Technology for Teaching (T4T)

Evidence Matrix
Annex A to the Guidance Note

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Education

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Abrami, P., Wade, A., Lysenko, L., Marsh, J., & Gioko, A. (2016). *Using Educational Technology to Develop Early Literacy Skills in Sub-Saharan Africa.*	
Reference	Abrami et al. (2016)
Focus	Understand the impact of an interactive web-based literacy programme designed for lower primary level students, teachers, and parents. *Components of the program:* The goal of the TPD was to improve teachers' skills in conducting ABRA classes, and to train them on the effective pedagogy in the teaching of literacy**.** The components included: a 3-day initial training workshop, planning sessions, provision of equipment and materials, weekly ABRA classes for 13 weeks (2 hrs each), weekly web conferences with the trainer, and technical and pedagogical help from staff at the lab site. *Target beneficiaries*: Students. Teachers played the role of a facilitator while students learnt from the ABRA software directly.
Methodology	A randomized evaluation of 6 elementary schools in Mombasa, Kenya. Twelve grade two English teachers and their students from six schools were randomly divided in half: an experimental group (N = 180) where ABRA was part of their English Language instruction and a control group (N = 174) where regular instruction was used. The study highlights program impact on teachers' pedagogical skills and their students' learning outcomes.
Relevant conclusions	- The difference between ABRA and control teachers was significant in self-reported instruction of writing and teaching with computers. - The observation reports suggest that teachers, in addition to reading ABRA stories, used ABRA activities targeting alphabetics (same words, basic decoding, rhyming), vocabulary and comprehension. - The lesson plans showed that teachers attempted to integrate activities targeting different literacy components including phonemic awareness, phonics, fluency, and comprehension. - The videos reveal that ABRA teachers and students grew increasingly comfortable with the technology and software. The teachers' capacity to use the tool to teach the English curriculum also improved: they were able to integrate ABRA to pursue the literacy objectives they had set. - All teachers (n=6) exhibited a positive shift in their attitudes towards using computers to teach literacy, as they saw a marked improvement in student achievement, especially with the slow learners, increases in student motivation and engagement, and greater facility with classroom management. ABRA software was complemented by a plethora of print-based materials that teachers used to implement the early grade reading strategies in their classrooms and that increased student engagement. Complementing a technology intervention with print-based materials can increase the impact of the program.

Agyei, D. (2020). *Integrating ICT into schools in Sub-Saharan Africa: from teachers' capacity building to classroom implementation.*	
Reference	Agyei (2020)
Focus	The teachers were involved in an instructional digital professional development programme targeted at building their capacity to embed ICT into school organizational and curriculum practices. This study sought to evaluate the impact of the ICT- instructional professional development programme in relation to the quality and the extent of the teachers' transfer of the programme's ideas from capacity building to classroom instructional practices.

	Components of the program: Training manuals complemented with facilitator support. *Target beneficiaries*: Teachers and Teacher Educators
Methodology	This study followed up on a selected cohort of 4,945 Science, Technology, English and Mathematics (STEM) teacher participants from six Sub-Saharan African countries namely: Kenya, Tanzania, Uganda, Ethiopia, Ghana, and Nigeria. Data for the study were collected using semi-structured survey instrument and diaries kept to maintain records of activities and events during the period of implementation.
Relevant conclusions	Findings revealed that the teachers expressed general satisfaction with content and processes of the training programme and demonstrated an increase in their ICT proficiencies; however, essential conditions to support transfer of the training's ideas to school level seemed not adequate during the period of implementation.

Beg, S., Lucas. A., Halim, W., & Saif, U. (2019). *Engaging Teachers With Technology Increased Achievement,Bypassing Teachers Did Not.*	
Reference	Beg et al. (2019)
Focus	This paper studies the effects of two implementation models of eLearn, a government program to improve student learning in government middle schools in math and science by providing brief videos of expert content. Only teachers had tablets in the classroom treatment arm, whereas the tablets were distributed to students in the tablet arm. The classroom arm also had LED screens to project the content. *Components of the program:* Teachers received a brief two-day training: one day on how to use the multimedia content and one day on how to incorporate it into a more effective, blended teaching practice. *Target beneficiaries*: Teachers and Students
Methodology	Two RCTs in middle schools in Pakistan to evaluate the effectiveness of eLearn classroom and eLearn tablet arms. To measure whether and how teachers used the classroom technology, the paper used three sources: data collected by the tablets, teachers' survey responses, and students' survey responses.
Relevant conclusions	- The two interventions had the opposite effect. A small augmentation in the way content was delivered during the school day–a short video lecture, lasting on average 9 minutes–transformed student achievement while the same content on a student tablet did not. - In the classroom treatment: Teachers were 33 percentage points more likely to report that they used technology to prepare for lessons and 78 percentage points more likely to report they used technology in the classroom. There were additional positive changes to teaching practices as reported by students and teachers. - Teachers and students in the classroom treatment schools increased their likelihood of being at school. - Across the two interventions, the LED screens appear to have the strongest complementarities with the content on the tablets–without the ability to project the content, teachers could not learn from student feedback about the effectiveness of the teaching style, receive immediate feedback on student understanding through the questions, nor mimic their additional classroom time after these two effective components.

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Berlinski, S. and Busso, M. (2015). *Challenges in Educational Reform: An Experiment on Active Learning in Mathematics.*	
Reference	Berlinski and Busso (2015)
Focus	This paper reports the results of an experiment with secondary school students designed to improve their ability to reason, argument, and communicate using mathematics. *Components of the program:* Teachers received 40 hours of on-site and distance training with virtual support. The training provided teachers with first-hand practice with the active learning approach and familiarized them with the accompanying teacher manuals and the technology. *Target beneficiaries*: Primary: Students and Secondary: Teachers
Methodology	Schools in Costa Rica were invited to participate in the experiment and a sub-set was randomly assigned to one of the following five conditions: control (20 schools), active learning (20), active learning plus an interactive whiteboard (15), active learning plus a computer lab (15), and active learning plus one computer per student (15). Data was collected through classroom observations, teacher and student surveys, and students tests. The analysis looks at the take-up for teachers and on learning and attitudes for students and teachers.
Relevant conclusions	A vast majority of teachers in the treatment arms participated and passed the training. The intervention promoted a new allocation of time in class with more time devoted to exploration rather than practice and a more active classroom experience for the student. Students in the treatment group explained concepts to the class more often, prepared more exercises for others to solve, and frequently discussed possible solutions or arguments with other students. Unfortunately, this did not translate into gains in learning. Students in the control group learned significantly more than those who received treatment. A framework to interpret this result is provided in which learning is the result of student-teacher interaction. The quality of such interaction deteriorated during the intervention.

