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Rapid Evidence Review: Radio

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Version 1

This publication is one part of a series of rapid evidence reviews that has been produced by the EdTech Hub. The purpose of the rapid evidence reviews is to provide education decision-makers with accessible evidence-based summaries of good practice in specific areas of EdTech. They are focused on topics which are particularly relevant in the context of widespread global challenges to formal schooling as a result of COVID-19. All the rapid evidence reviews are available at edtechhub.org

Summary

This Rapid Evidence Review (RER) provides an overview of the existing literature on the use of radio in education in low- and middle-income countries (LMICs). The present RER has been produced in response to the novel 2019 coronavirus (COVID-19), and the resulting widespread shutdown of schools. It, therefore, highlights transferable insights that may be applicable to educational responses resulting from the limitations caused by COVID-19. Established approaches to delivering distance education have renewed salience during this period because many students cannot access schooling in a school building due to social distancing requirements. As one of the longest-serving and most accessible types of educational technology (EdTech), and one that has had some success in education delivery in an LMIC context that was affected by an epidemic, it is particularly useful to focus on radio (Barnett et al., 2018; Hallgarten, 2020). Notably, the RER aims neither to advocate nor discourage the use of radio in education in response to the COVID-19 pandemic. Instead, it provides an accessible summary of existing evidence on the topic so that educators, policy makers and donors might make informed decisions about the potential of radio in education delivery.

The RER emerged from a systematic search for literature about educational radio from journals that feature education, social science and humanities disciplines. Grey literature was also explored. The main papers referenced within this RER are written in the last 20 years and focus on the education of children in LMICs using radio. However, literature that focuses on high-income contexts or that does not have child education as a key topic is also considered. Details on the inclusion criteria, as well as the associated limitations, are explained in the methodology section. The rapid nature of the review required a focused approach to literature discovery and a thematically guided process of analysis so that a timely response to COVID-19 might be provided. The search strategy was not designed to be exhaustive.

The findings of the thematic analysis of the included literature on radio for education are structured according to four themes:

1. **Pedagogies and modalities.** This theme discusses the pedagogical approaches and theory used in delivering educational radio, as well as how educational radio relates to various educational outcomes.
2. **Topical content and interest in radio.** This theme explores the topical content that is delivered using educational radio, as well as the factors that influence students' and teachers' interest, or disinterest, in radio as a medium.
3. **Equity, access and participation.** This theme focuses on how, why and whether educational radio might be used to promote greater equity, access and participation in education.
4. **Data and consent.** This theme focuses on considerations of how data will be used, and issues of consent, when implementing an interactive radio initiative (IRI).

The key findings from this review are:

1. **Radio, and specifically IRI approaches, can be used not only to directly facilitate more child-centred and interactive pedagogical approaches in the classroom, but also to mediate better pedagogical approaches for educators unable to access training opportunities.** However, there is limited evidence on how IRI, or educational radio more broadly, might be used by students in informal contexts– such as at home during the present pandemic. The pedagogical strength of educational radio approaches in the classroom can, however, be assumed applicable, at least to some degree, outside the classroom as well. This may be especially true when engagement with radio broadcasts at home is made as interactive as possible, such as when supplemented by phone-ins and social media as available. Interactive, student-centred approaches should be considered when using educational radio broadcasting during COVID-19.
2. **Radio is most popularly used in teaching maths and language-related subjects. However, the evidence suggests that radio is likely to be more effective in teaching language-related topics than maths, and especially among younger children. The strengths that support radio instruction include radio's affordability, portability and the access it gives to those who cannot read.** Amongst the weaknesses of radio is it being audio only and unable to be paused or replayed. Importantly, when using radio to teach any subject area at higher levels, it is worthwhile to explore how radio broadcasts might be supplemented so that teaching is more effective. This might be through the distribution of supportive print material to parents and students where relevant and appropriate, or, if feasible, the use of technologies with greater multimedia capabilities to supplement learning.
3. **Educational radio is a relatively cost-effective option in the long term for delivering educational content at scale and especially in communities with limited connectivity, digital literacy and electricity, and with hard-to-reach students, such as those in rural areas.** However, employing it may involve significant upfront costs and its comparative cost-effectiveness is likely to reduce when the target population is small. Its sustainability further depends on a liberalised broadcasting infrastructure, stakeholder collaboration and commitment to initiatives by successive governments, especially as more modern technologies become increasingly popular. There is therefore need to consider whether other technologies, or even the distribution of print-based resources, might be more cost-effective and feasible than radio during the present pandemic.
4. **Issues surrounding data storage, privacy and consent need to be carefully considered for initiatives that involve online and mobile-based interactive radio applications.** As radio is increasingly accessed through online and mobile applications, it will be necessary to critically consider issues of privacy, storage and consent with respect to user-generated data. This concern currently has limited relevance to many LMIC contexts as such data is largely not being collected, and a great deal of access to radio is done through traditional, offline broadcasts. However, since radio is increasingly moving online, critical reflection on this concern is needed in preparation.

1. Introduction

The COVID-19 pandemic has led to greater reliance on distance learning methods for students and teachers. Physical distancing policies, to suppress the spread of the novel coronavirus, often advise that students and teachers cannot congregate in schools in the conventional manner. Broadcasting technologies, such as radio, can play an important role in tackling the educational challenges of COVID-19 by delivering education over distance and at scale. This RER provides a summary of how radio has been used before and during the current pandemic. It does this in order to offer insight and evidence that can assist in the development and implementation of effective distance learning initiatives.

Purpose

Radio is widely considered relevant to COVID-19 education responses due its low cost, broadcasting speed, familiarity and accessibility, and history of tried and tested associated pedagogy (Bates and Bates, 2005). Understanding the evidence on how educational radio is applied in different contexts is crucial to informed decision-making in the COVID-19 response. This evidence review, alongside others, contributes to that emerging knowledge base and organises the most relevant literature into coherent themes for the consideration of key stakeholders in their own localised analysis of how to respond to the unique challenges of COVID-19.

Application

The insights presented in this RER are expected to be viewed as principles for the planning and implementation process of educational radio. The expectation is that readers will draw on their own expertise from their local context to apply the appropriate recommendations. The recommendations are not specific guidelines that can be applied universally. Patterns of good practice have emerged from the evidence on how, when and why radio can and should be used, and it can be reasonably expected that many of the insights are applicable in the COVID-19 context. Additionally, the Emerging Evidence Snapshots provide relevant examples of how radio is currently being used in the COVID-19 response. Though the examples in that section are current and will not yet have been evaluated, they can be viewed alongside the literature in the previous sections. This can serve as valuable guidance on how educational radio might be used specifically to address the challenges of COVID-19.

Research questions

Three research questions guide the study:

1. What are the key emergent themes in the available literature on educational radio in LMICs?
2. What are the current initiatives using educational radio in response to the COVID-19 pandemic?
3. What are the key recommendations that can be drawn from the available literature to inform a response to the COVID-19 pandemic?

Structure of the RER

Following this introduction, the methodological approach is discussed, including details of the scoping review, the literature search, eligibility criteria and possible limitations of the methodology. Detailed findings are then presented under the four themes that emerged from a thematic analysis of identified literature. Emerging evidence on educational radio interventions and projects is then presented. This section details recent examples of educational radio as a response to COVID-19, many of which have not yet been the subject of work studies published in academic or other outlets due to the recency of the interventions. Instead, this evidence was found through the EdTech Hub Helpdesk, as well as through word of mouth and searches of the news in LMICs. The report concludes by providing a synthesis of the findings from the literature and emerging evidence snapshots.

2. Methodology

The methodological approach for the primary systematic literature review is informed by the Cochrane Collaboration Rapid Reviews Methods Group interim guidance on producing rapid reviews (Garrity et al., 2020). This permits a rigorous and systematic approach, while defining the scope narrowly enough that it can be completed within a short span of time. Unlike other rapid evidence assessments, such as the Education Endowment Foundation's (2020) meta-analysis of other systematic reviews on remote learning, this RER is modelled on a systematic, thematic review of primary studies, reviews, grey and other literature.[1]

The research process therefore comprised a systematic sequence of scoping, searching and screening. In the scoping phase, the research questions and eligibility criteria were defined and a brief scoping review conducted to help elicit relevant search terms for the search queries. Then a focused set of searches was run within the relevant academic databases. The search results were then screened according to the inclusion criteria.

Scoping Review

Unlike systematic reviews, the criteria for scoping reviews are not yet well-defined. However, these reviews are widely considered as representing a stage prior to a systematic review where the key concepts and ideas that define a field are explored and discovered in an iterative process (Daudt et al., 2013; Levac et al., 2010). Notably, the scoping review of this study did not aim to map out all the concepts, theoretical and otherwise, included in the scope of 'radio in education'. Instead, it had a more specific focus: to identify keywords and terms that had been used in studies that discuss 'radio in education'.

The scoping review process began by noting relevant keywords and terms that were already known to the authors to search for additional literature. The process was

[1] According to Higgins and colleagues (2019): "*A systematic review attempts to collate all the empirical evidence that fits pre-specified eligibility criteria in order to answer a specific research question. It uses explicit, systematic methods that are selected with a view to minimizing bias, thus providing more reliable findings from which conclusions can be drawn and decisions made (Antman et al 1992, Oxman and Guyatt 1993)*."

iterative, with the terms found in one article leading to searches for other articles that then revealed different, or the same, terms. Using this method, a list of 24 search terms were compiled (Annex B). It is important here to draw attention to the point that when a search term brought up an article with a relevant title, those articles were saved to be screened later alongside those that were found during the main literature search that is explained below.

Literature Search

The literature search began after establishing the search terms at the end of the scoping review. A searchable publication database (SPUD), that was previously developed by the EdTech Hub, was searched first. Other databases were also searched thereafter, namely Google Scholar, Scopus and JSTOR. Figure 1 below details the process used to arrive at the articles that were ultimately thematically analysed in this review. It is important to highlight that unlike a more traditional systematic review process, which may screen all search results, the rapid review methodology used herein relied on a system of quotas. As such, only the top most relevant results (up to a maximum of the top 500 results), as ranked by each database used, were selected for the first round of title and abstract screening.

