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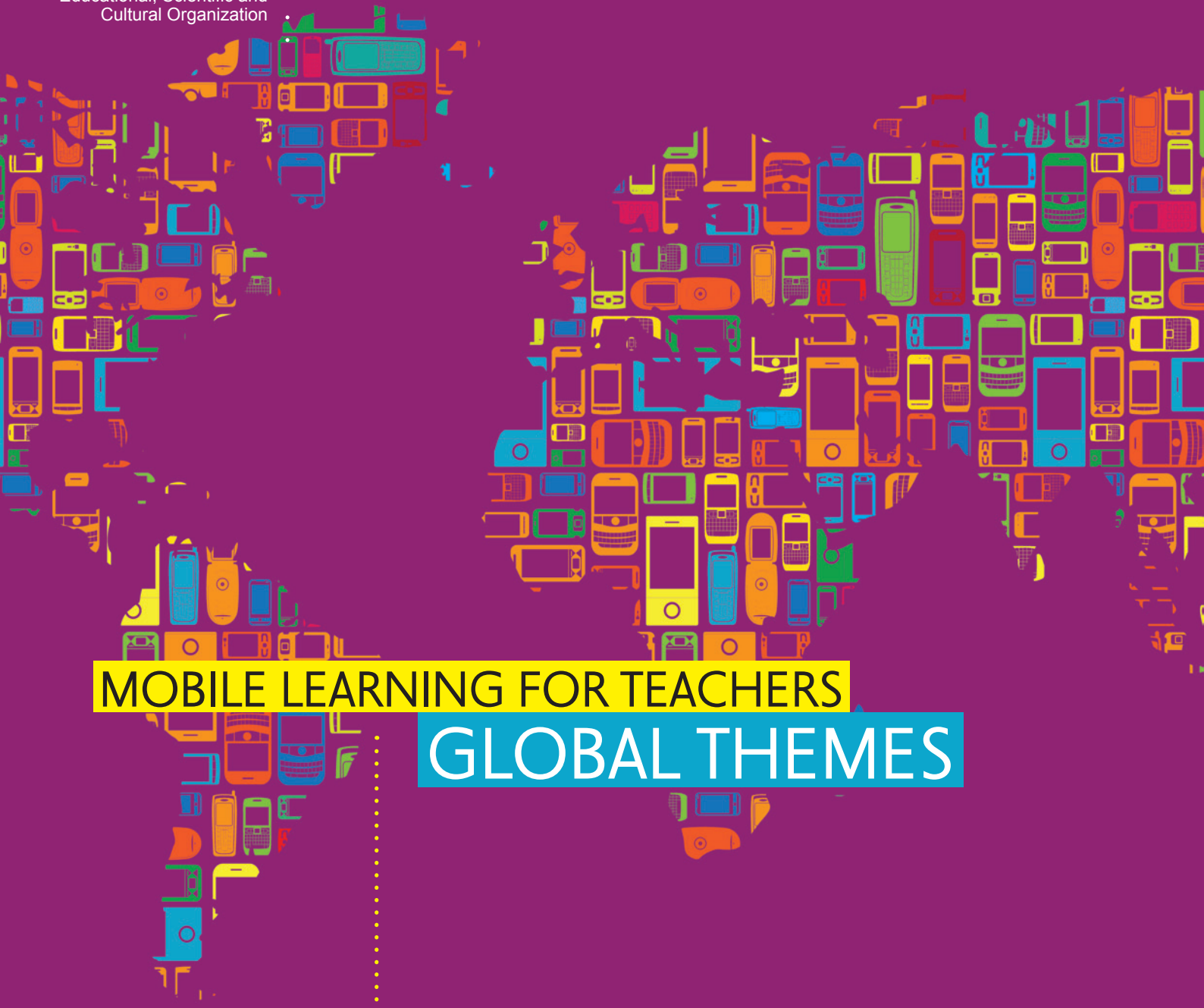

MOBILE LEARNING FOR TEACHERS

GLOBAL THEMES

TEACHER FOCUS

UNESCO Working Paper Series on Mobile Learning

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ABOUT THE SERIES

This paper is part of the UNESCO Working Paper Series on Mobile Learning. The Series seeks to better understand how mobile technologies can be used to improve educational access, equity and quality around the world. It comprises fourteen individual papers that will be published throughout 2012.

The Series is divided into two broad subsets: six papers examine mobile learning initiatives and their policy implications, and six papers examine how mobile technologies can support teachers and improve their practice.

Within the two subsets there are five geographical divisions: Africa and the Middle East, Asia, Europe, Latin America, and North America. Each subset also contains a 'Global Themes' paper that synthesizes central findings from the five regional papers.

Two additional 'Issues' papers round out the Series. One paper highlights characteristics shared by successful mobile learning initiatives and identifies supportive policies. A separate paper discusses how mobile technologies are likely to impact education in the future.

As a whole, the Series provides a current snapshot of mobile learning efforts around the world. Collectively and individually, the papers consolidate lessons learned in different regions to provide policy-makers, educators and other stakeholders with a valuable tool for leveraging mobile technology to enhance learning, both now and in the future.

UNESCO has plans to add additional titles to the Series after 2012. The Organization hopes that these resources will help diverse audiences better understand the educational potential of mobile technologies.

To access existing and forthcoming titles in the Series, please see:
http://www.unesco.org/new/en/unesco/themes/icts/m4ed/

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This paper is part of the larger UNESCO Working Paper Series on Mobile Learning. Francesc Pedró conceived of the Series, and Steven Vosloo and Mark West coordinated and completed day-to-day work on the project. Additional input was provided by a number of UNESCO education specialists, particularly David Atchoarena, Fengchun Miao and Jongwon Seo, as well as UNESCO's partners at Nokia, notably Riitta Vänskä and Gregory Elphinston. At UNESCO, Marie-Lise Bourcier deserves special mention for her valuable assistance. Finally, Rebecca Kraut made outstanding editorial contributions to the Series.

