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Minoritised languages, education, and technology: Current practices and future directions in low- and middle-income countries

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Minoritised languages, education, and technology: Current practices and future directions in low- and middle-income countries

This article explores the current status and future directions of minoritised language education and the use of technology in low- and middle-income countries. Our literature review of available academic sources in multiple languages reveals a lack of evidence on the use of technology in minoritised language education across different countries, especially multilingual contexts with greater linguistic diversity. To understand the issue in greater detail and to offer recommendations informed by current practice, we then conducted interviews and a collaborative workshop with four organisations with relevant EdTech initiatives. The analysis covers facilitating and limiting factors these organisations have encountered, as well as the impact of good practice initiatives on learners and society at large. We conclude by identifying the practical, policy, and research properties in the development of minoritised language education and technology.

Keywords: minoritised languages, mother tongue, educational technology, LMIC, multilingualism, language of instruction

Overview

There is strong evidence that mother-tongue language of instruction (LOI) increases engagement in school and improves foundational learning outcomes (Daly et al., 2020; Smits et al., 2008). However, there have been multiple barriers to operationalising this at scale, such as rigid policy frameworks regarding languages and LOIs specifically and the lack of availability of teaching and learning materials in minoritised languages. Indeed, around 2.3 billion people lack access to education in a language they speak (Thaung & Gracie, 2021), to illustrate this point, see CLEAR Global's¹ North-East Nigeria language analysis, where English is spoken by just 1% of households, despite it being the language of instruction in schools.

¹ CLEAR Global has been known until very recently as Translators Without Borders.

The research focuses on the potential of educational technology (EdTech) in promoting the increased use of minoritised languages, with an aim to improve foundational literacy outcomes.

Structure and methodology

This paper combines different research methods. First, a literature review was conducted to gather background information on relevant existing research and initiatives. Although the current research was largely undertaken in English, we have engaged with different languages in the process by conducting literature searches in multiple languages including: Arabic, Chinese, French, Kinyarwanda, Pashto, Portuguese, and Spanish². Searches were conducted in Google Scholar, and where little existing literature was available, Google searches (Baidu and Baidu Xueshu³ were also used for Chinese literature). A list of search terms can be found in the Appendix.

Relevant initiatives on EdTech and mother tongue education (MTE) were then identified through snowball sampling. Following informal conversations with partners from different initiatives, four good practice examples were selected and an online collaborative workshop was organised. Initiatives were selected based on:

² These languages were chosen for practical reasons as the authors are fluent in them so thorough searches and reviews could be conducted, and we acknowledge that these are only a small number of languages.

³ Baidu (<https://www.baidu.com/>) and Baidu Xueshu (<https://xueshu.baidu.com/>) are Chinese-language search engines operating in mainland China where Google services are not available.

- the extent to which ‘mother tongue’ or ‘minoritised’ languages were core aspects of the work;
- the extent to which links between languages and education — or specifically EdTech — were apparent;
- the amount of readily available documentation and/or data.

Informed consent was obtained from all participants of the workshop and a copy of the script can also be found in Appendix 2.

The remainder of this paper is organised into three sections: Section 2 first offers a brief literature review on the background of MTE, before going into more depth on some examples of EdTech in MTE from the multilingual literature review. The next section (Section 3) is structured thematically, focusing on four good practice examples that utilise technology to aid MTE and learning. Finally, Section 4 summarises the findings and lessons learnt from both the literature review and discussions with representatives of existing initiatives and provides recommendations for future research and initiatives.

Limitations

There are several limitations to the current study. Firstly, the literature search focused on academic publications, and did not include, for example, non-academic publications, evaluations, white papers, and industry reports. Future research should take into account similar grey literature to provide a fuller understanding of existing literature. Furthermore, due to the limited number of published papers on EdTech and MTE, especially those based on detailed and reliable research methods, the following literature review in Section 2 could not identify clear themes in terms of relevant findings. More good quality future research

should be encouraged to fill in this gap.

Terminology

A wide range of terms are used for languages in education specifically related to low- and middle-income countries (LMICs), with some of these terms more helpful than others. The reader will note, throughout the paper, a preference for ‘mother tongue’ — a term disfavoured in academic linguistic circles due to its strong association with monolingualism and relatedly, colonialism and Eurocentrism (Love & Ansaldo, 2010). This choice is a reflection on the use of ‘mother tongue’ as a calque for the more natural corollary in other languages, whether it is ‘*lingua materna*’, ‘*لغة الأم*’, or ‘*ururimi kavukire*’. Thus the term embraces an English usage which has global currency. Table 1 summarises the diversity of our thinking behind some of the range of terms found in different types of publications.

Table 1. Terminology for language use in education

Terms	Do we find it helpful?	Potential issues
First language/ L1, L2, etc.	Yes — it’s an accurate, individualised, and linguistic term relating directly to the levels of proficiency of a particular person.	<ul style="list-style-type: none"> • The level of individualisation can become a hindrance at the macro policy level when what is needed is decisions around which sets of languages are broadly employed in the education system to support the majority of learners. This perception, though a pertinent and practical issue for policymakers, must be challenged when attempting to effectively differentiate learning. • Even at the individual level, one can have more than one ‘first language’ and/or prefer to be educated in a language different to their L1. Additionally, it is often implied that one has a higher proficiency in their L1 than their L2, which is not always correct.
Minoritised language	Yes — it reflects the active effect of a language being minoritised by	<ul style="list-style-type: none"> • Some languages might be spoken by the majority of the population in certain countries, while still being marginalised for political and educational purposes. In this sense, the language has been minoritised, without being spoken by a minority, displaying different degrees of minoritisation.