It is important to highlight as well that the results were not screened and ranked for quality or limited to peer-reviewed/academic publications. Relying solely on peer-reviewed academic articles would have resulted in a narrower, less generalisable review. Crucially, this would also have excluded a larger number of voices from LMICs due to systemic factors excluding many academic researchers in LMICs from mainstream peer-reviewed journals.

Screening and eligibility criteria

The title and abstract screening, as well as all subsequent screening, were conducted by two coders according to the eligibility criteria laid out in Table 1. It should be emphasised that the screening criteria were not absolute. While the majority of sources included for thematic analysis met the eligibility criteria, a number of sources that were deemed especially informative but did not meet all the inclusion criteria were also included. These exceptions were made when an article met all except one of the eligibility criteria. An exception, for example, might therefore be made if a study explored educational radio pedagogy for children, but was based on a high-income country context, or if a study explored educational radio among children in LMICs but was published more than 20 years ago.

Figure 1. Literature search and screening process

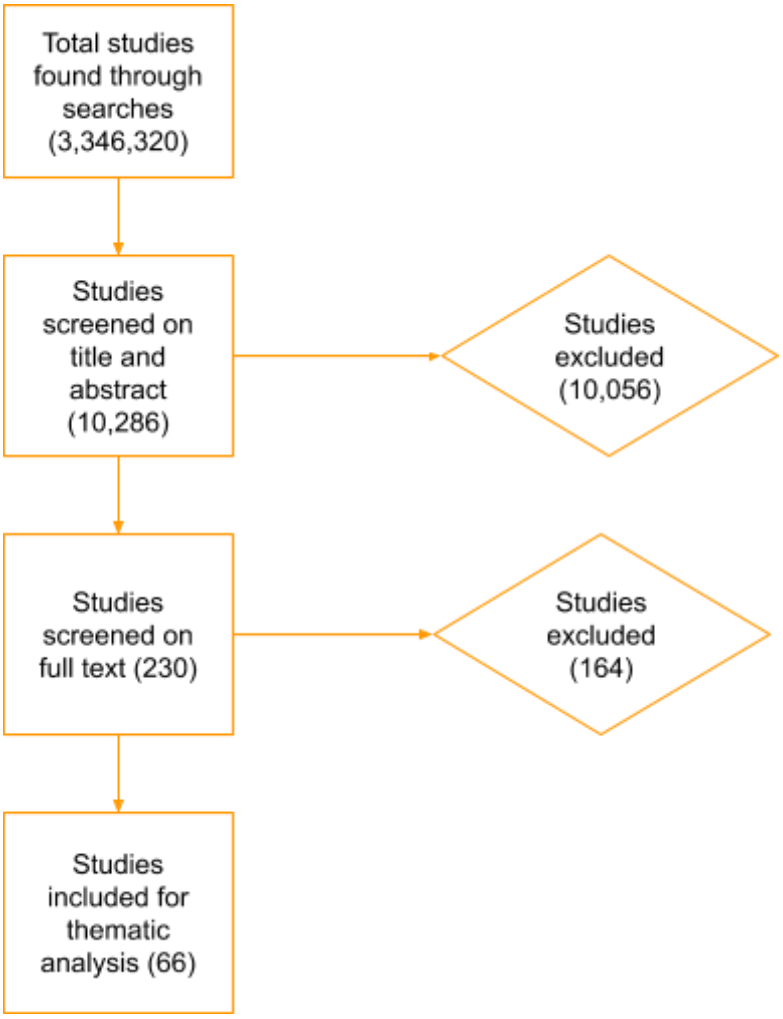

Table 1. Eligibility criteria for literature searches and screening

Criterion type	Inclusion criteria
Age	Under 18 years
Geography	LMICs
Literature type	All
Date	2000–2020

Finally, snowball sampling searches and expert referrals were used to discover relevant literature. While the main thrust of the literature review involved a highly systematic approach, we recognised that some influential sources might not be captured through those searches alone. We therefore decided to search the reference lists of the most relevant papers found through the systematic literature review for additional sources. Further, members of the EdTech Hub research team were asked whether they knew of

any educational radio literature that might be included in the RER. These two methods served to expand the literature and also as an important quality control step, validating the rapid searching strategy.

Upon completion of the literature search and screening process, 66 papers were selected and thematically analysed. The thematic analysis was conducted by the same two coders who screened the literature. The groupings that emerged from that analysis were: pedagogies and modalities for teaching and learning, topical content and interest in radio, equity, access and participation, and data and consent. These four themes provide the structure and coherent organising principle for the discussion of the literature in the section titled 'Systematic review and thematic analysis findings'.

Emerging evidence snapshots

A separate evidence review was also conducted in addition to the systematic evidence review detailed above. This involved expert consultations, searches of news related to radio use during the COVID-19 pandemic, as well soliciting examples through the EdTech Hub's social media channels and Helpdesk. The emerging evidence snapshots detail current initiatives that specifically address COVID-19-related challenges using radio. This differs from the previously described review, which explored historic initiatives on educational radio and which found literature through a systematic approach. Using word-of mouth and news articles was determined to be an appropriate approach to collating evidence that is most relevant to the present pandemic. The intention is that the findings of the systematic review and the emerging evidence snapshots combined provide a balanced overview of educational radio as a response to COVID-19.

Theme identification

The search and screening process identified 66 papers for analysis. A thematic analysis of these papers led to them being classified into four themes, most of which have sub-themes. Those themes and sub-themes, which are discussed in depth in the Findings section of this review, are:

- Pedagogies and modalities
    - Enhancing the capacity of teachers
    - Radio for in-class teacher training
    - Narrative and immersive learning
    - Techniques for learning
- Topical content and interest in radio
    - Topical content of educational radio
    - Interest in radio among school populations
- Equity, access and participation
    - Cost and sustainability of educational radio
    - Politics, policy and educational radio uptake
    - Rural education
    - Closing educational gaps for other marginalised populations
- Data and consent

Limitations

There are some limitations to this review stemming from the rapid timeframe and the nature of available evidence. These include:

- **The search and inclusion strategy.** An inherent limitation of the RER is that the search and inclusion strategy is not, by design, exhaustive and therefore it is possible that not all relevant literature has been located and included.
- **Limited comparative analysis.** Another limitation of this RER is that it does not rely on rigorous comparative analysis to draw insights, but largely on narrative summaries. While an in-depth comparative analysis involving statistical and more comprehensive thematic analysis would certainly be helpful in the future, this was not possible given the diversity of the literature encountered and the time constraints of this review.
- **The generalisability of the findings to the pandemic context.** A final limitation of this RER is that the evidence found relates to diverse contexts which correlate, to differing extents, with the current COVID-19 crisis. Nonetheless, many of the contextual factors remain consistent, and parallel challenges can be instructive in this case.

3. Findings

This section provides an analysis of the literature, grouped into the four main themes which help to structure the literature into a coherent narrative representing the breadth of important topics covered in the papers.

3.1. Pedagogies and modalities for teaching and learning

The literature related to the use of radio and related technologies in education adds particular value to the current review because of the pedagogical approaches that have been tested, refined and evaluated over half a century in a range of contexts with limited resources. Indeed, there are diverse pedagogical approaches associated with radio, with Interactive Radio Instruction (IRI) being the main approach around which educational radio has converged. In this review, 'educational radio' or 'radio' are terms used to discuss strategies for employing educational radio broadly. Distinction of the format of educational radio being referenced is made at times, and RIR is the strategy most commonly referred to. General strategies for in-classroom/formal and outside-classroom/informal, teacher/facilitator-directed and self-directed learning, that may not have a formalised theoretical name (such as 'IRI' has), are described as such where relevant. Some key insights found are that: radio can enhance the capacity of teachers; narrative and immersive example-based learning engages users and can be employed for behaviour change; and developing and refining specific pedagogical elements can improve engagement and learning outcomes.

Enhancing the teaching capacity of teachers

One of the most fundamental and integral uses of radio in education and learning has been to enhance teaching capacity, whether through extending the reach of teaching to learners without, or with limited, access to teachers, or through improving the quality of

pedagogical practices of existing teachers (Borton, 1977; Jamison, 1978; Burns & Trucano, 2006). The potential of radio to extend education to learners without, or with limited, access to teachers has been recognised since the inception of the medium (Keith, 1929; Bagley, 1930). This is further discussed in the later section on equity and access. The focus of this section is the use of radio to enhance teacher capacity to teach.

The pedagogical implications of radio on the teacher-learner interaction have received fuller attention since the late 1970s. In particular, the work of Borton on 'concomitant instruction', which he describes as "*teaching to divided attention*" (1977: p. 131) anticipates the diffusion of learning from primarily classroom-based contexts to a wide range of contexts. Similarly, Jamison extends Borton's focus to four categories across formal and non-formal education: "*using radio to enrich learning, direct instruction, extending in-school education, and distance learning*" (1978: p. 1). A range of formal and non-formal educational contexts are thus addressed with notable differentiation between contexts and pedagogical approaches where learner groups have different needs.

In formal classroom-based learning, the role of radio in supplementing the efforts of educators has mainly converged around interactive radio instruction (IRI). IRI covers a range of pedagogical approaches which focus on interspersing audio content, delivered by radio broadcasts, with learning activities, exercises and stories encouraging student participation and interaction (Ho & Thukral, 2009; Potter & Naidoo, 2006; Bosch; 2004). Short and regular pauses during the broadcast allow students and teachers to interact, participate and respond. This strategy of instruction was previously used in, and inspired by, children's TV series such as Sesame Street (Bosch, 2004). The development of the radio component of IRI to include various multimedia inputs has adapted to emerging technologies (Hapeshi & Jones, 1992; Edwards et al., 2019; Chatterjee et al., 2019). The interactive element describes interactions with the teacher and other learners, employed to varying extents based on the nature of the content and context (Potter & Naidoo, 2006).

