 2021[1]



Education systems around the world are investing in technology to help teachers be more effective. In some cases, the results are exciting. In others, the impact of technology falls short of expectations or remains unevaluated. The closing of schools worldwide due to the COVID-19 pandemic has highlighted the importance of understanding how to leverage technology well. This note lays out four principles for investing in technology for effective teachers and six aspects of teaching where technology can boost teacher performance, together with examples of tested, promising, and cautionary experiences with teacher technologies.

The Principles

Principle 1: Technology is not the solution to the learning crisis. But technology can be the solution to specific micro-problems within the education system.

When considering technology investments, the key is to begin with a specific problem and ask, What's the best way to solve this problem? And then to ask, can technology help in this case? Approached problem-by-problem, education systems can have realistic expectations of the promise of technology and ensure that they help teachers to help their students.

Principle 2: If you're going to invest in technology, invest in the training, support, monitoring, and maintenance to make it work.

Technology investments often come with a significant up-front investment. But it doesn't make sense to invest in the hardware or the software without budgeting for all the supplemental services required to make the technology work. Systems often underestimate the degree of sensitization and training required for teachers—along with others in the education system, like principals and ministry staff—to buy into a new technology and then to use it effectively.

Principle 3: Test the technology.

» **Make sure it works.** In an effort to use smart phones to monitor teachers in Haiti, the technology ultimately failed.[2] Government officials and partners alike have entered classrooms to see technology that may have worked once but was not in a place to be maintained. If the technology is beyond the infrastructure capacity of the weakest schools in the system, it won't deliver results.[3]

» **Make sure it is used.** An intervention that provided computers to classrooms in Colombia managed to get the computers there, but teachers largely ignored them because the technology was not integrated with the curriculum.[4] If teachers do not see the value of a technology, do not know how to use it, or are not comfortable using it, it won't deliver results. The goal is not to maximize the amount of time the technology is used, but rather to ensure that it is used at the right times.

» **Make sure it increases learning.** Even if the technology works and teachers use it, there is no guarantee that it will increase learning. In Kenya, a program provided tablets to teachers. The tablets had teacher guides, audio and visual aids, and assessments. Although many teachers used the tablets, the impact on student learning was no greater than for teachers who received printed teacher guides, despite a much higher price tag.[5]

Principle 4: Technology to monitor and manage teachers will only work with political buy-in.

Monitoring technology cannot outdo collusion by teachers, school principals, and education officials. Teacher allocation systems only work if teachers participate in them. Many technocratically informed technology programs have failed even to get off the ground because of political opposition. Governments need consultation and communication strategies that ensure that all participants – from administrators to teachers – see value in new interventions.

Technology, when wisely deployed, can provide benefits to teachers and to their students, but success is unlikely if teachers aren't partners in the process.

Applying the Principles

Technology has the potential to help teachers to be more effective in reaching every student. Keeping the principles in mind, here are six promising avenues for teacher-technology partnerships.

1. Coach and mentor teachers

A growing collection of evidence demonstrates the power of coaching and mentoring teachers. In South Africa, in-class coaching was twice as effective at boosting student reading ability as a traditional professional development training at a centralized location.[6] Why? Teachers who received coaching implemented better teaching practices in their classrooms. But in many settings – both high- and low-income – implementing a coaching system at scale proves challenging. The main reason is that for an effective coaching system, you need coaches with content knowledge, pedagogical knowledge, and who have the skill to mentor other teachers effectively. In many education systems, either there aren't enough excellent teachers to serve as coaches or there is a trade-off in removing those teachers from the classroom to serve as coaches. If they're coaching teachers, they're not teaching students.

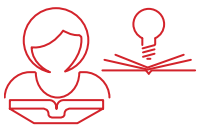
Technology can make it easier to coach many more teachers than traditionally possible. In South Africa, the United States and Uganda, virtual coaches could provide essential support to more teachers.