	another language.	<ul style="list-style-type: none"> For example, in Malawi, Chichewa is spoken by 70% of the population (Translators Without Borders, 2021) while English is spoken by just 26% of the population above the age of 14, yet English is the language of instruction from grade 5 (aged 10) onwards (USAID, 2021).
Home/ indigenous language	Somewhat — it's a useful term for non-transitory populations, which reflects the history and embeddedness of the particular language.	<ul style="list-style-type: none"> High levels of economic migration, forced migration and displacement, and refugee populations raise questions such as: 'What is home?' for these groups. Problematically, home language also implies that language is not suitable for 'public' domains. A further question relates to, who the language is indigenous for? And, how historically embedded does a language have to be to be considered indigenous? For example, Mauritius does not have an indigenous population, as no population pre-dates European explorers settling and colonialism (Maurer, 2010)). Therefore, Mauritian creole could not be considered an 'indigenous language', but it is widely spoken and is the LOI for grades 1–3 (aged 6–8) (Mahadeo, 2006).
Native language/ tongue/ speaker	No	<ul style="list-style-type: none"> 'Native', and 'nativeness' in general, is a vague, binary and racialised term which carries significant colonial baggage. This is particularly apt when discussing languages in education in LMICs, where previous colonial languages are often still employed as the language of education (Cheng et al., 2021).

Mother tongue	Yes — it's a commonly used term in the field and is therefore widely understood.	<ul style="list-style-type: none">• The language(s) that one speaks from birth, often learned and used in their household. It has strong ties to the notion of 'native speaker' and the Eurocentric monolingualism behind it.• Use of 'mother' could be exclusionary for some (e.g. orphans or those without mothers, or users' mothers who might not speak the relevant language).• 'Tongue' implies spoken, thus excluding written and other modalities (e.g. sign languages).
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Literature review

This section sets the background of the current study by summarising existing literature on relevant topics and reviewing several examples in the field of EdTech that focus on MTE.

Background on MTE

Historically, research on MTE has been limited, particularly regarding education in LMICs, as noted by (Evans & Mendez Acosta, 2021). However, since 2016, more and more academic publications have investigated this topic and demonstrated the positive impact of relevant research. We have also included two upper-middle-income countries (China and South Africa), taking into consideration the vast economic and educational inequalities within each country.

The role of MTE in improving literacy is most widely documented, not just in early literacy in the language of instruction, but also in secondary languages (Laitin et al., 2019; Taylor & von Fintel, 2016). Additionally, studies have identified the positive impact of early mother tongue literacy on general learning outcomes (Laitin et al., 2019; Seid, 2016; Taylor & von Fintel, 2016) and longer-term employment outcomes (Seid, 2019). A study on primary school children in Ethiopia linked MTE to an increase in attendance in early childhood and in the number of children entering school at the right grade level in relation to age; this further led to a long-lasting positive influence on learning outcomes throughout children's schooling years (Banerjee et al., 2016; Seid, 2016). The same study also found that MTE increased the possibility of enrollment for students from minority backgrounds (Seid, 2016), resulting in higher employment rates, quality of employment, and job satisfaction from students who had MTE since 1994 (Seid, 2022).

Existing research on several different languages shows similar benefits of MTE: for example, using indigenous African languages for instruction was found to improve students' performance in end-primary school exams in Burkina Faso (Bamgbose, 2011). In a study conducted with 1500 students in Ghana, the use of Asante Twi and Akan as the LOI has also been proven beneficial, enabling students to catch up in foundational literacy after transitioning from complementary education to government schools (Carter et al., 2020). Similarly, in Ghana, Piper and Zuilkowski (2016) also found improvement in oral reading fluency and comprehension when the mother tongue was used in addition to Kiswahili and English. In Cameroon, improvements were also seen in both English and maths test results, as well as increased attendance when Kom was used as LOI instead of English (Laitin et al., 2019).

Nevertheless, some studies highlighted a more complex picture of the effects of MTE. In Uganda, Brunette et al. (2019) found that not all languages used for MTE had a positive impact, and the effects depended on language characteristics and socioeconomic status. Similarly, Piper et al. (2018) also noted a lack of positive impact on learning outcomes in literacy and maths with the use of mother tongue in the Primary Math and Reading (PRIMR) Initiative in Kenya.

Contextualised evidence on the intersection of MTE and technology

This section summarises findings from the multilingual literature search on the intersections of MTE and technology in different locations. During the literature review process, published work in eight languages (Arabic, Chinese, English, French, Kinyarwanda, Pashto, Portuguese, Spanish) were searched, primarily on Google Scholar and where unavailable, its equivalence in the target language and general Google searches.

We first highlight two different countries, South Africa and Haiti, where some of the existing MTE and technology initiatives have been well-documented in academic literature. In the remainder of the section, we discuss relevant literature in other less-researched locations, both to provide an overview of the current status and to show the lack of existing research, and likely, existing initiatives, in non-English publications.

South Africa

South Africa has 12 national languages, with Zulu as the most spoken language, followed by Xhosa (spoken by 23% and 16% of the population respectively). English and Afrikaans are also widely used, especially in educational settings, though English is spoken by less than 10% of the population. In education, various mother tongues are used as LOI in grades 1 to 3, before shifting to English at grade 4 (USAID, 2020).

In a longitudinal study conducted in South Africa, digital materials in English and three different mother tongues (Xitsonga, Sepedi and Tshivenda) were provided to 215 students in grades 1 to 4, in order to improve early reading outcomes for these students. Students accessed the resources on multilingual, culturally appropriate and phonics-based software in computer labs. The improvement was estimated to 0.75 years of additional reading growth and twice as much for reading comprehension when compared to the control group (Castillo & Wagner, 2018).