Related to IRI is Interactive Audio Instruction (IAI). Like IRI, IAI similarly allows for interaction and participation between students with each other, and with their teacher and enhances the capacity of teachers to teach larger, more engaged, classes. However, unlike IRI, it is not solely related to a radio broadcast, but instead incorporates all audio instruction, inclusive of and beyond radio. It can therefore refer to recorded audio that can be played at convenience, such as on a CD or an MP3 player, mobile audio, or broadcast audio. Notably, both IAI and IRI are commonly delivered in formal-educational settings, such as schools, or otherwise in informal settings with the facilitation of teachers or other specifically trained facilitators. Whilst the benefits of IRI are best received by students when facilitated by a teacher, students in informal and out-of school settings can often still access IRI broadcasts once they have access to a radio and may be able to self-direct their learning or learn with the help of a facilitator in the family or community.

Radio for in-class teacher training

In the context of the aspiration of IRI to encourage enhanced pedagogy and improve teaching quality (Burns & Trucano, 2006), it must nevertheless be acknowledged that in

the absence of interactive pedagogical elements and teachers trained to facilitate those interactions, IRI becomes simply a delivery mechanism for content. The quality of instruction is therefore only as good as the quality of the curriculum and content, and may reinforce teacher-centred approaches, albeit with the radio taking the place of the teacher (Burns & Trucano, 2006). Where practised in a manner pedagogically consistent with its philosophy, IRI can fulfil a dual role, however, in both mediating interactivity in the classroom and modelling interactivity for teachers to change their practice more generally. This creates a space for in-service teacher training in the classroom, which can then transform the pedagogical approach of teachers even when they are not basing their lessons around radio broadcasts. Burns and Trucano (2006) demonstrate how an IRI programme aimed at students in Guinea also benefited teachers' professional development, and Potter and Naidoo (2006) refer to the role of in-service teacher training as an evolving priority of a large-scale intervention in South Africa. While these articles both point towards the possibility of IRI not only facilitating pedagogical changes in the classroom in their implementation but also catalysing changes in pedagogical behaviours more broadly, they do not provide sufficient evidence of its impact.

Narrative and immersive learning

Another pedagogical approach discussed in the literature involves the nature of the content of radio broadcasts. This takes into account particular learning contexts and may fit within a range of pedagogical approaches, including IRI, that might draw on narrative and story-based approaches and which build on the history of radio drama (Hapeshi & Jones, 1992). Notably,narrative and story-based approaches are not necessarily IRI- or classroom-specific, but can be applied in various radio-based instruction strategies both within and without classroom contexts, and which do not necessarily rely on interaction. Additional insight from the literature on digital storytelling is informative about the ways in which storytelling is central to cultural and personal forms of identity formation (Chatterjee et al., 2019). Radio is used not just for aural transmission of information but as a creative and engaging experience which encourages problem-solving in scenarios that are close to real-life scenarios. The context may also enable collaborative problem-solving and knowledge construction, which are key higher-order social learning skills (Rodero, 2012).

In the context of disruptions to education, radio can play a key role in encouraging learners to maintain engagement, especially where infrastructure is already in place, while also permitting relatively higher autonomy for the learner, in cases where their dedicated learning time or space is reduced.

Split attention and multitasking are also discussed in Bauwens et al. (2019) in the context of understanding complementarities between social media and radio. While this paper is not explicitly focused on LMICs, it does describe the current and emerging realities around social media use, proposing greater integration with radio programming through planned interactions at intervals. The following section explores some of the approaches to learning in more depth, as well as the role of attention in learning. Scenario-based learning, which develops the idea of narrative into a participatory activity drawing the learners into participating in the narrative of the

broadcast, was evident in two articles on educational radio responses to the Ebola crisis (Walker et al., 2016; Barnett et al., 2018). These two papers primarily discuss the same initiative in Sierra Leone, Pikin to Pikin Tok, which centred around educational messaging for behaviour change, particularly in relation to health practices which might limit the spread of Ebola. Barnett et al. (2018) emphasise in particular the need to work with existing groups with embedded relationships in the community in order to adapt quickly to a much larger scale of need.

Techniques for learning

Another category within the literature addresses specific techniques for learning. These papers are quite specific and focused on particular didactic strategies mediated by technology, such as spaced repetition for language learning (Şendağ et al., 2012), or employing humour to enhance engagement with learning (McKenna, 1993). However, they also often make pedagogical assumptions about the scope of learning within subject areas and cognitive processes. Specifically, there is a widespread assumption that improving learning is a delivery mechanism problem and that packaging knowledge in a more attractive way allows learners to absorb it more effectively. Where these approaches may be more innovative is in their integration of non-didactic elements to enable learning. For example, McKenna (1993) discusses the role of humour and play in learning, while Rodero (2012), Şendağ (2018) and Elekaei (2019) discuss various ways in which stimuli affect attention and their effects on the learning process. While these papers do not provide adequate evidence for these approaches to enhancing cognitive acquisition, such as memorisation of vocabulary for language learning, the role of repetition is widely accepted (Şendağ et al., 2018).

3.2. Topical content and interest in radio

The included literature also discussed the content of educational radio programmes, as well as factors that were found to encourage or discourage teachers' and students' interest in radio programming. Three key insights emerged from the literature. The first is that educational radio is best suited to teaching language-related subjects and maths, and younger children. Secondly, radio's portability, transparency to people who cannot read, affordability, listeners' ability to carry out other activities while also listening to the radio, and the general overviews radio programmes provide, make it preferable. Finally, the limitations of radio include the lack of accessibility to deaf users, its ephemeral nature, limited multimedia ability, the difficulty of monitoring its usage (such as through the collection of user-generated data), and its low interactivity.

Topical content of educational radio

This subsection focuses on the range of topics covered through educational radio in LMICs. The most commonly emerging topics converge on health (e.g. Barnett, et al., 2018 on Sierra Leone; Pappas-DeLuca et al., 2008 on Botswana), agriculture (e.g. Sasidhar, 2011 on India), the empowerment of different groups in society (e.g. Cheung, 2012 on women in Cambodia) and in terms of academic content, mathematics and language. Since this RER is intended to guide decision-makers' facilitation of academic education, the following discussion is limited to the use of radio for this specific

purpose. Further, the majority of the literature on the academic content of educational radio relates to IRI use in schools and as guided by a teacher. With that in mind, many of the points raised in the literature are most applicable to in-school, teacher-guided learning; where the literature is not specifically referring to school-based IRI, this is highlighted. There is little evidence on the effectiveness of radio for children's self-directed distance learning, and so these insights are less applicable in such contexts.

At the inception of the dominant format of educational radio, IRI, in Nicaragua in the 1970s, mathematics was the focus subject (Bosch, 2004). However, the subjects covered by IRI, and educational radio more broadly, have since increased, with language-related subjects (Potter, 2007; Odera, 2011–speaking on classroom-based, supplementary radio broadcasts) coming to dominate the sphere alongside maths (MacKinnon & MacKinnon, 2010). Ho and Thukral (2009: p. 52), in analysing the impact of IRI on marginalised populations, concluded that, "*the largest effect sizes were observed in English, followed by local language literacy, mathematics, and finally social studies. Also of note, the greatest amount of information (i.e., records) was available for English and the least for social studies.*" Mathematics and language-related topics, perhaps dominate as a factor of the higher rate of success there is in teaching those subjects, or perhaps as a factor of them being core subjects (Leary & Berge, 2007). Interestingly though, while both topics have been successfully taught using radio, there appears to be a shift occurring in the topic that dominates the IRI sphere, and educational radio more broadly: whereas mathematics was the main subject in the past, language-related topics appear to be the primary focus more recently.

The shift from maths to language

In 2004 Bosch reviewed 30 IRI initiatives and found an even split between those which included mathematics (12) and those that included a language-related topic (12), with the remainder focused on science, teacher education and health. However, it appears that more recently the emphasis of IRI and educational radio more broadly has shifted towards language-related education. Indeed, the searches conducted for this RER resulted in a majority of language-related papers.

The reasons for this apparent skew towards using educational radio for teaching language-related topics are not yet well-evidenced and more research is needed. The analysis below alludes to some of the potential factors which may be influencing this transition, and there are indications that it may simply be because language-related topics are those in which IRI can be most effective (Ho and Thukral, 2009).

Using radio for teaching language-related content

Levine and Franzel (2015), speaking on the utility of radio for classroom-based language-related learning, suggested that the lack of visual imagery on radio encourages students who are learning to write to think about telling rich stories using only words. A medium like radio can help students think in a more focused manner on language without the 'distraction' of imagery. The lack of visual references may prove more problematic in maths, particularly as the subject gets more advanced. Yelkpieri and colleagues (2011), in their study on radio for education both in classrooms and at home, found that secondary school students in Ghana used educational programming

on television more than they did on radio in part because radio did not include the visual aids needed for teaching complex calculations — a key part of later-stage maths. Further, Ho and Thukral (2009) found that while older students (Grade 4) consistently benefited from language-related IRI, the results were less stable for them with respect to maths. Importantly, Ho and Thukral (2009) found that younger primary level students generally benefited more from IRI, on average across all subjects, than older students did.

The language-related topics that were found in the articles reviewed for this RER included literature, particularly in the form of storytelling (Leguy & Mitsch, 2007–speaking on at-home/informal learning, with and without older family or community members joining in), English language (Perraton, 2000; Potter, 2007; Potter & Naidoo, 2006; Yelkpieri et al., 2011–speaking on classroom- and home-based radio learning; Odera, 201–speaking on classroom-based, supplementary radio broadcasts; Nekatibeb & Tilson, 2004; Alaro, 2007), writing (Levine & Franzel, 2015–speaking on classroom-based radio instruction) and speaking (Osorio et al., 2019–speaking on students, in a formal educational setting, creating a radio programme). Finally, it should be noted that the clear focus on using radio for language-related learning and maths does not mean that no instances of radio being used in other subject areas were found. Though not based in an LMIC context, Wathen and colleagues (2010) found that students from a predominantly African-American, low-income, urban high school benefited from participation in a science education radio programme. The students called into the programme from school, during their class-time, and it was found that the level of questioning by students improved significantly after participation.

