Reflections on technology, teaching, learning, and professional development: Findings from a teacher survey in Tanzania

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ABSTRACT

This paper presents findings from a survey of 774 government school teachers across Tanzania over the period 2020–2021. The aims were to capture teachers' recent experiences concerning (1) access and use of technology; (2) any student learning losses observed, and teachers' recommendations to address lost learning; and (3) experiences and needs concerning teacher professional development (TPD). Key findings were (1) forty percent of teachers reported that their school lacked access to any form of technological device, with almost half stating they never used digital technologies for teaching and learning purposes. (2) Almost half of the teachers perceived that girls' learning suffered more than boys, and more than 60% of teachers believed learners from the financially poorest households suffered the greatest learning losses. (3) Teachers in Tanzania engaged in very little TPD and wanted increased support. The key differences across teacher groups were further examined by demographic factors, with notable differences apparent between urban and rural teachers, teachers with different levels of experience and different qualification levels. Recommendations are presented to stakeholders across the education ecosystem, including policymakers, school leaders, TPD designers, teachers, and researchers. The findings inform a national technology-mediated TPD programme in Tanzania.

Keywords: Educational technology, learning outcomes, teacher needs, teacher professional development, teacher voice, technology access.

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INTRODUCTION

Teachers are considered the most important determinant of learning outcomes at the school level (Education Commission, 2019). However, student attainment in low- and middle-income countries (LMICs) remains persistently low, with the inconsistent provision of competent, qualified and well-supported teachers contributing to these poor outcomes. Teacher professional development (TPD) is viewed as a key driver in improving teaching quality consistently, and, when implemented effectively, leading to relatively positive outcomes for learners (Darling-Hammond et al., 2017). "TPD" is defined here as all forms of pre- and in-service teacher development that support teacher and student learning via on-/off-site provision, including formal programmes, mentoring and coaching, as well as informal teacher learning, for instance through teacher-led communities of practice (e.g., unstructured WhatsApp groups: Hennessy et al., 2022). When designed and implemented effectively, TPD interventions have shown promising results for both teachers and students (Angrist et al., 2020; Evans and Popova, 2015). However, all too often, the implementation and outcomes of TPD interventions have been mixed, particularly in LMICs (McAleavy et al., 2018; Sims and Fletcher-Wood, 2020).

Educational technology (EdTech) can offer ways to improve access to, quality of, and flexibility for teachers when engaging in TPD. For the purposes of this paper, "EdTech" is defined as digital technology — including hardware, software and digital content — that are either designed or appropriated for educational purposes. This is a broad, inclusive definition of EdTech, covering the use of information and communications technology (ICT) at any point within the education system. A blended, hybrid and asynchronous TPD programme can allow teachers to access TPD content at a location and time of their choosing, whether in person or remotely, online or offline (de Clercq and Shalem, 2014). Likewise, technology-supported TPD content can be channelled through multiple modalities, including video, audio, or printed materials. If teachers have the opportunity, with the appropriate infrastructure (access to devices, reliable power, and connectivity, etc), they can access more engaging, interactive content of their choosing. As such, tech-supported TPD has the potential to support improved delivery, quality, and application of TPD in the classroom.

However, constraints around the effectiveness of technology must be noted, as an investment in EdTech has often not produced the expected or assumed benefits (Cheney, 2021). In these instances, too much focus has frequently been placed on hardware (Hare, 2007), especially high-tech hardware, e.g., laptops. This high-tech focus creates significant problems due to the contextual circumstances prevalent in LMICs. For example, many countries have low digital literacy levels, insufficient and unreliable power and connectivity access, and issues around storage and maintenance of devices (Evans, 2017; Trucano, 2010). As such, continued research into the conditions that can create successful educational outcomes, within specific contexts, using EdTech, is needed. The tech-supported TPD space is no different.

Research on TPD must involve teachers. Too often, TPD research is done *to* teachers, not *with* them (Hennessy et al., 2022). Neglect of the teacher's voice can lead to TPD design and implementation that is irrelevant to teachers' everyday practices (Biesta et al., 2017). This paper (following a global survey: Pota et al., 2021) synthesises the messages emerging from an in-depth analysis of a large-scale teacher survey conducted in Tanzania. It aims to offer insights related to teachers' experiences and needs concerning teaching with technology, with findings organised by technology access and use, student learning, and TPD.

