targeted support provided by teaching assistants narrowed the gap between achievement of at-risk children and national norms (Savage and Carless, 2008).

A few studies that have examined the effects of teaching assistants and community volunteers in low income countries indicate that they have an important role in improving learning outcomes for disadvantaged children. In Costa Rica, for example, a tutoring programme using secondary school volunteers to provide structured learning support for pre-school children from low income families was more effective than extra materials for teachers or family support activities in improving reading skills. Children who received tutoring finished the school year with higher scores than those who did not. However, the impact of tutoring was greatest in combination with extra teaching materials and family support, highlighting the importance of integrated approaches (Rolla San Francisco et al., 2006).

Trained teachers in formal schools often come from different cultural or linguistic backgrounds than those of children in marginalized groups. Using teaching assistants who come from pupils' communities can help build a more inclusive learning environment. In Hong Kong, for example, bilingual teaching assistants with a South Asian background took on a dual role of helping South Asian pupils learn Chinese and acting as cultural mediators between the dominant school culture and that of the South Asian community (Gao and Shum, 2010).

Trained and supported community volunteers, working with teachers, can improve learning for marginalized children. One example is the balsakhi programme in India, which provided targeted support for children in government schools lagging behind their peers. Instruction focused on foundation literacy and numeracy skills from a standardized curriculum developed by Pratham, an Indian NGO. A trained female community volunteer (balsakhi or 'child's friend') provided daily support to children identified as low achievers, many of whom were working children who had been unable to attend school regularly. An evaluation conducted in 2001/02 found a significant positive impact on test scores. The greatest learning gains were among previously low scoring children, who were the most likely to have been chosen to receive

instruction from the balsakhi. While only 6% of pupils were able to carry out two-digit addition at the start of the study, by the end of the year the proportion had risen to 51% for children in classes with balsakhi, but 39% in other classes (Abdul Latif Jameel Poverty Action Lab, 2006; Banerjee et al., 2005).

Deploying technology to reduce learning disparities

Technology is a medium that, without a doubt, facilitates learning in school, but that will never take the place of the work of a teacher.
- Carlos, teacher, Santiago, Chile

Among technologies that have potential to support classroom teaching, interactive radio and television programmes can lead to improvement in learning outcomes for marginalized and disadvantaged groups. Computers and portable electronic devices can supplement – but not replace – classroom teaching as long as teachers are trained to make the best use of the technology available. If new technology is to have wider benefits for learning among disadvantaged groups, however, learners need better access to information and communication technology (ICT) within and outside of school.

Radio and television can help improve learning outcomes

Radio and television programming can improve learning and narrow achievement gaps for disadvantaged children, particularly those in isolated or underserved settings. The use of radio and television can enrich curriculum delivery and develop familiarity with a second language. Well-designed programmes can improve the flexibility of curriculum delivery, contributing to better learning in a variety of contexts.

Interactive radio programming is an enduring and successful example of the use of technology to deliver basic education to underserved groups. Popular since the 1970s as a means of expanding access, radio broadcasting has had a resurgence, with several well-funded projects using interactive radio instruction to counteract poor resources, inadequate teacher training and low levels of learner achievement

Using trained teaching assistants who come from pupils' communities can help build a more inclusive learning environment

291

CHAPTER 7

(Ho and Thukral, 2009). Interactive learning activities such as song, movement and role-playing are introduced and guided by classroom teachers or, in non-formal contexts, trained community teachers, who follow broadcast instructions. Several such programmes aim to benefit not just learners but also teachers, who can learn new methods of teaching (International Research Foundation for Open Learning, 2004).

Interactive radio instruction is associated with higher achievement, particularly for early-grade pupils in hard-to-reach communities

A review of 15 projects showed that interactive radio instruction was associated with higher achievement of learners in English and mathematics in a range of developing countries, particularly for early grade pupils in hard-to-reach communities and schools in fragile states. The review identified encouraging trends in narrowing of urban-rural disparities in learning outcomes, which were particularly pronounced for children in very remote areas. In Pakistan, for example, the positive effects of interactive radio programming on the learning outcomes of grade 1 pupils were greatest in schools categorized as isolated. In such remote contexts, radio addresses barriers to learning raised by distance, poor access to resources, and an insufficient supply of quality teachers and of teacher supervision and support (Ho and Thukral, 2009).