Bett, H. and Makewa L. (2018). *Can Facebook Groups Enhance Continuing Professional Development of Teachers? Lessons from Kenya.*	
Reference	Bett and Makewa (2018)
Focus	The main aim of the study was to explore the discussions on the Teachers of English (ToE) Facebook Group, and to establish if these discussions had any professional contribution to its members. Majority of the active members in the group were primary and secondary school teachers of English in Kenya. *Components of the program:* A closed Facebook Group–Teachers of English (ToE)–which was formed in 2011 and had a membership of 11,000 at the time of the study (2015) and of 20,592 at the time of writing (2018). *Target beneficiaries*: Teachers
Methodology	The study utilizes an exploratory cross-sectional survey focused on discussions teachers had in the month of February 2015 on the Facebook Group named 'Teachers of English'. A directed content analysis of the 647 posts following Shulman's category of teacher knowledge base was conducted. These categories included content knowledge, general pedagogical knowledge, and curriculum knowledge to name a few. The study focused on posts to the Facebook Group only, and not the attendant comments.
Relevant conclusions	- Overall, the study highlights that the social media platforms can prove useful with regard to teachers' professional development. Teachers on Facebook Groups discussed matters that were professionally rich and

related to their everyday practice as teachers. Closed Facebook Groups seem to provide a promising, cost-effective, and sustainable approach to enhance continuous TPD. In particular, the teacher posts on the closed group evolved around:

- o Content Knowledge (31.8%). Findings seem to suggest that teachers in the study were either less confident on content knowledge, or generally desired to improve in this area.
- o Bonding (27.2%). Members desired to get to know each other more. For example, it was common for members to explain their working contexts and experiences while posting on the Group. Consequently, relationships among active members in the Group improved.
- However, it would be misleading to suggest that all the members were beneficiaries of the discussions on the Facebook Group. Those who would benefit the most from the Group are those who are active on the platform.

Blimpo, M., Gajigo, O., Owusu, S., Tomita, R., & Xu, Y. (2020). *Technology in the Classroom and Learning in Secondary Schools.*	
Reference	Blimpo et al. (2020)
Focus	This paper studies the impact of a computer-assisted learning program on learning outcome among high school students in The Gambia. The program uses innovative technologies and teaching approach to facilitate the teaching of mathematics and science. *Components of the program:* 2-week training at the beginning, a weeklong follow-up training after 4 months, another follow-up training, and 10-day additional training for teachers. A subset of the trained teachers became master trainers and trained the next cohort of teachers both in the Gambia and other countries. *Target beneficiaries*: Teachers
Methodology	16 treatment and 16 control schools were part of the study in The Gambia with 252 students from grade 9-12 in the treatment group. Qualitative surveys as well as focus group interviews were conducted with teachers to understand their perceptions of the technology, whether any implementation challenges occurred, and to what extent the challenges would help explain the results obtained in the rigorous quantitative evaluation.
Relevant conclusions	- Teachers indicated that the program changed their teaching practice in that the nature of the program required them to spend more time preparing for their classes. - Similarly, the teachers indicated that the program forced them to spend more time going through the same material relative to their traditional teaching methods. - Using local teachers trained in the PSI-PMI methodology to train subsequent cohorts of teachers can lead to substantial cost savings. - Teachers' enthusiasm for the intervention (i.e., teachers saw value in the program) helped in the success of the intervention (researchers' conjecture).

Bruns, B., Costa, L., & Cunha, N. (2017). *Through the looking glass: can classroom observation and coaching improve teacher performance in Brazil?* The World Bank.	
Reference	Bruns et al. (2017)

Focus	Understand the impact of a program combining classroom observation feedback and access to expert coaching on teacher performance of in-service secondary school teachers, where self-led learning is accessed both as print and online, and coaching support, both in person and via Skype. *Components of the program:* performance feedback on teacher practice, self-help materials, face-to-face interaction with high-skill coaches, expert coaching support via Skype. *Target beneficiaries*: school-level pedagogical coordinators (who provided feedback to teachers and were supported by expert coaches).
Methodology	A randomized evaluation of 350 secondary schools in Ceará, Brazil using a 'low-inference classroom observation instrument' (Stallings): measuring program impact on teachers' classroom practice and their students' learning outcomes.
Relevant conclusions	The combination of classroom observation feedback and expert coaching delivered in person and online raises teacher effectiveness. The program: − increased teachers' use of class time for instruction (0.25 sd). − increased teachers' use of questions during their lessons. − improvements in schools' average results were achieved by reducing the within-school variation in teacher practice. Coaching delivered by Skype kept the costs of the program low and produced cost-effective impacts on learning. Digitizing classroom observations (using tablets as opposed to paper) led to higher inter-rater reliability and lower errors in the observation form.

Cardim, J.; Molina-Millán, T.; & Vicente, P. (2021). *Can Technology Improve the Classroom Experience in Primary Education? An African Experiment on a Worldwide Program.*	
Reference	Cardim et al. (2021)
Focus	The paper studies the impact of a highly innovative program that combines three important components of successful Computer-assisted Learning (CAL) programs: instruction tailored to students' needs, the inclusion of teachers as the main intermediaries in the implementation of the CAL - i.e., securing substantial interaction between teachers and students -, and the possibility of undertaking activities in student groups through the CAL package. *Components of the program:* *Target beneficiaries*: Teachers, Principals, primary level students
Methodology	A randomized field experiment to test the impact of ProFuturo in Angola. From the 42 primary schools in Luanda that were selected to receive ProFuturo, 21were randomized to receive it in the beginning of 2018, and 21 were assigned to start using it in 2019. The paper employs a comprehensive set of measurements, including detailed school principal, teacher, student, and household surveys, three rounds of class systematic observation, student standardized tests in Mathematics, Portuguese, and Science, as well as administrative data from schools and the program.
Relevant conclusions	A year after the program was introduced, it was found that: - Teachers in the treatment group are more likely to employ computer during their lectures (0.09 sd) - ProFuturo was effective at decreasing teachers' absenteeism by 0.69 sd as compared to previous month and by 0.4sd during the complete school year - Positive effect of 0.23 sd on the motivation of teachers reported by the enumerators that observed classroom teaching in the final round.

