



# DISTANCE EDUCATION FOR TEACHER TRAINING:

## Modes, Models, and Methods

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## Section I. Chapter 2

# AUDIO-BASED DISTANCE EDUCATION

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## Audio-based instruction has delivered learning to teachers and students even in the face of formidable obstacles.

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### 2.1 Overview

Since the 1920s, audio-based instruction has enjoyed an enviable track record as a proven mode of distance learning. Over the decades, programs such as the British Broadcasting Corporation (BBC's) "wireless" education in the 1930s; two-way Schools of the Air that delivered formal schooling to children in "bush schools" in Australia's remote outback beginning in the 1950s; the first Interactive Radio Instruction program, *Radio Math*, for Nicaraguan children in 1974; and *English for Latin America* (ELA), Education Development Center's (EDC) current English-language audio program for students and teachers in Latin America have revealed the power of the human voice and of the spoken word to engage, entertain, and instruct.

Audio-based instruction has delivered learning to teachers and students even in the face of formidable obstacles. Primarily through broadcast and interactive audio instruction, audio programming has reached students and their teachers in areas of conflict in Mali; afforded educational continuity to 58% of the world's learners during COVID-19 pandemic school closures;<sup>1</sup> and ensured home learning access during 2014 Ebola outbreaks in Liberia and Sierra Leone (Education Development Center, 2020; Gutierrez & Wurie, 2021). In addition to its

reach, audio's potential as a mode of distance education rests in its accessibility—it can be accessed via phones or through radio, the most commonly owned technology device across the globe, listened to weekly by three billion people (Social, 2022)—and its ease of use. Radio, as well as other forms of playback devices for audio programming—phones, MP3 players, CD-ROM players—are simple technologies that teachers often know how to use.

This chapter explores the more established forms of audio delivery—radio broadcasts, two-way radio, and radio lessons—and it discusses emerging models of audio-based instruction—Internet-based audio, interactive voice response, podcasts, and audiobooks. Its focus, however, is on the most successful model of audio-based instruction for both student and teacher learning: interactive audio instruction.

All of these distance-based teacher education models are examined in the next section.

### 2.2 Models of Audio-based Instruction for Teachers

No other model of distance education approaches the success of interactive audio instruction (IAI) as a tool, not just for student learning but for teacher

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<sup>1</sup>Audio-based instruction used either alone or as one component of distance education programming, as reported by the United Nations Children's Fund (UNICEF) in a survey of 127 countries (UNICEF Latin America and the Caribbean Section, 2020). These included countries with relatively strong Internet access: Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Honduras, Panamá, Perú, México, Cuba, and Venezuela. Few countries used audio-instruction alone for remote learning.

learning (See Figure 2.1 for its overall impact on student learning.). Interactive audio instruction has evolved over the decades to respond to some of the most pressing needs in education, such as continuing education in times of pandemic, epidemic, conflict, and crisis. It has delivered education to the most vulnerable learners, such as internally displaced children or orphans in Sub-Saharan Africa; children in post-conflict settings in South Sudan, Somalia, and the Democratic Republic of Congo; and in classrooms where there are no teachers. Increasingly it has been deployed to augment the content knowledge and skills of teachers as it educates students.

### 2.2.1 Interactive Audio Instruction

Interactive audio instruction or IAI is a comprehensive instructional approach to teaching and learning with audio-based instruction at its core. It involves the use of *one-way audio transmission* to reach *two audiences* (students and their in-class teachers)—a “dual audience, direct instruction” approach. Lessons are delivered by either (1) radio *broadcasts* (thus, often termed “Interactive Radio Instruction”) or (2) the use of audio-based technologies, such as MP3 players, memory cards, USBs, CD-players, or phones, connected to speakers and delivered to a defined, smaller audience according to the class schedule (a process known as *narrowcasting*). IAI combines highly scaffolded classroom-based engaging learning activities, exercises, and stories encouraging student participation led by the “audio teacher.”

Both the content and activities of the audio programs are based on the national curriculum and use a series of structured learning episodes. Within classrooms or learning centers, audio broadcasts typically run approximately 30 minutes and integrate games, songs, stories, and activities that encourage problem solving and self-directed

#### Figure 2.1 Interactive Audio Instruction for Student Learning

It is not possible to fully appreciate interactive audio instruction without documenting its impact on *student* learning. Decades of cumulative research beginning in the 1970s essentially concur that exposure to IAI is associated with higher levels of student achievement compared to students *not* exposed to IAI (Ho & Thukral, 2009, p. 1). While effect sizes<sup>2</sup> range from small (.24 in Thailand) to large (.94 in Bolivia), IAI has improved learning outcomes in conventional classrooms by between 10% and 20% when compared with control classrooms not using IAI (Ho & Thukral, 2009; Tilson et al., 1991).

Evidence-based research from contexts such as Kenya, South Africa, Malawi, India, Sudan, Pakistan, Zanzibar, the Democratic Republic of Congo, Liberia, Cabo Verde, and Zambia have demonstrated IAI’s significant role in improving students’ language learning performance (Education Development Center, 2009; Hanemann, 2018; Ho & Thukral, 2009; Leigh, 1995; Ministry of Education and Vocational Training, Zanzibar and Radio Instruction to Strengthen Education (RISE), 2009, p.7).

Analyses of interactive audio instruction across several countries—Bolivia, Honduras, El Salvador, Zanzibar, and Indonesia—suggest that audio-based instruction promotes early childhood literacy and numeracy for vulnerable students such as orphans and children who initially scored lower than those in the control group (Education Development Center, 2014, 2020; Ho & Thukral, 2009, pp. 25, 27, 31; Ministry of Education and Vocational Training, Zanzibar and Radio Instruction to Strengthen Education (RISE), 2009, pp. 24, 25).

exploration into the formal curriculum. Programs cover a range of subject areas in early childhood and basic education, as well as nonformal and

<sup>2</sup>An effect size specifies the number of standard deviation (SD) units separating the outcome scores of treatment and control groups in a study. An effect size is positive when the treatment group in a study outperforms the control group; it is negative when the control group outperforms the treatment group. Effect sizes of around 0.2 are typically considered to be small; 0.5, moderate, and 0.8, large in size. Effect sizes above 0.25 are considered large enough to be educationally meaningful (Cohen, 1988; Slavin, 1990). For a more complete definition of effect sizes see *Appendix 2: Glossary*.

accelerated programming for youth and adults. The methodology of IAI employs a range of pedagogical approaches that focus on leveraging audio content with learning activities, exercises and stories encouraging student participation and interaction, teaching guides, teaching and learning materials, out-of-class teacher professional development, and, in some cases, coaching (Education Development Center, 2014).

In this dual-audience direct-instruction approach of IAI, the audio teacher is not “live” (as in Schools of the Air, discussed below) but prerecorded. Once the in-class teacher turns on the radio or MP3 player, the audio “teacher” delivers content and orally directs the in-class teacher to apply a variety of interactive instructional approaches within his/her classroom. The participatory nature of the guided lessons engages learners in multiple ways—“cognitively, physically, emotionally, creatively and socially” (Christina & Louge, 2015, p.3).

### **IAI for Teacher Professional Development**

As highlighted in Figure 2.1, interactive audio instruction has a robust longitudinal body of large-scale, multi-subject, and multi-country evaluations examining student performance on a range of measures. IAI also possesses an increasingly cumulative body of evidence demonstrating its power as a tool for *teacher learning*. Many of these evaluations employ control groups to examine teacher performance in a variety of subjects (math, French, Lingala, Bahasa Indonesian, English) and in a variety of contexts (Cabo Verde, the Democratic Republic of Congo, Guinea, India, Indonesia, Liberia, Madagascar, Mali, South Africa, and Zanzibar) and are examined in the next several pages of this section.