Interactive radio instruction also holds promise as a strategy to support second-language acquisition. In Guinea, the Fundamental Quality and Equity Levels project builds on traditions of storytelling and song to encourage children to read and speak French; in contrast, standard French literacy education in Guinea focuses on recitation and memorization (Education Development Center, 2006). The programme has helped to narrow achievement gaps. Rural pupils who participated in the programme scored as high or almost as high as their urban counterparts on French tests (World Bank, 2005).

Radio broadcasts can be successfully incorporated into both formal and non-formal settings, increasing access to quality education, as an early childhood project in Zanzibar (United Republic of Tanzania) demonstrates. The Radio Instruction to Strengthen Education project was established in 2006 to develop and pilot models for extending early childhood education

to underserved communities. By 2010 it was reaching over 20,000 children on the islands of Pemba and Unguja. The project uses interactive radio instruction to build children's foundation skills and prepare them for primary school, using games, song, stories and problem-solving activities linked to the Zanzibar curriculum. An evaluation in 2008 found that children who had received interactive radio instruction, whether in non-formal or formal settings, had greater overall learning gains than children in formal classrooms who had not received radio instruction. Overall, learning gains, relative to the control group, were 12% higher for the non-formal group and 15% higher for the formal group. Results also show greater learning gains for children from Pemba communities, which have lower incomes, lower adult literacy, and poorer access to health and social services than those in Unguja (USAID and Education Development Center, 2009).

Radio can also support education in fragile states, including those emerging from conflict, by allowing education systems with shortages of infrastructure, qualified teachers and learning materials to reach large numbers of children and provide second-chance education to returning refugees and out-of-school youth. For example, between 2006 and 2011, the South Sudan Interactive Radio Instruction project enrolled over 473,000 pupils through Learning Village audio lessons targeting grades 1 to 4. The half-hour lessons were linked to the national curriculum and included instruction in English, local language literacy, mathematics, and life skills elements such as HIV/AIDS and landmine risk awareness. In addition, the project has reached 55,000 out-of-school youth with 180 audio lessons offering the primary school curriculum, together with civics, health and English-language content, via a non-formal accelerated learning programme. In locations that are out of range of any radio signal, the project distributed digital MP3 players to be used by trained teachers (Leigh and Epstein, 2012).

Television-assisted instruction, similar in approach to interactive radio instruction, is popular in parts of Latin America, where there have been several long-running, large-scale programmes. Telesecundaria in Mexico, for example, was launched in 1968 to extend

access to lower secondary education; by 2010, 1.26 million students were enrolled in the programme (UNESCO, 2012b).

Digital classrooms can enhance learning and bridge knowledge and skills gaps among less qualified teachers. Digital Study Hall is a small, innovative project that uses ICT to improve the accessibility and quality of education for disadvantaged children in India and, more recently, in Pakistan and Nepal. It provides digital video recordings of classes taught by expert teachers in Indian schools that correspond to state curricula. The recordings are distributed on DVDs to rural and slum schools, along with a TV, a DVD player and a means of providing electricity, such as a car battery or inverter (Digital Study Hall, 2013). Teachers are expected to mediate the recorded lessons and facilitate interactive learning, while the video provides a structured framework, content and a model of teaching for less qualified teachers. An evaluation of four schools in Uttar Pradesh state in India found that, after eight months, 72% of pupils had improved test scores; of these, 44% had an increase greater than 150% and almost a third improved by more than 200% (Sahni et al., 2008).

New technology can be used to supplement children's learning, but disadvantaged groups need support

We are studying with mobile phones. You get questions sent and you answer them and then you get the correct answer. It has helped me to improve my grades in my examinations. I enjoy studying with the phone; it's given me more enthusiasm to like reading.

- Joshua, aged 14, Mathare North, Kenya

Innovation in the use of technology can help improve learning by enriching teachers' curriculum delivery and encouraging flexibility in pupil learning. Greater access to computers in schools helps reduce the digital divide between low and high income groups. However, new technology is not a substitute for good teaching. Opportunities for computer-assisted learning need teachers' support. They must also be targeted at children who are denied

the greater access to ICT enjoyed by those from higher income backgrounds and urban dwellers.