Global survey

A landmark global survey of teachers' views and needs concerning educational technology (EdTech) use in teaching was initiated and administered by T4 Education between April and May 2021. The survey was designed and analysed in collaboration with EdTech Hub.[1] It provided information about in-service teachers' recent experiences and the challenges they faced. Questions asked teachers about their own and their pupils' access to and use of technology and the levels of post-Covid-19 learning loss that teachers observed among their students. Three of these questions were, by request from OECD (Organisation for Economic Co-operation and Development), taken from their Programme for International Student Assessment (PISA). These additions have served as an additional benchmark for PISA's three-yearly sampling survey of 15-year-olds' ability to use reading, mathematics, and science knowledge and skills. The survey also asked teachers what training and professional development they were offered during the pandemic and what participants thought schools and governments should prioritise to address any perceived learning loss among children.

The focus on the Covid-19 pandemic period of the preceding year (April/May 2020 to April/May 2021) brought into sharp relief some of the issues that teachers were already facing when school closures forced them to adopt new tools and pedagogical approaches. The global survey yielded over 20,000 responses across 165 countries and findings are reported in a joint T4 Education and EdTech Hub publication: *Turning to technology: A global survey of teachers' responses to the Covid-19 pandemic* (Pota et al., 2021).

Survey in Tanzania

Initial responses to the global survey in Tanzania were sparse — just 16 respondents completed it. Thus, an additional round of data collection (between July and November 2021) was commissioned by EdTech Hub to shed more light on Tanzanian teachers' experiences of teaching with technology. This expanded data collection exercise used the same survey items as per the global survey, which was already translated into Kiswahili. The additional data collection was conducted to inform an ongoing initiative, as EdTech Hub is currently working with the Government of Tanzania (particularly the Tanzania Institute of Education (TIE)) to develop and test a national-scale TPD reform. The large-scale, 5-year reform includes using digital technology for blended TPD provision, including a learning management system

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[1] EdTech Hub is an 8-year programme funded by the UK government, Bill & Melinda Gates Foundation, World Bank, and UNICEF; that aims to provide evidence to policymakers, researchers, non-governmental organisations (NGOs), practitioners and other education stakeholders concerning how EdTech can be harnessed to improve learning outcomes in LMICs.

(LMS), mobile devices and access to video resources in school-based teacher communities of learning. As such, the survey in Tanzania offered a unique and timely opportunity to canvass the opinions of a wide range of teachers: there were 774 responses. The survey inquires about teachers' uses of, and views concerning, technology, the challenges they faced — including student learning losses and how to address them — and their subsequent professional needs looking ahead.

Though the global survey did focus on the Covid-19 pandemic, it must be noted, according to UNESCO Institute for Statistics (UIS) (2022), that schools were fully closed in Tanzania for just 11 weeks (from March 19, 2020, to May 30, 2020). They were then partially open for 4 weeks (from June 5, 2020, to June 24, 2020). From this point on, schools reopened, and the usual academic calendar was reinstated. Thus, experiences of the pandemic in schools in Tanzania are different from other country contexts where schools stayed closed for longer periods and remote teaching and learning became a more established delivery modality.

Teachers' voices from this survey will contribute to EdTech Hub research on TPD in Tanzania, in collaboration with TIE and Aga Khan University. The messages from teachers will directly inform policy, practice, further research, and above all, decisions related to professional development and EdTech provision going forward, in and beyond Tanzania.

LITERATURE REVIEW

EdTech in low- and middle-income countries

The use of technology in education in LMICs has become increasingly apparent in recent times. EdTech can take many forms and influence different parts of the education system. In one sense, EdTech can be used by policymakers, facilitating greater access to data. For example, in Sierra Leone, technology has been used to collect school-level data (e.g., teacher and student attendance), aiding the government in making informed decisions on service delivery based on the continuous and systematic data collected from schools (McBurnie et al., 2021). EdTech can also be used by teachers for various purposes, such as for their own professional development, for teaching in the classroom, or for other administrative matters. For example, in India, a multilingual Open Educational Resources (OER) teacher education toolkit has been developed to improve teaching practices and ultimately improve learning at primary and secondary levels (Wolfenden, 2015). In addition, EdTech can be used by students to support their own learning. Personalised adaptive technologies are increasingly pertinent means of improving learning with appropriate differentiation in place for students to navigate through learning content. For example, in Brazil, the use of the *onebillion* software by students, which adapts content to children's first language, resulted in significant learning gains in mathematics compared to standard practice (Outhwaite et al., 2020).

The ways that technology can be used within education are promising; it has the potential to improve processes and practices across education systems. However, historically, the investment in EdTech in LMICs, and the subsequent implementation of EdTech programmes, has sometimes been technology- rather than purpose-driven; this has led to mixed outcomes (Hennessy et al., 2021). This historical evidence speaks to the complexity inherent in using technology effectively across educational contexts, which has not often been recognised by investors, programme designers and implementers, and policymakers.