Another study researched potential challenges for the integration of ICT in the South African classroom setting. Questionnaires and interviews were used to ask students from four schools in Cape Town about their ICT access, skills and use both in and outside schools. Despite the availability of ICT, language barriers including a lack of platforms, software and content available in local languages, and the limited technical capacity of teachers, were

identified as the major challenges for ICT integration in classrooms. When interviewed about the needs of content and software in their home languages, Afrikaans-speaking students showed a great desire to access more online content in Afrikaans. IsiXhosa-speaking students, however, preferred English because they thought that writing and reading in their local language was difficult and that English was more valued by teachers (Gudmundsdottir, 2010).

Haiti

In Haiti, there are two official languages: Haitian Creole (Kreyòl) and French. Kreyòl is the most popular language spoken by 95% of the population followed by French which is spoken fluently by only 5% of the population (most Haitians speak Haitian French rather than Standard French). In education, Standard French is the only language used as a language of instruction, despite the fact that only a small percentage of Haitians are fluent in the language.

The Mother Tongue Book project (2010) was a project focused on reading, writing, maths and science skills in Kreyòl, especially in Science, Technology, Engineering and Mathematics (STEM) subjects, at a primary school in Matenwa, La Gonave, Haiti. After being exposed to books in Kreyòl for a year, DeGraff & Stump (2018) noted that around 270 students in grades 1 to 3 showed an improvement in reading and maths. Building on this, the MIT-Haiti Initiative (2012) was established, which aimed to advocate the inclusion of minoritised languages and linguistics in teaching, together with the incorporation of local languages, active-learning pedagogy, and educational technology for quality education in Haiti. The author also made several recommendations on how to approach similar cases when

developing resources in minoritised languages, especially in the engagement of partners (DeGraff & Stump, 2018).

A second paper by DeGraff (2020) also presented further findings from the MIT-Haiti initiative, advocating the use of Kreyòl as the national language of instruction to help Haitian students to access high-quality education despite the linguistic barrier. The trial phase of the project focused on incorporating technology by developing software and tools to translate educational resources into Kreyòl, with a strong focus on STEM subjects. The initiative was later expanded to all subjects by crowdsourcing, co-creating, curating and sharing of educational materials in Kreyòl. In September 2019, the launch of their project website (<https://mit-ayiti.net/>) enabled the sharing of all resources. The author also noted that the project would benefit the general public, as the majority population already speak Kreyòl (DeGraff, 2020).

Kenya

In the English language literature, in addition to the above examples of good practice EdTech initiatives, there are a growing number of studies on MTE which inherently have a technology-enabled mode of delivery, but do not focus on technology in any related research publications. For example, the research on MTE in Kenya (Piper et al., 2016) is based on the implementation of PRIMR (see Section 2.1), which is technology-enabled. The research does not, however, compare tech with non-tech implementation; instead, it focuses on the combination of languages used. This demonstrates how, as technology use becomes more prevalent in education, more research is needed on the intersections of MTE and technology rather than solely on language use. Other applications and EdTech initiatives serving minoritised language communities are prevalent in Kenya's vibrant technology ecosystem,

including, notably, M-Lugha, which has been recognised as one of Africa's '10 most outstanding education innovations' by the African Union, but these have only been covered in the media and not in academic journals thus far.

Hispanophone countries

Outside English language literature, there are several relevant studies on MTE in Spanish, with some investigating EdTech initiatives. In Spain, Spanish is the only official language and is used by 99% of the population (of which, 88% use it as their first language) while there also exist four co-official (regional) languages, which include Basque, Catalan, Galician and Occitan. Rodríguez & Antón (2020) found that EdTech motivated university students to develop their language skills and communicate in their regional languages. In a study conducted in Ucayali in the Peruvian Amazon, Flores Fasanando (2021) noted a positive effect on oral communication in speakers' first language with the use of Zoom in secondary education. Also in Peru, Hynsjö and Damon (2015) linked the use of indigenous languages to an improvement in children's maths scores but not in their L1 Quechua.

In Mexico, where approximately 94% of the population speak Spanish with another 5% speaking Spanish plus other indigenous languages, Cruz Pérez et al. (2016) found that secondary school students viewed indigenous languages as a limiting factor in the education process. Furthermore, Cruz-Aldrete & Cruz-Aldrete (2021) pointed out that the technology used to ensure continued learning during Covid-19 risked further marginalising speakers of minoritised languages, including Mexican sign language users. (Koffi, 2016; Nkenlifack et al., 2011)

Arabophone countries

Overall, very few relevant academic studies were available in the other languages within the search strategy (Section 1.1), further highlighting the lack of and the need for academic research on the topic of MTE and technology. Regarding Arabic literature, our searches returned some articles discussing the use of Arabic in education in Indonesia, where Arabic is a minoritised language spoken by Arab Indonesians, but these were mostly undergraduate theses and/or focused on higher education, and therefore out of scope. Existing Arabic literature from Algeria, Palestine and Egypt, all of which use more than one variety of Arabic (i.e. Modern Standard Arabic, the written/official standard, coexists with other regional and national varieties used in informal as well as, increasingly, formal settings) largely reflected nationalistic and political views, rather than informed linguistic engagement with these complexities (Al-Otaibi, 2018). In contrast, literature published in English focused more explicitly on the linguistic issues around Arabic language use in education (e.g. Shendy, 2019).

China

In mainland China, mother tongue education is typically associated with ethnic minorities (e.g. Mongolian or Korean Chinese) who have additional languages other than Mandarin Chinese, which is the official language and LOI. Only some teaching of ethnic minority students is bilingual while most remains monolingual in Mandarin Chinese. Very little relevant academic literature was found on minority MTE or on EdTech (Liu & Zhang, 2015).

Afghanistan and Pakistan

Likewise, little literature exists on MTE in Pashto, spoken mainly in Afghanistan and Pakistan: a number of articles highlighted the importance of MTE, mentioning general benefits such as increased enrollment, improved attendance, and higher test scores without any empirical evidence (Hatsaandh, 2019).