Technology may be able to help. In the United States, there was no clear difference in effectiveness between a dozen virtual coaching programs tested in different states and a host of in-person coaching programs.[7]

In a pilot in South Africa, one set of teachers received in-person visits from a coach three times a term, whereas another set received coaching virtually with weekly interactions via tablet. Every couple of weeks the "virtual coach" would check in to discuss instructional practice and check progress on the curriculum, and she would send a weekly motivational message to all teachers participating in the virtual coaching. Both kinds of coaching improved student learning equally at the end of a year. The real gain was that the virtual coach could reach far more teachers since she didn't have to travel.[8] Unfortunately, after two more years of the program, teachers with virtual coaches still delivered better student results than teachers without coaches, but in-person coaches delivered far better results on a wider range of skills.[9]

For virtual coaching to deliver sustained benefits, a blended approach may be needed, building rapport between teachers and coaches with at least some in-person visits and then complementing those with virtual contact. While web-based or tablet-based virtual coaches do not observe teachers firsthand to give feedback, they can answer questions and give advice more frequently at lower cost. For some teachers, a virtual coach may feel more respectful of the autonomy of their classroom. On net, virtual coaching may be an effective tool to strengthen teachers. In addition to helping education systems with the challenge of scaling, tablets can help coaches provide better feedback to teachers: In Uganda, tablets that coaches could use to input their classroom observations would then generate feedback which coaches could use to guide their discussions with teachers. After the introduction of tablets, coaches gave more specific guidance to help teachers with reading instruction.[10]

2. Complement teacher content knowledge and pedagogical skills



Evidence from many countries demonstrates that teachers often lack mastery of the content they are supposed to teach.[11] These

shortfalls in teacher knowledge may explain up to one-third of students' failure to keep up with the curriculum.[12] Technology presents opportunities for teachers to increase their content knowledge, together with their pedagogical skills. For example, the Teacher Education in Sub-Saharan Africa initiative provides locally adapted resources used by teachers in several countries, and it gave rise to its own massive open online course (MOOC).[13] Likewise, systems may experiment with teachers using global tools like Khan Academy, Coursera, Wikiversity, or others to improve their mastery of math, science, or other topics. Some of those tools give the added value of demonstrating how to explain challenging concepts in those subjects. In addition to making sure that teachers are aware of these resources, education systems may consider formalizing their use within programs of continuing professional development and accreditation. Although not yet formally evaluated, some U.S. states have used online platforms for "micro-credentialing," in which teachers can learn and gain mastery in individual topics and receive professional recognition for it.[14]

In schools where teachers have limited pedagogical knowledge and content mastery, providing them with detailed lesson guides – sometimes known as scripted lessons – has proven useful across many countries.[15] In addition to providing content support, these guides can improve pedagogy by nudging teachers who might otherwise rely purely on lecture or call-and-response into a range of active learning exercises. In South Africa, teachers received detailed lesson plans via tablet.[16] In Pakistan, a program provided guidance to teachers by tablet as well as screens installed in classrooms to show content that complemented the teachers' lessons.[17] One private company provides entirely scripted lessons via tablet and encourages teachers to follow the script strictly. The data on lesson delivery and evaluation results are then analyzed to improve process.[18] On the whole, providing detailed, practical guidance to teachers can complement the talents and training they bring to the classroom. Using technology to deliver this guidance could make it easier for teachers to incorporate audio and visual aids as well as receive content updates.

3. Create virtual communities of practice for teachers

One motivator for professionals is the opportunity to collaborate with other experts. Despite being in a room filled with people, teaching can feel like a solitary profession, as teachers often have sole charge of students for several hours. Especially in smaller or rural schools, a teacher may be the only one in her discipline, lacking opportunities to compare notes on how to improve. Virtual platforms can help teachers learn from peers, share lesson plans, and engage in a professional community. These communities of practice are feasible even in low-income countries: in Tanzania, a survey of secondary school teachers showed that three-quarters had smartphones, nearly two-thirds used WhatsApp regularly and one-third used Facebook regularly.[19]

In Kenya, teachers of English use Facebook groups both to ask each other content questions and to create social relationships.