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SITUATING THE GLOBAL TEACHER CRISIS

The need to train high-quality teachers is urgent. According to the latest data available from the UNESCO Institute for Statistics, the world is facing a massive teacher supply problem. The planet will need approximately 8.2 million new teachers to achieve the UN Millennium Development Goal of providing universal primary education by 2015. Of the 8.2 million primary-school teachers required, 6.1 million will be needed to replace teachers that leave the profession in the next three years, and 2.1 million are needed to assume new posts. To put these numbers in sobering perspective, 8.2 million is roughly equivalent to the entire population of the United Arab Emirates, 6.1 million is more than all the primary- and secondary-school educators in the United States combined, and 2.1 million is approximately the total number of people who will fly on commercial airlines in the next 24 hours. Imagine, for a moment, the labour and resources that would be required to turn every airline passenger – walking through terminals from Santiago to Moscow – into an effective primary-school teacher. Such an analogy, however crude, helps expose the enormity of the current teacher shortage.

Compounding these numerical challenges is the fact that the teacher crisis, far from being evenly distributed, is most severe in countries and communities that confront other difficulties, including high unemployment, poverty, unreliable infrastructure and political instability. While a number of developed countries actually have a surplus of qualified teachers, many poor countries face massive deficits. Of the 2.1 million new teaching posts that need to be established, 50% should be located in sub-Saharan Africa alone. Many countries in that region need to literally double, triple, or sometimes quadruple the size of their teacher workforce.

However staggering these figures may be, they do not include secondary-school teachers. If secondary education is taken into account, millions of teachers, *beyond* the 8.2 million required to ensure universal primary education by 2015, should be trained and employed. In many developing countries the teacher crisis impacts every level of education. From primary schools all the way up to universities there is an alarming dearth of educators.

A severe deficit in teacher quantity is unfortunately not the end of the bad news: low teacher quality is a related and equally serious concern. Data from the UN indicate that a large number of teachers working in classrooms around the world are unqualified or underprepared to meet the educational demands of the twenty-first century. Despite the fact that employers increasingly require workers who are able organize, filter and use information creatively, many school instructors simply ask students to memorize information in textbooks. Also, given the exigencies of the modern workplace, educators who do not teach students how to leverage technology to improve their productivity unintentionally fail to prepare them for employment. UNESCO and other international organizations have recognized that getting adults into classrooms is only half the challenge of providing effective education. The other half of the equation is building and upholding teacher quality. Like the teacher shortage, low teacher quality is concentrated in developing countries. Many educators are unfamiliar with the subjects they teach, and some arrive in classrooms with limited or no pedagogical

training. Often these teachers are poorly paid, do not have opportunities for professional development, and are insufficiently supported by administrators.

In summary, the world needs to accomplish two very difficult tasks simultaneously in order to seriously address the global teacher crisis: it must raise both the *quantity* and the *quality* of the global teacher workforce. This needs to be done as quickly as possible, especially in poor communities where the crisis is most pronounced. As the papers in this Series make clear, mobile technology can help move countries closer to both of these goals. While not a panacea, mobile devices, often functioning in concert with other technologies, have a track record of improving educational efficiency and helping novice and experienced teachers alike acquire complex skills and complete meaningful work in classrooms. The 'Mobile Learning for Teachers' papers examine this record and describe some of the myriad ways mobile technologies are being used to support and train teachers in different regions and contexts around the world.

MOBILE LEARNING FOR TEACHERS: KEY FINDINGS

Traditionally teachers' access to information and communications technology (ICT) in schools has been limited and often non-existent in communities facing the most serious educational challenges. Today, however, this situation has changed. Currently, there are over 5.9 billion mobile phone subscriptions worldwide thanks to the rapidly declining cost of mobile phone ownership. Even in areas where computers and teacher training institutions are scarce, mobile phones are common, and, more often than not, teachers understand the basics of how to use them. In Africa, the continent facing the most pressing educational needs, the number of mobile phone subscriptions, which totalled 600,000 in 1995, is expected to surpass 735 million before the end of 2012. (It is perhaps worth noting that the last technology to spread this fast in Africa was the AK-47.) For the first time in history a majority of teachers, whether in developed or developing countries, have individual access to powerful communications technology, and this opens up exciting educational opportunities.

The five 'Mobile Learning for Teachers' papers shed light on some of the ways in which mobile technologies are currently assisting educators, either by aiding their work with students or by helping teachers improve their own pedagogical and content knowledge. The papers, which are part of the larger UNESCO Working Paper Series on Mobile Learning, are organized geographically and describe a host of innovative projects, from efforts to facilitate teacher-student communication in Mozambique to Finland's Presemo initiative, which uses mobile devices to promote participation and interactivity among large groups of students. While many of these projects are still very much in their infancy, they preview some of the ways that mobile devices – growing more powerful by the day – might impact and improve education in the future. They also allow policy-makers and educators to 'think outside the box' when brainstorming responses to the teacher crisis. If nations cannot, for example, afford to train teachers in universities or dedicated institutes, they might be able to extend meaningful support via mobile devices that teachers already own. Conversely, a country with a robust network of teacher training centres might employ mobile devices to complement or expand opportunities for professional development. Collectively, the five regional papers examine how different schools, school systems and governments have sought to leverage mobile phones to benefit teachers.