**IAI can provide professional learning for teachers who would otherwise be unable to access it.** In many parts of the globe, teachers are unable to access professional development for a variety of reasons—an insecure environment, cultural constraints, lack of professional development opportunities, expense, family responsibilities, or distance.

### **IAI offers in-class, just-in-time professional learning for such teachers (Education Development Center, 2014; Morris & et al., 2015).**

Just-in-time professional development integrates teacher learning as the teacher needs it—with actual implementation of the strategy. This convergence eliminates issues of latency—the time lag between learning and implementation. By providing in-class, just-in-time learning, IAI allows teachers access professional learning while still attending to other responsibilities once the school day ends.

As will be discussed, this just-in-time, classroom-based support can improve teacher effectiveness and enhance previous teacher preparation. This is especially pertinent when teacher training or knowledge is low, in geographies/subject-matter areas where there is a scarcity of teachers, and for hard-to-teach topics (Gutierrez & Wurie, 2021, p. 23).

**IAI provides highly structured, high quality professional development.** Studies of effective teacher professional development note that it engages teachers in active learning, is situated in the contexts in which teachers teach, and is highly supportive (Darling-Hammond et al., 2017; Desimone & Stuckey, 2014). As a model of pre- and in-service distance education, IAI is aligned with many best practices in professional development that provide demonstrable teaching and learning benefits (Evans & Pier, 2008; Gaible & Burns, 2007; Ho & Thukral, 2009; Richmond et al., 2021).

At its core, each IAI program is a small, highly scaffolded, in-class professional development session for the teachers. During each program, teachers are asked to follow an instructional model that accomplishes three purposes: students learn; teachers learn to teach better through hands-on practice under controlled conditions (as opposed to more abstract training that happens outside of the classroom); and teachers come to understand the linkages between good classroom practice and improved learning (Gutierrez & Wurie, 2021, p. 7).



Audio programs essentially provide live coaching and support to teachers in ways that other technology cannot. The approach is both empowering and repetitive; thus, over time, teachers often are able to internalize the teaching method cultivated by IAI (Gaible & Burns, 2007; Thukral, 2016, as cited in Richmond et al., 2021).

**IAI can be used to support teachers who have had little or no initial teacher preparation.**

Teacher preparation systems, where they exist, often are weak. In Sub-Saharan Africa, in particular, as discussed in Figure 2.2, the quality of pre-service education is particularly problematic, with many teachers receiving no preparation at all. IAI is especially germane in such contexts because it can guide and support community volunteers, paraprofessionals, and even secondary-level students who serve in place

of trained teachers (Damani & Mitchell, 2020; Gutierrez & Wurie, 2021).

In Malawi, EDC, in partnership with USAID, the Ministry of Education Science and Technology (MEST), and the Malawi College of Distance Education (MCDE), utilized *Tikwere! (Let's Climb!)* IAI programs as part of a formal distance learning program for pre-service teachers. Cohorts of pre-service teachers gathered weekly in listening circles as IAI programs led them through reviews of their course work and practical discussions on the application of instructional skills (Education Development Center, 2012; Richmond et al., 2021).

The above professional development-related benefits are valuable. But the real worth of any type of teacher professional development is its translation into improved teacher practice and

**Figure 2.2  
Initial Teacher Preparation in Sub-Saharan Africa**

Because of poverty, weak education systems, and civil strife, future teachers in Sub-Saharan Africa (SSA) may enter their initial preparation with a low level of education. Results from the 2019 Programme for the Analysis of Education Systems (PASEC) revealed that a majority of students in Francophone SSA were below the "sufficient" threshold in reading and mathematics at the end of the primary cycle. In practical terms: More than 72% of these students could not read more than 20 letters in one minute (Conférence des ministres de l'Éducation des États et gouvernements de la Francophonie, 2020).

Education systems with weak potential teacher candidates are further hampered by low, unclear, or non-existent selection criteria for candidates wishing to matriculate through pre-service teacher training. Bonnet (2005) notes that more than half of teacher candidates in Anglophone and Francophone Africa have attained upper secondary education, but in many cases without a diploma. In Mali, the qualifications of pre-service teacher candidates have often been so low upon their arrival in pre-service teacher training colleges that they drop out at high rates because they cannot complete basic pre-service teacher coursework. Giorgi & Christmann (2009) report that, unlike other research to the contrary, even having a baccalaureate degree does not necessarily translate into better performance (cf. Morris et al., 2015).

Secondary school teachers in Anglophone countries generally tend to receive more pre-service preparation than their Francophone counterparts (Tilak, 2009). Though dated, the most recently available information shows that only 27% of teachers in Chad have received training and 36–37% in Madagascar and Togo (Tilak, 2009).

Across the Sub-Saharan region, situations are highly diverse. While teachers in Cabo Verde and South Africa are required to have a four-year bachelor's degree, 2006 data from Lesotho showed that only 58% of its secondary school teachers received initial preparation (Education International, 2007). In rural areas, conflict zones, and countries with large internally displaced populations, many of those teaching, including contract and volunteer teachers, have received no initial preparation to teach (Lauwerier & Akkari, 2015).



improved student learning outcomes. Here, results of IAI are noteworthy and supported by data.

**Improved teaching quality is linked to participation in IAI.** IAI has been linked to improvements in the quality of teaching and these effects appear to be positively associated with more frequent participation in IAI. For example, data from the Democratic Republic of Congo (DRC) and India suggest that documented improvements in teaching practice were most influenced by the degree to which teachers listened to IAI and their participation in continuing professional development activities in which IAI played a central role (Education Development Center, 2014; Ho & Thukral, 2009; Richmond et al., 2021).

In EDC's *Projet d'Amélioration de la Qualité de l'Éducation* (2009–2014), a five-year, USAID-funded literacy project in the DRC, data from 45 experimental schools in three provinces found that changes in teacher practice were most influenced by their IAI listenership rate—14.2% of the variance in teachers' change in *overall instructional practices* could be explained by their rate of IAI listenership ( $p=.004$ ,  $ES=0.37$ ) (Education Development Center, 2014, p. 9). Additionally, continuing professional development activities accounted for 18.3% of the variance in teachers' gains in *general classroom practices* ( $p=.012$ ,  $ES=-.42$ ) (Education Development Center, 2014, p. 10). More critically, IAI appears to have spillover effects. In a study of 37 IAI programs at Education Development Center, observations of teachers who use IAI reported that their instructional practice in *non-IAI* classes also improved and that they more frequently "utilized active learning techniques in lessons independent of radio guidance" (Ho & Thukral, 2009, p. 2).

**IAI can mitigate variability in teacher quality.**

Like instructional television, which will be discussed in the next chapter, well-designed IAI programs may be able to compensate for variability in local teacher quality and preparedness and poor instruction. For instance, rural students in Bolivia,

Thailand, and South Africa who were taught by less-qualified teachers but who participated in IAI programming attained test scores that were as high or almost as high as those for urban students (Anzalone & Bosch, 2005).

Since it is so highly scaffolded, IAI can compensate for the learning curves required of a novice teacher with little degradation in the quality of instruction because teachers, like their students, react verbally and physically to prompts, commands, questions, and exercises posed by audio characters (Gaible & Burns, 2007). Research from India suggests that after approximately 50–60 program episodes, a poorly prepared teacher will grow in confidence and begin to "mimic the instructional skills demonstrated by the radio teacher, providing more feedback, encouragement, and elaboration for students" (Thukral, 2016, as cited in Richmond et al., 2021, p. 28).