Few of these technology-based communities of practice have been formally evaluated, but examples of how teachers use these in practice can demonstrate what they find useful. In Kenya, teachers of English use Facebook groups both to ask each other content questions and to create social relationships.[20] In Turkey, science teachers use WhatsApp groups to share pedagogical content knowledge, teaching practices, and to provide each other with emotional support.[21] In Hong Kong, teachers use WhatsApp to share pictures of their blackboards and student writing so that colleagues can gain ideas and provide feedback.[22] In some cases, these groups are actively organized and facilitated by the education system. In the virtual coaching program implemented in South Africa, coaches facilitated a WhatsApp group in which teachers shared videos of themselves teaching and engaged in friendly weekly competitions to demonstrate excellent teaching.[23] [24]After a similar program in India, teachers reported that they felt

positive peer pressure to perform well, shared problems, and received feedback and guidance, which initially came from the coordinator but ultimately became a collective activity with the other teachers.[25]

These communities of practice don't have to wait until teachers are on the job to begin. In Malaysia, one university encouraged teacher training students to use Facebook to share materials and ideas about teaching. The vast majority of participants enjoyed doing this and said that they planned to continue using it once they entered service as teachers. Students said that participating in the online community of practice made them want to be better teachers.[26] Another preservice training program in Malaysia used WhatsApp to reflect on their teaching practice with other student teachers as well as a supervisor.[27]

4. Manage teachers effectively

Students won't learn if teachers don't make it to school, and technology offers new opportunities to manage teacher attendance, either supplementing traditional methods or replacing them. In Pakistan, a staff of assistants visit schools but use tablets to verify teacher attendance with a biometric device. The program has been used to monitor hundreds of thousands of teachers, and officials have followed up with tens of thousands of absent teachers.[28]

Technology can help to manage teacher performance – but for this to work, teachers have to be on board.

When can efforts to use technology to manage teachers fail? First, education systems or donor partners may be tempted to implement technology beyond what current infrastructure can support. In a low-income environment, an intervention in Haiti sought to use smartphones to monitor teachers' attendance and due to repeated delays and challenges with the software, ultimately failed to be implemented effectively.[29] In a middle-income environment, one urban state of Brazil sought to have teachers use swipe cards when they entered and exited the classroom, but connectivity proved unexpectedly inconsistent and that aspect of the digital program was ultimately scrapped. Second, programs that are purely focused around top-down monitoring may elicit resistance in teachers or even administrators. To draw an example from health, one program encouraged health workers in India to timestamp their arrival to and departure from work, in exchange for monetary incentives. Over time, a number of the timestamp machines were destroyed; some appeared to have been hurled into a wall.[30] Without buy-in over time from teachers and administrators, any program is doomed to fail. Beyond the physical destruction, administrators ultimately increased the exempt days for health workers, taking the teeth out of the program. The tablet monitoring and support program in India described above may offer a solution in giving teachers more than just monitoring: It offers a peer support group as well.

5. Deploy the teacher workforce effectively

Many countries send too many teachers to some schools and too few to others. One study found that more than a quarter of the variation in teacher allocation could not be explained by the number of students.[31] In Ghana, just forty percent of teacher allocation could be explained by enrollments.[32] In Malawi, a new data system is allowing the government to map where all of its teachers are and to classify schools based on the characteristics that make teachers want or not want to be stationed there (road access, electricity, distance to a trading center).[33] A database like this can allow the government to experiment with incentives for teachers and prioritization of understaffed schools and monitor subsequent progress. In Ecuador and Peru, governments are testing electronic systems to provide candidates with better information about schools and communities to improve the fit of teachers to schools.[34]

Technology can help improve teacher working conditions, such as by speeding up salary payments.