Interest in radio among school populations

Another sub-theme that emerged from the analysis of the literature concerned the aspects of radio that fostered interest or disinterest among students and teachers. The first section presents the reasons behind disinterest in radio, and the second follows with its strengths. Notably, the literature in the section focuses less on IRI and classroom-based instruction, and more on radio as a format more broadly.

Reasons for lack of interest in radio

One of the key reasons for disinterest in radio is its audio-only format (Mangal & Mangal, 2009). While this can be a strength as well, as indicated in the previous discussion of the 'distraction of visual elements', an audio-only format of education delivery may not hold the attention of some students. Yelkpieri and colleagues (2011), after studying secondary school students in Ghana, explained that those students favoured educational programming on television over educational programming on radio because television combined both the visual and the aural. TV allowed students to better follow complex lessons by using on-screen aids (an example of which are mathematical calculations), or to follow by lip-reading when they did not hear a word, and it also helped students feel a greater sense of community with fellow students when other students were shown on the TV broadcast. The audio-only format of radio can also make it inaccessible to students and teachers who are deaf or have other special educational needs (SEN). Bates and Bates, discussed educational radio broadly

and further noted that radio tends to provide more general knowledge and instruction for a broad audience, rather than the more personalised instruction which is sometimes desired. Other inherent educational limitations within radio as a broadcast medium are that it is ephemeral (Bates and Bates 2005), has limited possibilities for tailored repetition (Elliot & Lashley 2017; Christina and Louge 2015) and only allows genuine interactivity through additional services such as phone-in (Bates and Bates 2005) or social media (Gavaza & Pearse, 2019). As an analog broadcast medium, radio usage also can not be monitored from the point of transmission which limits the potential for data collection.

It is perhaps for these reasons that radio is losing its appeal for some young students today (Negara & Amal, 2017; Yadav & Kharate, 2017; Pedrero-Esteban, Barrios-Rubio & Medina-Ávila, 2019). They increasingly see radio as an unimportant format for accessing educational content, with secondary school students in Mumbai, for example, preferring textbooks and online formats instead (Yadav & Kharate, 2017). Even though engagement with audio-only content remains high, that engagement is largely with respect to music, rather than spoken educational content. Further, that engagement with music is increasingly being done through online streaming, where accessible, rather than through radio (Pedrero-Esteban, Barrios-Rubio & Medina-Ávila, 2019). Notably though, whilst online educational content, or even music streaming, is increasingly popular, radio still remains a popular and important format for youth who have limited cheap Internet access and who live in rural areas. Whether young students prefer radio or not therefore depends largely on their local and socioeconomic context.

In light of the affordances provided by other technologies, Naidoo and Potter (2008) emphasise the need to consider whether radio might best be used instead in combination with other technologies. Though there is limited research on how radio might be supplemented by newer, more advanced technologies, such as social media, for education delivery in LMICs, there is promise in increasing the effectiveness and reach of radio if used alongside other EdTech.

Reasons for interest in radio

There is also significant emphasis within the literature on all the aspects of education through radio that serve to foster interest amongst students and teachers. Notably, this subsection does not focus on broader interest or strength in radio formats, such as due to its large-scale purported cost-effectiveness or policy, but instead on the first-hand experience of using and accessing it for learning or teaching.

Findings indicated that students who favour radio do so because: it is more affordable than television, it is often accessible with batteries and not dependent on mains electricity, it can be listened to while doing other things, it is highly portable, and it has lots of relevant educational content (Yelkpieri et al, 2011). The economic and social stability of Ghana and its relatively higher financial outcomes should be considered, as these findings may not apply in more challenging contexts.

Osorio and colleagues (2019) also explored Colombian students' perceptions of educational radio, specifically when used as a strategy to develop English speaking skills. They found that students generally had a positive perception of the radio programme they participated in and found it engaging. A final reason for interest in

radio was highlighted by Christina and Louge (2015: p. 4) who, speaking on Early Childhood Development (ECD) in 2015, explained that:

> *"Audio content, particularly when delivered over radio, also makes learning more transparent for families and community members, who may otherwise not understand what their children are learning if they themselves cannot read. This transparency is a particular advantage in contexts where ECD is newly available, as parent support and buy-in is critical to increasing ECD access."*

3.3. Equity, access and participation

The use of radio for equity, access and participation in education is another theme that was explored by the literature. Four sub-themes emerged in the literature discussing this topic, all of which may in some ways relate to radio's longevity as an EdTech intervention. These themes are discussed in turn and relate to: the cost and sustainability of educational radio; politics, policy and educational radio uptake; rural education, and closing education gaps for other marginalised populations. Notably, in the section, educational radio is spoken about in broad terms, but where it is especially important to highlight, it is noted whether a finding refers to IRI or another educational radio format. The five key findings are summarised below.

Firstly, educational radio is a relatively cost-effective option for delivering educational content at scale. However, it may not be the best option when the target population is small. Secondly, educational radio initiatives are more effective when policy allowing decentralised broadcasting is in place and there is thorough planning on what the country's broadcasting framework can realistically deliver. Thirdly, the sustainability of educational radio programmes relies heavily on stakeholder collaboration and commitment to educational radio initiatives by successive governments and in the face of newer technologies. Fourthly, educational radio, especially classroom-based IRI, has had particular success in closing education gaps between rural and urban populations; this is both in terms of access and quality. Finally, the success in closing education gaps extends beyond the rural/urban divide to other gaps as well, such as between boys and girls, and for certain special educational needs populations.

Cost and sustainability of educational radio

Perhaps chief among the reasons for radio's popularity as an educational medium is its relative cost-effectiveness (Barnett et al., 2018; Trucano, 2010; Eastmond, 2000; Ali, 2015) and sustainability (Bosch, 2004). In part because of this, educational radio has long received support from donors, including from the Education Development Centre (EDC, 2015; Trucano, 2010), the Inter-American Development Bank (Trucano, 2010), USAID (Teas & Tilson, 1989; Trucano, 2010), DFID (Aderinoye, 2008), the Japanese International Cooperation Agency (Aderinoye, 2008) and the UN (Aderinoye, 2008). Various national and regional governments have also shown support, including Ethiopia (Nekatibeb & Tilson, 2004); Zambia and Nigeria (Aderinoye, 2008) ; Sierra Leone (Barnett et al., 2018); India (Vyas, et al., 2002), and Guyana (MacKinnon & MacKinnon, 2010).

The relative cost-effectiveness of radio

The cost-effectiveness of radio is especially evident when compared to other educational technology interventions such as television, tablets or laptops. Unlike those more recent EdTech innovations, many more people already have access to radios (Aderinoye, 2008). This means that radio has the potential to be a highly accessible agent of education delivery. Further, unlike more recent technologies, which have had mixed results in terms of learning outcomes and questionable sustainability (Bulman & Fairlie, 2016), radio has a proven track record of having a positive impact on students' learning in many LMICs (Trucano, 2010) as well as having multiple examples of programmes that have operated in a sustainable manner (Bosch, 2004). The relative cost-effectiveness of radio can also help ensure that access to education, both in formal and informal educational settings, is maintained even when financial or other limitations result in a shortage of trained and skilled teachers (Ali, 2015). Only a few teachers are needed to reach many students when radio broadcasting is used, and students may be able to self-direct their learning at home if they do not have access to classroom-based education. A more detailed analysis on the impact of radio on student outcomes can be read in the above section on 'pedagogies and modalities for teaching and learning'.

While educational radio's relative cost effectiveness is relatively well evidenced, Bosch (2004) notes that some projects still fail because of prohibitive recurrent costs. Radio is cost-effective when compared with most other EdTech, but it still entails significant upfront implementation and maintenance costs. Bakshi (2011) notes that the cost-effectiveness of radio, specifically IRI, is dependent on achieving scale, because the fixed costs remain similar regardless of the number of listeners. In a comparison of the cost-effectiveness of IRI and CD/MP3-based interactive audio instruction (IAI) in India, Bakshi found that the IAI intervention was cheaper than the IRI intervention. However, the IRI intervention reached a larger number of students. Overall, the cost per user of implementing IRI was cheaper than IAI. The cost efficiency of IRI is only achieved when large numbers of students are reached, and so IAI can provide a more cost effective option when the target group of students is smaller, such as those speaking a minority language or who might be otherwise marginalised. Beyond the broadcaster fees specific to broadcast radio, Bakshi highlighted associated costs including creating the content/programme design, producing the content, training instructors, printing related material, distribution, audio devices, and monitoring and evaluation. Solutions for reducing the cost of educational radio include exploring avenues for partnerships across countries or states, especially when they share the same language (Bakshi and Jha, 2013; Anzalone & Bosch, 2005).

The Education Development Centre (EDC) (2015), detailing the challenges associated in making radio and audio instruction more sustainable in both formal and informal schools, based on the RISE and ZTUR projects in Zanzibar, echoed some of the considerations also highlighted by Bakshi and Jha (2013). Namely, they highlighted the need for support for: fixing old radios and buying new ones, related continuous teacher professional development, integrating programmes into existing curricula and lesson

timetables, printing materials, monitoring and evaluation, and students with special educational needs.

Although radio's cost-effectiveness is among the top reasons for its uptake, it can also counterintuitively be a barrier. Trucano (2010) notes that it is sometimes the case that international donors prefer to invest in interventions that they believe would otherwise not be financed because of their expense. Therefore, because radio is relatively cheap, donors sometimes avoid investment in the medium, leaving it to local governments and other smaller organisations, and instead prefer focusing on more expensive technologies. The relationship of politics, policy and educational radio uptake, including the involvement of governments and international donors, is discussed more in the following section.