In many locations, educational quality is impacted by high rates of teacher absenteeism. Because lessons are pre-recorded or broadcast according to a pre-set schedule, students who participate in IAI may simply do better because they have been exposed to the entire curriculum planned for that school year and are thus not as adversely impacted by teacher absenteeism as may be the case in non-IAI settings.

**IAI can result in documented improvement of teacher knowledge.** Teachers' knowledge—in particular, of content, the language of instruction, how children learn, and the best approaches to optimize learning—is foundational to good teaching, as will be discussed in Chapter 8 (Desimone & Stuckey, 2014). IAI's impact on teacher learning has been extensively documented. IAI initiatives have proved effective in imparting basic content knowledge to teachers as well as to students—particularly when IAI is combined with professional development, teaching materials, and supported group study (Anzalone & Bosch, 2005; Education Development Center, 2014; Perraton, 1993).

Data from South Africa, Guinea, Madagascar, Comoros, and the Democratic Republic of Congo suggest that IAI can improve teachers' knowledge of the language of instruction (Education Development Center, 2009; Education Development Center, 2014; Evans & Pier, 2008; Potter & Naidoo, 2009; Richmond et al., 2021), knowledge of reading optimal instructional practices (Education Development Center, 2014; Ho & Thukral, 2009), and awareness of the cognitive development of young learners and how they learn (Morris et al., 2021).

**IAI can result in positive changes in teachers' instructional practices.** As will be emphasized throughout this guide, particularly in Chapter 8, good teaching matters. Where IAI has been used exclusively as a professional development tool to build teachers' skills, observational data suggest that IAI can help teachers employ research-based instructional approaches including student-centered, child centered or active learning techniques.<sup>3</sup> Consequently, teachers have a better understanding of "pedagogical concepts emphasized by (programs)" and (are) "able to utilize active learning and student-centered techniques in lessons" (Ho & Thukral, 2009, p. 37; Thukral, 2016, as cited in Richmond et al. 2021, p. 20; see also Evans & Pier, 2008).

The above claims are substantiated by the following three examples.

In Madagascar, following participation in IAI, teacher surveys revealed that the percentage of teachers using targeted student-centered instructional practices rose from 58% to 96% according to teachers (Evans & Pier, 2008). Teachers reported that IAI programs had helped them:

- learn new games (83% of teachers) or songs (82% of teachers) to use with their students;

- involve students in their own learning to a much larger degree than before IAI (91% of teachers);
- use group or pair work with students (91% of teachers);
- make learning more interesting for students (85% of teachers); and,
- employ new teaching techniques or strategies generally (90% of teachers) (Education Development Center, 2009).

In Mali, the USAID-funded, EDC-administered Formation Interactive des Enseignants par la Radio (FIER) project, an educational radio program, reported significant positive effects on teachers' use of child-centered interactive teaching practices. Also in Mali, audio-based instruction supported the delivery of the new curriculum and the coaching of teachers in reformed reading instruction (Richmond et al., 2021).

As Chapter 8 will elaborate, pedagogical content knowledge—that is, understanding one's subject area and knowing how to teach it—is essential for student learning. Data from EDC's aforementioned PAQUED program in the DRC, document that first- and second-grade teachers, as part of an IAI programming, increased the amount of instructional time they spent on reading subskills, such as comprehension and fluency (Education Development Center, 2014). Within a year of IAI programming, students in experimental schools, whose teachers utilized IAI and received professional development, significantly outperformed students in control schools. Teachers' gains in instructional practices related to fluency-building, vocabulary-building, and comprehension-building, were significantly linked to IAI listenership, suggesting that teachers may have been "transferring the modeled practices embedded within the IAI programs and applying them to their own teaching" (Education Development Center, 2014, p. 10).

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<sup>3</sup>These terms are synonymous.

These changes in teachers' instructional practices have been observed in other contexts— Zanzibar, India, Indonesia, Malawi, and Guinea. In all of these locations, observations have documented that, as noted previously, changes in teaching practice are most influenced by how much teachers listen to IAI and the degree to which they participate in continuing professional development activities in which IAI plays a significant role (Burns, 2006; Education Development Center, 2009, 2012, 2014; Ho & Thukral, 2009; Thukral, 2016, as cited in Richmond et al., 2021).

**When combined with ongoing professional development, coaching, support guides, and teaching materials, IAI can help teachers implement new instructional approaches with a high degree of fidelity.** The instructional improvements in the previous paragraphs result in large measure from teachers' abilities to apply evidence-based reading practices with a high degree of fidelity. Fidelity of implementation is often further supported by visits from a coach, school-based trainings, additional school-based support, and group reflection activities to help teachers enhance their knowledge of reading instruction and support their adoption of new practices.

For example, in the PAQUED program discussed previously, the ensemble of IAI interventions and supports—new skills, the use of a teaching guide, reading materials (read-aloud books, leveled readers), and teachers' participation in weekly and monthly continuing professional development— was "positively and significantly linked" to teachers' adherence to the program of reading activities (Education Development Center, 2014, p. 8). Their involvement in professional development helped teachers come to understand how children learn to read, identify the fundamentals of skilled reading instruction, become aware of their own beliefs about how children learn to read, and reflect on their practice as they learned from their experience, their peers, and their coaches. These realizations, combined

with structured IAI programs, helped teachers employ the reading program as designed (Education Development Center, 2014, p. 8). Indeed, 14.3% of teachers' overall knowledge of reading instruction was found to be predicted by how faithfully they applied this program (Education Development Center, 2014, p. 8). This "faithful application of prescribed instructional techniques and strategies was strongly correlated with improvements in students' reading performance" (Education Development Center, 2014, p. 5).

**IAI can support changes in teacher attitudes and dispositions.** For teachers to change practice, there must be changes in their understandings, beliefs, and values (Education Development Center, 2014). Observational evidence of IAI's impact on teachers' attitudes is strong, with teachers in many programs reporting that IAI has increased their motivation, enabled them to overcome embarrassment at their lack of subject mastery, changed their approaches to teaching and learning, helped them focus "less on the mechanics of a practice and more on how to adapt it to their students' needs," made them more gender-sensitive in their classrooms, and reinforced positive attitudes toward teaching (Anzalone & Bosch, 2005; Burns, 2006; Ho & Thukral, 2009; Education Development Center, 2014, p. 8; Masoud, 2020, as cited in Morris et al., 2021).

Evaluation data from Bolivia, Honduras, Zanzibar, and Indonesia show that early childhood caregivers who used IAI lessons in their centers scored higher on measures of positive interaction with children than did their control peers and were consistently more positive in their reviews of children's attention levels, skills, and general enjoyment of learning activities than were caregivers in control classrooms (Ho & Thukral, 2009, p. 26; Morris et al., 2015). The IAI lessons helped caregivers acquire skills that improved their interaction with their students and their delivery of lessons. Across treatment groups, IAI lessons also added value to the time children spent with caregivers. In Malawi, where 25,000

teachers and 2.7 million students participated in the IAI-based initiative *Tikwere* from 2007–2012, evaluation data demonstrated significant improvement in caregivers' skills in providing effective early childhood instruction (Education Development Center, 2012).

Not every IAI intervention is successful. Those that are share several commonalities. First, while, IAI can serve as stand-alone teacher professional development it works best when packaged as part of an overall approach of self-study, study groups, trainings, and support (Education Development Center, 2014). Next, successful IAI interventions often have “relatively well-funded evaluation components, often (teach) a single subject, and (focus) almost entirely on improving quality” (Ho & Thukral, 2009, p. 2). Third, successful IAI interventions constantly update content, ensure rigorous mechanisms of control of the quality of learning, and consider teacher and student needs in terms of design (Christina & Louge, 2015). Finally, unlike other technology interventions that bypass the teacher to work directly with students (as will be discussed in the next two chapters), successful IAI interventions empower teachers. It is teachers themselves, and their actions, “which generate interactivity (and) make IAI most effective compared with other education radio programs” (Gutierrez & Wurie, 2021, p. 14).