6. Increase the attractiveness of the teaching profession

Teachers in many countries face challenging working conditions. Salary payments are delayed, they have limited recourse with grievances, and the stature of the profession is diminished.[35] In what is now South Sudan, a simple electronic payroll system (using Excel) made it possible for teachers to receive their pay at the school rather than having to travel to the county headquarters, dramatically reducing travel time and cost.[36] Electronic systems hold the promise of allowing teachers to submit concerns or complaints either anonymously or discreetly to higher authorities. Finally, traditional technologies like television and radio can boost the reputation of the profession. In Chile, a program used those media to encourage high performing youth to enter the teaching profession. Together with scholarships for top students, the program appears to have increased students' interest in teaching and parents' interest in their children becoming teachers.[37] Technology has the potential to improve both the status and the conditions of the teaching profession.

Technology across these six areas can clearly be complementary. Coaching and mentoring teachers will be even more effective when they have tools to improve their pedagogy (such as structured lesson plans) and gain mastery of the content they are to teach. Systems that improve the quality of life for teachers (improving allocation of teachers and timeliness of salary payments) increase the palatability of systems that monitor teacher attendance and performance. Ultimately, technology can be a valuable complement to the best efforts of an education system's teacher workforce.

Endnotes

[1] Thank you to Melissa Adelman, Cristobal Cobo, Ezequiel Molina, Elizabeth Ninan, Tracy Wilichowski, and especially Tara Béteille for substantive feedback on this note.

[2] World Bank. 2015.

[3] Baker T, Tricario L, Bielli S. 2019. Making the Most of Technology in Education: Lessons from School Systems around the World. Nesta Foundation.

[4] Barrera-Osorio, F, Linden LL. 2009. The Use and Misuse of Computers in Education: Evidence from a Randomized Experiment in Colombia. World Bank Policy Research Working Paper 4836.

[5] Piper B, Simmons Zuilkowski S, Kwayumba D, Strigel C. 2016. Does technology improve reading outcomes? Comparing the effectiveness and cost-effectiveness of ICT interventions for early grade reading in Kenya. International Journal of Educational Development 49: 204-214.

[6] Cilliers J, Fleisch B, Prinsloo C, Taylor S. 2019. How to improve teaching practice? An experimental comparison of centralized training and in-classroom coaching. Journal of Human Resources.

[7] Kraft MA, Blazar D, Hogan D. 2018. The Effect of Teacher Coaching on Instruction and Achievement: A Meta-Analysis of the Causal Evidence. Review of Educational Research 88(4).

[8] Kotze J, Fleisch B, Taylor S. 2019. Alternative forms of early grade instructional coaching: Emerging evidence from field experiments in South Africa. International Journal of Educational Development 66:203-213.

[9] Cilliers J, Fleisch B, Kotze J, Mohohlwane N, Taylor S, Thulare T. 2020. Can Virtual Replace In-person Coaching? Experimental Evidence on Teacher Professional Development and Student Learning in South Africa.

[10] Brunette T. 2019. Technology enhanced coaching improves quality of feedback in Uganda. SharEd: RTI International's shared resources for international education.

[11] Bold T, Filmer D, Martin G, Molina E, Stacy B, Rockmore C, Svensson J, Wane W. 2017. Enrollment without Learning: Teacher Effort, Knowledge and Skill in Primary Schools in Africa. Journal of Economic Perspectives.

[12] Bold T, Filmer D, Molina E, Svensson J. 2019. The Lost Human Capital: Teacher Knowledge and Student Achievement in Africa. World Bank Policy Research Working Paper 8849.

[13] Acquah S, Nyaaba M. 2019. Access, Use and Challenges of Adopting TESSA Science OER by Basic School Science Teachers in Ghana. European Journal of Research and Reflection in Educational Sciences. See also Stutchbury K, Chamberlain L, and Amos S. 2019. Supporting Professional Development through MOOCs: the TESSA experience. Pan-Commonwealth Forum 9.