Politics, policy and educational radio uptake

As noted above, governmental and donor will to support radio for education was another important theme in the literature. Political and policy support for educational radio is multifaceted, involving the implementation of suitable broadcasting policies, stakeholder collaboration, and commitment to educational radio across time – both in the face of new technologies which may appear more 'progressive' and changes in administration. The literature that explored those issues is presented in the following paragraphs.

Broadcasting policy

A governmental consideration, if educational radio uptake is to be successful, is broadcasting policy with regard to centralised versus decentralised delivery of educational radio programming. There appears to be no clear answer in the literature as to the most effective approach and the reasons behind this. Educational radio broadcasts can be more targeted if programmes are delivered by a local provider, but a centralised national broadcaster may reach more people, albeit with potentially less relevant content. Despite the lack of a clear answer on whether programmes should be local or not, there is clear recognition in the literature regarding the importance of financial provision for decentralised broadcasting. Berman (2008: p. 5), notes on this issue that, "*A key enabler of the rural radio movement in Africa has been the liberalisation of radio waves, although some countries (e.g., Namibia, Uganda, and Zambia) provide rural radio programmes from a centrally controlled radio network.*" Others have noted the importance of reform to open up the broadcasting sector to competitive and community provision, and to provide a centralised communications regulatory environment. Regardless of the broadcast infrastructure in place in a country, planning and thorough consideration is needed about how educational radio might be delivered in any particular broadcasting context (Anzalone & Bosch, 2005).

Stakeholder collaboration

The need for sustained, flexible and considerate stakeholder collaboration was another issue raised in the literature (Alaro, 2007; Barnett, 2018; Naidoo & Potter, 2007). These different stakeholders include governments, donors, radio broadcasters, implementing partners, teachers, parents and students. Barnett and her colleagues (2018) wrote at

length on multisectoral collaboration on radio in Sierra Leone after the Ebola epidemic. They described the Pikin to Pikin Tok radio programme, which ran during a period of school closure. Listening groups were established, within which children engaged in facilitated discussion related to the radio programme. There were both formal and informal listening groups, with their trained facilitator commonly being school teachers. Children who could not attend a listening group session were still able to listen at home and call-in to the programme, as were children who were part of the listening groups. When schools reopened, some teachers continued to use the programmes as part of their in-class lessons. The researchers, after an evaluation of Pikin to Pikin Tok, highlighted factors involved in successful collaborations between stakeholders in educational radio, as well as challenges. Crucially, they stated that successful collaboration involved: "*Sustained commitment and flexibility from all partners, during and after the crisis [...] Adaptability in response to changing contexts [and...] Expanding the multistakeholder network effectively*" (pp. 124–127). Regarding the challenges faced and lessons learnt, they noted the need for on-going adaptation and innovation, monitoring of impact, the close involvement and education of donors, local coordination mechanisms, and "*evolution based on continuous feedback, with children at the heart.*" (pp. 128).

Naidoo and Potter (2008) also spoke on challenges associated with monitoring impact and the related need for donor flexibility. They explained that many donors require specific evaluation requirements, often involving measurement-driven impact assessments of learning gains. However, at times those evaluations do not allow flexibility in responding to unplanned demands from other stakeholders or allow for other methodological programme assessments that are less measurement-driven, but which may take other social and political problems into consideration.

Commitment to radio

A final point on politics, policy and educational radio uptake relates to consideration of the commitment to educational radio, particularly in the context of newer technologies, changes in government administrations, declining funding and its focus on rural populations. Trucano (2010) notes that among the political barriers to educational radio uptake was radio being seen as old technology, with the potential to damage the image of the government as progressive or modern. He further raised the issue of new governments discontinuing programmes initiated or previously overseen by the last government. This concern was also previously highlighted by Bosch (2004) and Anzalone and Bosch (2005). Regarding the scale of programmes, Naidoo and Potter (2008) highlight the difficulties in whether or not to commit to large-scale programmes in the context of declining support from donors. They considered whether it was justifiable to take a 'leap of faith' and proceed with a large-scale programme in the hope that the impact might be worth it, or instead to focus on a smaller initiative that was more feasible in the long run but might have a smaller impact.

Rural education

That educational radio programmes are often focused on rural areas where less people live might also be a barrier since there is less scope for a government to enhance their

influence if they target less populated areas as opposed to more populated ones. Similar sentiments were echoed by Berman (2008: p. 4) who noted that:

> *"Overall, as in India, the successes of educational radio in China have been overlooked and the movement has been allowed to wane, spurred by the promise of new technologies such as TV and the Internet, and by a general lack of investment in rural education, which is the main target of radio programmes."*

Using radio to help give access to, and improve the outcomes of, education in rural areas was commonly discussed in the literature (Ali, 2015; Eastmond, 2000; Berman, 2008; Aderinoye, 2008; Nekatibeb & Tilson, 2004; Leary & Berge, 2007). Ho and Thukral found that IRI helped bridge urban-rural achievement gaps in mathematics and English, though evidence of closing gaps in local language literacy was less conclusive. Nekatibeb and Tilson (2004) described how IRI increased learning gains equally in urban and rural Ethiopian primary schools. Cheung (2012) also wrote on the matter, explaining the utility of radio for increasing children's primary school attendance in rural Cambodia, and Jumani (2009) explored the positive effect of radio in rural Pakistan.

Opportunities for education are commonly centred around urban and suburban geographies, with children in rural areas commonly only having access to poorly trained teachers who quickly move on from the profession (Ho & Thukral, 2009). Radio has proven to be one route to solving that problem. Adding to this, Nekatibeb and Tilson (2004) explain that IRI eliminated differences in learning gains that were the result of differences in teachers' levels of experience. Ali (2015: p. 2) further explained how,

> *"In rural areas especially, regular and frequent face-to-face classes are difficult to organize though (sic) lack of teachers and the often thin scatter of students for higher level classes. [...] educational radio broadcasts can again be used providing continuity through the long periods when teacher and student cannot meet, with the added advantage of the best radio teachers being used."*

Finally, it is important to note that although radio is a crucial tool for rural education, this should not mean it is excluded from use in urban contexts where it can be also highly effective (Naidoo and Potter 2008).

Closing education gaps for other marginalised populations

The use of radio to improve learning outcomes is not, however, constrained to closing gaps between 'rural' and 'urban', but between other marginalised and privileged groups as well. These marginalised groups often include girls, children in fragile states, out-of-school children, nomadic children (Aderinoye et al., 2007), orphans and otherwise vulnerable children (Ho & Thukral, 2009; Aderinoye, 2008). Nekatibeb & Tilson (2004) emphasised the positive effect of IRI on girls' education by noting that girls learnt more through IRI than boys did in Ethiopian primary schools. Bakshi (2011) highlights the promise of radio for delivering education to the physically and visually impaired, while the Education Development Centre's International Development Division (2010) note that IRI has helped increase learning outcomes among students in scheduled castes in India.

3.4. Data and consent

In the previous subsection on the weaknesses of radio, it was noted that radio does not allow teachers to monitor usage, unlike other electronic formats that may allow for the gathering of usage metrics and other data (Christina and Louge, 2015). However, that analysis may only apply to traditional broadcast radio rather than radio accessed through an online portal or mobile device. Schweighofer and Schmautzer's 2019 paper discusses the latter. Their paper does not directly focus on educational radio, but instead on interactive radio more broadly and within the context of General Data Protection Regulation in Europe. Despite not being directly focused on educational radio in LMIC contexts, the ethical considerations raised in the paper are still worth considering.

They discuss the extent to which informed consent is needed for online interactive radio initiatives, especially in the context of the storage of personalised data and monitoring. This issue is especially pertinent to interactive radio via an internet-based platform, such as through a website or mobile applications. Notably, 'interactive radio' online has different connotations than in its traditional sense where the interactivity is typically between people in a physical classroom – the interaction with online radio may often be virtual. When interactive radio is accessed through online platforms, whether in a school setting or at home, unique identifiers may be accessed and stored by radio service providers so that content is more personalised to the individual, but that also raises privacy concerns. While this issue is not pertinent to interactive radio in its most traditional sense, it may be a greater concern in the future as radio is increasingly accessed through online platforms and by individual students and teachers for personalised learning and monitoring.

4. Emerging evidence snapshots

The previous section focused on past initiatives and research on educational radio. It largely converged around the use of radio in formal, teacher-/facilitator- directed educational contexts as there is limited research outside those contexts. However, this section explores how educational radio is being used in response to the COVID-19 pandemic; a time during which many schools and other formal educational settings are closed. It highlights applied evidence, outside the academic literature, that is based in current programmes and which predominantly describes learning in informal, self-directed or family and community facilitated contexts. Firstly, an overview is presented of the technologies currently being used in response to COVID-19, with particular focus on the comparative use of radio against, and alongside, other technologies. Secondly, examples of current educational radio initiatives are highlighted.

4.1. The comparative use of Radio during COVID-19

The preceding systematic review detailed reasons why radio might be considered for use in educational contexts, with key reasons being its cost-effectiveness, accessibility in rural areas and track record of positive effects on learning outcomes. Those strengths are especially pertinent to low-income countries where more recent, and expensive

technologies are less prevalent than in high-income countries and therefore less applicable to the COVID-19 response. Although Vegas (2020) showed that low-income countries are the least likely to have any distance-learning response to COVID-19 at all (less than 25% of those countries have any provisions in place), she also noted that some do. About 4% of low-income countries use radio only for distance-education delivery during COVID-19, and about 9% each use either TV and radio or a combination of online, TV and/or radio. Radio is therefore the most popular singular form of distance-education delivery in low-income countries.