## 2.2.2 Educational Broadcast Radio

*Broadcasting* is the transmission of audio content to a dispersed audience across a region or country via radio transmitters. Anyone with a radio can then tune into the programming.

Broadcast radio has long been a popular model of distance-based teacher instruction, primarily in terms of upgrading existing teachers' content knowledge skills. As a teacher training tool, it has been utilized in countries where radio is a common technology and radio infrastructure pervasive; where radio listening is a primary source of entertainment and information; where television is often unavailable or less available; where Internet connectivity, computers, and

computer-literate teachers are in short supply; and where radio can substitute for the absence of a well-developed and widely distributed corps of teacher trainers and professional development opportunities. Even more than print-based instruction, broadcast radio has proved to be a successful means of conveying information to teachers, particularly in areas of conflict, areas marked by difficult terrain, and locations that are remote and isolated. Indeed, educational broadcast radio enjoyed a renaissance during COVID-19 pandemic school lockdowns, particularly in Latin America as part of countries' “I Learn at Home” remote learning initiatives (Burns, 2020; Cobo et al., 2020).

An example of how educational broadcast radio often works is provided by Radio Bhutan, operated by the Bhutan Broadcasting Service. Radio Bhutan provides education information to teachers and students in the national language, Dzongkha, as well as in English, Lhotshamkha, and Tshanglakha, mainly via airwaves and in some places through the Internet (Bhutan Broadcasting Service, 2022). It is typically broadcast in rural communities where Internet access is unavailable. Listeners to a particular radio program can request that radio broadcasters research specific information, which is then broadcast on the radio program. Many educational broadcast programs such as Radio Bhutan have generally evolved into Internet-based audio or other forms of distance education—mainly online learning.

### DIKLAT SRP: Indonesia

One of the most enduring models of broadcast radio for teacher training was Indonesia's DIKLAT SRP, an in-service radio broadcast program, which began in 1975 to help primary school teachers in 21 Indonesian provinces implement the country's new curriculum. The program was administered by Indonesia's Center for Information and Communication Technology for Education (PUSTEKKOM) and the teacher training curriculum was developed by Indonesia's Open University. Teachers participating in DIKLAT SRP were required to complete six learning packages

over three years, focusing on Indonesian language, science, mathematics, and social studies, curriculum and instruction, and additional topics such as basic education and educational psychology.

Teachers were given a paper-based test at the end of each package. Those who passed the test received a two-credit Certificate of Accomplishment counting toward teachers' promotion and receipt of their Diploma II.

One hundred and sixty radio programs were broadcast twice daily, six days per week. Teachers, organized in learning groups under the coordination of the school principal, first read their printed materials, then listened to that day's 20-minute radio broadcast on a government-issued radio provided to each school. Broadcasts were followed by a 10-minute discussion facilitated by the school principal, who was trained in the face-to-face Primary School Teachers' Development Project.

The program ended in the mid-1990s. Evaluation of DIKLAT SRP teachers indicated that broadcast radio provided extensive reach to teachers across Indonesia's vast archipelago, which enabled professional development that might otherwise not have been possible. No significant difference was found between the skills of teachers who went through face-to-face professional development and those receiving professional development via radio (Sadiman, 1999).

There is research suggesting that these programs may have constrained teacher learning as much as they helped it. Teachers reported concerns about the quality and length of DIKLAT SRP programming, suggesting that episodes were too short and topics not sufficiently developed. Much of the content of the Diploma II curriculum (56 of 80 credits) could not be broadcast either via DIKLAT SRP or Indonesia's follow-on radio broadcast program for teachers, *Diploma 2 by Air*, because radio was not a suitable medium for delivering more complex types of activities (Gafur, 1994, as cited in Sadiman, 1999).

### 2.2.3 Two-Way Radio: Schools of the Air

Another model of audio-based distance education is *interactive two-way radio*. In this approach, a distance teacher provides instruction and guides students and an in-class teacher (typically in isolated and hard-to-reach locations, as will be discussed) through the national curriculum. Unlike radio broadcasts or IAI, two-way radio allows live back-and-forth communication between the teacher and students.

Australia's Schools of the Air (SOTA) is the most well-known example of this approach. Launched in the early 1950s and still ongoing, two-way audio high-frequency radio transceivers are used to send and receive lessons and messages to and from students in the Northern Territories and Western Australia and their radio teacher in

#### Figure 2.3 Interactivity

Though frequently used, the term "interactivity" is often ill defined. Software vendors are fond of stating that a particular application is "interactive" because learners can click, select, or exercise a certain degree of choice. But as Sims (2003) notes, "interactivity" is a far more involved cognitive and affective process that encompasses the following features:

- Interaction with an object or person in a way that allows learners to improve their knowledge and skills in a particular domain
- Multiple communication between learners around an object of study, a tool, or an experience
- Learner control and program adaptation based on learner input
- Reciprocal processes of information exchange and sharing ideas between students and teachers
- Multiple forms of synergistic participation and communication that aid the development of meaningful learning (Sims, 2003)

The term, "interactivity" recurs throughout this guide.

Canberra, Darwin, or Brisbane. Like instructional television, discussed in the next chapter, students typically interact with the radio teacher (the teacher of record) and with other students around Australia at regularly scheduled times during the day (Australian Government, 2011).<sup>4</sup> SOTA also provides access to curricula and instruction in remote primary and secondary schools where teachers may not be certified to teach a particular content area, or where curriculum and materials may be lacking. This use of shortwave transceivers for synchronous, omnidirectional communication was the first example of educational technology being used to create a “community of learners” (Fowler, 1987).

Schools of the Air exist in every Australian state except Tasmania. All learning equipment, including radios, is furnished by the Australian government. The exact configurations of students and teachers varies across and within states, depending on geography, density, and the availability of an adult to be the in-class teacher. For example, in some locations, students may have in-person classes with a teacher (who may or may not be certified) during mornings and with the radio teacher in the afternoon (or vice versa). Schools of the Air also offer tutoring (Crump et al., 2010).<sup>5</sup>

As with educational broadcast radio, SOTA have constantly updated their technologies. In the late 1990s, several schools shifted from radio to telephone networks. In 2009, most schools switched from shortwave radio to wireless Internet technologies to deliver lessons that include live one-way video feeds and two-way audio. These tools have been supplemented by video cameras, Internet access, and interactive whiteboards (IWBs), enabling teachers at the studio sites to give lessons via satellite to learners who have Internet access. Students can watch and respond in real time via Web cameras attached to their computer or via synchronous collaboration

tools, thus providing greater interactivity between students and teachers, among students in varying remote locations, and between students and the learning material. (Figure 2.3 explains the term “interactivity.”) As well as providing two-way audio and video, students can email teachers and each other, interact with the IWB, and answer pop-up questions. They also can hear their classmates and participate in live group discussions.

Research on the effectiveness of SOTA is hard to come by. An overview of 60 years of SOTA information suggests that the educational results of the School of the Air students have been higher than comparable results obtained by traditional (in-person) schools’ students, though this could be attributable to a host of other factors, including high teacher-to-student ratios. The same research suggests benefits for families and communities, but nothing for teachers (Catalano, 2018).