[14] DeMonte J. 2017. Micro-credentials for Teachers: What Three Early Adopter States Have Learned So Far. American Institutes for Research.

[15] Piper B, Sitabkhan Y, Mejia J, Betts K. 2018. Effectiveness of teachers' guides in the Global South: Scripting, learning outcomes, and classroom utilization. (RTI Press Publication No. OP-0053-1805). Research Triangle Park, NC: RTI Press.

[16] Kotze J, Fleisch B, Taylor S. 2019.

[17] Beg SA, Lucas AM, Halim W, Saif U. 2019. Beyond the Basics: Improving Post-Primary Content Delivery through Classroom Technology. NBER Working Paper 25704.

[18] Anderson J. 2018. The controversial Silicon Valley-funded quest to educate the world's poorest kids. Quartz January 22, 2018.

[19] Liana LH, Ngeze LV. 2015. Online Teacher Communities of Practice: A Proposed Model to Increase Professional Development in Tanzania. Journal of Informatics and Virtual Education 3(1).

[20] Bett H, Makewa L. 2018. Can Facebook groups enhance continuing professional development of teachers? Lessons from Kenya. Asia-Pacific Journal of Teacher Education.

[21] Cansoy R. 2017. Teachers' Professional Development: The Case of WhatsApp. Journal of Education and Learning 6(4).

[22] Hargreaves A, O'Connor MT. 2018. Leading Collaborative Professionalism. Centre for Strategic Education Seminar Series Paper #274.

[23] Kotze J, Fleisch B, Taylor S. 2019.

[24] Alsofrom K. 2020. How video-clip technology works to improve the teaching of reading. Initial findings from case studies in the Early Grade Reading Study II. Wits University.

[25] Nedungadi P, Mulki K, Raman R. 2018. Improving educational outcomes & reducing absenteeism at remote villages with mobile technology and WhatsAPP: Findings from rural India. Education and Information Technologies 23(1): 113-127.

[26] Kabilan MK. 2016. Using Facebook as an e-portfolio in enhancing pre-service teachers' professional development. Australasian Journal of Educational Technology 32(1).

[27] Yee BC, Nawi AM, Abdullah T. 2016. Supporting and Improving Reflective Practice among Pre-Service Teachers Through WhatsApp. Jurnal Pendidikan Nusantara. Special Edition: 53-72.

[28] Ansari A. 2018. Sindh School Monitoring System. Background Note for South Asia Education Report. World Bank.

[29] World Bank. 2015. HAITI: Can Smartphones Make Schools Better? From Evidence to Policy note.

[30] Banerjee AV, Glennerster R, Duflo E. 2008. Putting a Band-Aid on a Corpse: Incentives for Nurses in the Indian Public Health Care System. Journal of the European Economic Association 6(2-3): 487-500.

[31] Majgaard K, Mingat A. 2012. Education in Sub-Saharan Africa: A Comparative Analysis. Washington, DC: World Bank.

[32] Bashir S, Lockheed M, Ninan E, Tan JP. 2018. Facing Forward: Schooling for Learning in Africa. Washington, DC: World Bank.

[33] Asim S. 2018. A Smarter Way to Keep Teachers in Malawi's Remote Schools. World Bank Blogs: Education for Global Development. January 22, 2018.

[34] Elacqua G. 2019. Using new technologies and behavioral economics to improve equity and efficiency in teacher allocation in Latin America. Presentation at the World Bank.

[35] Evans DK, Yuan F. 2018. The Working Conditions of Teachers in Low- and Middle-Income Countries. RISE Conference.

[36] Goldsmith C. 2011. Teachers' pay: making the pipe work; the role of improving teachers' payroll systems for education service delivery and state legitimacy in selected conflict-affected countries in Africa. UNESCO.

[37] Bassi M, Covacevich C. 2012. How can we bring the best talent to the classroom? Preliminary results of Elige Educar. IDB Education Briefly Noted No. 19. Inter-American Development Bank.