	- Short-term effects on increasing passive teaching (e.g., monitoring). However, these short-term effects do not last and are substituted by positive effects on active teaching, namely through practice and drill (1.2 percentage points), and on improved knowledge (0.35 sd) in the last round of class observations - Negative treatment effects on teachers' performance in standardized test scores assessing knowledge of Portuguese.

Cilliers, J., Fleisch, B., Kotze, J., Mohohlwane, N., Taylor, S., & Thulare, T. (2021). *Can Virtual Replace In-person Coaching? Experimental Evidence on Teacher Professional Development and Student Learning in South Africa*

Reference	Cilliers et al. (2021)
Focus	To experimentally compare on-site with virtual coaching of South African teachers. Teachers were trained on early grade reading strategies – phonics, phonemic awareness, group guided reading, vocabulary development, shared reading and writing. *Components of the program:* Initial training, orienting teachers to the tablets, and regular support from coaches, which included ongoing interactions over WhatsApp for the virtual arm. *Target beneficiaries*: Teachers
Methodology	A randomized evaluation of elementary schools in two districts in the Mpumalanga province in South Africa. Randomly assigned 100 schools (50 of which to virtual arm) to receive either virtual or on-site coaching support, and another 80 schools to the control, where teachers could still receive business-as-usual professional development support provided by government. In addition to the impact on students, the study measures teacher impact on Home Language (HL) and English as Second Language (ESL) through classroom observations.
Relevant conclusions	- While on-site coaching is more costly than virtual coaching, given the large differences in student learning outcomes, on-site coaching turns out to be more cost effective. For every USD 100, on-site coaching increased oral language proficiency by 0.16 sd, and reading proficiency by 0.07 sd. For every USD 100, virtual coaching increased oral lang proficiency by 0.07 sd and had no impact on reading. - Classroom observations show that on-site coaching improved teaching practices, and virtual coaching led to larger crowding-out of home language teaching time. Implementation and survey data suggest technology itself was not a barrier to implementation, but rather that in-person contact enabled more accountability and support. - Most likely, a more effective coaching program should involve a combination of some initial face-to-face coaching to establish the relationship, followed up with virtual coaching to sustain the instructional practice change.

Hennessy, S., Haßler. B., & Hofmann R. (2016). *Pedagogic change by Zambian primary school teachers participating in the OER4Schools professional development programme for one year.*

Reference	Hennessy et al. (2016)
Focus	Reports on a trial of a pioneering, multimedia programme supporting interactive mathematics and science teaching using open educational resources and classroom digital technology, where available. The paper highlights impact of the program on teachers' pedagogical skills was analyzed through: lesson

	observations and recording; interviews; post-lesson audio reflections and teacher portfolios.
	Components of the program: Teachers participate in 28 weekly sessions (1-2 hours) for training on different pedagogical techniques to teach math and science using technology. Teachers were shown videos of different techniques and shared relevant OERs in the session. This was followed by a teacher discussion about ways to implement the strategy in their classroom. Additional components included audio reflections and portfolios detailing teacher reflections and resources used.
	Target beneficiaries: Teachers
Methodology	A qualitative analysis of a weekly program that ran for one school year with 12 teachers in a low-resourced primary school (grades 4-6) in Lusaka, Zambia. The study examined the impact on teachers' thinking and classroom practices. Data were derived from observations, lesson and workshop recordings, teacher interviews, portfolios and audio diaries.

Relevant conclusions	- Through a teacher-led workshop approach and trialing new pedagogical strategies, teachers raised their expectations of pupils, adapted to learners' knowledge levels, used more practical and group work, and integrated technology use. In particular:
	  o Pedagogic Change: There are two main pedagogic changes that we distilled from the teachers' accounts: making space for more pupil-led talk and exploration of topics and ideas and building on pupils' prior knowledge.
	  o Teachers' perspectives on the impact of pedagogic changes for pupils' learning and engagement: The pedagogic changes are described in the teachers' accounts as having affected various improvements in the pupils' education, and as impacting pupil enjoyment, classroom atmosphere, pupils' engagement in classroom learning and actual learning.
	- Teachers reported that low performing students struggled with the new teaching practices. The authors conjecture that this could be because emphasizing pupil initiative and independence made the struggles of weaker pupils more visible to the teachers.

Hoop, T., Ring, H., Siwach, G., Dias, P., Tembo, G., Rothbard, V., & Toungui, A. (2020). *Impact of e-Learning Technology and Activity-Based Learning on Learning Outcomes: Experimental Evidence from Community Schools in Rural Zambia.*

Reference	Hoop et al. (2020)
Focus	The study presents experimental evidence on the impact of a multi-faceted eSchool360 program that integrates technology into education, provides ongoing teacher training and professional development, includes community ownership, and offers free primary education.
	Components of the program: Teacher coaching, observation of teacher practices in the classroom, and creating community ownership. Additionally, locally hired teachers received weekly training focused on using technology and enhancing their pedagogical skills.
	Target beneficiaries: Students and Teachers
Methodology	A cluster-Randomized Controlled Trial (RCT) across 3 districts in Zambia in which 63 eligible schools were randomly assigned either to receive the eSchool360 program (30 treatment schools) or not to receive the program (33 control schools).