Rwanda

In Rwanda where Kinyarwanda is spoken as a first language by 99.4% of the population, together with three other official languages (English, French, and Swahili, all spoken by less than 1% of the population). In education, there has been a shift in LOI from French to any of French, Kinyarwanda or English (Niyibizi, 2015; Niyomugabo, 2015), to English exclusively (Mutanganshuro, 2019). Again, no literature was found on the use of EdTech in Kinyarwanda teaching.

Francophone and Lusophone countries

Most existing literature in French and Portuguese concerns only non-LMICs such as Switzerland, Canada, Belgium, Portugal, and Brazil. Since our focus here is on LMICs, they are deemed to be out of the scope for this study. Two French articles highlighted pedagogical challenges for the incorporation of ICT in MTE in Cameroon and Ivory Coast (Koffi, 2016; Nkenlifack et al., 2011), but without any empirical evidence.

EdTech and minoritised language initiatives

In order to build on the existing evidence detailed in the literature review, we identified

several initiatives working in the field of EdTech and minoritised languages in LMICs. As previously noted, though, existing evidence on the specific intersection of EdTech and minoritised languages is scarce. As such, this section is structured around recurrent themes from conversations the EdTech Hub team had with a selection of initiatives, both through individual interviews and a collaborative workshop. This section is split into four themes that were recurrent through these conversations: 1) Pedagogical approaches; 2) Facilitating factors; 3) Limitations; and 4) Impact. An overview of each of the four participating initiatives are presented in Table 2.

Table 2. Initiatives participating in workshop and interviews

Name	Geography	Languages	Summary of activities
African Storybook ⁴	Africa	227 African languages	Provides open-access, downloadable, illustrated storybooks as well as the Reader and Maker Apps for offline use
CLEAR Global ⁵	148 countries	220+ languages across contexts	Offers language services to humanitarian and development organisations
Curious Learning ⁶	Africa	50+ languages across contexts	Offers curation, localisation, distribution and measurement of free open source apps to help children learn to read

⁴ <https://www.africanstorybook.org/> Retrieved 3 November 2022

⁵ <https://clearglobal.org/> Retrieved 3 November 2022

⁶ <https://www.curiouslearning.org/> Retrieved 3 November 2022

eLimu ⁷	East Africa	Alur, Kiswahili, Lugbarati, Somali	Offers a repository of interactive digital learning resources and apps
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Pedagogical approaches

Apart from CLEAR Global, who provide language and technological support in a wide range of areas including, but not limited to, education, the other three initiatives articulated clear pedagogical principles underpinning their work in interviews and at the workshop. For Curious Learning and eLimu, a focus on phonics is central to their approach, with users introduced to phonemes and corresponding graphemes in the beginner stages before progressing to whole words and phrases. This approach is especially crucial for Curious Learning, as it enables them to offer students access to syllabically complex languages such as Zulu.

Curious Learning, eLimu and African Storybook all adopt scaffolded progression approaches, through which users are presented with increasingly complex sounds, words and sentences. In the case of Curious Learning's Feed The Monster app (Curious Learning, 2022), repetition is also key; users repeatedly encounter phonemes and corresponding graphemes in increasingly complex combinations.

These three initiatives also use restricted exposure as a pedagogical approach. The eLimu representative described limiting stories to a maximum of 100 phonically accessible words to ensure a high level of comprehensibility, though they also admitted that the content was sometimes less engaging as a result. Similarly, the Curious Learning representative

⁷ <https://e-limu.org/> Retrieved 3 November 2022

reported presenting single phonemes and graphemes in a highly controlled way to keep content manageable and providing students with ‘bitesize chunks for mastery over time’.

Additionally, both eLimu and African Storybook noted their use of contextualised stories to increase relatability for readers. The African Storybook representative noted that stories in their archives were often written by teachers with deep contextual knowledge who are able to write stories that resonate with students’ immediate experiences. Furthermore, the eLimu representative explained that their story translations also involved localisation; for example, the wolf in ‘The Boy Who Cried Wolf’ might be replaced by a hyena when translated into African languages.

Visuals are also an important feature of all of the initiatives’ offerings. Curious Learning’s ‘Feed The Monster’ app is highly visual in its presentation, employing colourful, animated, and interactive content to engage users. For eLimu and African Storybook, the consistent use of illustrations is used to support comprehension.

Finally, the African Storybook representative reported that their resources were designed to facilitate pedagogical translation in the classroom. Teachers are able to use parallel translations of the same storybook for contrastive analysis between the texts to highlight language differences and clarify meaning. Through the ‘Adapt’ function on the website, teachers can adapt any storybook by raising or lowering its difficulty level to suit the learners as well as adapting storybooks to ‘picture-only’ for picture reading.

As such, in each of the initiatives, pedagogy underpinned the design and implementation of the work. Supports and scaffolds that guide learners while making content engaging were integrated within the technology to ensure that the interventions were learner-centred.

Facilitating factors

A list of facilitating factors were identified by interview and workshop participants and are discussed in this section.

Technology

Representatives from all initiatives noted the ways technology supports their internal operations, particularly in the creation of their products. The African Storybook representative noted that their African Storybook Author mobile application had enabled their organisation to easily adapt and translate content for storybooks into different languages. Similarly, the Curious Learning and CLEAR Global representatives identified app technology as a particularly effective means of adapting content, removing the need to ‘reinvent the wheel’ for each language iteration and allowing for ease of working multilingually. This is consistent with existing research by Major et al. (2021), whose meta-analysis of personalised adaptive learning interventions found similar forms of technology-supported learning had a statistically significant, though moderate, positive effect size of 0.18 on learning outcomes.

Secondly, both the African Storybook and Curious Learning representatives highlighted that technology had enabled them to source the linguists needed to translate and quality assure their products in the languages required. Indeed, Curious Learning noted that their success could not have been achieved without access to these linguists through platforms such as Upwork⁸ and Fiverr,⁹ which help organisations to connect with freelancers. However, they also acknowledged that finding enough linguists to produce content in all of their target languages remained a challenge despite these resources.