Rapid advances in ICT and availability of computers and mobile devices have made it possible for these new technologies to be used as teaching tools in many countries. However, simply introducing computers in schools is not enough to improve learning, nor can they replace teachers as the primary source of classroom instruction: several studies in Europe and the United States have found little or no correlation between greater general ICT availability in schools and increased pupil achievement (Sprietsma, 2007). A recent experimental study of 1,123 grade 6 to grade 10 students in 15 schools in California found no effect on grades or test scores (Fairlie and Robinson, 2013).

In poorer countries, the availability of ICT infrastructure remains a crucial consideration. Many countries cannot yet support widespread computer-assisted learning because schools lack internet access or, in some cases, even electricity supply. But, given the investment required by poorer countries to ensure that all schools have electricity supply or internet access, the use of ICT is unlikely to be as cost-effective as spending more on teachers to reduce class sizes. Teachers remain central to curriculum delivery, particularly for low achievers needing additional support.

ICT can be more effective as a means to improve learning and address learning disparities if it plays a complementary role, serving as an additional resource for teachers and students. A study in India evaluated computer-assisted mathematics programmes, implemented both as a stand-alone substitute for regular teaching in an in-school programme and as an after-school programme to reinforce teachers' curriculum delivery. The results showed that the in-school programme, far from leading to improved scores, actually caused pupils to learn significantly less than they otherwise would have done. By contrast, using the after-school programme to supplement regular teaching brought increased learning gains, particularly for low achievers (Linden, 2008).

Introducing computers in schools cannot replace teachers as the primary source of classroom instruction

293

Teachers' ability to use ICT as an educational resource plays a critical role in improving learning. A study in Brazil found that the introduction of computer laboratories in schools had a negative impact on pupils' performance in and of itself, but that teachers' use of the internet as a pedagogical resource to support innovative classroom teaching and learning resulted in improved test scores, especially in mathematics (Sprietsma, 2007).

A programme in rural India showed higher achievers are better able to take advantage of the benefits of learner-led mobile learning

Children from low income backgrounds can benefit from access to computer-aided learning that includes well-designed interactive software supporting skills development, alongside curriculum-based competencies. A small-scale study in schools in low income areas of Tel Aviv found that grade 5 pupils using a computer-aided programme of interactive learning activities, delivered via individual laptops, had significantly higher learning gains than pupils taught in a traditional learning environment. The specifically designed software, aligned to the national curriculum, allowed teachers to provide different materials to pupils with different levels of achievement and let pupils work according to their own ability (Rosen and Manny-Ikan, 2011).

Effective use of ICT for learning requires careful consideration of how pupils' overall access to technology affects learning outcomes. Children from low income groups are less likely to have experience of ICT outside school, and may thus take longer to adapt to it. In low income countries, the digital divide is often extreme and strategies are needed to ensure that ICT exposure outside school does not exacerbate disparities for disadvantaged groups. In Rwanda, a study found that 79% of students who used computers in secondary schools had previously used ICT and the internet outside school (primarily in internet cafés) for various activities and that this additional exposure supported their learning in school. However, girls and rural children were at a disadvantage because they were less likely to have access to internet cafés or other ICT resources in their communities (Rubagiza et al., 2011; Were et al., 2009).

One promising way of increasing the accessibility of ICT for teaching and learning is 'mobile learning' – the use of mobile phones and other portable electronic devices, such as MP3 players. Mobile phones have perhaps the greatest potential for ICT-based learning, particularly in low income countries, where they are often the only widely available technology. Mobile phones do not require the same level of infrastructure as computers, networks are more widely available and phones increasingly have internet access and video capabilities. However, while they can increase learning opportunities, these new technologies need to tailor content and delivery to the varying needs of learners, especially weaker students.

In rural India, an after-school programme for children from low income families used mobile phone games to support English language learning. Two-hour sessions were conducted for a total of 38 days. This resulted in significant learning gains on tests of the spelling of common English nouns. However, the learning gains were greatest for children in more advanced grades who had stronger foundation skills. As higher achievers are better able to take advantage of the benefits of learner-led mobile learning, more attention is needed to develop software and other support mechanisms to include weaker learners (Kam et al., 2009).