Although approaches vary enormously from region to region, country to country, and programme to programme, it is possible to identify a number of important trends that cut across geographic boundaries. First, mobile phones have the potential to expand educational access to populations of teachers and students outside the reach of traditional education systems. Second, mobile phones can be used to support classroom instruction, administrative communication and professional development for teachers. Third, teachers are crucial to developing an education system that embraces mobile learning, and it is essential to effectively train teachers and enlist their support. Fourth, while many educators and parents cite online safety concerns as a reason to ban mobile devices from schools, mobile learning actually provides an opportunity to promote student safety, both through teaching students to navigate online environments responsibly, and by using the communication features on

mobile phones to provide learners with safety-related information quickly, efficiently and privately. Finally, digital educational content, software platforms and pedagogical models need to be updated, expanded and improved to allow teachers and students to take full advantage of the unique opportunities mobile learning affords. These key findings from the regional papers are discussed in the following sections.

MOBILE PHONES CAN EXPAND EDUCATIONAL ACCESS

If there is one common thread that connects the various projects described in the UNESCO papers, it is the enormous potential of mobile phones to extend educational access to isolated and underprivileged learners. Many students who do not own books or computers do have mobile phones, as do learners who are not served by traditional schools either because they are not available in their area or because students cannot afford to attend them. Examples of projects that rely on mobile devices to deliver educational content are numerous. For instance, in Lahore, Pakistan, a UNESCO project is underway that uses Short Message Service (SMS) technology to send educational content to socio-economically disadvantaged learners who have completed face-to-face literacy training at education centres. The programme seeks to help students retain and solidify their newly acquired literacy skills, which typically atrophy without consistent practice. Another example is the Boat School in Bangladesh, which relies on mobile phones and other technology to help bring educational opportunities to 87,000 families living in marginalized waterside communities. Without internet-enabled mobile devices these families would not be able to connect to the information society. By and large these projects and others like them have brought meaningful education to areas where it did not exist before. Researchers have also noticed that projects often carry unintended benefits. For example, women who were provided with mobile phones in the Middle East and Africa reported feeling more empowered and connected to their community outside the home; children participating in various mobile learning initiatives taught their parents how to use mobile devices more productively; and, in some instances, students who started participating in experimental mobile learning networks communicated with each other about educational topics more often than teachers anticipated.

Beyond assisting students facing severe hardships, the projects described in this Series also extend learning opportunities to individuals who cannot easily attend brick-and-mortar schools due to their professions. The BLOOM (Bite-sized Learning Opportunities on Mobile Devices) project, for instance, which was rolled out in several European Union countries, targeted transportation workers, such as taxi drivers, whose irregular work hours prevented them for attending traditional classes. The project demonstrated that relevant content could be delivered to students in unusual circumstances to support lifelong learning objectives. At the University of Leeds Medical School in the United Kingdom, educators decided to move certain assessments and tutoring modules to mobile phones in recognition that students working in health clinics and hospitals scattered throughout the region were not able to easily attend courses or communicate with professors at the university campus. The Leeds system was designed to provide learning opportunities that were situation-specific. For example, as soon as a medical student finished evaluating a patient, he or she would use a mobile device to reflect on the quality of the evaluation. This approach ensured that students would

remember the particulars of the evaluation, note questions to ask senior physicians, and reflect on strategies for improving future evaluations.

As the price of mobile technology continues to decline, students of all ages in rich as well as poor communities are able to more easily pursue self-directed learning. With a mobile phone, information is no longer a scarce 'commodity', and even basic handsets provide a portal to galaxies of educational content. Recognizing that the transmission of information has ceased to become the exclusive purview of schools, the regional papers suggest that education systems should help students cultivate a love of learning while providing them with the cognitive skills necessary to engage in learning that is not necessarily school-related. In a rapidly changing economy and world, schools can no longer hope to introduce students to all or even a fraction of the information that they will likely need in their personal and professional lives. Instead, schools should teach students how to learn with the best technologies available so they are well-prepared to acquire skills relevant to their evolving needs outside of formal education.

Despite concerted efforts to provide universal primary education and expand secondary and postsecondary education offerings, millions of young people are still not in school, and millions of teachers lack access to basic educational resources. Mobile devices, due to their near ubiquity, can bring educational opportunities to students and teachers where they are, and this, in a nutshell, is what makes mobile learning so exciting. According to the papers that make up this Series, the ability of mobile technology to positively impact the education of disadvantaged students and assist teachers working in difficult circumstances may be without precedent.

MOBILE PHONES CAN SUPPORT INSTRUCTION, ADMINISTRATION AND PROFESSIONAL DEVELOPMENT

A number of mobile learning projects highlighted in the regional papers have sought to help teachers do a difficult job better, both by supporting their day-to-day work in classrooms and by opening up new avenues for professional development. First, the availability of online content, much of it accessible via mobile devices, gives teachers and students access to a vast array of educational materials to support and supplement classroom instruction. Second, mobile phones can facilitate improved administrative communication between schools, students, teachers and parents. Third, mobile phones can enhance teachers' professional development by supporting mentoring and observation for pre-service and in-service teachers, and by allowing teachers to participate in online professional communities.

ONLINE EDUCATIONAL CONTENT

Today rich repositories of lesson plans and educational content are now freely available online. Teachers without computers had trouble accessing this material in the past, but much of it can now be downloaded, reviewed, and even projected or printed using mobile devices like smartphones. Mozambique is one country that has recognized how mobile phones can facilitate the delivery of curriculum to students and teachers. The Mozambique Ministry of

Education has adapted curricular materials for mobile phones and created multiple versions to accommodate particular cultural and linguistic contexts. Similarly, in the United States the Department of Education has put its weight behind efforts to build easily searchable online databases of educational materials. Ideally these databases will enable features such as peer review of content and promote organization by subject and grade level. Many such databases already exist. The Khan Academy offers an impressive library of educational lectures, and iTunes, Apple's online store, has a wing dedicated to freely disseminating content uploaded by universities. More recently, digital platforms like Cousera and Udacity have put entire courses online as well as systems for testing, grading, providing student-to-student assistance and awarding certificates of completion. Far from being educational outliers, these projects are supported by some of the most prestigious universities in the world, including Stanford, Harvard and the Massachusetts Institute of Technology (MIT). Teachers can use these online tools to brush up on their own content knowledge and better support students who might be falling behind or, conversely, challenge those who are excelling. Because a great deal of this educational material is accessible from mobile devices both online and offline, teachers can browse repositories at times best suited to their schedules.

