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WORKING PAPER

Minoritised Languages, Education, and Technology

Current practices and future directions in low- and middle-income countries

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Abbreviations and acronyms

ICT	Information and communication technology
L1	First language
L2	Second language
LMICs	Low- and middle-income countries
LOI	Language of instruction
MTB MLE	Mother-tongue-based multilingual education
PRIMR	Primary Math and Reading Initiative (USAID and Kenya)

Abstract

This article explores the current status and future directions of mother-tongue-based multilingual education (MTB MLE) and the use of technology in low- and middle-income countries (LMICs), focusing on the use of minoritised mother tongues. An initial literature review of available academic sources in multiple languages reveals a lack of evidence on the use of technology in MTB MLE 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, interviews and a collaborative workshop with four organisations with relevant educational technology (EdTech) initiatives were conducted. The analysis covers facilitating and limiting factors these organisations have encountered, and the potential positive impact on learners and society generally. We conclude by identifying practical, policy, and research priorities for multilingual education and educational technology in general.

1. Introduction

This article explores the current status and future directions of mother tongue-based multilingual education (MTB MLE) and the use of technology in low- and middle-income countries (LMICs), focusing on the use of minoritised mother tongues. (↑UNESCO, 2018) defines multilingual education as "The use of two or more languages in the educational system". MTB MLE is therefore used when one of these languages is a student's first language (L1). MTB MLE is recognised specifically as a remedial strategy to tackle the foundational literacy of children who do not understand or speak the official language of instruction (LOI) when they begin school. In MTB MLE, students therefore learn to read and write in their mother tongue before progressing to learning in the LOI. For the purposes of this paper, the term MTB MLE will be used throughout, although the authors acknowledge that various similar terms are common in the field (see Section 2.2 below).

While there is increasing evidence for the positive effects of MTB MLE on learning access, equity, and quality (↑Ball, 2010; ↑Ouane & Glanz, 2011; ↑Seid, 2019), little is known about the potential of educational technology (EdTech) to facilitate and enhance its application. For the purposes of this paper, we use ↑Hennessy et al.'s (2020) broad definition of EdTech: "[T]echnologies — including hardware, software, and digital content — that are either designed or appropriated for educational purposes."

Given this gap in the literature, this paper seeks to explore how EdTech can best be used to facilitate the increased use of minoritised mother tongues in the classroom. Although MTB MLE may be applied at all educational levels to some extent, this paper will focus on the development of foundational literacy outcomes at the primary level.

This paper is organised into five sections. Section 2 sets out our methodology. Section 3 provides a literature review on the background of MTB MLE followed by a deeper exploration of some examples of EdTech within MTB MLE. Section 4 gives a thematic presentation of the experiences of four initiatives that utilise technology to aid MTB MLE and learning. Section 5 is a summary of the lessons learnt and future directions identified from both the literature review and discussions with the four initiatives.

2. 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 Spanish. Searches were conducted in Google Scholar, and where little existing literature was available, Google searches (Baidu and Baidu Xueshu were also used for Chinese literature).[1] A list of search terms can be found in the Appendix. Results from the multilingual searches fed into the country case studies are presented in Section 3.2.

Relevant initiatives on EdTech and MTB MLE were then identified through snowball sampling. The authors contacted their networks and developed a list of relevant initiatives that work in the field of EdTech and minoritised languages in LMICs. Initiatives were shortlisted and selected based on:

- 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.

Of the initiatives identified, four strongly aligned with the above criteria and were available to participate in data collection within the study timeframe. Following an initial conversation with each about the nature of their current work and availability, an online collaborative workshop was organised. The workshop was remote as the research team and participants were spread across geographies (Kenya, Pakistan, Rwanda, UK, USA). The intention of the workshop was to bring together the voices of each initiative to:

1. identify recurrent themes related to implementation of work in the minoritised languages and EdTech space;
2. collectively problem-solve some of the issues raised during the session;

[1] 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.

3. chart some priorities related to research, policy, and practice on the topic, based on the workshop discussions.

Informed consent was obtained from all participants of the workshop.

2.1. Limitations

The study has two key limitations. Firstly, the literature search included academic publications only. Although this decision was made to ensure that the review was based on rigorous research, the exclusion of grey literature may have resulted in valuable sources being missed, especially those from contexts with more limited access to academic publications for socio-economic or linguistic reasons. It may have been especially helpful to include grey literature, given the limited number of published papers on EdTech and MTB MLE.