However, the context in middle-income countries is different. In middle-income countries, there is much greater provision of distance-learning during COVID-19; just over 75% of lower-middle income countries, and just over 80% of upper-middle income countries, provide distance education. Further, Internet access, as well as TVs are more common within those populations. Relatedly, there is much less of a singular dependence on radio and online education delivery, in combination with TV and radio, dominate. This is closely followed by the use of online education on its own. Much fewer middle-income countries rely on TV alone, with an even smaller number relying on a combination of TV and radio. Middle-income countries that use radio alone to deliver education during the present pandemic are scarce (Vegas, 2020). More recent technologies, though more expensive – and in the case of online learning, with a shorter history of empirical backing for positively affecting learning outcomes– allow for more advanced educational interactions than broadcast radio does. These interactions extend beyond the aural to include the visual (an aspect of TV and online) and the ability to pause and resume lessons at one's own pace (online). This can make those newer technologies more engaging, and when appropriately designed, more accessible to those with special educational needs. The choice of more advanced technologies for distance-education delivery during COVID-19, in countries that can afford them and already have the infrastructure in place, is therefore readily justified.

4.2. Examples of new educational radio initiatives

This section provides several examples of new educational radio initiatives. A more comprehensive list of initiatives can be found in a World Bank brief "How countries are using EdTech (including online learning, radio, television, texting) to support access to remote learning during the COVID-19 pandemic" (2020).

Argentina

The Ministry of Media and Public Communication, alongside the Ministry of Education jointly prepared a radio broadcast called Seguimos Educando that is being aired on Radio Nacional. The programmes target students from pre-school to secondary school using stories, song and talks. Pre- to primary school topics include, at different stages, Music, Natural Sciences, Social Sciences, Physical Education, Sex Education, Language and literature and Mathematics. Secondary school students are taught the Arts, Physical Education, Chemistry, History, Geography, Philosophy, Language and literature and Mathematics (Ministry of Education Argentina, 2020).

Democratic Republic of the Congo

An educational radio programme called Okapi Ecole was launched in the DRC in April to help give access to education to millions of Congolese children during the COVID-19 pandemic. The broadcast focuses on teaching Mathematics, French, Reading and Writing for primary school students. Health and environmental education are also taught. Broadcasts for secondary school students focus on Mathematics, French Technology as well as three groups of sciences (Computer, Life and Earth). The programme is currently expected to last at least six months (UN Info, 2020).

Guyana

The Guyanese Ministry of Education has listed a number of educational resources on its website to assist in education delivery during the COVID-19 crisis. Amongst those resources are radio broadcasts on six radio stations using IRI to teach grades 1 to 3. Broadcasts geared to grades 3 to 6 are also aired on one radio station (Ministry of Education Guyana, 2020).

South Sudan

In South Sudan, interactive radio broadcasts on English Language, Math and Sciences, for primary and senior students, are being presented on Radio Miraya (UNICEF, 2020; Mold, 2020). The initiative launched in May. Awut Deng Acuil, Minister of General Education explained that, *""Education is a right for all children. In this difficult and uncertain time, education becomes much more important, particularly for girls and children with disabilities, who are most hit by this pandemic. I therefore do urge all our children, especially my daughters to take this opportunity and attend lessons on radio""* (UNICEF, 2020). The initiative was developed by the Ministry of General Education and Instruction and UNICEF and is scheduled to run for at least 6 months.

Rising Academies

There are noteworthy examples where Open Educational Resources (OER) for radio allows users to edit content to suit their particular contextual needs. An example of such free, editable content, produced specifically for educational radio, is that of Rising Academies. Their curriculum, originally geared to Liberia and Sierra Leone, is called Rising on Air and is now freely available to whoever might need it in a format for broadcast radio. Rising on Air is a 20-week programme of ready-to-air radio scripts that covers literacy/language arts and numeracy/maths from pre-school through to secondary school. Teacher professional development content, as well as safeguarding and health information to help ensure children's safety during the COVID-19 pandemic, are also provided (Rising Academies, 2020). The scripts can be freely edited to suit the local contextual needs of education providers and students, and can be re-recorded in local languages and accents so that the content might be more relatable and better understood. Rising Academies additionally record and broadcast educational radio to students in Sierra Leone who are currently learning from home. Motivated by the lack of research on educational radio in informal settings, they are working alongside the Centre for Global Development to evaluate that implementation of educational radio in informal settings. They expect to report on students' learning outcomes, as well as the

successes and challenges of educational radio in informal settings, upon the completion of the programme and their associated research.

5. Synthesis

The findings of the thematic analysis and systematic review, as well as the emerging evidence snapshots, need to be reflected upon together. The present synthesis critically discusses the research presented in both of those sections in light of addressing the challenges of COVID-19. The discussion is closely aligned with the themes established earlier in the present RER and offers recommendations on how and when educational radio might be used. Links across themes are highlighted so that there might be a more comprehensive awareness of the significance of educational radio during and beyond the present pandemic.

Pedagogies and Modalities

Amongst the many reasons highlighted for the longevity of educational radio is its success at enhancing teaching capacity in LMICs and enabling teacher professional development on more effective pedagogies. In formal education settings, teacher professional development on student-centred learning has been enhanced primarily by IRI. IRI has also been instrumental in helping teachers to effectively hold the attention of large classrooms of students when there is a chronic shortage of teachers. In informal settings, educational radio broadcasts have been able, and are being used, to assist in student education at home, where it can provide teaching on subjects when otherwise there might be none. It is this use in informal settings that is particularly pertinent to the COVID-19 crisis, as many students must access education outside the typical bounds of school. However, it is also within informal contexts that there is less evidence on the effectiveness of educational radio and the most appropriate pedagogical tools to apply.

Given the limited understanding of how radio might be used as a distance-education tool in informal settings, more research needs to be done on how the pedagogy of educational radio in formal classroom settings might best be employed outside it. There are teaching tools that might be reasonably employed for student learning at home though. These include the use of storytelling, which is an engaging way to capture the attention of younger learners, and impart knowledge. This is especially so when storytelling is cognisant of the cultural context, group identities and oral histories of a group of learners. Apart from and within storytelling, the use of didactic strategies during broadcasts, such as spaced repetition for language learning, and the use of humour to increase engagement are tools that might also be effectively employed in the physical absence of teachers. Coupled with tools that allow greater interactivity between student listeners and broadcast educators during broadcasts, such as phone-ins and social-media or text messaging, distance-learning through radio might be made to be closer to the experience of real-time, interactive classroom learning.

Importantly though, there has been limited exploration of the combined usage of these tools within LMICs, and it is also not clearly understood which tools are the most effective for different student age-groups. It is also important to consider that whilst Internet access, to allow social media interactivity during radio broadcasts, might be less

of a concern in middle-income countries, the same cannot be said for some low-income countries, and especially within rural contexts, where electricity and Internet access can be expensive and unreliable and therefore not easily available. In low income countries therefore, and especially amongst the most marginalised amongst them, options for phone-ins and text messaging to supplement radio broadcasts, and increase interactivity, should also be considered.

Topical Content and Interest

The pedagogical strength of radio is the basis upon which it is employed in teaching various academic topics. Another benefit of radio is that it allows for inclusion in the learning process, such that students, and parents or guardians who cannot read, can still engage with that academic content. This is of particular salience during the COVID-19 pandemic when much of students' academic learning takes place at home, and sometimes with help from parents who cannot themselves read.

Whilst the delivery of academic content through radio can take several formats, the most developed format of radio for delivering academic education is IRI. IRI began with a focus on mathematics, but has expanded to include a wealth of subject areas such as the sciences, arts, and language-related subjects. The application of radio to educational challenges during COVID-19, such as in the previously described examples of Argentina, the DRC and South Sudan, illustrates this topical breadth. Despite the broad topical application of radio, in recent years, it has most commonly been used in teaching language-related topics. Whilst it is evident that radio might be effectively used in teaching language-related topics broadly, there is less evidence on the specific aspects and educational levels of language that radio might be most effectively used to teach.

More research is needed on radio's applicability to teaching sight- or tactile- based aspects of written language, or indeed of any subject-area, as it is possible that the aural format may at times render it ineffective for certain topics. That broadcast radio is only aural is one of several weaknesses; it also suffers from being ephemeral, such that it cannot be paused and repeated so that learners might move at their own pace, it may be less engaging, offers less means of interaction for SEN students than some other educational technologies, and has seemingly reduced effectiveness at secondary level. Despite these limitations, the accessibility and often cost effective nature of educational radio means that it is worth considering as part of a national education delivery strategy.

In light of this need to consider radio, particularly for contexts where other forms of education delivery are less easily accessible during and beyond the COVID-19 pandemic, it will be crucial to develop programmes that thoughtfully build on the strengths of radio and compensate for its weaknesses, including combining it with other technologies, such as television, online or mobile applications. The emerging evidence snapshots showcased that this is already taking place in several LMICs, though there is little evidence as yet regarding the extent to which radio and other technologies are being used to supplement each other on the same programme, as opposed to teaching different programmes entirely. Finally, the distribution of print material, including and

beyond textbooks, for students and parents may be another effective route to supplementing educational radio programming in some contexts.

Equity, access and participation

Radio's relative cost effectiveness, accessibility and sustainability have been key reasons stated for its adoption throughout this review. Despite the inherent challenges of radio, it often remains amongst the most feasible options for education delivery in low income countries, particularly in a pandemic and associated school shut-down. Within these contexts it is a particularly important educational tool for rural communities and communities with limited or no digital literacy. It is also important for communities with limited or no access to electricity, or other broadcasting and internet infrastructure. However, it is necessary to remember that although educational radio is relatively cheap and easy to use once operational, it still has significant associated upfront costs. This means investing in educational radio should be part of a long-term strategy, and should be designed for implementation at scale.

Educational radio broadcasting costs in countries or communities that do not already have the relevant infrastructure and resources in place may include the creation of radio-specific content. This is significant as the effectiveness of educational radio relies heavily on thoughtful curricula, pedagogy and content. Whilst some broadcast content is already available and free to use, other OER content for broadcast radio is limited, both in terms of the languages and topical content available. Costs also include paying broadcasters, training educators to deliver the programme, and at times the costs of supplementary print materials (for students, teachers, parents and broadcasters). The development of liberalised broadcasting infrastructure, as relevant, should also be considered, as well as efforts to bring governments, donors and other educational stakeholders on board in support of radio.