ADMINISTRATIVE COMMUNICATION

The regional papers also describe a number of projects that utilize mobile phones in practical, if decidedly 'unsexy', ways. Many initiatives, for example, rely on mobile phones to communicate short, simple and concise bits of information. For instance, the Mobile Oxford system designed by Oxford University in the UK provides students with a mobile web portal to access information about their classes. Learners can view syllabi and schedules and download reading material on their mobile devices. The platform, which uses a proprietary web-based application framework called Molly, works on almost any model of mobile phone. Schools in the Middle East have built systems that allow educators to send text messages timed to remind students when homework assignments are due. Other projects allow teachers and school administrators to send messages to students' parents to notify them about academic progress and absences. Still other projects use mobile devices to disseminate information about events and school closures. While simple, these programmes work. They may not use the newest microchip in the latest smartphone or take advantage of ultra-fast processing power, but they provide a service for teachers and schools, and, as detailed by the papers, more often than not they do it well. To cite just one documented result, parent attendance at back-to-school nights increased from around 60% to over 80% when educators in Norway decided to send parents SMS messages reminding them of the event. By leveraging a technology people use on a daily and sometimes hourly basis, the Norway project successfully improved communication between parents and teachers. Revealingly, in countries around the world parents and students have indicated that they prefer receiving updates and information on mobile phones. And unlike paper-and-ink leaflets, digital messages can be used to elicit as well as disseminate information, by collecting data from parents and students via SMS queries or polls. For example, using widely available technological tools, a school principal can inform a parent that his or her child is in danger of failing a class via text message while simultaneously proposing a time to meet to discuss the student's performance. The parent who receives this message can confirm the meeting by pressing just one or two buttons on his or her mobile phone. The meeting will then be automatically notated on the principal's calendar. In most cases, messages sent by mobile devices are faster, more reliable, more efficient and less expensive than alternative channels

of communication. It seems natural that educators would take advantage of them to facilitate administrative communication with both students and parents.

PROFESSIONAL DEVELOPMENT

Mobile phones, especially larger-screen smartphones, can assist more complex tasks as well. As detailed in the regional papers, they provide a cost-effective avenue for supporting the professional development and pre-service training of teachers, mainly by facilitating mentoring and participation in professional communities.

One of the most effective types of professional development is mentoring. This process generally calls for a master teacher to observe the practice of less experienced educators and provide constructive feedback. Mobile phones may be able to alleviate some of the costs associated with mentoring by increasing the number of teachers a mentor can support and reducing the time required for observations and meetings. As the North America paper explains:

> By conducting video observations and sending feedback via mobile devices, a mentor could potentially provide more frequent feedback while reducing travel time between classrooms and schools. Not only is this arrangement more convenient from a logistical perspective, but it may also improve the quality of feedback by allowing the mentor to pause and replay the video, something that is not possible in live observations. Mentoring using mobile technologies can also strengthen the level of support teachers receive by facilitating more regular communication between teachers and mentors.

Similar approaches can be used to support pre-service teachers. Novice instructors in North America and other regions have used smartphones, which are highly portable and commonly equipped with powerful cameras and microphones, in lieu of more expensive video cameras to film themselves teaching a lesson or lesson segment. These video clips are then uploaded to a server where professors and peers can watch them at their convenience. Such a system allows instructors to build portfolios of teaching practice that can be referenced at later points to evaluate growth. Pre-service teachers and their instructors can review the videos to dissect and discuss particular interactions. Videos also help novice teachers reflect on their teaching and brainstorm ideas for improvement. While this practice is still relatively new, there are already dedicated smartphone applications designed specifically for this purpose.

The most common use of mobile technologies in teacher development is for participation in online professional communities. These communities can be either formal or informal, but they are all dedicated to improving knowledge and practice within a shared profession. The communities are often grade- or subject-specific and bring together teachers who might otherwise be isolated from colleagues. For example, a number of communities exist to support special education teachers who often do not have professional counterparts at their school campuses or in the districts where they work. Teachers who participate in professional communities use mobile devices to collaborate with peers; pose questions and discuss ideas; and share videos, lesson plans, presentations and other resources quickly and easily. Some of the communities are hosted on dedicated websites or inside mobile applications. Others rely on already established and widely used social networking platforms like Facebook, Google+ or Twitter. Typically these educator communities mix face-to-face meetings with digital

communication. As an illustration, the Teaching Biology Project in South Africa runs three in-service teacher training workshops each year. The workshops seek to improve teachers' knowledge of evolutionary biology and to allow them to network with other teachers from different schools. In between meetings the group sends and receives motivational, administrative and content-specific SMS messages. The project has also established a Facebook page, a Twitter account and a profile on MXit, a popular social media platform in South Africa. Teachers regularly access the resources and messages posted to these sites from their mobile phones. The project is well-liked by teachers and shows that mobile technology can enable important peer support among educators belonging to a professional community. Similar projects are active in other countries.