Relevant conclusions	- Mixed-methods evidence suggested the positive effects were primarily driven by increase in school enrolment, improvements in the quality of education, increases in school attendance for both teachers and children, and strong fidelity of program implementation. - Teachers were regularly present at school, used the participatory pedagogical approaches on which they were trained (such as putting students into small groups and inviting them to actively participate in the lesson), adhered to the curriculum prescribed in the curriculum map, and used technology (tablets and projectors) as intended. - Improvements in teacher knowledge and practices such as familiarity with innovative teaching methods (activity-based teaching, using technology in the classroom). Their commitment to teaching seemed to increase as well, as indicated by their attendance numbers and follow-ups when students were absent. The difference was felt by parents, supervisors, and students. Supervisors noted that the trainings increased teachers' capabilities and confidence in the classroom.

Johnston, J. and Ksoll, C. (2017). *Effectiveness of Interactive Satellite-Transmitted Instruction: Experimental Evidence from Ghanaian Primary Schools.*	
Reference	Johnston and Ksoll (2017)
Focus	The study estimates the impact of a program that broadcasts live instruction via satellite to rural primary school students. Instructors provided math and English lessons to classrooms in the treatment group. The model is interactive, and students in satellite classes could communicate in real time with their remote teachers. *Components of the program:* In-person facilitators received a 5-day residential training in classroom management, pedagogy, and student-centered learning at the outset of the program and attended a 4-day refresher training at the start of the subsequent academic year. The facilitators also received 2-day training before the start of each term. Additionally, the program trained the studio teachers (continuous coaching) and school heads (operational support). *Target beneficiaries*: Primary: Students and Secondary: Teachers
Methodology	A cluster randomized controlled trial of a program that equipped classrooms in 70 randomly selected Ghanaian schools with the technology required to connect to a studio in Accra. An additional 77 schools served as the control.
Relevant conclusions	- No impact on attendance and classroom time-on-task (as measured through unannounced classroom observations), suggests that these gains may result from improved instructional quality rather than from increased instruction time. - Anecdotal evidence from qualitative interviews suggests that new teaching methods and approaches were introduced into classroom instruction, not just through the presence of the studio teacher, but also through learning on the part of the facilitators through their interactions and observations of studio teachers.

Jukes, M., Turner, E., Dubeck, M., Halliday, K., Inyega, H., Wolf, S., Zuilkowski, S., & Brooker, S. (2017). *Improving Literacy Instruction in Kenya through Teacher Professional Development and Text Messages Support: A Cluster Randomized Trial.*	
Reference	Jukes et al. (2017)

Focus	The study evaluated the HALI program to improve literacy instruction on the Kenyan coast using training workshops, semi-scripted lesson plans, and weekly text-message support for teachers to understand its impact on students' literacy outcomes and on classroom practices leading to those outcomes. *Components of the program:* A 3-day initial workshop, a problem-solving workshop four months after the commencement of the school year, and a 2-day refresher training the following school year. *Target beneficiaries*: Teachers
Methodology	The evaluation involved a cluster-randomized trial (Brooker et al., 2010), in which 101 public primary schools in Kenya were randomly allocated to one of four arms receiving either: (a) the malaria intervention alone; (b) the literacy intervention alone; (c) both interventions combined; or (d) neither intervention. Children from Grade 1 were randomly selected and followed up for 24 months to assess the impact of the interventions.
Relevant conclusions	- Classroom materials were well received, and teachers found the weekly text messages to be a good source of new teaching ideas. - Text messages were successful in creating a sense of community, making teachers feel valued and listened to, and being an important mechanism for feedback and improvement of the intervention. This was possible because teachers were given the opportunity to respond to text messages - Teachers identified changes in their abilities to respond to student needs. Teachers also started using more written text at the expense of oral presentations and also used illustrations and visual materials that contained no visual text. Furthermore, teachers appeared to be more confident to comment on student growth and monitor progress. The study found improvements in learning that were large when compared with many other types of intervention. But projects that use in-person coaching have typically found larger improvements. This suggests that coaches cannot be replaced by mobile phones, but coaching can certainly be supplemented by technology to reduce costs and to provide additional expertise for struggling coaches. Text messages also have the advantage that they can provide support in areas that people will not or cannot reach.

Kafyulilo, A., Fisser, P. & Voogt, J. (2016). *Teacher design in teams as a professional development arrangement for developing technology integration knowledge and skills of science teachers in Tanzania.*	
Reference	Kafyulilo et al. (2016)
Focus	The study investigated the impact of teacher design teams as a professional development arrangement for developing technology integration knowledge and skills among in-service science teachers. Technological pedagogical content knowledge (TPACK) was used as a conceptual framework for developing teachers' knowledge and skills in integrating technology in science teaching. *Components of the program:* Teacher design teams described as at least two teachers, from the same or related subjects, worked together on a regular basis, with the goal to (re)design and enact (a part of) their common curriculum. The intervention program consisted of a 10-day introductory workshop (6 hrs each), lesson design in design teams (twice / thrice a week for about 2 hrs each), lesson implementation in the classroom, and reflection (about 1 hr each) on the designed and implemented lesson. *Target beneficiaries*: Teachers

Methodology	A qualitative analysis of a program conducted at a secondary school in Tanzania, where 12 in-service science teachers participated in a workshop about technology integration in science teaching and worked in design teams to prepare technology-enhanced biology, chemistry and physics lessons. Data were collected before and after the TPD by using questionnaire, interview and observation data. Focus group discussion and reflection questionnaire data were used to assess teachers' experience of working in design teams at the end of the TPD.
Relevant conclusions	- Findings showed an increase in teachers' technology integration knowledge and skills between pre- and post-measurements. Collaboration in design teams had the potential for teachers to share knowledge, skills, experience and challenges related to technology-enhanced teaching. - School principal buy in was critical, as teachers had to spend time together in design teams to create lessons.