Secondly, while the authors view the multilingual search strategy as a strength of the study, it must also be emphasised that the search languages were chosen for practical reasons. These are all languages the authors are fluent in to ensure that thorough searches and reviews could be conducted. We acknowledge the limitations of using this small pool of languages.

2.2. Terminology

A wide range of terms are used for languages in education within LMICs, some of which are 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 'lengua materna' in Spanish, 'لغة الأم' in Arabic, or 'ururimi kavukire' in Kinyarwanda. Thus, the term embraces an English usage which has global currency. Table 1 below 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 language proficiency of a particular person.	▪ The level of individualisation can become a hindrance at the macro policy level when what is needed are 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, a person 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 a person has a higher proficiency in their L1 than their L2 (second language), which is not always correct.
Minoritised language	Yes — it reflects the active effect of a language being minoritised by another language.	▪ 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. ▪ 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 (age 10) onwards (↑USAID, 2021).

Terms	Do we find it helpful?	Potential issues
Home / indigenous language	Somewhat — it's a useful term for non-transitory populations, which reflects the history and embeddedness of the particular language.	▪ 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. ▪ Who is the language 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 (ages 6–8) (↑Mahadeo, 2006).
Native language / tongue / speaker	No	▪ 'Native', and 'nativeness' in general, is a vague, binary, and racialised term which carries significant colonial baggage. This is particularly problematic 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.	▪ The language(s) that a person speaks from birth, often learnt 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).

3. Literature review

This section begins with a general review of the literature on MTB MLE. We then focus on a set of examples from different linguistic contexts, demonstrating the ways in which EdTech has been effectively implemented to facilitate or enhance MTB MLE involving minoritised languages. While the majority of examples are from LMICs, we have also included two upper-middle-income countries (China and South Africa), given the vast economic and educational inequalities within these countries.

3.1. Background on MTB MLE

Historically, research on MTB MLE has been limited, particularly regarding education in LMICs, as noted by ↑Evans & Mendez Acosta (2021). However, since 2016, studies have increasingly investigated this topic and demonstrated its positive impact (↑Benson et al., 2016). In LMICs, the use of L1 in education is strongly associated with improved access, quality, and equity for marginalised groups (↑Ball, 2010; ↑Ouane & Glanz, 2011; ↑Seid, 2019), as well as foundational literacy gains (↑Bühmann & Trudell, 2008; ↑Daly et al., 2021; ↑Smits et al., 2008). This is significant, as 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). Meanwhile, mismatches between L1 and LOI have been identified as a key root cause of school wastage (repetition, failure, drop-out) (↑Benson et al., 2019).

For example, a study on primary school children in Ethiopia linked MTB MLE to increased 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 MTB MLE increased the possibility of enrolment for students from minority backgrounds (↑Seid, 2016), resulting in higher employment rates, quality of employment, and job satisfaction from students who had MTB MLE since 1994 (↑Seid, 2022).

Existing research on several different languages shows similar benefits of MTB MLE: using indigenous African languages for instruction was found to improve students' performance in end-of-primary school exams in Burkina Faso (↑Bamgbose, 2011). In a study conducted with 1,500 students in Ghana,

the use of Asante Twi and Akan as the LOI has also been proven to be beneficial, enabling students to catch up in foundational literacy after transitioning from complementary education to government schools (↑Carter et al., 2020). Similarly, in Kenya, ↑Piper et al. (2016) 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 the LOI instead of English (↑Laitin et al., 2019).

The use of multiple L1s in the same classroom is also supported by a robust body of literature, although this remains largely based on high-income contexts. A notable movement in favour of plurilingualism in education has been witnessed in Europe in recent years (↑Daryai-Hansen et al., 2015; ↑Le Pichon-Vorstman et al., 2021), arguably facilitated by the European Union's recognition of multilingualism as a core principle (↑European Parliament, no date). Plurilingual approaches, which embrace translanguaging in the classroom, not only support the linguistic development of multilingual learners, but also normalise multilingual communication as practised outside school (↑Benson et al., 2016; ↑García, 2011). In the urban Canadian context, ↑Ntelioglou et al. (2014) found that multilingual classroom practice changed the classroom dynamics and allowed students to identify positions of expertise, increasing their literacy investment and engagement, and learning.