TEACHERS ARE CRUCIAL TO MOBILE LEARNING EFFORTS

Tellingly, most of the mobile learning projects detailed in the regional papers require more expertise and skill on the part of teachers, not less. Take for instance the large and successful Text2Teach (T2T) initiative underway in the Philippines, which is described in detail in the Asia paper. This programme, part of a multisector association of interactive multimedia education programmes around the world called BridgeIT, utilizes mobile phones to help primary-school teachers plan and deliver engaging lessons aligned with national curricula. Specifically, teachers use project-provided mobile phones to download educational videos that correspond to recommended lesson plans. Project managers train teachers on how to use the mobile phones to select relevant videos from an online library and play them for students by connecting the phones to digital projectors or televisions. Beyond helping teachers navigate technical hurdles, trainers also show teachers how to integrate the videos into lessons in ways that facilitate inquiry-based and collaborative learning. Pedagogical training, not technical know-how, constitutes the central focus of the programme. Teachers are also encouraged to use the mobile phones to communicate with other educators participating in the T2T programme, thereby building communities of practice. Using a social media platform, teachers share ideas, discuss problems and pose questions related to project implementation.

T2T is important because, like several other projects described in the papers, it recognizes the central role of teachers and seeks to expand their pedagogical and curricular repertoires by training them to leverage technology to advance student learning. The programme does not attempt to bypass instructors in favour of digital devices, nor does it employ technology needlessly. The reasons for integrating technology are clearly delineated: the videos help spark student interest in particular subjects, and the mobile phones and supporting technological platform provide teachers with workable, multimedia-rich instructional aids. External evaluations of the programme indicate that T2T has improved student achievement and reduced drop-out rates. At the same time, the programme has brought powerful learning materials to resource-poor schools and improved the ICT skills of the country's teacher workforce.

While T2T owes its success to many factors – from robust partnerships and community buy-in to regular evaluation and revision – the authors describing the project emphasize the salience of a quality that is often overlooked: ease-of-use for teachers. Too often efforts to integrate mobile technologies in education fail because they unintentionally make life more difficult for

already busy and sometimes overwhelmed instructors. Mobile learning strategies are often viewed by teachers as 'yet another thing to do', rather than as a tool to make their jobs easier. The approach of T2T is different. Each video is accompanied by a suggested lesson plan, which reduces teachers' workloads and, according to the paper, gives teachers more time to spend with their families. The project – from its inception to its on-the-ground implementation – has sought to make teachers more effective but to also ensure that they complete less work, not more. Teachers report liking T2T precisely because it makes their challenging jobs a bit simpler.

Across the regional papers it is evident that most mobile learning projects do not do enough to train teachers to use mobile technologies to improve their work with students. Research has strongly indicated that without dedicated interventions, teachers will often use technology to 'do old things in new ways', rather than substantively changing their pedagogical approaches. The Latin America paper captures this tension eloquently and builds a strong case for making teachers central to any mobile learning initiative:

> While digital resources form an important component of mobile learning, they are not sufficient on their own; in order to be effective, programmes must also design pedagogical strategies with which to use these resources. Regardless of the technologies used, most learning that occurs in a school context is facilitated by a teacher. The teacher is not just someone who provides resources to students and guides them through a predetermined sequence of activities. Teachers are constantly modifying and tailoring learning activities to meet the needs of their individual students. They use their knowledge of students' backgrounds and interests to motivate their classes; engage in continual assessment, both formal and informal, to determine what their students already know and what knowledge and skills they need to develop; anticipate the types of mistakes and difficulties their students usually encounter and decide how best to address them; use feedback to determine what questions to ask during a lesson to further students' understanding; and evaluate student progress and learning on an individual and class basis. In sum, the teacher is critical to the learning process. The importance of the teacher's role is often overlooked by mobile learning project designers, who may be more concerned with technology than with student learning.

To drive this point home the Latin America paper devotes significant space to contrasting two major initiatives underway in the region: BridgeIT and EMIA-SMILE (Entorno Móvil Interactivo de Aprendizaje, or Mobile Interactive Learning Environment, based on the Stanford Mobile Inquiry-based Learning Environment). While both initiatives seek to improve teaching and learning, they employ radically different approaches. BridgeIT, which is substantively similar to the T2T programme described above, dedicates significant resources to training teachers to plan interactive and student-centred lessons. Mobile devices – equipped with a library of videos aligned with particular subject curricula – are provided only to teachers. In contrast, EMIA-SMILE, a programme developed at Stanford University by Professor Paul Kim, gives mobile devices to small groups of students in order to direct collaborative and inquiry-based learning in classrooms. The EMIA-SMILE project is less reliant on teachers and, unlike BridgeIT, does not spend large sums of money on training them. Instead, the instructional pedagogy is mostly embedded in the mobile devices themselves. The software guides students step-by-step through the learning process and, in this sense, strives to be almost 'teacher-proof'. The authors of the Latin America paper are sceptical about whether a project can succeed that does not give pedagogical reins to a classroom instructor. Because EMIA-SMILE does not seem to have a clear strategy for continually supporting teachers as they experiment with inquiry-based learning, the project would likely be more beneficial if it placed additional emphasis on training teachers in specific principles and methodologies rather than simply

relying on software to transform pedagogy. However, the paper is frank in its admission that changing teachers' practice is hard. External evaluations of the BridgeIT programme in Latin America have revealed that it has not been particularly effective in improving instruction. According to a project audit, teachers generally used project lesson plans and videos but continued teaching in the same ways they had in the past, failing to increase student interaction or participation using the methods introduced in training seminars. Even so, all five regional papers are adamant that providing teachers with a pedagogical framework to guide the use of new resources and technologies is vital to the success of any ICT initiative, including mobile learning projects.