Lautz-Cauzanet, E. & Bruillard, E. (2021). *From Connection to Community. A Medium-Term Contribution of a Mobile Teacher Training in Madagascar – the Genesis of a Social Network.*	
Reference	Lautz-Cauzanet et al. (2021)
Focus	This article presents a Social Network Analysis (SNA) of the medium-term contributions of a mobile phone supported teacher training project. *Components of the program:* Teachers were provided with mobile phones containing audio files and on that same phone, would receive a daily quiz question related to their training content. All trainees gathered every 3 months for 3 days, whilst also meeting every month in small groups in their nearby villages with an assigned tutor. *Target beneficiaries*: Teachers
Methodology	Social network analysis with a mixed-method approach was conducted, making use of qualitative and quantitative datasets covering both the training period and the aftermath (2 years) of the project in Madagascar.
Relevant conclusions	The results indicate that a mobile supported teacher network has been formed by former participants and sustains autonomously. The mobile phone plays a hybrid role, both as a tool for communication whilst also transforming relationships, leading to teachers identifying as a community which in turn generates professional practices such as collaboration and innovation. Finally, the SNA also allowed for the identification of network leaders whose skills, competencies, and activities contribute to the value and sustainability of the network.

Lehrer, K., Mawoyo, M., & Mbaye, S. (2018). *The impacts of interactive smartboards on learning achievement in Senegalese primary schools.*	
Reference	Lehrer et al. (2018)
Focus	The study evaluates the impact of Project Sankoré a digital classroom with an interactive whiteboard consisting of the whiteboard, a computer, a data projector and digital resources for grades 1 and 2 of primary schools in Senegal on student learning outcomes. *Components of the program:* 2-5 days of initial training to use the Open Sankoré resources; Four training sessions were organized for the ministry of education officials as well. The principals also received training. *Target beneficiaries*: Teachers

Methodology	The research methodology uses a difference-in-difference evaluation strategy to investigate the intention-to-treat impacts of the project (student learning outcomes). The study evaluates the impacts of the Sankoré equipment in grades 1 and 2 of primary school in Senegal, in addition to, utilizing qualitative evidence on teacher training.
Relevant conclusions	Though much of the qualitative evidence suggested difficulties in the implementation of the project, including in the training of teachers and technicians and in repairing broken material, the quantitative evidence suggests, on average, large positive impacts of the program on student learning, primarily for mathematics in urban schools. Where kits were being utilized, there were positive reports of improved student and teacher motivation due to: - Teachers indicated that time was saved in preparation of the lessons as all content was on the kit; students did not have to clean the blackboard. - Pedagogy change: High value was placed on the whiteboard's visualization capabilities. teachers also saved time drawing on the board (or in some cases finding the images) as clear images from the kits were helpful. The clear images from the kit made students understand more quickly which meant the teacher could do more exercises during the lesson. - These gains were not sustained over time due to issues such as unscheduled power outages or permanent technical challenges.

Mendenhall, M., Skinner, M., Collas, S., & French, S. (2018). *Expanding Teacher Support through Mobile Mentoring in Kakuma Refugee Camp: Benefits and Challenges.*	
Reference	Mendenhall et al. (2018)
Focus	The study shares findings from a mobile mentoring component of a teacher professional development initiative implemented in Kakuma refugee camp in Kenya and reflects on the benefits, challenges and lessons learned from the perspectives of the key stakeholders involved, namely the global mentors, mentees (refugee and Kenyan teachers), and project management team. *Components of the program:* The mentor provided regular support over WhatsApp for six months to a group of 4-5 teachers. Mentorship entailed sharing experiences, problem-solving, and offering teaching tips directly connected to the training, which were reinforced by a mobile mentoring curriculum. Teachers also participated in a WhatsApp group with all of the members from their training cohort, which served as a platform for teachers to exchange information and ideas with a larger group of approx. 30 teachers. *Target beneficiaries*: Teachers
Methodology	A qualitative analysis of teacher professional development initiative implemented in Kakuma refugee camp in Kenya. The article draws on data collected during the first year of implementation of the *Teachers for Teachers* initiative. The WhatsApp chats for the 130 teachers who participated in the first mentoring groups, along with 33 global mentors, were coded and analyzed based on key themes related to the TPD model.
Relevant conclusions	Perceived Benefits of Mobile Mentoring: - Connecting people and resources inside and outside of the refugee camp - Sharing, testing, and improving teaching strategies

	- Building confidence and motivation (of teachers and mentors) through mobile mentoring The study reveals that while mobile technology can positively impact a teacher's professional development in meaningful ways, it does not function in isolation. Factors such as infrastructure and the quality of the partnerships are out of the initiative's control and contribute to a number of challenges not directly related to a program's design, yet nevertheless affect its impact and sustainability. This research also shows that the use of mobile technology for teacher professional development in crisis contexts offers intertwined benefits and challenges. For example, while the use of mobile phones was shown to be beneficial because of the immediacy in global mentor and teacher responses, this has also proven to be inconsistent depending on group dynamics or challenges with infrastructure such as a weak network or inconsistent electricity.

Motteram, G., Dawson, S., & Al-Masri, N. (2020). *WhatsApp supported language teacher development: A case study in the Zataari refugee camp.*	
Reference	Motteram et al. (2020)
Focus	This paper explores the possibilities and challenges of using the social media tool WhatsApp to support language teacher development in the Zataari refugee camp in Jordan. *Components of the program:* WhatsApp group chats which were active for roughly 7 months *Target beneficiaries*: Teachers
Methodology	The paper takes a sociocultural perspective on teacher development where WhatsApp is a mediating tool in the broader sociocultural landscape. A thematic analysis of the postings and exchanges from the WhatsApp group is performed.
Relevant conclusions	Three main uses of WhatsApp chat: for interpersonal interactions, for professional development, and for organizational purposes. The analysis suggests the WhatsApp group contributed to the teachers' English language knowledge, provided a platform for them to share and discuss issues related to the challenges of their particular context, enabled them to contribute to the development of some teaching materials and begin to address some of the issues they had in a meaningful way.