Teaching, learning, and teacher professional development in low- and middle-income contexts

TPD in LMICs is often too theoretical. It has been found to be at odds with teaching and learning in the classroom and the input is rarely sustained over time (Akyeampong et al., 2013). Pervasive issues with TPD design and implementation have significant consequences for teachers in LMICs, whose learning and growth within the profession are stunted. As a result, vast numbers of learners, especially those in marginalised population groups, endure a poor quality educational experience as they navigate a schooling system where low levels of teaching quality collide with other persistent problems (e.g., resource provision, infrastructure, etc.). This is evidenced by UNESCO Institute for Statistics (UIS), stating more than 380 million children worldwide (56% on average and 85% in sub-Saharan Africa) will finish primary school without being able to read or do basic mathematics (UIS, 2017). Indeed, these figures are likely to have worsened following the Covid-19 pandemic; in a large-scale survey of teachers, more than half stated that students had not progressed in their learning to expected levels (Meinck et al., 2022).

The need for teacher development increases with the proliferation of EdTech use (World Bank, 2018b). For instance, Major and Francis' (2020) Rapid Evidence Review on tech-supported personalised learning indicates that learning gains are greater when an experienced teacher is available to offer contextualised input and feedback. Furthermore, a meta-analysis of 77 randomised experiments focused on primary-level student learning in LMICs found that the largest (albeit still modest) effect sizes were associated with the use of EdTech (0.15) and teacher training (0.12) (McEwan, 2015). Coupled with findings from other, naturalistic studies across educational contexts (Basal, 2015; Harley and Barasa, 2012),

this evidence indicates that the nexus of TPD and EdTech is vital to improved teaching and learning processes in LMICs. The crux is understanding *how* and *in what ways* EdTech can support and enhance TPD, whether through design, delivery, or classroom application. Canvassing teachers' opinions can go some way to ascertaining the best ways in which EdTech and TPD can intersect effectively to support teacher and student learning.

Most "ICT training lacks attention to the context in which teachers work" (Kalogiannakis, 2010: 14). Thus, involving teachers systematically in decision-making processes related to planning, design, and implementation of TPD is required. There are various methods of ensuring teachers have the space to input into what they are going to learn. Co-design is one, and methodologies such as Design-Based Implementation Research (DBIR) can ensure models are adaptive and responsive to contextual needs (Fishman et al., 2013; McKenney and Reeves, 2013). Anwar's (2017) DBIR study in Pakistan established a connection between the researcher and the teachers so that they worked together to collaboratively evolve the implementation and evaluation of the programme. Another way of understanding teacher needs in-depth is through needs assessments. Onguko's (2014) pre-study needs assessment in Kenya for the JiFUNzeni blended TPD model, for example, discovered that urban teachers preferred TPD focusing on assessment, whereas rural teachers wanted TPD which would support improved teaching of large classes. The TPD implemented was subsequently adapted for these different contexts and contributed to longer-term pedagogical improvements for both sets of teachers.

Consideration of other groups of potentially marginalised teachers' needs has been very rare though. Exceptions include Wormnaes and Sellaeg (2013) who found that visually impaired teachers in Uganda benefited from audio-described educational video material, yet they contributed less to discussions when paired with sighted teachers. Likewise, while women often have less access to technology than men (Laurillard et al., 2018), female higher education teachers in Pakistan reported that digital platforms countered negative, gendered attitudes to give them more of a voice than was afforded by face-to-face peer discussion (Khan, 2018). A few studies have highlighted successful technology-mediated TPD for teachers in refugee/displacement contexts, where language barriers and emotional trauma commonly pose specific problems (most prominently, the work of Mendenhall, et al., 2018, in Kenya). However teachers are included in decision-making processes on TPD, what is crucial is that this step is taken systematically, based on developing a deep understanding of teacher needs. Otherwise, the TPD that is offered risks not being contextualised and relevant to teachers. These risks can lead to continued issues around access to, quality of, and flexibility within, TPD for teachers.

The Tanzanian context

World Bank (2018a) data show the average pupil-teacher ratio was 51:1 in Tanzanian primary schools in 2018, with some schools having ratios greater than 200:1. Thus, in addition to increasing the supply of teachers, building a competent and effective teaching workforce is vital to meeting the current and future demands of the system (where an estimate suggests that the overall teaching workforce needs to double to meet steady rises in student enrolment rates (World Bank, 2017). Of course, TPD is crucial to enhancing the competencies and effectiveness of this front-line workforce. Specifically, good pre-service education is essential to a more rigorous and systematic recruitment process of competency development.