Despite these benefits, some studies highlight a more complex picture of the effects of MTB MLE. In Uganda, ↑Brunette et al. (2019) found that not all languages used for MTB MLE had a positive impact, and the effects depended on language characteristics and socio-economic 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.

In addition, there have been multiple barriers to operationalising MTB MLE at scale. These include rigid policy frameworks regarding LOIs and the lack of availability of teaching and learning materials in minoritised languages (↑Bühmann & Trudell, 2008; ↑Mackenzie & Walker, 2013). Indeed, around 2.3 billion people lack access to education in a language they speak (↑Thaung & Gracie, 2021). This is well illustrated by CLEAR Global's[2] language analysis of North-East Nigeria ↑(2019), where English is spoken by just 1% of households, despite it being the LOI. Concerns have also been raised that

[2] CLEAR Global has been known until recently as Translators Without Borders.

the use of multiple L1s in the classroom may place increased stress on teachers, who may not have knowledge of all students' mother tongues (↑Daly et al., 2021; ↑Macaulay, 2023).

3.2. Contextualised evidence on MTB MLE and EdTech

In this section, results from the literature search on MTB MLE and EdTech are presented. The section is organised by location / country covering South Africa, Haiti, Kenya, Hispanophone countries and all other contexts investigated during the searches.

3.2.1. South Africa

The English-language literature search yielded two relevant studies on the use of EdTech within MTB MLE in South Africa. Firstly, 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 1–4, 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 information and communication technology (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 school. 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).

3.2.2. Haiti

In the Haitian context, the Mother Tongue Book project, started in 2010, 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. ↑DeGraff & Stump (2018) noted that around 270 students in Grades 1–3 showed an improvement in reading and maths after being exposed to books in Kreyòl for a year. Building on this, the MIT-Haiti Initiative was established in 2012 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.

A second paper by ↑DeGraff (2020) presented subsequent findings from the MIT-Haiti initiative and advocated for 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[3] enabled the sharing of all resources. The author also noted that the project would benefit the general public, as the majority of the population already speaks Kreyòl ↑DeGraff (2020).

3.2.3. Kenya

Applications and EdTech initiatives serving minoritised language communities are prevalent in Kenya's vibrant technology ecosystem, including notably M-Lugha,[4] which has been recognised as one of Africa's "Ten most outstanding education innovations" by the African Union (↑Cordeiro, 2021), although these have only been covered by the media and not reviewed in academic journals thus far. In addition, ↑Piper et al.'s (2016) research on MTB MLE in Kenya focuses on the implementation of PRIMR, the delivery of which is technology-enabled. The research does not, however, compare technology-based implementation 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 MTB MLE and technology rather than solely on language use.

3.2.4 Hispanophone countries

Outside English language literature, there are a small number of studies

[3] See https://mit-ayiti.net Retrieved 29 January 2024
[4] See https://m-lugha.com/ Retrieved 29 January 2024

into MTB MLE and EdTech published in Spanish. In a study conducted in Ucayali in the Peruvian Amazon, ↑Flores Fasanando (2021) noted the positive effect of using Zoom in secondary education for first-language oral communication. Also in Peru, ↑Hynsjö and Damon (2015) linked the use of children's mother tongue (Quechua) to an improvement in their maths scores, but not in their language scores.

Conversely, in Mexico, ↑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 the Covid-19 pandemic risked further marginalising speakers of minoritised languages, including Mexican sign language users.

3.2.5 Other contexts

Literature searches carried out in Arabic, Mandarin Chinese, French, Kinyarwanda, Pashto, and Portuguese yielded few relevant results, highlighting a pronounced need for further research on MTB MLE and EdTech in a wider variety of languages and contexts. Two French language articles highlighted pedagogical challenges for the incorporation of ICT in MTB MLE in Cameroon and Ivory Coast (↑Koffi, 2016; ↑Nkenlifack et al., 2011), but without any empirical evidence. One relevant study emerged in Chinese: a feasibility study into the development of bilingual electronic textbooks for secondary students in Xinjiang Uygur Autonomous Region showed that the Apple iPad is an ideal platform due to its wide user base and simple process when designing resources, although the study does not tie the development to actual learning outcomes (↑Liu & Zhang, 2015).

4. EdTech and minoritised language initiatives

Built on the existing evidence detailed in the literature review, this section is structured around four recurrent themes emerging from individual interviews and a collaborative workshop with representatives from four initiatives working with MTB MLE and EdTech:

1. Pedagogical approaches
2. Facilitating factors
3. Limitations
4. Impact.

An overview of each of the four participating initiatives is presented in Table 2 below.