Naik, G., Chitre, C., Bhalla, M., & Rajan, J. (2020). *Impact of use of technology on student learning outcomes: Evidence from a large-scale experiment in India.*	
Reference	Naik et al. (2020)
Focus	The intervention analyzed SAMIE (Satellite and Multimedia Interactive Education) program to deliver content in government schools in rural Karnataka. A central studio in Bengaluru was used to transmit live lectures that cover State Board syllabus for English grammar, Math and Science for grades 5 to 10. *Components of the program:* Manuals were sent to schools and teachers were provided basic training for 1-2 hrs through the tele-education system. Apart from this basic training, the intervention also provided basic training to moderators (subject experts who responded to student doubts over the phone). *Target beneficiaries*: Primary: Students and Secondary: Teachers
Methodology	A large-scale experiment in 1823 schools across 18 districts in the state of Karnataka was conducted. The randomization comprised of 1000 schools as treatment and 823 schools as control. As part of the intervention, multimedia

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	teaching aids in Math, Science and English Grammar was used in classrooms for grades 5-10 by trained teachers. The paper evaluates the intervention based on a sub-sample of 143 schools which were randomly selected from the larger sample.
Relevant conclusions	- Quantitative impact on teachers in classroom is not reported, but authors find the use of tele-education classes to be beneficial to teachers. Specifically, as noted in the paper: - - Many teachers use the tele-education classes to update their knowledge, teaching techniques, and to revise concepts of newly introduced topics. - The intervention can serve as a channel for continuous teacher training where teachers learn by observing the lectures conducted under the programme – all without making any additional demands on the state administrative machinery for teacher retraining. - Transmitting live lectures directly to the classroom and retaining the traditional classroom practices allowed the teachers to focus their efforts on integrating the lessons covered in the intervention lectures with their classroom teaching rather than on the technical aspects of creating and collating content. All this kept the teacher retraining requirement to a minimum. - Technology adoption can increase if it does not involve a substantial change in pedagogical practices. The intervention retained the central role of the teacher in the teaching - learning process and the instructional mode of teaching but with an additional component of multi-media usage, and therefore had a higher probability of being accepted at the school level (authors' conjecture). - Local teachers bought into the program because the intervention took only one third of their instructional time, so they did not feel replaced.

Nedungadi, P., Mulki, K., & Raman, R. (2018). *Improving educational outcomes & reducing absenteeism at remote villages with mobile technology and WhatsApp: Findings from rural India.*	
Reference	Nedungadi et al. (2018)
Focus	This paper presents the AmritaRITE (Rural India Tablet Education) monitoring methodology using WhatsApp along with other apps for monitoring remote teachers and classrooms. The main objective of the research study was to assess the ability of this methodology, using mobile tablet technology for monitoring and supporting teachers, to reduce both teacher and student absenteeism and improve student performance. *Components of the program:* Teachers were trained to use WhatsApp installed on their tablets. The tablets also support ongoing training of teachers as well as sharing of content and experiences. The central coordinator helps plan lessons, sends lesson plans and short instructional videos, and provides feedback on teaching and learning in the classroom after watching class videos. *Target beneficiaries*: Teachers
Methodology	Qualitative: As part of an ongoing project involving schools and educational centers in rural areas spread across 21 Indian states, the study coded and analyzed nine months of messages (n = 8968), both photographs and texts, posted by 26 participants. This study investigated how implementation of two simple, accessible technologies could not only reduce absenteeism but also increase teachers' effectiveness and improve student performance.
Relevant conclusions	- The AmritaRITE method has increased teacher attendance, peer learning, and adherence to planned activities. Feedback suggests that it boosts their

interest and engagement in teaching as they can share new learning resources for the students with the aid of technology. This helps teachers improve performance by receiving learning modules from experts, getting immediate answers to their queries and sharing ideas with peers, thus providing both pedagogical knowledge and classroom strategies.
- This model functions well in rural settings where there is poor internet connectivity and lack of supporting infrastructure. Remote schools can easily adopt this tablet-based model to reduce teacher absenteeism, improve teaching techniques, improve educational resources, and increase student performance.

Oakley, G., Scarparolo, G., & King, R. (2018). *An Evaluation of ELLN Digital Technology-Supported Teacher Professional Development on Early Language, Literacy, and Numeracy for K-3 Teachers.*	
Reference	Oakley et al. (2018)
Focus	This report describes the study of the Early Language, Literacy, and Numeracy Digital (ELLN Digital) teacher professional development (TPD) program pilot. The ELLN Digital course covers both literacy and numeracy teaching in the early years, however, this evaluation study focused on literacy teaching only. *Components of the program:* a) Self-study and b) Communities of practice through participation in learning action cell (LAC). *Target beneficiaries*: Teachers
Methodology	A mixed methods study of the ELLN Digital TPD program pilot in the Philippines, which took place in 2016-2017. 4,040 teachers enrolled in the pilot, but the evaluation study was conducted with a sample of 10% (n =434) of the teachers. The study aimed to evaluate the effectiveness of the TPD, a blended learning version of the established face-to-face ELLN course. Data were collected through multiple methods, including an end-of-course survey; pre- and post-course assessments of teacher pedagogical and content knowledge, and teacher strengths and needs; interviews, focus group discussions, and observations in six case study schools.
Relevant conclusions	- The findings suggest that, overall, the ELLN Digital course was beneficial to teachers in many ways, and that the blended model of self-paced courseware and communities of practice (CoP) in the form of LACs was effective.
	- Analysis of the pre-and post-course content and pedagogical knowledge (CPK) tests indicated that, overall, there was significant improvement in overall content and pedagogical knowledge of teachers.
	- Analysis of qualitative data also indicated valuable improvements in teachers' pedagogical and content knowledge, but with emphasis on the former. The main aspects of pedagogical knowledge and pedagogical content knowledge that participants felt had improved were: (1) Knowledge about teaching strategies; (2) Knowledge about assessment techniques; (3) Knowledge about differentiated instruction.
	- Many teachers reported that because of the ELLN Digital course, they were moving away from the traditional or conventional teacher-centered teaching style to include more games, storytelling, and active student participation.
	- Support from the school leadership was cited as a supporting factor for the successful implementation of the course by teachers.
	- Lack of adequate resources affected implementation (LAC venue, technology, classroom resources, and snacks): Teachers reported that

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required classroom materials needed to implement the learning from the training was not adequately provided and hindered implementation. Teachers also faced issues accessing the material on CD. Some teachers also raised the issue of not being able to find adequate space in their schools to conduct LACs.