Data and Consent

Though the type of broadcast radio referred to throughout the majority of this review refers to literature on traditional radio, radio is increasingly being accessed through online and mobile portals. In light of this reality, and future possibility, it is essential that there is deeper consideration of how mobile and online data, related to online radio, should be used and stored. The ability to access, and therefore the risk of misusing personal data can increase when radio is accessed online, and therefore safeguards need to be put in place to ensure that users' confidentiality, usage data and other personal information are protected.

Annex A: Bibliography

Aderinoye, R. (2008). Literacy and communication technologies: Distance education strategies for literacy delivery. *International Review of Education / Internationale Zeitschrift Für Erziehungswissenschaft / Revue Internationale de l'Education, 54*(5/6), 605–626. JSTOR. https://doi.org/10/fk7tpb

Aderinoye, R. A., Ojokheta, K. O., & Olojede, A. A. (2007). Integrating Mobile Learning into Nomadic Education Programme in Nigeria: Issues and perspectives. *The International Review of Research in Open and Distributed Learning, 8*(2). https://doi.org/10.19173/irrodl.v8i2.347

Alaro, M. (2007). *A Study on The Implementation of English Interactive Radio Instruction (IRI) in Selected Government Primary Schools in Addis Ababa* [Thesis, Addis Ababa University]. http://etd.aau.edu.et/handle/123456789/2227

Ali, M. A. (2015). Radio for Equitable Education to All. *VFAST Transactions on Education and Social Sciences, 7*(1), Article 1. https://doi.org/10.21015/vtess.v7i1.232

Anzalone, S., & Bosch, A. (2005). *Improving educational quality with interactive radio instruction: A toolkit for policymakers and planner*s (No. 35742; pp. 1–140). World Bank. http://documents.worldbank.org/curated/en/288791468035958279/Improving-educational-quality-with-interactive-radio-instruction-a-toolkit-for-policymakers-and-planners

Bagley, W. C. (1930). Radio in the Schools. *The Elementary School Journal, 31*(4), 256–258. https://doi.org/10.1086/456559

Bakshi, S. (2011). *Cost Effectiveness of Interactive Radio Instruction Program Karnataka: Basic and Program Cost Effectiveness*. In Working Papers (id:4576; Working Papers). eSocialSciences. https://ideas.repec.org/p/ess/wpaper/id4576.html

Bakshi, S., & Jha, J. (2013). *Interactive Radio/Audio Interventions in Elementary Schools in Karnataka, India: A Policy Simulation Exercise. Global Development Network*. http://www.gdn.int/sites/default/files/India-Interactive%20RadioAudio%20Interventions%20in%20Elementary%20Schools%20in%20Karnataka%2C%20India%20A%20Policy%20Simulation%20Exercise_0.pdf

Barnett, S., Van Dijk, J., Swaray, A., Amara, T., & Young, P. (2018). Redesigning an education project for child friendly radio: A multisectoral collaboration to promote children's health, education, and human rights after a humanitarian crisis in Sierra Leone. *BMJ (Online), 363*, 123–129. https://doi.org/10/ggqvr7

Bates, A. W., & Bates, T. (2005). Radio, audio cassettes and compact disk players. In *Technology, E-learning and Distance Education* (pp. 115–127). Psychology Press.

Bauwens, R., Jennes, I., Bailer, W., Lievens, H., Wijnants, M., & Pike, C. (2019). *Interactive radio experiences*. TVX '19: Proceedings of the 2019 ACM International Conference on Interactive Experiences for TV and Online Video, June 2019, 273–278. Scopus. https://doi.org/10.1145/3317697.3323347

Berman, S. D. (2008). Technical Evaluation Report #62: The Return of Educational Radio? *International Review of Research in Open and Distance Learning, 9*(2). Scopus. https://doi.org/10/ggsnf6

Borton, T. (1977). Reaching Them Where They Are: Guidelines for Developing Concomitant Instruction. *Curriculum Inquiry, 7*(2), 131–143. JSTOR. https://doi.org/10/c56fbp

Bosch, A. (2004). Sustainability and interactive radio instruction: Why some projects last. In D. W. Chapman & L. O. Mahlck (Eds.), *Adapting Technology for School Improvement A Global Perspective* (pp. 149–173). United Nations Educational Scientific, and Cultural Organization, & International Institute for Educational Planning. https://files.eric.ed.gov/fulltext/ED495385.pdf

Bulman, G., & Fairlie, R. W. (2016). Chapter 5 - Technology and Education: Computers, Software, and the Internet. In E. A. Hanushek, S. Machin, & L. Woessmann (Eds.), *Handbook of the Economics of Education* (Vol. 5, pp. 239–280). Elsevier. https://doi.org/10.1016/B978-0-444-63459-7.00005-1

Burns, M., & Trucano, M. (2006). *Improving Teaching Quality in Guinea with Interactive Radio Instruction* (No. 46621; pp. 1–15). http://www.infodev.org/infodev-files/resource/InfodevDocuments_500.pdf

Chatterjee, P., Mishra, D., Padhi, L. K., Ojha, J., Al-Absi, A. A., & Sain, M. (2019). Digital Story-Telling: A Methodology of Web Based Learning of Teaching of Folklore Studies. *21st International Conference on Advanced Communication Technology (ICACT)*, 573–578. Scopus. https://doi.org/10/ggsrnk

Cheung, M. (2012). Edutainment Radio, Women's Status and Primary School Participation: Evidence from Cambodia. In *Research Papers in Economics* (2012:5; Research Papers in Economics). Stockholm University, Department of Economics. https://ideas.repec.org/p/hhs/sunrpe/2012_0005.html

Christina, R., & Louge, N. (2015). *Expanding Access to Early Childhood Development Using Interactive Audio Instruction*. World Bank and Education Development Center, Inc. http://documents.vsemirnyjbank.org/curated/ru/743571468204574547/pdf/940100REVISED000ELP0WB0EDC0Feb02015.pdf

Daudt, H. M. L., van Mossel, C., & Scott, S. J. (2013). Enhancing the scoping study methodology: A large, inter-professional team's experience with Arksey and O'Malley's framework. *BMC Medical Research Methodology, 13*, 48. https://doi.org/10.1186/1471-2288-13-48

Eastmond, D. (2000). Realizing the Promise of Distance Education in Low Technology Countries. *Educational Technology Research and Development*, *48*(2), 99–111. JSTOR.

Education Development Center. (2010). *T4 India*. http://idd.edc.org/resources/publications/india-technology-tools-teaching-and-training-t4

Education Development Center. (2015). *Radio Instruction to Strengthen Education (RISE) and Zanzibar Teacher Upgrading by Radio (ZTUR): Post-Project Evaluation in Zanzibar*. https://www.eccnetwork.net/sites/default/files/media/file/RISE%20and%20ZTUR%20evaluation.pdf

Education Endowment Foundation. (2020). *Remote Learning: Rapid Evidence Assessment*. Education Endowment Foundation. https://educationendowmentfoundation.org.uk/public/files/Remote_Learning_Rapid_Evidence_Assessment.pdf

Edwards, E., Ireland, J., Lezina, B., Omarali, S. B., Schallert, H., Robertson, J., & Zierer-Clyke, M. (2019). Radio and audio in 2018. *Journal of Radio and Audio Media, 26*(2), 351–359. Scopus. https://doi.org/10/ggsrm8

Elekaei, A., Tabrizi, H. H., & Chalak, A. (2019). Distance education and vocabulary podcasting tasks: Attitude in focus. *Turkish Online Journal of Distance Education, 20*(2), 105–120. Scopus. https://doi.org/10/ggsrnb

Elliot, V., & Lashley, L. (2017). The effectiveness of Interactive Radio Instruction (IRI) within selected Primary Schools in Region Number Four (4). *Social Science Learning Education Journal, 2*(9), Article 9. https://doi.org/10.15520/sslej.v2i9.38

Elzroth, C., & Kenny, C. (2003). *Broadcasting and development: Options for the World Bank* (World Bank Working Paper 11). http://documents.worldbank.org/curated/en/129701468763468998/Broadcasting-and-development-options-for-the-World-Bank

Garritty, C., Gartlehner, G., Kamel, C., King, V., Nussbaumer-Streit, B., Stevens, A., Hamel, C., & Affengruber, L. (2020). *Cochrane Rapid Reviews: Interim Guidance from the Cochrane Rapid Reviews Methods Group*. Cochrane. https://covidrapidreviews.cochrane.org/sites/covidrapidreviews.cochrane.org/files/public/uploads/cochrane_rr_-_guidance-23mar2020-final.pdf

Gavaza, M. A., & Pearse, N. J. (2019). Assessing the Social Media Maturity of a Community Radio Station: The Case of Rhodes Music Radio in South Africa. *The African Journal of Information and Communication*, *24*, 1–21. https://doi.org/10.23962/10539/28661

Hallgarten, J. (2020, April 20). 4 lessons from evaluations of the education response to Ebola. Blog. Global Partnership for Education [Global Partnership for Education]. *GPE's COVID-19 Response*. https://www.globalpartnership.org/blog/4-lessons-evaluations-education-response-ebola

Hapeshi, K., & Jones, D. (1992). Interactive Multimedia for Instruction: A Cognitive Analysis of the Role of Audition and Vision. *International Journal of Human-Computer Interaction,* 4(1), 79–99. Scopus. https://doi.org/10/fm792h

Higgins, J. P. T., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. A. (2019). *Cochrane Handbook for Systematic Reviews of Interventions*. John Wiley & Sons.

Ho, J., & Thukral, H. (2009). Tuned in to Student Success: Assessing the Impact of Interactive Radio Instruction for the hardest-to-reach | International Development. *Journal of Education for International Development, 4*(2), 34–51.