Like IAI and instructional television, Schools of the Air have been used to support unqualified teachers, but unlike IAI, data regarding SOTA’s impact on teacher effectiveness are inaccessible. Despite this absence of evidence, two-way radio still may be a potentially feasible and useful model of teacher training in certain contexts. More accessible and rigorous evidence, though, is needed to substantiate such an assertion.

#### 2.2.4 Radio Lessons

While broadcast radio programs and Interactive audio instruction provide in-service instruction to existing teachers, other forms of audio-based instruction have been developed to support community volunteers or university-aged learners serving as teachers. One common form of audio-based instruction for teachers and students is radio lessons. (Figure 2.4 outlines their use in Cabo Verde).

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<sup>4</sup> In extremely remote areas where there are no other students, a student may work alone using his/her high-frequency radio and printed material.

<sup>5</sup> To see a particular School of the Air in action, visit Kimberley School of the Air at <https://www.ksota.wa.edu.au/>

Radio lessons are what they sound like: radio programs (typically) that broadcast instruction into a classroom. Like IAI, they serve as a master teacher, often supporting volunteer teachers who are teaching on an emergency basis.

#### Figure 2.4 Educational Radio in Cabo Verde

Cabo Verde, a sparsely populated archipelago of 10 islands off the coast of west Africa, has relied on educational radio for years. All Cabo Verdeans have access to radio, and it is part of the background noise of the country. Indeed, “distance education” in Cabo Verde is essentially radio-based education. The Law of Foundations of the Education System of Cabo Verde recognizes it as a “special modality” and mandates that students receive academic credit for participating in radio-based distance education programs (Hanemann, 2018).

The small island nation initiated its national educational radio service in 2003. Three years later, it launched radio tutoring programs for adults and out-of-school youth. These tutoring programs—*Radio Escola*—are intended to enable any learner to access education, regardless of literacy skills, levels of formal education, or economic status. The programs are supported by print packages of learning materials distributed to learners. Over the course of 30 minutes, the radio tutor explains a topic and learners complete a lesson following the radio tutor’s instructions. Learners can phone in with questions (Burns et al., 2019). Twenty-eight of Cabo Verde’s radio instructors have been trained in this radio pedagogy (Radio ECCA, 2022).

In addition to radio tutoring, Cabo Verde has or has had a number of educational radio options—weekend morning educational radio programming for children, complete with stories and songs; radio lessons; radio broadcasts to support teacher professional development; educational radio dramas (though not in the last few years); and educational radio to help the general population with Portuguese skills or environmental education (Burns et al., 2019).

Radio lessons often borrow techniques from both broadcast radio and IAI and occupy a middle ground between the two. Like broadcast radio, lessons are often largely didactic; though, like IAI, there may be a set of continuous characters with pre-recorded lessons. Typically, the radio “instructor” provides information, asks questions of the learners, and directs the teacher to do certain actions.

However, unlike IAI, which incorporates the teacher into learning, radio lessons often circumvent teachers or include them only marginally. This is in part because many programs are designed to be used for self-study.

#### Africa Educational Trust: Somalia, South Sudan, Kenya, Uganda

A well-known model of radio lessons is the Africa Educational Trust (AET). In association with the British Broadcasting Corporation 4 (BBC4), AET offers radio lessons to learners—both teachers and students—in refugee camps in South Sudan, Somalia, Kenya, and Uganda. Where a radio signal is not available, AET distributes the same lessons on CDs and MP3 players. The initiative has focused on helping community volunteers who assume teaching roles to help learners gain basic literacy and numeracy skills. Radio lessons also focus on important daily topics for the community (e.g., cattle raising, issues with alcoholism). AET’s program have reached approximately 250,000 Somali learners (Africa Educational Trust, 2014).

In 2013, the new nation of South Sudan adopted English as its official language. AET’s *Speak Up II* was introduced to help community volunteer teachers learn English so they could teach it to students. Via teacher surveys and interviews, almost all volunteer teachers and learners credited the program with improving their English and rated the quality of programming as “excellent” (Carfax Projects, 2019, p. 28). However, community volunteer teachers reported that radio broadcasts were not enough in terms of learning how to teach. AET thus provided more site-based support,



helped volunteer teachers develop lesson plans, simplified the monitoring process, and created clear success criteria to measure the volunteer teachers' performance. According to volunteer teachers' self-reported data, these modifications appeared to increase their confidence levels and resulted in more learner talk and less teacher talk in learning centers (Carfax Projects, 2019). These findings echo aforementioned research regarding IAI—that audio programming works best when integrated into a comprehensive package of teacher professional development and support (Anzalone & Bosch, 2005; Education Development Center, 2014; Evans & Pier, 2008; Richmond et al., 2021). This is a lesson that is highly relevant for all forms of distance education.

## 2.3 Other Forms of Audio-based Distance Education

Audio-based distance education is extraordinarily diverse. This section examines other models that while not explicitly used for teacher education, certainly could be.

### 2.3.1 Internet-based Audio Lessons

As noted previously, a good deal of audio-based instruction has shifted to the Internet as Internet radio listening increases at a rapid rate (Social, 2022). In particular, formerly on-air media broadcast services stations (such as Radio France Internationale [RFI], the British Broadcasting Corporation [BBC], Rádio e Televisão de Portugal [RTP], and Radio DeutscheWelle [DW]) are continually evolving their on-air services and programs for the Internet.

Some of these offerings are extensions of traditional broadcasting, such as conventional radio or television stations with websites that feature streaming of audio or video programs (i.e., webcasting). Others are unique to the Internet, such as Internet-only broadcast stations.

Particularly in Sub-Saharan Africa, where French, English, and Portuguese are still spoken as national languages, these national media broadcasters have developed extensive online platforms with significant educational content to promote language and cultural education. One example is TV5 Monde's *Apprendre le français*, which provides free French lessons linked to the Common European Framework of Reference that defines various levels of proficiency thus allowing learners' progress to be measured at each stage. Many of these audio-based offerings—podcasts, interviews, language lessons—surpass what is offered via airwaves alone as well as what is offered on commercial foreign-language instruction websites.

### Audio Lessons in the Canarias: Radio ECCA

In addition to Cabo Verde (discussed in Figure 2.4), the Canarias (Canary Islands), another set of volcanic islands off the northwest coast of Africa and an autonomous community of Spain, have made extensive use of audio-based learning in the form of audio-based lessons for continuing education for adults in general and for young people who have dropped out of school. This archipelago-wide initiative, Radio ECCA, offers hundreds of audio-based courses via the Internet, CDs, or broadcast over the airwaves. It is geared toward all adult learners, including teachers.

Radio ECCA's approach consists of (1) materials required to follow the course; (2) detailed recorded lessons—typically 30 minutes in length, in which the learner follows along using paper or digital learning materials; and (3) tutoring—this can be phone-, email-, text- or online-based tutoring between teachers, individual learners, and peer groups. Courses are free—there is an extensive searchable Spanish-language database—however, there is a small cost to receive continuing credit. Upon passing courses, students receive credits that can be applied toward their *bachillerato*, the post-16 stage of

education in Spain, comparable to A Levels in the United Kingdom.<sup>6</sup> Radio ECCA's model has been exported to a number of Latin American countries and even to Ukrainian refugees (Radio ECCA, 2022).

Internet-based radio can make radio more available across geographic boundaries for anyone who has Internet connectivity and access to a smart phone, tablet, or computer. Where infrastructure is available and stable, Internet-based radio can circumvent some of the transmission issues associated with community and short-wave radio: It is easier and less expensive to produce and broadcast and doesn't require licensing. This makes possible multiple types of non-formal programming that might not exist without it. However, Internet-based radio also makes it easier for governments to block sites of broadcasters with which they disagree or whose content they disapprove.