Table 2. *Workshop and interviews: participating initiatives*

Name	Geography	Languages	Summary of activities
African Storybook[5]	Africa	227 African languages	Provides open-access, downloadable, illustrated storybooks as well as the Reader and Maker Apps for offline use
CLEAR Global[6]	148 countries	220+ languages across contexts	Offers language services to humanitarian and development organisations
Curious Learning[7]	Africa	50+ languages across contexts	Offers curation, localisation, distribution, and measurement of free open-source apps to help children learn to read
eLimu[8]	East Africa	Alur, Kiswahili, Lugbarati, Somali	Offers a repository of interactive digital learning resources and apps

[5] See https://www.africanstorybook.org/ Retrieved 29 January 2024
[6] See https://clearglobal.org/ Retrieved 29 January 2024
[7] See https://www.curiouslearning.org/ Retrieved 29 January 2024
[8] See https://e-limu.org/ Retrieved 29 January 2024

4.1. Pedagogical approaches

Apart from CLEAR Global, who provide language and technological support in a wide range of areas, including education, the other three initiatives articulated clear pedagogical principles underpinning their work (through interviews and at the workshop). For Curious Learning and eLimu, a focus on L1 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, although they also highlighted that the content was sometimes less engaging as a result. Similarly, the Curious Learning representative 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.

Visuals are also an important feature of all 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 supports 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.

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.

4.2. Facilitating factors

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

4.2.1. Technology

Representatives from all the 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 Maker 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.

Furthermore, both the African Storybook and Curious Learning representatives highlighted that technology had enabled them to source the linguists needed to translate and quality control their products in the languages required. Indeed, Curious Learning noted that their success could not have been achieved without access to linguists through platforms such as Upwork[9] and Fiverr,[10] which help organisations to

[9] See https://www.upwork.com/ Retrieved 29 January 2024
[10] See https://www.fiverr.com/ Retrieved 29 January 2024

connect with freelancers. However, they also acknowledged that finding enough linguists to produce content in all of their target languages remained a challenge.

The African Storybook representative also noted the democratising power of technology for 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 such as local authors and teachers, who might otherwise struggle to find audiences, to make their work available online and publicly accessible via the African Storybook archive. Content is 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. The eLimu representative also noted the importance of quality assurance, noting that sometimes teacher-authored content was inappropriate for the age of learners (for example, the content may include references to violence or 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 WorldReader,[11] Learning Equality,[12] SquidReader[13] and community libraries such as the Kibera library,[14] while Curious Learning and eLimu representatives noted that their app-based offerings were available through Google Play.

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 organisation's databases in one language, and students can simultaneously follow the story in another language within the database,

[11] See https://www.worldreader.org/ Retrieved 29 January 2024
[12] See https://learningequality.org/ Retrieved 29 January 2024
[13] See https://www.imlango.com/our-literacy-strategy Retrieved 29 January 2024
[14] See https://eifl.net/resources/kenya-national-library-service-kibera-public-library-tablet-computers-support-childrens Retrieved 29 January 2024

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 Google Play Store (Curious Learning);
- increased ability to monitor and measure impact (eLimu);
- ability to store large amounts of multilingual resources in one place (African Storybook).

4.2.2. Policy

All participants acknowledged the significant power wielded by policymakers in the success of their initiatives, noting that this could 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. A study conducted in Nigeria found that providing students with devices preloaded 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. Curious Learning cited examples of ministries who had purchased devices without considering issues related to 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). Subsequent research examining the impact of device distribution on female learners, in particular (↑Jordan & Myers, 2022), found hardware-only interventions were 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 policies included the ones favouring the use of technology to sustain learning during the Covid-19 pandemic (Curious Learning). Many African countries, including Malawi and Mauritius (African Storybook), have 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. However, 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).

4.2.3. 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.