⁸<https://www.upwork.com/> Retrieved 2 November 2022

⁹ <https://www.fiverr.com/> Retrieved 2 November 2022

The African Storybook representative also noted the democratising power of technology within content creation. The possibilities for self-publishing presented by the internet enable small organisations to bypass lengthy publishing processes and manage content creation in-house. This then creates an opportunity for independent contributors who might otherwise struggle to find audiences, such as local authors and teachers, to make their work available online and publicly accessible via the African Storybook archive. Quality assurance is then carried out by the African Storybook by having the content checked by a language expert and storybooks that have undergone quality assurance are identified as ‘ASb approved’ on the website. Additionally, further quality assurance is conducted when working with a national education department as per the department’s criteria. However, the eLimu representative stated that sometimes content needed to be revised as there were instances in which teachers wrote storybook content that was inappropriate for the age of learners (including violence or references to sensitive issues). As such, quality assurance mechanisms are necessary features to ensure content is appropriate and aligned to learning.

All participants agreed that their initiatives had successfully increased their users’ access to multilingual content thanks to a variety of platforms where their resources were available. African Storybook used various platforms such as WorldReader¹⁰, Learning Equality¹¹, SquidReader¹² and community libraries such as the Kibera library¹³, while Curious Learning and eLimu representatives noted that their app-based offerings were available through Google Play.

¹⁰ <https://www.worldreader.org/> Retrieved 3 November 2022

¹¹ <https://learningequality.org/> Retrieved 3 November 2022

¹² <https://www.imlango.com/our-literacy-strategy> Retrieved 3 November 2022

¹³

<https://eifl.net/resources/kenya-national-library-service-kibera-public-library-tablet-computers-support-childrens> Retrieved 3 November 2022

Both the eLimu and African Storybook representatives highlighted the scaffolding capacity of technology in classrooms where the teacher does not speak the mother tongues of some of the students, or in situations where multiple mother tongues are present within the same classroom. For example, teachers may lead students through a story from the organisations' databases in one language, and students are simultaneously able to follow the story in another language within the database, or check words in online dictionaries where needed. This function to effectively differentiate and target learning to students' needs is a critical affordance of personalised technologies, and linguistic differentiation and scaffolding facilitated by technology could be a powerful tool as the EdTech and minoritised language nexus grows.

Another significant way technology increases access to content is through increased engagement. The eLimu representative highlighted the opportunities that technology provides for gamification and interactivity, which can render content more engaging for students. The Curious Learning representative added that app-based learning carries the potential for increased positive reinforcement in the mother tongue, citing 'small things like encouragement by characters in the app'. In the case of the African Storybook, technology has enabled children and marginalised groups such as girls, to add their voice to storybooks. Children use the Maker App to create and publish their own picture storybooks about their own experiences.

Additional benefits of technology use included enhanced communication within the organisation (African Storybook) and with users (CLEAR Global), easier distribution of content through social media and app carriers such as PlayStore (Curious Learning), increased ability to monitor and measure impact (eLimu) and ability to store large amounts of multilingual resources in one place (African Storybook). A study conducted in Turkey found

that the use of technology in teaching the mother tongue improved all the four basic language skills, increased students' motivation, and enhanced their mental and affective development. For teachers, this intervention contributed to their motivation, creativity and self-confidence (Üzeyir & Serkan, 2022).

Policy

All participants acknowledged the significant power wielded by policymakers in the success of their initiatives, noting that this could effectively make or break their ability to reach their target audiences. The Curious Learning representative gave the example of the potential power of device distribution policies. In a study conducted in Nigeria, the team found that providing students with devices pre-loaded with content resulted in learning gains across all age groups and genders that were second only to one-to-one tutoring (Orozco-Olvera & Rascón-Ramírez, 2022). The eLimu representative agreed, noting that the Kenyan government's policy to provide devices for all primary age students held great promise in terms of facilitating access to mother tongue resources, although the scheme was ultimately disappointing and fraught with incompatibility issues. The Curious Learning representative added that such policies must be carefully thought through in order to deliver on their promises, citing examples of ministries who had purchased devices without thinking through students' access to content or ability to charge the device in particular environments. The emphasis of these programmes on device distribution runs counter to evidence from the World Bank 'Smart Buys' meta-analysis (World Bank, 2020) and subsequent research examining the impact of device distribution on female learners in particular (Jordan & Myers, 2022), where hardware-only interventions were found to be less effective. Similar complications with the distribution of devices have also been highlighted elsewhere, for

example, Trucano (2013) suggested such distribution should be carefully designed according to local contexts in LMICs.

There were other examples of government policies facilitating engagement with EdTech mother tongue initiatives, such as policies favouring the use of technology to sustain learning during the Covid-19 pandemic (Curious Learning), and language education policies advocating the use of the mother tongue (the language of the catchment area, in the case of Kenya) in the first years of schooling in many African countries, including Malawi and Mauritius (African Storybook). Although it is worth noting that in practice, such policies might not be fully implemented (e.g. in Malawi), thus failing to deliver the promised multilingual education (Reilly et al., 2022).

Decolonisation agenda

Finally, it was suggested that the current upsurge in efforts to decolonise literacy and children's literature may facilitate engagement with mother tongue resources. The African Storybook representative noted how this cultural shift had resulted in local language experts becoming more interested in writing for children in their languages, which was in turn supported by a renewed desire and pride in some communities to preserve their languages and cultures. This echoes relevant work on linguistic decolonisation in and outside Africa, where actions are taken to challenge and even overturn the dominance of colonial languages and Eurocentric language ideologies (Agyekum, 2018; Poudel et al., 2022). In Ghana, Agyekum (2018) illustrated how linguistic decolonisation could have a positive impact on many aspects of life: for example, by normalising the use of indigenous and endangered languages in mass media, language users could learn new vocabularies as well as challenging the dominating status of colonial languages. The inclusion of Akan, for instance, in mass

media, pop culture, schools and teachers' colleges helped to advance the linguistic documentation and legitimisation of multilingualism in multilingual communities in Ghana.