### 2.3.2 Soap Operas/Radio Dramas

The popularity and broad ownership of radio makes it a powerful tool for information and social change, particularly in countries and communities with strong traditions of oral literacy.

One form of radio broadcast—soap operas, novelas, or radio dramas—has been employed successfully in other sectors, such as public health and agriculture, to reduce high-risk behaviors and promote positive ones. Such approaches have enjoyed success. A 2011 United States Agency for International Development (USAID) study of radio listenership in 27 Sub-Saharan African countries reported that radio broadcasts appear to be more effective than television as a conduit of information about knowledge, attitudes, and behaviors associated with HIV/AIDS (Westoff et al., 2011).

The “edutainment” value associated with radio novelas, their proven persuasive ability to influence behavior, and their capacity to diffuse information in a social and engaging way, would suggest that radio novelas are worth exploring in some capacity as one of a number of formal teacher learning tools. Radio dramas have been used on a limited basis in education—most well-known might be the defunct *Silk Road Radio*, which ran regularly from 1998–2006 and focused on urban and rural youth in Tajikistan, Uzbekistan, and Kyrgyzstan (The Natural Resource Management Network, 2006). As with serialized television programming, discussed in the next chapter, the educational and entertainment value of radio is noted here as a possible, though unexamined, form of teacher professional development.

### 2.3.3 Podcasts

The Internet and mobile technologies are transforming all forms of audio-based learning. One of the most popular innovations in audio-based open and distance learning for teachers is the use of podcasting. Podcasts are a *series* of audio files distributed over the Internet by syndicated download through RSS Web feeds to phones, tablets, and laptops.<sup>7</sup> Though the same content also may be made available by direct download or streaming, a podcast differs from other digital media formats in its ability to be syndicated, subscribed to, and downloaded automatically when updated content is added. (Podcasts will be referenced again in *Chapter 5: Online Learning*).

There is no shortage of teacher podcasts from which to choose. The Australian Council for Educational Research (ACER) *Teacher Magazine*; *Two Mister Ps in a Pod(cast)*; *the Educational Podcast Network*; *Teach Me a Lesson*; *The Ten-Minute Teacher*; and *The Cult of Pedagogy* all are

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<sup>6</sup>After taking the *Bachillerato*, a student may enter vocational training (Higher-level Training Cycles, *Ciclos Formativos de Grado Superior*) or take the *Selectividad* tests for admission to university.

<sup>7</sup>Podcasts are typically a form of social media. Social media will be discussed in *Chapter 5: Online Learning*.

popular podcasts that offer practical teaching ideas. Teachers receive content automatically on phones or computers through RSS feeds, listen through audio services such as *SoundCloud*, *Spotify*, *Apple*, or *Google Podcasts*, or tune in as desired.

Though the focus was not educators, *per se*, one research study at a U.S. university examined the potential effects of podcasts via two treatment arms: Both sets of university students received print handouts of the lecture, but one group also received podcast lectures. Exam scores revealed that this latter group of “podcast students” scored 9% higher on examinations than did non-podcast students, but only if they took notes on the handouts. Podcast students who did not take notes scored the same as the non-podcast students (McKinney et al., 2009).

Studies with pre-service teacher candidates suggest that content acquisition podcasts (CAPs) can provide pre-service teachers with content knowledge (for example, related to language and disability) while other studies have pointed to improved English-language acquisition (Ting, 2014), improved ability to teach ambiguous and complex information, such as language usage and disability, for preservice teachers (McNamara et al., 2020). Cross (2016) suggests enhancing podcasts’ effectiveness as a teacher education tool by providing learner-specific guidance related to podcast choice, goal setting, task selection, structured listening activities, and keeping a reflection journal.

Podcasts are increasingly easy to create with free and low-cost tools such as *Wavepad*, *ScreenCastify*, *Audacity*, *Garageband*, and even the basic audio recorder found on most phones. Podcasts can be stored for free on sites like *Podomatic* or *SoundCloud*. For those wishing to learn more, the United States public radio

broadcaster National Public Radio offers a free, complete guide on how to start a podcast.<sup>8</sup>

### 2.3.4 Audiobooks

Like podcasts, audiobooks have become a valued and popular vehicle for accessing content. For more than a decade, digital audio has grown by double digits annually. In 2021, audio book revenues totaled US\$1.67 billion, an increase of 25% from 2020. Nearly 74,000 audiobooks were released in 2021, many of them new titles (Audio Publishers Association, 2022). Like all audio files, they can be accessed via phones, tablets, and laptops.

Audiobooks—books narrated in an audio recording, versus text-based or “talking books”—are commonly used for students in early childhood to secondary-level settings. Their use as a tool as part of teacher education appears scant, however.

Yet as seen with several of the approaches profiled in this chapter, audio-based learning has multiple learning benefits—e.g., improved reading comprehension, improved reading accuracy and fluency, and improved content knowledge—outcomes that, as Chapter 1 posits, are not always true of print- and text-based reading (Best, 2020). Their greatest benefit may rest in their simplicity—the act of being read to—and the pleasure that ensues from a well-read recording of a book that brings otherwise dull information to life. As one fulsome testimonial from an audiobook user notes, audiobooks can “envelop the reader in aural cues—inflection, emphasis, animation, accent, tone—that deepen and illuminate the experience of encountering the author’s words” (Jacoby, 2023).

Attributes like these have made audiobooks a popular way to consume information (Jansen, 2019). Daily audiobook listeners spend more time listening to books than to any other form of audio (radio or podcasts), and younger (versus older) adult readers are more enthusiastic consumers of audiobooks (Audio Publishers Association,

<sup>8</sup> See <https://www.npr.org/2021/06/22/1009098800/how-to-start-a-podcast-npr-advice>

2022; Best, 2020). A 2022 U.S. consumer survey reported that 54% of audiobook listeners are younger than 45 (Audio Publishers Association, 2022). Such demographic data are important for distance education planners: They suggest that pre-service and novice teachers may be more amenable to reading via audiobooks than from print documents. Further, distance education developers can record audiobooks and then use a free service such as *Audiobook Creation Exchange*, where the audiobook can be converted and sold on sites like Amazon's *Audible*,<sup>9</sup> *Spotify*, *iTunes*, and Google or uploaded and accessed for free via *Digitalbook.io*.

**Schools don't have to purchase computers; they don't need Internet connectivity; and teachers do not need to learn complex technology skills in order to participate in audio-based professional development**

### 2.3.5 Interactive Voice Response

Interactive voice response, or IVR, is an automated telephone system that combines pre-recorded messages or text-to-speech technology with a dual-tone multi-frequency (DTMF) interface to engage callers, allowing them to provide and access information without the presence of a live human being. If the IVR system cannot retrieve the information that the caller is looking for, the programmed menu options can provide assistance in routing callers to the appropriate representative for help (IBM, 2021). By integrating computer and telephony technologies, IVR has been used for "nudges" (to remind learners to do something), for data collection, and to disseminate simple information and content to

teachers and learners during COVID-19 pandemic school closures (Burns, 2021; Morris et al., 2021).

IVR is increasingly popular in donor-funded programs in the Global South, and its use continues to expand and evolve. However, the research on its potential effectiveness has not kept up with its implementation.

## 2.4 Considerations: Audio for Distance Education

Audio is a simple technology with which many teachers across the globe are familiar. Schools don't have to purchase computers; they don't need Internet connectivity; and teachers do not need to learn complex technology skills in order to participate in audio-based professional development. Audio-based, oral learning is a culturally familiar modality that doesn't require either the reading and writing skills needed to undertake print-based instruction or the technology skills demanded by online learning—requirements that often prompt teacher attrition in distance education programs.