UNESCO and other organizations have published work intended to provide policy-makers with clear ideas for how to improve the ICT skills of their teacher workforces. In 2011 the organization released the *ICT Competency Framework for Teachers* toward this end. Training teachers to use technology themselves is a necessary first step for preparing them to help students leverage technology for learning. Surveys suggest that teachers are hungry for this type of professional development. Indeed in a global economy that increasingly values digital literacies and the ability to use technology to sort, filter, organize and consume information, teachers and students alike need to know how to successfully navigate a broad spectrum of ICT and, if current trends continue, mobile devices in particular, in pursuit of education and knowledge.

MOBILE LEARNING PROVIDES AN OPPORTUNITY TO PROMOTE STUDENT SAFETY ONLINE AND ELSEWHERE

Online safety is often cited as one of the reasons mobile technologies should be banned from schools. Yet the reality is that mobile devices are so powerful and widely available that students will use them regardless of whether schools decide to embrace them. Teachers are well-placed to help students learn how to responsibly navigate the content accessible from devices like smartphones. And if teachers do not engage these issues, who will? Because mobile devices have become such an essential component of modern life, teachers need to initiate conversations with students not only about how to use mobile technologies for learning but also about how to use them safely.

The Series contains several examples of how mobile phones have been employed to improve student safety. The North America paper explains how Virginia Tech, a university on the east coast of the United States, built a text message warning system after a student shot and killed thirty-two people on the university's campus in 2007. The system was employed in 2011 when a student from a nearby university entered the Virginia Tech campus and fatally shot a police officer. Within minutes the university had issued emergency text messages to students and faculty members and kept them informed at regular intervals for the next several hours. While this case is extreme, it illustrates how instant communication can help protect students. Other examples are more commonplace: schools around the world send text messages to parents informing them when children are absent, alerting parents to a potentially dangerous situation. Mobile phones have also been used to inform young people about safe sex and the dangers of drugs. Mobile devices make especially good mediums for these types of messages because they are usually private; students can read, for example, informational text messages

about an issue that is culturally or socially sensitive without others being aware of what they are doing. Some development organizations have provided people with minor incentives to become more informed about diseases like HIV. It is relatively easy, for instance, for project organizers to send credit or minutes to the account of a mobile phone user who reads a short piece of informational text and then correctly answers a handful of comprehension questions. Collectively, these examples show that mobile phones, far from posing risks to students, can, with careful planning, be employed to help mitigate them.

EDUCATIONAL CONTENT, SOFTWARE PLATFORMS AND PEDAGOGICAL MODELS NEED IMPROVEMENT

While the regional papers describe a number of innovative attempts to optimize educational content for mobile devices, this process is still very much in its infancy. To be sure, a great deal of mobile content is still quite basic: software often provides students with digital flashcards and rudimentary games with an educational twist, but not much more. To a certain extent, this is understandable: content is limited by the device through which it is accessed, and much of the content currently available was designed for use on older handsets. In general, software has had difficulty keeping up with advances in hardware. With a handful of notable exceptions, educational programmes and applications do not yet take advantage of the unique affordances of newer mobile devices by, for example, making learning geographically specific or prompting students to use a camera on a smartphone to collect data. Content has also tended to focus on subjects and concepts that are taught in a linear and, for the most part, universal way. For example, there are numerous mobile applications that aim to help people learn mathematics, English language and, to a lesser extent, science, but far fewer offerings for the humanities or social sciences. In terms of pedagogy, the primary learning paradigm is one of brief explanations followed by numerous and typically rote practice sets. Although there is a degree of interactivity, this regularly amounts to little more than software informing a student whether he or she answered a given question correctly and then selecting a new question based on the previous result. This is a start, surely, but as more powerful devices become readily available, it is important that software exploit a fuller range of device features to make learning more interactive, interesting and creative. Finally, most educational content available on mobile devices is fixed, meaning that individual teachers do not have opportunities to build or tailor particular learning modules to meet their students' needs. At present, the dominant model is a one-size-fits-all approach similar to that offered by physical textbooks. In summary, while the technological environment for mobile learning is rich, the available content is still limited, not so much in quantity but in quality. It is clear that content providers have yet to fully embrace the possibilities of a truly mobile digital platform for education. However, this is probably to be expected given that mobile learning is still a relatively new phenomenon. Just as it took years for, say, television news broadcasts to shake the parameters and conventions of print newspapers, it will likely take some time before mobile learning fully blossoms into its unique medium.

This is not to say that inventive approaches do not exist. The papers in this Series detail mobile content that aims to move away from centuries-old models of learning. Serious efforts have been made in North America, for example, to 'flip' classrooms. According to this model, students use mobile devices or computers to watch video lectures that can be paused and

replayed as many times as necessary at home, and then at school they apply the information conveyed in the lectures by, for example, completing problem sets in a mathematics course. What was formerly homework becomes schoolwork, and what was formerly schoolwork becomes homework – hence the term 'flipping'. Many schools have 'flipped' their classes because it enables students to gain an introduction to knowledge through a wide variety of media resources – text, video and interactive websites to name just a few – and provides them with a teachers' support in applying this knowledge, when students are likely to need the most assistance. Because students take mobile devices to school and virtually everywhere else they go, these devices are uniquely situated to help bridge in-school and out-of-school learning. The 'flipped' classroom is arguably the most ambitious attempt to capitalize on this potential.