Limiting factors

In addition to the facilitating factors mentioned above, representatives from different initiatives also pointed out various limiting factors impacting on their work and these are addressed in the following section.

Technology

Despite the notable benefits of using technology to promote mother tongue learning, all participants identified limitations to its usage. Firstly, the African Storybook, Curious Learning and CLEAR Global representatives all noted that successful technology use was heavily dependent on the existing infrastructure in each operating context. Indeed, the unreliability of electricity and internet in many LMICs limited students' abilities to charge devices or access online content reliably (Curious Learning, African Storybook).

Additionally, more widely accessible low-tech options (e.g. radio) whose infrastructure is more established cannot always cater for the variety of minoritised language users in a given context (CLEAR Global). It should be noted that some radio-based initiatives do attempt to work across languages, such as Rising on Air¹⁴; thus, these low-tech approaches are worth exploring in tandem with minoritised languages in the future.

The African Storybook and eLimu representatives also highlighted device-related limitations. Many students are unable to access devices due to their prohibitive cost (African Storybook), forcing some to share devices with their families (eLimu). On this last point, the

¹⁴ <https://www.risingacademies.com/onair-old> Retrieved 3 November 2022

eLimu representative elaborated that, in their experience, parents were often reluctant to lend their devices to their children: not only do they worry that children might misuse or break the device, but also that allowing children access to their devices would limit parents' own device usage. They also noted that some devices may not have the storage capacity required to access the content created by their organisation (eLimu).

While technology facilitates content creation in many languages, the Curious Learning and African Storybook representatives also reported encountering problems associated with working across different writing systems. For example, one of the programming languages used by Curious Learning, Unity, as well as some app carriers (Play Store), do not support the scripts used by languages such as Hindi, forcing the organisation to seek alternative options to develop their Feed The Monster app. Similarly, African Storybook has worked with some content creators who struggled to download the keyboards needed to write in certain languages, especially when using older devices.

Other tech-related limitations included a lack of minoritised language data leading to limited effectiveness of online translation tools (CLEAR Global), incompatibility between apps and devices (eLimu), and the resource-intensiveness for organisations on maintaining apps on the Play Store (Curious Learning) and trouble-shooting user issues (CLEAR Global). As an example, the eLimu representative explained how their organisation had developed an app for the Android operating system, only to discover that the Kenyan government had decided to buy students Windows devices, meaning they were unable to access the eLimu app due to software incompatibility at the time (eLimu).

Policy

Despite the potential and importance of government policy to facilitate access to EdTech

mother tongue initiatives (Evoh, 2007), governments were also identified as key gatekeepers, whose support is essential for making meaningful progress. The lack of relevant policies regarding the use of ICT in education in Africa has been noted by Kaliisa and Picard (2019) in their review of policies and practices related to mobile learning in 10 African countries.

Both Curious Learning and eLimu mentioned the need to align resources to national curricula as a potential barrier, since the governments were unlikely to approve new content otherwise. The participant from Curious Learning, who does not explicitly align content to national curricula, noted that alignment might compromise the effectiveness of the initiative if the curriculum design itself is not effective. Even for those who align content to national curricula, subsequent curricula reforms could lead to significant increase in costs for developers to re-align materials to repeatedly shifting criteria. Indeed, this was precisely the experience of eLimu in the Kenyan context.

Government bureaucracy emerged as another major policy-associated limitation. Both the eLimu and African Storybook representatives reported prolonged governmental quality assurance processes led to extensive delays in receiving approval for their content; these delays create further issues when considering currency and relevance of content. According to eLimu, this was also the case at the school level, where bureaucratic processes also slowed down schools' adoption of resources.

Other policy-related limitations included a lack of political prioritisation of teacher professional development which would enable trained teachers to use digital resources in their classes (eLimu), and language policies that impose unsuitable LOIs, which negatively affect the adoption of mother tongue materials (Curious Learning). Finally, the eLimu representative reported that governments were known to censor story content prior to

approval, and in cases where content might be in competition with upcoming resources developed by the government, delaying such approvals.

Community attitudes and perceptions

All participants agreed that the impact of their initiatives was sometimes limited by the views held by some parents and teachers regarding MTE. The Curious Learning, Elimu and African Storybook representatives pointed out that not all parents and teachers see any value of learning to read in the mother tongue, regarding colonial languages as more important for their children. The eLimu and African Storybook representatives added that many parents and teachers did not realise or understand that mother tongue literacy could act as a bridge for literacy in other languages where children could learn to read in unfamiliar languages with the help of a language they are already familiar with. This is often noted in research where community language attitudes, influenced by the elite, often educated in colonial languages rather than local minoritised languages, strongly prefer the former and discourage the use of the latter (Bamgbose, 2011).

Teachers' and parents' attitudes towards technology may sometimes constitute a barrier to effective technology usage. The African Storybook representative noted that during the pilot phase, it was evident that many teachers felt uncomfortable using technology in their classes due to a lack of confidence and sense of embarrassment. This follows the literature where teachers' existing digital literacy skills and broader attitudes towards technology are found to be strong predictors of technology use for teaching and learning (Hennessy et al., 2022). The eLimu representative also identified a persistent fear that technology would threaten teachers' jobs.

In addition, the eLimu representative explained that parents with more traditional views of teaching and learning would associate using devices such as phones with fun rather than serious study, leading them to disapprove of, or even forbid, their children to learn in this way. Conversely, the Curious Learning representative also highlighted the potential of having content readily available in an app that could be accessed at home to encourage parents' engagement with and participation in their children's learning.