4.3. Limiting factors

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

4.3.1. 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 supply and internet connectivity limits the ability of many students 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, such as Rising on Air[15] do attempt to work across languages; 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 eLimu representative elaborated that, in their experience, parents were often reluctant to lend their devices to their children. Parents worry that children might misuse or break a device, and also that allowing children access to their devices would limit the parents' own device usage. Furthermore, some devices may not have the storage capacity required to access the content created by some learning platforms (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,[16] as well as some app carriers (Google Play Store), do not support the scripts used by some minoritised languages, forcing the

[15] See https://www.risingacademies.com/onair-old Retrieved 30 January 2024
[16] See https://unity.com/ Retrieved 30 January 2024

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);
- resource-intensity for organisations maintaining apps on the Play Store (Curious Learning) and troubleshooting user issues (CLEAR Global).

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, rendering their app incompatible with the devices that children were using.

4.3.2. 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 & 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 governments were unlikely to approve new content otherwise. The representative from Curious Learning, which 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 do 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 that led to extensive

delays in receiving approval for their 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). Furthermore, language policies that impose unsuitable LOIs can 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 government resources, delay such approvals.

4.3.3. 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 MTB MLE. The Curious Learning, Elimu, and African Storybook representatives noted that not all parents and teachers see the 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 do not realise or understand that mother tongue literacy can act as a bridge for literacy in other languages. 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, many teachers felt uncomfortable using technology in their classes due to a lack of confidence and sense of embarrassment. Other literature shows that 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.

4.3.4. Language

As previously noted, the possible existence of multiple mother tongues in the same classroom is a challenge., although, it may be possible for the use of multilingual resources and parallel texts to mitigate this to some extent. Participants acknowledged, however, that not only is it unrealistic to expect teachers to have working knowledge of multiple languages, but also 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. 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.

4.4. Impacts

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

4.4.1. 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, in a small-scale pilot in Ethiopia led by Curious Learning, Curious Learning 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).

4.4.2. 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."

4.4.3. 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 indicate that mother-tongue usage 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.

4.4.4. 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 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 attitude 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.

5. 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 and good practice initiatives in order to offer an applied and evidence-based view on future pathways. This section details selected practical, policy, and research priorities emerging from this research synthesis, which the evidence suggests will lead to improved discourse and practice on MTB MLE moving forward.

5.1. Practical priorities

5.1.1. Funding

Funding was an area repeatedly identified by all representatives as necessary for improved practice. There is limited investment in minoritised languages, 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 funding for 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 which areas of the education system this funding should target.

5.1.2. Content

A need for sustained publishing of books and other educational content was noted by all participants. 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 Storybook 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.

5.2. Policy priorities

5.2.1. Government and donor coordination

All participants identified a need for greater coordination between government and donors to create a conducive space for the 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 the growth of EdTech initiatives. 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 that 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.

5.2.2. Teacher and parental engagement

A systematic approach to supporting teachers of 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. Moreover, 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 undertaken 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 skills 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.

5.3. Research priorities

5.3.1. 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, although 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 data[17] as one such portal. Programmes must also systematically collect data from project participants regarding language preferences (both written and oral) to support the language mapping data work led by organisations such as CLEAR Global (↑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.

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.

[17] See https://translatorswithoutborders.org/language-data-by-country/ Retrieved 30 January 2024

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

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Appendix: Search terms

English

(edtech OR technology) AND education AND language AND ("first language" OR "mother tongue" OR "mother language" OR vernacular OR "home language") OR "multilingual education" NOT "language learning"

Arabic

التعليم "التكنولوجيا" اللغة "اللغة الأولى" أو "لغة الأم" أو "اللغة الأم" أو "اللغة العامية" أو "اللغة الأم" و "لغة 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 OR 多语教育 OR 双语教育 NOT 语言学习 NOT 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" OR “éducation multilingue” -"apprentissage d'une langue"

Kinyarwanda

"edtech" CYANGWA "ikoranabuhanga" ururimi rwuburezi "ururimi rwambere" CYANGWA "ururimi kavukire" CYANGWA "ururimi kavukire" CYANGWA "ururimi kavukire" CYANGWA“uburezi mu indimi nyinshi“- "kwiga ururimi"

Pashto

زده کړي په مورنی ژبه کی" یا "زده کړي په لومړنی ژبه" یا "زده کړي په کورنی ژبه" یا "علمی تیکنالوژي په مورنی ژبه کی"یا"څو ژبی زده کړه

Spanish

educación tecnología lengua "primera lengua" OR "lengua madre" OR "lengua materna" OR "lengua vernácula" OR "lengua autóctona" AND "lengua minoritaria" OR "lengua indígena" OR "educación multilingüe" -"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" OR "educação multilingue" -"aprendizado de línguas"

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