Because so many mobile learning projects envision the end-user as a single individual working in relative isolation, the regional papers take care to describe initiatives that break this traditional mould either by conceptualizing the teacher as the primary user or by focusing on small groups of students working in collaboration. BridgeIT, a project that involves technology and education partners around the world, targets teachers rather than students. The goal is to improve student learning by providing teachers with engaging content and nudging them to adjust their pedagogy to promote collaborative and question-based learning. In this sense BridgeIT is very much a mobile learning programme that seeks to educate teachers. EMIA-SMILE and Eduinnova, two projects active in Latin America, challenge the 1:1 (one device per student) paradigm by conceiving of mobile technology as a tool that can facilitate and streamline the workings of a group of learners. In both programmes, small groups of students share a single mobile device to either pose questions or answer them. The methodologies differ slightly: EMIA-SMILE, as explained by the authors of the Latin America paper, emphasizes inquiry-based learning, asking students to generate their own questions about subject matter. Eduinnova, in contrast, focuses on collaborative learning and pushes students to answer teacher-generated questions with the help of peers. Interestingly, Eduinnova initially relied on handheld devices, but the project leaders eventually decided to switch to netbooks because they were less expensive than smartphones. The takeaway here is that the most educationally useful approaches are device-neutral. What matters is the learning, the pedagogy, the methodology and, of course, the cost; the device itself is merely a tool (albeit an extremely powerful one) to advance student understanding and productivity.

Other projects, such as ViDHaC2 (Videojuegos para el Desarrollo de Habilidades en Ciencia a través de Celulares, or Video Games for Developing Science Skills through Mobile Phones) in Chile, have broken new ground by offering teachers opportunities to tailor science video games for use on mobile phones. Ideally these approaches will become more mainstream. Teachers, due to their proximity to learners and knowledge of their students' individual needs, should be able to fine-tune mobile content to ensure it complements their work and maximizes benefits for students. This presents a technical challenge as well as a pedagogical one. The technical challenge is that, generally speaking, mobile devices are difficult to program. The job of developers, then, is to make it easier for educators to adjust digital content without having to write code in markup languages like HTML (HyperText Markup Language). Classroom management platforms like Moodle have come a long way in this regard. Just a few years ago Moodle appealed almost exclusively to computer-savvy teachers who were willing to slog through complex menus to upload files and evaluate student work. Gradually, though, the open-source software became increasingly user-friendly, and now teachers with average computer skills find it helpful and easy to navigate. Google Maps is yet

another technology that has enabled users to appropriate maps for specific purposes. Instead of a closed, one-size-fits-all system, Google Maps is closer to a blank canvas, which users can appropriate for their own idiosyncratic purposes. Educational content for mobile phones should afford teachers similar control.

Another promising project described in the papers is Apps for Good. Started in the UK, Apps for Good is essentially a dedicated class that teaches students how to design and build mobile applications to solve real-world problems. The instructors take care to move technology to the background. Students begin the class not by exploring the flashy capabilities of mobile technology but by articulating, in detail, something that is wrong with the world around them. Students are then introduced to mobile applications and over time they design and build an application that helps address this problem in some way. In the Apps for Good class students do more than simply use mobile software; they build it. In doing so, students not only gain technological skills but also become more adept at evaluating the usefulness of other, more professionally designed applications. Just as students are more likely to grasp and appreciate the literary dexterity of Shakespeare by composing their own plays, so too are they better equipped to critically examine the functionality and design of commercial applications by developing their own. This skill is becoming increasingly vital. Thomas Friedman, a columnist for *The New York Times* who has written extensively about globalization, recently announced that 'the world has gone from connected to hyperconnected' thanks to the spread of high-speed wireless technology, high-speed internet, smartphones, Facebook and other social media, and cloud computing. Increasingly, mobile applications are the tools we use to navigate this hyperconnected world and its vast oceans of information. Today, knowing how to critically evaluate, leverage and in some instances even author mobile software is less a niche skill than a survival skill.

Across the Series, it is evident that the most effective mobile learning software and initiatives respond to educational needs rather than technological possibilities. Projects work when they address particular challenges faced by teachers and students, and stall when they employ technology for technology's sake. Presemo, for example, has gained traction in Finland because it aims to help instructors teaching large, lecture-style classes promote active participation and interactivity between students. The software allows a teacher to pose questions to groups of students and consolidate responses in real time. The programme is designed to allow teachers to process and evaluate significant amounts of information coming from students while still preserving the pace and flow of their presentations. The Road to Reading programme in Mali is another project that responds to a clear, if very different, educational need: namely, supplying engaging lesson plans to teachers working in resource-poor settings. Sample lesson plans are posted to a web page that can be easily accessed from internet-enabled mobile devices. Although the lesson plans are produced externally, the project solicits feedback from teachers via text messages to better tailor lessons to local contexts. In all of these examples, projects have used mobile technology not simply because it is available, but because it offers teachers workable solutions in response to their immediate needs.

POLICY CONSIDERATIONS

Although the 'Mobile Learning for Teachers' papers do not explicitly highlight policy issues (as the 'Turning on Mobile Learning' papers do), it is possible to outline a few important considerations for policy-makers and education leaders developing mobile learning projects that seek to assist teachers or address the teacher crisis:

1. ***Consider targeting teachers or small groups as end-users rather than individual students***
   Collectively the papers found that a majority of mobile learning projects ask students to interact directly with handsets and that, generally speaking, this approach is considered effective for promoting experiential learning and building twenty-first-century skills. This assumption, the papers conclude, may explain why the vast majority of mobile learning initiatives, regardless of region, tend to view students rather than teachers as the primary end-users of mobile technology. Yet, as illustrated by projects like BridgeIT, EMIA-SMILE and Eduinnova, among others, the 1:1 approach is not necessarily the most effective. It is also significantly more expensive, due to the greater number of devices required and the connectivity plans that usually accompany those devices. Governments should consider whether they might get a larger return on their investments by providing phones to teachers as opposed to students or, conversely, by promoting pedagogical models in which small groups of students use a single mobile device.