Language

As previously noted, the possible existence of multiple mother tongues in the same classroom is a challenge. Though it may be possible for the use of multilingual resources and parallel texts to mitigate this to some extent, participants acknowledged that not only is it unrealistic to expect teachers to have working knowledge of multiple languages, but that the use of several languages at once may cause confusion for the students.

The issue of linguistic consensus was also a prominent one. Taking the Somali context as an example, the eLimu representative highlighted that communities using diverse varieties of the language often contested spelling and word choices. An editor was therefore needed to make final decisions on language choices. This gives rise to the difficult issue of prioritisation and linguistic hierarchies; choosing one version of a word runs the risk of increasing the perceived importance of one variety while decreasing the status of others (African Storybook). This issue is also present when working with entirely different languages; the eLimu representative reported ongoing confusion around which mother tongue schools should use for stories, as several might be spoken in any given location.

Impacts

Participants provided information and evidence on the positive impact of their initiatives; these are organised into different topics and presented here.

Learning outcomes

Both Curious Learning and eLimu representatives were able to provide reports of marked basic literacy gains for students using their apps, which echoes those benefits reported in Section 2.1 (Laitin et al., 2019; Seid, 2016; Taylor & von Fintel, 2016). In the case of eLimu, this success was especially pronounced when the programme was trialled with refugees in the Dadaab refugee camp in Kenya. Somali-speaking refugee students in accelerated and youth education treatment groups received tablets with the Elimu app and made greater learning gains than the control group (Kipruto & Denny, 2019). Meanwhile, Curious Learning reported that Syrian students using their app made the same amount of literacy progress in 22 hours that they would have made in 2.5 months of ‘high-quality schooling’. Furthermore, in a small-scale pilot in Ethiopia led by Curious Learning, they found that children’s literacy improved in both English and Oromo over a four year period based on follow-ups with a subset of the sample (Curious Learning, 2017).

Students’ confidence and self-expression

The African Storybook representative noted the positive impact that mother tongue resources could have on students’ freedom and confidence of expression. Being able to access content in their mother tongues has enabled students to ‘feel free to use whatever language they need to express themselves’. Furthermore in Kenya, this also had a knock-on effect on their use of

other languages: ‘Once they felt free to speak in Ng’aturkana, then they were confident to go ahead in the other languages’.

Teachers

Participants also reported a marked impact on teachers. The African Storybook representative noted that teachers who engaged with their stories were increasingly willing to use students’ mother tongues in class, and also to allow students themselves to use their mother tongues, thereby creating better in-class communication overall. The eLimu representative also commented that using mother tongue resources had served to motivate teachers, as they were often involved in designing and writing the stories. These findings align well with those presented in Stone (2012), which indicates that the use of mother tongue made teachers more comfortable and confident to read and write, teach literacy content and manage the classroom. It also encouraged the teachers to prepare their own mother tongue materials.

Minoritised language representation

All participants agreed that EdTech-based mother tongue initiatives have the capacity to increase the profile and perceived importance of minoritised languages. They felt that these initiatives had led to increased visibility of languages that have been minoritised and pushed to the fringes (Curious Learning). Indeed, the initiatives have enabled some minoritised language users to access an app in their mother tongue for the first time. This increased representation also reportedly helped to counteract the homogeneous attitudes that ‘English is what you need to do anything’ (African Storybook). Relatedly, the eLimu representative noted that exposure to mother tongue resources helped students, teachers and parents to discover enjoyment through their mother tongues, creating pleasure and pride when using

them.

Scoping the future

This paper intends to both synthesise the existing evidence in the field of EdTech and minoritised languages, and chart the future of this relatively nascent topic. The evidence we have discussed is drawn from academic literature (Section 2) and good practice initiatives (Section 3) in order to offer an applied and evidence-based view on future pathways. This section details selected practical, policy and research priorities unearthed from this research synthesis, which we believe will lead to improved discourse and practice on MTE moving forward.

Practical priorities

Funding

Funding was an area repeatedly identified by all representatives as necessary for improved practice. There is limited investment in the minoritised language space and this limits the impact and sustainability of initiatives. Elimu's representative wished for a greater commitment from government and multilateral donors to support localised initiatives. The Curious Learning representative noted that widening the discourse to issues related to foundational literacy is an opportunity; however, they also noted that focusing on foundational literacy must start at pre-primary levels, as learners of this age group are often neglected.

Recommendation: The broader focus on foundational literacy — and the associated funding pots available in this area — should be leveraged in the first instance. Prioritisation should

then take place of what areas of the education system this funding should target.

Content

Sustained publishing of books and other educational content was noted by all participants as a need. Notably, non-fiction storybooks about local contexts focusing on current issues such as climate change were identified as a current gap. Collaborating with established institutions and systems, such as national libraries, was seen by the African Storybooks representative as an opportunity to sustainably produce content in minoritised languages. It was also noted that printed materials are essential to widen the reach of the minoritised language content, reducing the infrastructural constraints related to access. Thus, approaching minoritised language content delivery through multiple modalities, including print, is an important method of reaching a greater and more diverse range of learners.

Recommendation: Work with established content and publishing institutions — including libraries — to widen access to minoritised language content in multiple modalities, and reduce issues of inequitable access.

Policy priorities

Government and donor coordination

Greater coordination between government and donors was noted by all participants in order to create a space conducive to effective implementation of programmes related to EdTech and minoritised languages. Active, long-term support was emphasised as critical to allowing initiatives the space to iterate and adapt. The freedom to experiment was noted by the Curious Learning representative as a crucial element of fostering long-term success. It was also noted

that initiatives with existing working relationships with education departments should facilitate smaller initiatives' access to the policy dialogue. It was also suggested that government gatekeepers (e.g. curriculum authorities) should use their positions of power to facilitate EdTech initiatives' growth. This role in providing ease of access and accelerating bureaucratic processes can be the difference between an organisation's success or failure.