- Size of the LAC matters: Teachers pointed out that some LACs were too large to have any meaningful discussion. A cap on the number of members per LAC may help in making these sessions more effective.

Piper, B., Jepkemei, E., Kwayumba, D., & Kibukho, K. (2015). *Kenya's ICT Policy in Practice: The Effectiveness of Tablets and E-readers in Improving Student Outcomes.*	
Reference	Piper et al. (2015)
Focus	The Kenyan government designed the Primary Math and Reading (PRIMR) Initiative to capitalize on the nexus between educational outcomes and ICT in the context of a program developed to improve the quality of literacy and numeracy outcomes for children in grades 1 and 2. This paper summarizes the findings of the effects of the ICT investments under PRIMR. *Components of the program:* The Teachers' Advisory Centre (TAC) tutors in each of the three treatment groups received 15 days of teacher training. Teachers participated in a total of 10 days of training led by the TAC tutors, supported by the PRIMR technical teams. *Target beneficiaries*: Teachers and Supervisors
Methodology	The Primary Math and Reading (PRIMR) Initiative implemented a randomized controlled trial of three ICT interventions to enhance learning outcomes: tablets for instructional supervisors, tablets for teachers, and e-readers for students.
Relevant conclusions	- All three treatment groups had better performance on the key variables than did the control group, and the differences were statistically significant. The results showed that the TAC tutor tablet and teacher tablet interventions had larger impacts on these key measures than the e-reader interventions, although the e-reader group also saw an increase in the proportion of pupils reading at the appropriate benchmark. Even more, The TAC tutor group consistently displayed higher effects compared to the other two groups. This could be explained by the effort made by various TAC tutors to supervise and support teachers as they undertook the ICT intervention. It might be that the additional impact shown in the TAC tutor group was due to the fact that teachers were required simply to teach better, rather than required to utilize ICT, which for them proved a challenge. - Providing the ICT at higher levels of the education system—that is, tablets for TAC tutors rather than for teachers or pupils—limits cost as well as targets the ICT on a more manageable instructional improvement problem.

Pouezevara, S. and Khan, R. (2007). *Learning Communities Enabled by Mobile Technology: A Case Study of School-Based, In-Service Secondary Teacher Training in Rural Bangladesh.*	
Reference	Pouezevara et al. (2007)
Focus	The goal of the study is to enhance the quality of secondary education in Bangladesh by improving teaching quality. The study's aims were (i) to highlight promising models of ICT integration and best practices, (ii) to identify drivers and barriers to successful ICT integration, and (iii) to share lessons learned, with a specific focus on rural and remote areas.

	Components of the program: 6-week distance-mode training: A blended approach to providing continuous PD via distance learning was adopted. A combination of print-based learning materials; a face-to-face orientation workshop; synchronous, on-demand voice communication; asynchronous SMS text messaging; video and photo sharing; and school-based group discussion activities were all incorporated into the design of the study. *Target beneficiaries*: Teachers and Teacher Trainers
Methodology	The research study is exploratory and descriptive. The investigation style reflects quasi- experimental and case study approaches. A control group of teachers undergoing standard face-to-face training were compared with results of the study group using the smartphone for distance-mode training. The data for the study was collected in several phases during the site assessment, training and closing workshops, and monitoring visits.
Relevant conclusions	Analysis of various evaluation instruments indicates that trainees did learn at least as well as through face-to-face training. In particular, analysis of pre- and post-test scores shows that the study teachers did improve their scores after the training program in both Bangla and math. Head teachers also report having observed changes in classroom practice, and the trainees themselves report that a more learner-centered and participatory approach to teaching and learning had been created. Seventeen of 18 trainees reported on the post-training evaluation questionnaires that the training program brought positive changes in the teaching and learning in the classrooms. Specific changes mentioned were: - Understanding the importance of lesson plans, inclusive teaching concept, participatory and collaborative approach, and classroom management. - Becoming aware of personal development, problem-solving skills and evaluation, learner attitudes, and learner-centered learning. Head teachers were critical to success. They took it very seriously as a professional development opportunity for the whole school, and it was only on their initiative that the teachers came together on a regular basis.

School-to-School International (STS). (2017). *GraphoGame Teacher Training.*	
Reference	STS (2017)
Focus	The goal of the GraphoGame Teacher Training Service (GG-TTS) project was to improve the ciNyanja literacy skills of Grade 2 students by providing struggling readers with GG and teachers with online training focused on literacy instruction in mother tongue languages and techniques to support struggling readers. *Components of the program:* In-person training on GraphoGame (GG) and how to use it in their classroom. Additionally, teachers attended a 2-day, in-person training on the GG-TTS teacher training website; they then used the website to complete online training on techniques to teach literacy in mother tongue languages and support struggling readers. *Target beneficiaries*: Primary: Students and Secondary: Teachers
Methodology	Mixed Methods Study: Thirty schools in a rural district in the Eastern province of Zambia were selected. To answer research questions, assessment data was collected at three time points throughout the project: baseline, midline, and endline. Additionally, interview sample data was used to supplement the assessment data.

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Relevant conclusions	Teachers in intervention schools appear to feel that their teaching methods are better addressing student reading problems at endline, as over 62 percent say their methods are addressing student reading problems "very well." This proportion increased from about 29 percent at the baseline period. In contrast, teachers at comparison schools reporting "very well" on this question was reduced from about 37 percent at baseline to about 27 percent at endline. Overall, teaching practices varied across classrooms, and only on the designing your own literacy game composite was the maximum observational score equal to the maximum score possible. This indicates that although teachers may have been exposed to content through the website, it is unclear if teachers effectively incorporated what they learned into their classroom practices.