2. ***Recognize the legitimacy of online professional communities for teacher development***
   While many education experts agree that online professional communities can help build the skills and knowledge of in-service teachers, they are not formally recognized as a type of professional development. Teachers, in effect, do not receive credit for participating in these types of communities in the same way that they might receive credit for, say, attending a one-day seminar at a university. According to the North America paper, online communities lack the perceived legitimacy of other forms of professional development. If governments want to encourage teachers to be active in these communities, they should consider developing strategies to recognize and perhaps reward participation.

3. ***Develop national curriculum standards to encourage digital content development***
   Coherent national curricula can help spark innovations in mobile learning by regularizing subject matter. When curricula vary from school to school, district to district, or state to state, mobile software developers have less incentive to build costly content because the market is too small and fragmented to justify large investments of time and resources.

4. ***Provide targeted funding for mobile learning to enable sustainability and scalability***
   To date, mobile learning projects are almost uniformly small in scale and rarely receive substantial financial support from governments. Many of the projects detailed in the regional papers were not sustainable due to a lack of funding. Tellingly, other projects are sustainable due to their small size and only in rare instances do they expand. Almost across the board, successful projects employ disciplined strategies to control costs.

5. ***Choose technology appropriate to educational goals and contexts, even if it is 'low-tech'***
   Too often projects are driven by technological innovations rather than educational needs specific to the local context. Some of the most significant mobile learning projects in Latin America have been implemented in schools that already have access to ICT. Thus far mobile learning initiatives, despite their considerable potential to reach students in the most vulnerable and isolated communities, have not yet done so in a substantive way. The number of learners projects do reach typically total in the thousands and only occasionally in the tens of thousands. Governments lending support to mobile learning initiatives should look to project models that use technology efficiently and effectively to benefit the largest number of learners and specifically target underserved populations, even if that technology is not the most advanced or cutting-edge available.

6. ***Take equity issues into account when designing mobile learning initiatives***
   Questions of equity loom large with mobile learning. Many schools have experimented with approaches that allow students to bring their own mobile phones to school, but clearly this model isolates students who do not own or cannot afford mobile phones. This matter is further complicated by the fact that in many regions there are serious gender disparities with regard to mobile phone ownership. Project planners must be careful to ensure that mobile learning initiatives ameliorate educational and gender inequities rather than exacerbate them.

7. ***Consider substituting smartphones for laptops to achieve 1:1 learning environments***
   Evidence suggests that many laptop programmes in Africa and the Middle East have stalled due to high costs and a dearth of fixed-line high-speed internet connections. Mobile learning projects, due to a technological climate that favours mobile phones, seem more primed for success. In countries struggling to implement 1:1 laptop programmes, internet-enabled mobile phones such as smartphones may provide an alternate or complementary path to achieving a 1:1 learning environment.

8. ***Look to higher education and lifelong learning for models of mobile learning projects***
   Generally speaking, mobile learning projects tend to be more concentrated in the higher education levels, including secondary and tertiary education, and in lifelong learning programmes. One reason is that teenagers and young adults are more likely to own and know how to use mobile phones than younger children. It is also assumed that adults are more responsible users of mobile devices, so there is less concern about online safety and liability. Educators and policy-makers may find useful models for mobile learning projects in these educational sectors, which can be adapted for use in primary education. However, issues related to access, safety and child development will have to be addressed when implementing mobile learning projects with younger students.

CONCLUSION

Supporting the work of teachers is crucial to addressing the global education crisis and meeting the needs of students worldwide. Teachers are the individuals best placed to guide and mentor students, and collectively they form the foundation of any education system. Given the huge number of mobile phone owners, mobile technology offers an especially promising avenue to train new teachers, build the capacities of working teachers, and support the work of educators both in and outside of classrooms. As demonstrated by the five regional papers, mobile technologies can help teachers working in a variety of contexts learn more about their subjects; develop new and more considered pedagogical approaches; reflect on practice with experienced instructors; access a rich array of content and use it to improve student learning; develop a sense of belonging and community with other educators working in similar settings and facing similar day-to-day demands; and enhance and speed up communication with students, parents and other educators. By leveraging mobile technology, teachers can work faster and more efficiently with learners in contexts that better approximate the often technologically saturated world outside of schools.

In the past national Ministries of Education as well as international organizations have sometimes overlooked the important role played by teachers when discussing ICT for education generally and mobile learning specifically. The almost reflexive goal of many policy-makers is to put technology in the hands of students. Surely this is important, but teachers are vital to the educational process as well, and it is essential to empower them with the technological tools and knowledge to do their jobs efficiently and effectively. It is for this reason that UNESCO wishes to explore, directly rather than as an afterthought, how mobile technology can support teachers and contribute to their professional development. The Working Paper Series on Mobile Learning marks the beginning of this meaningful enterprise.

Today there are over 5.9 billion mobile phone subscriptions worldwide, and for every one person who accesses the internet from a computer two do so from a mobile device. Given the ubiquity and rapidly expanding functionality of mobile technologies, UNESCO would like to better understand their potential to improve and facilitate learning, particularly in communities where educational opportunities are scarce.

This paper synthesizes findings running across the five regional 'Mobile Learning for Teachers' papers. By identifying global trends and analysing their implications, it reveals important lessons for policy-makers and other stakeholders seeking to better leverage mobile devices to assist the work of educators.

Complementing the six papers about teacher support is a separate set of six papers which describe illustrative mobile learning initiatives and their implications for policy. These papers are also organized geographically.

Two 'Issues' papers will be added to the Series later in 2012. One will anticipate the future of mobile learning, and another will articulate considerations for creating policy environments in which mobile learning can thrive.

Collectively and individually, the papers in the UNESCO Working Paper Series on Mobile Learning scan the globe to illuminate the ways in which mobile technologies can be used to support Education for All Goals; respond to the challenges of particular educational contexts; supplement and enrich formal schooling; and, in general, make learning more accessible, equitable and flexible for students everywhere.

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