At the school and community level, the Elimu representative stated governments should provide promising EdTech initiatives with access to schools where they could run pilot projects, creating the freedom to experiment.

Recommendation: Longer-term programmes should be commissioned, which enable smaller-scale initiatives to test and iterate effective approaches that could then be scaled over time.

Teacher and parental engagement

A systematic approach to support teachers working with students who speak minoritised languages is necessary. This must be coherently established in pre-service education, and then flow into in-service professional development provision. What's more, supporting teachers who primarily speak minoritised languages is essential.

While supporting teachers is a priority area to target attitudinal shifts at the school level, similar work must be done to support parents and/or caregivers. Parents and caregivers have a significant role in illustrating the importance of literacy and the role in which the language spoken at home could support literacy skill development. However, first, parents and/or caregivers must also understand this significance.

Recommendation: Teacher professional development programmes should comprise modules

related to working with learners of minoritised languages, particularly in multilingual settings. These programmes must be supplemented with broader community engagement and support for parents and/or caregivers to supplement this work outside of school.

Research priorities

Methods

Related to the points made above regarding the freedom to experiment, adaptive research projects which support learning and iteration of EdTech initiatives should be promoted. The Elimu representative asserted that though the gold standard for education research is the randomised control trial, the costs associated with such trials are prohibitive, particularly in an already underfunded area. Support for local universities to deliver contextualised research is also needed.

Centralised databases are also critical to providing initiatives with the information they require to ensure their work is in line with the latest thinking in the sector. CLEAR Global promoted the use of their language mapping data¹⁵ as one such portal. Data-wise, programmes must systematically collect data from project participants regarding language preferences (both written and oral) to support the language mapping data work organisations such as CLEAR Global are leading (EdTech Hub, 2021).

Recommendation: Smaller-scale evaluative approaches which are independently commissioned — and locally-sourced — should be promoted, in line with available funding across the sector. When funding for larger-scale trials is available, these approaches can be scaled.

¹⁵ <https://translatorswithoutborders.org/language-data-by-country/> Retrieved 3 November 2022

Further research was identified in order to elevate and develop the discourse on using EdTech for minoritised languages. These focus areas are framed as possible research questions that could be explored in future.

- (1) How do children learn to read in minoritised languages?
- (2) What is the impact of multilingual storybooks on literacy acquisition?
- (3) How does the freedom to choose a language to learn in influence literacy outcomes?
- (4) What does a reading disability look like in a minoritised languages? And how can minoritised language students with specific reading disabilities be identified?

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Appendix 1: Search terms

English:

"edtech" OR "technology" education language "first language" OR "mother tongue" OR "mother language" OR vernacular OR "home language" -"language learning"

Arabic:

التعليم "التكنولوجيا" اللغة "اللغة الأولى" أو "لغة الأم" أو "اللغة الأم" أو "اللغة العامية" أو "اللغة الأم" و "اللغة الأقلية" أو "اللغة الأصلية" - "تعلم اللغة" - "تعلم اللغة"

Chinese:

Main string - “教育” “科技” OR "教育信息化" 语言 “第一语言” OR “母语” OR “家庭语言” - ”语言学习” -“语言习得”

Additional keywords - 少数民族 (‘ethnic minorities’) 电教 (‘e-teaching’)

French:

"edtech" OR "technologie" langue d'éducation "première langue" OR "langue maternelle" OR "langue maternelle" OR vernaculaire OR "langue parlée à la maison" -"apprentissage d'une langue"

Spanish:

educación "tecnología" lengua "primera lengua" OR "lengua madre" OR "lengua materna" OR "lengua vernácula" OR "lengua autóctona" AND "lengua minoritaria" OR "lengua indígena" -"aprendizaje de idiomas" -"aprendizaje de lenguas"

Portuguese:

educação "tecnologia" língua "primeira língua" OR "língua materna" OR "língua vernácula" OR "língua autóctone" AND "língua minoritaria" OR "língua indígena" -"aprendizado de línguas"

Pashto:

زده كړې په مورنۍ ژبه كې "يا "زده كړې په لومړنۍ ژبه" يا "زده كړې په كورنۍ ژبه" يا "علمي ټيكنالوژي په"
"مورنۍ ژبه كې"

Kinyarwanda:

"edtech" CYANGWA "ikoranabuhanga" ururimi rwuburezi "ururimi rwambere" CYANGWA
"ururimi kavukire" CYANGWA "ururimi kavukire" CYANGWA "ururimi kavukire" - "kwiga
ururimi"

Appendix 2: Workshop consent script

Please review the below informed consent information ahead of the workshop. At the beginning of the workshop itself, we will check that everyone is happy with the way in which the workshop and all resulting data will be handled by the EdTech Hub team and obtain verbal consent from everyone.

The workshop will last for approximately 2 hours, including a 10-minute break. The language used for this workshop will be English.

The workshop will be recorded and detailed notes will be taken throughout. These will be securely stored in our internal document storage system and will not be accessible beyond the EdTech Hub team.

The names of your organisation and specific mother tongue initiative will be used in the journal article resulting from this workshop unless you specifically state that you wish to remain anonymous (we will give you the opportunity to state any wish for complete anonymity before we begin). Prior to the journal article being submitted for publication, you will have the opportunity to review the article to check that you are satisfied with the way that your organisation has been represented, and the EdTech Hub team will address any concerns raised. You yourselves will not be mentioned by name, though if you would like to be named within the acknowledgements then please let us know.

You can choose not to participate in any individual activity during the course of the workshop, and you can also decide to cease participation in the workshop and withdraw your consent at any time.