Shaheen, R., Walsh, C., Power, T., & Burton, S. (2013). *Assessing the impact of large-scale teacher professional development (TPD) in Bangladesh: English in Action (EIA).*	
Reference	Shaheen et al. (2013)
Focus	This paper demonstrates an innovative school-based teacher development (SBTD) model, designed to reach large scale (80,000 teachers and 10 million students by 2017) and impact positively on teachers' communicative language teaching (CLT) practices, increasing both the English proficiency of teachers and students. *Components of the program:* 12-18 months of continuous professional development including face-to-face meetings, peer support, head teacher support, cluster meetings, and audio-visual (AV) materials on mobile phones. The AV materials were complemented with other support in-school support materials such as print teacher guides. *Target beneficiaries*: Teachers
Methodology	Large-scale quantitative surveys using a classroom observation focusing upon the use of English by teachers and students. The model is currently being used with 4,000 teachers after an initial pilot period with 690 teachers (supported by 59 Teacher Facilitators) and 132,700 students (2008–2011). The paper illustrates, using the findings from studies conducted for the pilot phase intervention, the successful impact on teachers and students after participating in the project for just one year.
Relevant conclusions	SBPD (School-based PD) complements the AV materials by combining the 'trainer in your pocket'/ AV materials with cyclical face-to-face cluster meetings (beyond school support) which led to peer learning. Presently, the SBPD has impacted positively on both teachers' and students' lives by significantly increasing their English language competence. Teachers have learned and embodied new communicative language teaching (CLT) practices and adopted robust student centred teaching approaches that have transformed classrooms across Bangaldesh.

Slade, T., Kipp, S., Cummings, S. & Nyirongo, K. (2018). *Short Message Service (SMS)–Based Remote Support and Teacher Retention of Training Gains in Malawi.*	
Reference	Slade et al. (2018)
Focus	The chapter critically reviews the design, implementation, and evaluation of an attempt to study an exploratory short message service (SMS)–based intervention conducted under the auspices of the United States Agency for International Development's (USAID's) Malawi Early Grade Reading Activity (EGRA).

| | Components of the program: 49 SMS messages (an average of seven messages per week) over a 7-week span following teacher trainings. The program included regularly occurring training of teachers in phonics-based instructional methodologies and support for instructional coaching.
Target beneficiaries: Teachers |
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| **Methodology** | The EGRA program team developed and deployed an assessment tool with the goal of measuring the effectiveness of professional development activities. The instrument was divided into three sections, each focusing on one of three salient aspects of the EGRA intervention and the Malawian educational context: teaching according to the lesson cycle, classroom management in a context of large classes, and utilization of supplementary readers. |
| **Relevant conclusions** | Effect of SMS on Teacher Knowledge Retention:
Teachers recorded high scores on the Learning Gains instrument at all three assessment points, with very little variation overall and no differences at the $p < .05$ level between treatment groups. There were no statistically significant differences in scores between treatment and control teachers at any of the points of assessment, either before the intervention or after.
- In the absence of a sophisticated and adaptive messaging system, targeting SMS content to a teacher's lesson for the day would have required a substantially greater investment.
- Had the campaign begun immediately after the conclusion of zonal training, or shortly thereafter, it is conceivable that the SMS content would have more clearly facilitated knowledge retention.
While the analyses found no impact from the SMS campaign on its own, given the substantial limitations, it would be premature to conclude that a more-tailored, better-targeted SMS campaign whose impact is measured with a better assessment tool may not demonstrate a meaningful impact. |

Wennersten, M., Quraishy, Z., & Velamuri, M. (2015). *Improving student learning via mobile phone video content: Evidence from the BridgeIT India project.*	
Reference	Wennersten et al. (2015)
Focus	This paper presents the results of a mobile phone-based intervention conducted in the Indian states of Andhra Pradesh and Tamil Nadu in 2012–13. The BridgeIT project provided a pool of audio-visual (AV) learning materials organized in accordance with a system of syllabi pacing charts. Teachers were notified of the availability of new videos via text messages (SMS), which they showed with suggested activities to students.
Components of the program: 2-day initial training at a central regional location. Teachers were trained to implement the programme (use of the technology) and had access to a helpdesk (phone and SMS) for technology and delivery support.
Target beneficiaries: Teachers
Methodology	A quasi-experimental approach was adopted to evaluate the efficacy of the 2012–13 implementation of BridgeIT India program for Standard 5 and 6 English and Science classes. The paper reports the findings on classroom lesson quality.
Relevant conclusions	- For Andhra Pradesh teachers, BridgeIT had a strong, positive, and statistically significant effect on teaching. The amount of Direct Instruction (DI) went down, i.e., lessons became more student-centred. Mean number of indicators of effective teaching increased (lesson quality went up) by 32 percent, teaching style changed on average from telling to constructivist, and students took more active roles in classroom.

	- The effect for Tamil Nadu was not statistically significant. Based on the results, the authors argue that is possible to use mobile phones to produce a strong positive and statistically significant effect in terms of teaching and learning quality across a large number of classrooms in India at a lower cost per student than past computer-based interventions.

Wolfenden, F., Cross, S., & Henry, F. (2017). *MOOC Adaptation and Translation to Improve Equity in Participation.*	
Reference	Wolfenden et al. (2017)
Focus	This paper offers a critical review of a large-scale MOOC deployed in English, and then in Hindi, to support targeted sustainable capacity building within an education development initiative (TESS-India) across seven states in India. *Components of the program:* 6 weeks MOOC—designed to occupy no more than four to six hours each week. Blended model with local contact classes, meeting weekly or fortnightly throughout the period of the MOOC with a duration between 90 minutes and three hours. *Target beneficiaries*: Pre-service and In-service Teachers
Methodology	Qualitative: The study draws on multiple sources of participant data to identify and examine features, which stimulated a buzz around the MOOCs, leading to over 40,000 registrations and a completion rate of approximately 50% for each of the two MOOCs.
Relevant conclusions	- The TESS-India MOOC offered an innovative way to support professional development within a large-scale change project, disrupting traditional cascade models. All participants had space to contribute. It developed a collective sense of shared endeavour for participants and was highly cost efficient, particularly when available in the dominant language. - For almost all participants, the MOOCs helped to improve the effectiveness of teaching (98%, English MOOC) and the use of a more learner-centred pedagogy in their teaching (98%, Hindi MOOC). - Success in terms of participant completion and changes in subsequent classroom teaching is attributed to a blend of the digital and physical learning spaces.