Like every technology, audio offers both strengths and weaknesses as a distance learning mode for teacher education. These are enumerated below.

### 2.4.1 Benefits of Audio-based Distance Education

Audio-based instruction holds multiple benefits for education in general and for teacher education in particular. Radio broadcasts, IAI, two-way radio, live radio tutoring, and radio lessons can provide information to teachers at scale; deliver the national curriculum to learners and teachers in remote areas; support community volunteer teachers who have little or training in teaching to successfully implement a lesson; provide targeted instruction, support, and tutoring to learners who may struggle with a particular

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<sup>9</sup>*Audible* is by far the biggest audio book retailer, with more than 760,000 titles, many of them audio originals (as of January 2023). With a free account users can listen to up to 11,000 titles (Audible.com, 2023).

### Figure 2.5 Sustainability at the Teacher Level

The goal of any innovation and a critical component of scaling innovations is “sustainability.” However, successful implementations are often difficult to sustain in the face of competing priorities (Coburn, 2003). Yet, some innovations may persist, as the following example shows.

From 1998–2006, Guinea’s Fundamental Quality and Equity Levels project, funded by USAID and implemented by EDC, began as an IAI project with the popular, in-class program, *Sous le Fromager*. The country’s FM radio station broadcast each program until the 2004–2005 school year, when the three ministries that oversaw the program were unable to provide funding for its continued broadcast.

But that didn’t stop teachers from using the program in class—at least in rural schools visited by the author. Teachers audiotaped radio broadcasts and created and shared vast libraries of the popular audio program. Parents solicited donations to purchase CD players for schools, and entrepreneurial village residents established CD-ROM and cassette player repair shops. *“IRI” continued without the “R” because substitute technologies were affordable and easy to use.*

Some schools were unable to afford the simplest technologies but still continued with IAI lessons. How? Since IAI is not just a technology, but rather an instructional methodology, teachers who had used the programs for years had internalized the interactive teaching practices and could do them even without the technology.

This points to a fundamental characteristic of sustainability—*depth*. Teachers must have deep knowledge about and comfort with the innovation. They must see that it has value for them and their students. Once this happens, depth results in *shifts* in teacher behavior and these shifts can *spread* throughout a school and become an integral part of teacher repertoire, part of the school’s instructional culture (Coburn, 2003). When this happens, many teachers will then do their part to sustain the innovation in their own classrooms even when governments and institutions cannot.

topic, skill, or in a certain content area; provide educational experiences to teachers and learners with no connection to the Internet or cellular services; and offer some degree of standardized educational quality where there are no teachers.

In terms of audio-based distance education, it is interactive audio instruction that has been shown to tower above other audio-based approach, improving teacher learning as it improves student learning and helping teachers apply new pedagogical techniques in lessons facilitated by audio (Ho & Thukral, 2009). The benefits of IAI have been extensively documented throughout this chapter; thus, this section enumerates some of the more diffuse and general benefits of audio-based distance education.

### **Audio is often the only technology able to provide educational opportunities in the most challenging geographic, geopolitical, and public health environments**

Audio-based formats of distance education, such as radio broadcasts, radio lessons, IAI, and two-way audio are able to reach teachers and students in remote geographic regions or areas of conflict, as well as home-bound audiences and refugee and internally displaced communities in ways that other distance technologies cannot.

For example, the Organization of American States InterAmerican Teacher Network (OAS-ITEN) used radio in South America to reach teachers in the vast, remote Amazon regions of Bolivia, Colombia, Ecuador, Perú, and Venezuela. These teachers could not have otherwise participated in professional development (Inksater, 2017).

In the arctic and sub-arctic region of Canada's Northwest Territories—an area of 1.14 million square kilometers and home to 41,000 of Canada's most remote inhabitants, half of whom are the Dene, Inuit, and Metis people—education during COVID-19 was only possible through educational storytelling via local radio stations and print packets (Bates, 2023; Soanes-White, 2022).

Audio-based instruction has been employed in areas where accelerated learning programs are not possible because of conflict, such as in Mali, Somalia, and Nigeria. In the USAID-funded, EDC-run Education Recovery Support Activity (ERSA) in Mali, IAI, in combination with support to facilitators (teachers) and with rich sets of learning materials, provided basic education, life skills, and livelihood training for approximately 2,800 out-of-school youth (OSY) during armed conflict (Education Development Center, 2020).

### **Radio has proven to be a low-cost, high-reach mode of distance education**

Where radio infrastructure is available,<sup>10</sup> its range is formidable, reaching large numbers of targeted teachers in geographically remote and isolated areas as well as a potential “shadow audience” of caregivers, out-of-school children and youth, and other adults in the community (Morris et al., 2021, p. 10). Further, radio-based programming allows for additional learners at very low marginal costs. All of these factors make audio in general a highly cost-effective technology<sup>11</sup>—this is particularly true when taking into account the learning gains for teachers and students using IAI. The broad reach of audio-based distance programming means that more teachers can be trained, thus reducing the overall instructional unit cost per teacher (Anzalone & Bosch, 2005; Gaible & Burns,

2007). Further, because teachers can listen to radio broadcasts or audio programs during the school day, schools do not need to worry about paying for substitute teachers, paying teachers' travel to workshops, or losing class time for students.

The cost effectiveness of *narrowcast* technologies, such as audio instruction delivered via phones, CDs, and MP3 players, is also well documented (Christina & Louge, 2015; Damani & Mitchell, 2020; Ho & Thukral, 2009; Richmond et al., 2021). IAI has been successfully deployed since the 1970s in many areas of Africa, the Caribbean, Sub-Saharan Africa, Latin America, and Asia—contexts with often limited human and financial resources (Richmond et al., 2021).

However, as will be discussed, while audio is a cost-effective distance education modality, especially compared to television, virtual reality, and other forms of distance learning, it still entails significant capital costs in terms of developing the entire audio-based distance learning system and recurrent costs such as updating, implementation, and maintenance (Damani & Mitchell, 2020).

### **Audio is renewable and sustainable at the individual and institutional level**

Finally, audio-based learning is both renewable and sustainable, as the vignette from Guinea in Figure 2.5 about IAI illustrates. The technologies used for audio-based learning—radio, MP3 players, mobile phones, CD-ROM players—have proved to be inexpensive, portable, one-to-many technologies that require minimal training to use, are aligned with traditional oral means of imparting information, such as songs and stories, and are popular with teachers and students (Richmond et al., 2021). With IAI in particular,

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<sup>10</sup> Many parts of the world where IAI has been a fixture on the teacher professional development landscape (South Asia, Latin America, and sub-Saharan Africa) have well-developed radio and audio production capacity.

<sup>11</sup> Cost-effectiveness answers the questions, “What did this intervention cost per outcome delivered? How does that compare to other interventions that produce this outcome?” (Walls et al., 2020, p. 7). Cost effectiveness is difficult to establish in education because it requires both cost data and impact data (Walls et al., 2020, p. 7). Further, given the variability of labor, material, and production costs across countries, it is difficult to establish an exact per-teacher expenditure for IAI across countries. Christina & Louge (2015) draw on Adkins' 1999 World Bank Education and Technology Technical Notes volume *Interactive Radio Instruction: Impact, Sustainability, and Future Directions* (pp. 37–50) for cost effectiveness data. They report that the cost effectiveness ratio for IAI (effect per dollar in cost) was .91, versus .54 for textbooks and .08 for traditional teacher training programs (p. 33).



teachers see its value in terms of improved student engagement and learning; they see its value as a tool for their own professional learning and teaching. Because it's part of the school day and what teachers do, teachers can easily integrate it into teaching and assimilate its practices to expand their teaching repertoire.