Jamison, D. T. (1978). Radio for formal education and for development communication. *Development Communication Report, 24*, 1–2. Scopus.

Jumani, N. B. (2009). Study on role of radio for rural education in Pakistan. *Turkish Online Journal of Distance Education, 1*0(4), 176–187. Scopus.

Keith, A. (1929). Educational radio in Europe and America. *Music Supervisors' Journal, 16*(2), 39–43.

Leary, J., & Berge, Z. (2007). *Successful Distance Education Programs In Sub-Saharan Africa*. https://doi.org/10.13016/m2sooa-rbqx

Leguy, C., & Mitsch, R. H. (2007). Revitalizing the Oral Tradition: Stories Broadcast by Radio Parana (San, Mali). *Research in African Literatures, 38*(3), 136–147. JSTOR. https://doi.org/10/ccbbmr

Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). *Scoping studies: Advancing the methodology. Implementation Science , 5*(69). https://doi.org/10.1186/1748-5908-5-69

Levine, S., & Franzel, J. (Jones). (2015). *Teaching Writing with Radio. The English Journal, 104*(5), 21–29. JSTOR.

MacKinnon, G., & MacKinnon, P. (2010). Technology Integration in the Schools of Guyana: A Case Study. *Computers in the Schools, 27*(3–4), 221–246. https://doi.org/10.1080/07380569.2010.523884

Mangal, S. K., & Mangal, U. (2009). Hardware instructional aids. In *Essentials of Educational Technology* (pp. 45–71). PHI Learning Pvt. Ltd. https://books.google.co.uk/books?id=Sc9upWs956cC&lpg=PR2&ots=cNAlgjJACc&dq=educational%20broadcasting%20radio&lr&pg=PA54#v=onepage&q=radio&f=false

McKenna, L. M. (1993). The Relationship between Attributes of a Children's Radio Program and Its Appeal to Listeners. *Educational Technology Research and Development, 41*(1), 17–28. JSTOR. https://doi.org/10/dwrjq3

Ministry of Education Argentina, educ ar. (2020). *Programación en Radio Nacional de Seguimos Educando*. https://www.educ.ar/recursos/151434/seguimos-educando-en-radio-nacional-ciclo-basico-de-educacion-secundaria

Ministry of Education Guyana. (2020). *Ministry of Education COVID-19 Advisory*. https://education.gov.gy/web/index.php/mediacenter/item/5696-ministry-of-education-covid-19-advisory

Mold, F. (2020, May 11). *UNMISS' Radio Miraya broadcasts school lessons for South Sudanese children during COVID-19*. UNMISS. https://unmiss.unmissions.org/unmiss%E2%80%99-radio-miraya-broadcasts-school-lessons-south-sudanese-children-during-covid-19

Naidoo, G., & Potter, C. (2007). *Ethical issues in using interactive radio in South Africa. International Journal of Phytoremediation, 22*(2), 159–165. Scopus. https://doi.org/10.1080/02680510701306707

Negara, P. W., & Amal, N. N. (2017). N-Gen, the Small Share That Continues to Listen: Reports from Media-Use Online Diaries of Teenage Radio Listeners. *KnE Social Sciences*, 105–114. https://doi.org/10.18502/kss.v2i4.875

Nekatibeb, T., & Tilson, T. (2004). Distance education in Ethiopia. In D. W. Chapman & L. O. Mahlck (Eds.), *Adapting Technology for School Improvement A Global Perspective* (pp. 123–148). United Nations Educational Scientific, and Cultural Organization, & International Institute for Educational Planning. https://files.eric.ed.gov/fulltext/ED495385.pdf

Odera, F. Y. (2011). Learning English Language by Radio in Primary Schools in Kenya. *US-China Education Review,* Online Submission. https://eric.ed.gov/?id=ED529920

Osorio, M. F. J., Muñoz, M. C. C., & Bohórquez, I. C. T. (2019). A Radio Program: A Strategy to Develop Students' Speaking and Citizenship Skills. *HOW Journal, 26*(1), 8–33. https://doi.org/10.19183/how.26.1.470

Pappas-DeLuca, K. A., Kraft, J. M., Galavotti, C., Warner, L., Mooki, M., Hastings, P., Koppenhaver, T., Roels, T. H., & Kilmarx, P. H. (2008). Entertainment–Education Radio Serial Drama and Outcomes Related to HIV Testing in Botswana. *AIDS Education and Prevention, 2*0(6), 486–503. https://doi.org/10/bgkz6g

Pedrero-Esteban, L. M., Barrios-Rubio, A., & Medina-Ávila, V. (2019). Teenagers, smartphones and digital audio consumption in the age of Spotify. *Comunicar. Media Education Research Journal*, *27*(2). https://doi.org/10.3916/C60-2019-10

Perraton, H. D. (2000). *Open and Distance Learning in the Developing World*. Psychology Press. https://books.google.co.uk/books/about/Open_and_Distance_Learning_in_the_Develo.html?id=66CEAgAAQBAJ&redir_esc=y

Potter, C. (2007). South Africa: Interactive Radio for Supporting Teachers of English as a Second Language. In H. Perraton (Ed.), *International case studies of teacher education at a distance* (pp. 231–252). BIS-Verl. der Carl-von-Ossietzky-Univ.

Potter, C., & Naidoo, G. (2006). Using Interactive Radio to Enhance Classroom Learning and Reach Schools, Classrooms, Teachers, and Learners. *Distance Education, 27*(1), 63–86. https://doi.org/10.1080/01587910600653280

Potter, C., & Naidoo, G. (2009). *Evaluating large-scale interactive radio programmes. Distance Education, 30*(1), 117–141. https://doi.org/10.1080/01587910902845980

Rodero, E. (2012). See It on a Radio Story: Sound Effects and Shots to Evoked Imagery and Attention on Audio Fiction. *Communication Research, 39*(4), 458–479. Scopus. https://doi.org/10/fstvvs

Sasidhar, P. V. K., Suvedi, M., Vijayaraghavan, K., Singh, B., & Babu, S. (2011). Evaluation of a distance education radio farm school programme in India: Implications for scaling up. *Outlook on Agriculture, 40*(1), 89–96. Scopus. https://doi.org/10/fxgxkd

Schweighofer, E., & Schmautzer, F. (2019). Legal issues of user engagement with interactive radio stations. Jusletter IT, February. Scopus. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85072887976&partnerID=40&md5=fe5a764a6b26cc7669007d6012b0793b

Şendağ, S., Gedik, N., & Toker, S. (2018). Impact of repetitive listening, listening-aid and podcast length on EFL podcast listening. *Computers and Education, 125*, 273–283. Scopus. https://doi.org/10/gd5kg6

Teas, M. M., & Tilson, T. (1989). Bolivia: Instruction through interactive radio. Mothers and Children, 8(1), 4–5. Scopus.

Trucano, M. (2010). Interactive Radio Instruction: A Successful Permanent Pilot Project? https://blogs.worldbank.org/edutech/iri

UN Info. (2020, May 1). Coronavirus: En RDC, Radio Okapi lance une émission scolaire pour les enfants privés d'école. *ONU Info*. https://news.un.org/fr/story/2020/05/1067982

UNESCO. (2020). *Call for Joint Action: Supporting Learning and Knowledge Sharing through Open Educational Resources (OER)*. UNESCO.

UNICEF. (2006). *Behaviour change communication in emergencies: A toolkit*. UNICEF.

UNICEF. (2020). *Scaling up radio education for children in South Sudan.* https://www.unicef.org/southsudan/press-releases/scaling-radio-education-children-south-sudan

Vegas, E. (2020, April 14). School closures, government responses, and learning inequality around the world during COVID-19. *Brookings*. https://www.brookings.edu/research/school-closures-government-responses-and-learning-inequality-around-the-world-during-covid-19/

Vyas, R. V., Sharma, R. C., & Kumar, A. (2002). Educational Radio in India. *Turkish Online Journal of Distance Education, 3*(3). https://pdfs.semanticscholar.org/6835/c32818cbfe179e629b450d1e22abf3291847.pdf

Wathen, A., Llewellyn, D., Ludovice, P., Hunt, W., & Usselman, M. (2010). *A Study of Inquiry Based Informal Science Education in an Urban High School Physics Class.* Paper presented at 2010 Annual Conference & Exposition, Louisville, Kentucky. https://peer.asee.org/a-study-of-inquiry-based-informal-science-education-in-an-urban-high-school-physics-class

World Bank. (2020). *How countries are using edtech (including online learning, radio, television, texting) to support access to remote learning during the COVID-19 pandemic* [Text/HTML]. World Bank. https://www.worldbank.org/en/topic/edutech/brief/how-countries-are-using-edtech-to-support-remote-learning-during-the-covid-19-pandemic

Yadav, A. K. S., & Kharate, P. M. (2017). Access and Use of Traditional and Internet Media by Secondary School Children in Mumbai, India. School Libraries Worldwide; Edmonton, 23(1), 29–40. http://dx.doi.org.ezp.lib.cam.ac.uk/10.14265.23.1.003

Yelkpieri, D., Kweku, W. E.-D., & Kwesi. (2011). Patronage of Educational Broadcasts and its Effects on Academic Growth of Students of Winneba and Apam Senior High Schools in the Central Region of Ghana. *Academic Leadership: The Online Journal, 9*(1). https://scholars.fhsu.edu/alj/vol9/iss1/40

Annex B: Search terms

- Radio
- Radio education
- Education radio
- Interactive radio
- Distance Education
- Interactive media
- Interactive radio instruction
- IRI
- Rural education radio
- Rural education
- Radio storytelling children
- Learning at home
- Interactive multimedia instruction
- School radio
- Public services radio access
- Educational broadcasting
- Educational broadcasting radio
- Community radio broadcasting
- Participatory communication education
- Out-of-school radio
- Teaching with radio
- Audio-based distance education
- Educational audio podcast
- Concomitant instruction