#### 2.4.2 Limitations of Audio-Based Distance Education

Like any technology, many forms of audio-based instruction also have limitations, as discussed below.

##### **Educational radio broadcasts often lack measures for quality and outcomes**

Educational radio broadcasting for in-service teacher professional development has often been termed “spray and pray”—it can help teachers gain the basics in curriculum, content knowledge, and awareness around new instructional skills, but soon exhausts its capabilities because of its limitations as a largely passive broadcast medium. Because many radio broadcasts for teacher learning have had limited or no monitoring, school-based follow-up, or formative evaluation, many radio broadcast professional development programs spur more questions than answers. For example, what percentage of teachers listens to the broadcasts with any regularity or at all? What percentage implements with fidelity what has been taught via broadcasts? (Morris et al., 2021).

##### **Audio-based instruction is more effective when there is interactivity and support**

Data over the decades has shown that teachers are more likely to complete their course of audio-based studies, such as radio broadcasts, when there is support, monitoring, and coaching (Perraton, 1993). This is true for other forms of audio-based instruction such as IAI, where data from the Democratic Republic of Congo and Zanzibar show that teacher support, in addition to ongoing professional development, can improve practice (Education Development Center, 2009; Morris et al., 2015).

The technologies used for audio-based learning—radio, MP3 players, mobile phones, CD-ROM players—have proved to be inexpensive, portable, one-to-many technologies that require minimal training to use ... and are popular with teachers and students.

##### **Audio, and radio in particular, is viewed as an outdated technology**

Audio may be seen as an unattractive technology by youth despite what appears to be a constant practice of listening to phone-based audio via headsets. Trucano (2010, as cited in Damani & Mitchell, 2020), has singled out this view as a political barrier to the adoption of educational radio. The author too has witnessed multiple cases of Ministries of Education—despite having strong radio infrastructure and weak Internet infrastructure—rejecting IAI or radio lessons as “old” in favor of online learning. Audio-based instruction among many Ministry of Education officials across the globe is often viewed as not modern and fit only for the poorest contexts.

##### **Like any technology, audio-based instruction depends on strong design**

For teachers to move beyond basic skills in instruction toward more intermediate or advanced skills, other types of audio-based professional development have proven more successful. Indeed, reviews of research on audio-based instruction indicate that those that are most effective are also the most interactive, such as interactive audio instruction (Damani & Mitchell, 2020).

Poorly designed audio programs can still promote watered-down instruction. There are numerous audio-based programs that call themselves “interactive” and claim to be “learner-centered,” but such claims are often debatable. Some of this results from poor design. Some results from



a failure to completely understand the concept of learner-centered instruction (See *Chapter 10: Instruction*). Though students may be more *physically* active in some IAI programming, if it is not grounded in clear concepts of learner-centered instruction, the scripted nature of IAI programming diminishes teacher and learner agency and perpetuates the same didactic dynamic of passive teaching and learning (Burns, 2006).

### **Audio-based distance education has high initial development costs**

Though cost-effective in terms of adding new learners at low marginal costs like any technology-based distance education system, audio-based distance education programs are expensive to build. This is particularly true in terms of radio broadcasts. Exact costs are often hard to determine, for a variety of reasons (labor, cost of inputs, insurance, and other indirect costs), but Christina & Louge (2015) note that major audio-based distance education costs vary according to the technology used. These involve the following:

- **Radio**—Broadcast costs; costs of radios for users; electricity (solar power or crank-charged), or battery-charging costs
- **MP3 or CD**—Costs of playback devices and of digital media recording and distribution; electricity or battery-charging costs
- **Mobile phones**—Costs of mobile phones and of Secure Digital (SD) card recording and distribution; battery charging costs
- **Costs of mobile phones and of toll-free line**—User costs of interactive voice response is not funded by the government or telecoms; battery-charging costs

Technology is just one cost associated with audio-based instruction. There are multiple other costs, such as scriptwriting, content development, recording episodes, and distribution costs. However, there are avenues for free editable content developed for educational radio. For example, Rising Academies, which originally developed audio content for Sierra Leone and Liberia, makes its ready-to-air radio scripts freely available. All content is licensed under Creative Commons Attribution-NonCommercial 4.0 International license (see Figure 12.6 in *Chapter 12: Developing Content*). Example topics include literacy, language arts, numeracy, and mathematics from preschool through to secondary school. Teacher professional development content also is provided, and all scripts can be edited and localized (Rising Academies, 2021).

### **Radio is dependent upon infrastructure**

Where radio broadcasts, radio lessons, and IRI are used, they depend upon government or private radio transmission for their dissemination to schools. When that is lacking, all programming may be halted—though as Figure 2.5 illustrates, there are exceptions to this. As Figure 2.5 also shows, radio, like any broadcast medium, is vulnerable to political, economic, and infrastructural forces beyond the control of distance education entities. Community and rural radio may not always have strong signals; broadcast times may bypass students in the morning or afternoon shifts of school; and windup radios may easily break.

Using other audio formats such as CDs or audio programs on phones or MP3 players circumvents these issues.

## 2.5 Summary of Audio-based Distance Education

Audio will be discussed again in *Chapter 12: Developing Content*. Figure 2.6 summarizes the role of audio-based distance learning and its strengths and limitations as a distance education mode.

**Figure 2.6**  
Summary of Audio-based Distance Education

Roles in Teacher Professional Development	Strengths	Limitations
<ul style="list-style-type: none"> <li>• IAI and radio lessons can substitute for or complements the in-class teacher as an instructor.</li> <li>• Radio and IRI are used to reach large student and teacher populations.</li> <li>• IAI provides a highly scaffolded form of professional development for teachers.</li> <li>• Audio is often targeted toward teachers with weak literacy, content, or pedagogical skills.</li> <li>• Audio-based distance education offers instruction in basic skills, e.g., math, health, language of instruction (English, French, Portuguese).</li> <li>• IAI is used to promote teacher development, primarily via demonstration, guided and hands-on classroom management, and building subject knowledge.</li> </ul>	<ul style="list-style-type: none"> <li>• Radio is a known quantity in all countries, and radio production skills are widespread.</li> <li>• Demonstrable improvements in students' and teachers' learning.</li> <li>• Lack of literacy skills is not a barrier.</li> <li>• It can combine hands-on development of teacher skills with student learning.</li> <li>• It enables instructional continuity across grades and subjects.</li> <li>• It is durable and can survive extreme environments and long-term use with minimal care.</li> <li>• It requires only moderate classroom infrastructure and low technical support.</li> <li>• It can largely facilitate portable and "anytime, anyplace" learning.</li> <li>• IAI as a teacher education tool is supported by a growing body of rigorous research.</li> <li>• Audio-based learning can add new learners at marginal costs.</li> </ul>	<ul style="list-style-type: none"> <li>• The value of content may degrade over time—long-running programs must evolve with schools and education systems.</li> <li>• Broadcast radio often reinforces rote learning models—interactivity may be limited, and attention to needs of individual learners is limited.</li> <li>• Audio may promote a linear, one-size-fits-all approach.</li> <li>• With IRI/broadcast radio, issues such as scheduling, budget, receptivity, or reaching rural regions can interrupt or stop broadcasts.</li> <li>• Hardware replacement programs are necessary: Radios, CD-ROM players, and batteries may be stolen or damaged; windup radios may be fragile.</li> <li>• In some contexts, FM broadcasts have weak signals and short-wave broadcasts are susceptible to solar interference.</li> <li>• Government-funded radio and IRI broadcasts may be interrupted or cancelled for political or financial issues.</li> </ul>

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