However, the *Continuous Professional Development Implementation Roadmap for Tanzania* (Cambridge Education, 2021), and a recent review of the challenges and opportunities for TPD in Tanzania (Komba and Mwakabenga, 2019), show that historically ineffective top-down TPD approaches, such as cascade models, have been repeatedly implemented. These models which attempt to transfer large amounts of content or pedagogical knowledge without continuous support or teacher input have proved costly and ineffective in enhancing teaching quality in Tanzania. This is demonstrated by a baseline study on the quality of classroom interaction following the provision of TPD, conducted to inform the Teacher Development and Management Strategy (2008-2013) (UNICEF, 2008, in Hardman et al., 2011). The study covered 300 primary-level English, mathematics, Kiswahili, and science lessons at Standards 3 and 6 spanning eight districts. The analysis found that pupil-centred forms of learning made up just 14% of lesson time and paired or group work made up only 6% of lesson time. On the other hand, traditional "chalk and talk" methods took up over half of lesson time (Hardman et al., 2011). From this, it was also found that coherent policies and the regular provision and monitoring of TPD were persistent problems, with added confusion over which government functions were responsible for which parts of the TPD ecosystem (Hardman et al., 2011). Chirwa's (2018) study of the use of technology in Tanzanian teacher colleges supports Hardman et al.'s assessment that there remains an overreliance on 'chalk and talk' classroom instruction (Chirwa, 2018). So, a systemic issue is apparent here, where learner-centred pedagogies have not been taught in teacher training, thereby impacting teachers' in-classroom practice. These data present the state of teaching practice in Tanzania over the past decade. They show that ineffective pedagogies have historically been commonplace, in turn proving ineffective in raising educational attainment. This follows Schweisfurth's (2015) argument that implementation of purportedly more effective pedagogies, i.e., learner-centred approaches, has been problematic in LMICs and highlights the need for appropriate contextualisation so as to realise the expected benefits of these approaches (van de Kuilen et al., 2020).

The findings above collectively highlight the need for a shift in the approach to teaching and learning in Tanzania. In an

EdTech Hub country-level review of Tanzanian research initiatives, Jordan et al. (2021) note that the key recommendations from Hardman et al.'s (2011: 676) study centre on:

1. A shift towards school-based professional development opportunities for teachers;
2. Employing established pedagogical approaches (such as reflective practice); and,
3. Implementing a blended, flexible model, using "paper-based and online distance learning materials, and face-to-face meetings with tutors and cluster meetings of teachers".

Furthermore, Mgaiwa's (2018) review of the prevailing issues affecting teaching and learning in Tanzania identifies five underlying problems:

1. Imprecise policies related to TPD;
2. Inadequate focus on a continuous or ongoing approach to TPD;
3. The need for an autonomous teacher regulatory body;
4. Inadequate use of ICT in TPD; and,
5. Poorly qualified candidates joining the profession.

When considering the inadequate use of ICT, various studies have shown that technology is rarely used as a tool for instruction — instead any available technology is often used by head teachers or school leaders for administrative purposes (Hare, 2007; Mgaiwa, 2018; Swarts and Wachira, 2010; Tilya, 2007). Indeed, Swarts and Wachira (2010) assert that the low uptake of technology by teachers across the country is due to limited knowledge and skills in how to integrate technology in teaching. This presents a snapshot of the intersection of technology and teaching in Tanzania, where often access to technological devices and broader infrastructural obstacles are coupled with low levels of digital literacy among teachers (Mgaiwa, 2018). This shows the need for the systematic and widespread roll-out of tech-supported TPD in Tanzania, which can help teachers apply these skills in their everyday classroom practices.

Linking teacher learning to classroom practice — and measuring the effects, including on student learning — is essential, yet extraordinarily rare across the field (Hennessy et al., 2022). A recent study by Filmer et al. (2021), spanning 392 schools, 436 teachers and 3,019 students in Grades 2 and 3, states that the strongest predictors of teacher effectiveness in Tanzania measured via student learning outcomes are: teacher preparation (measured through pre-service course assessments), teacher practice (measured through classroom observations and student surveys), and teacher beliefs (measured through teacher surveys). For example, in mathematics, the most important predictors of student learning gains were the teacher's practice of providing students with written feedback on homework/tests and reviewing key concepts at the end of class (measured through student surveys), the teachers' belief that they can help disadvantaged and struggling students learn, and teachers' preparation for teaching these foundational concepts (Filmer et al., 2021). As such, TPD must hone in on — and measure — preparation, practices, and beliefs longitudinally in order to truly assess teacher effectiveness in the classroom. It is hoped that our study can support this process, by offering insight into teachers' practices, teachers' beliefs in relation to key issues such as teaching with technology, and what teachers' needs are moving forward.

This section has presented literature related to EdTech, teaching and learning and TPD — globally and in Tanzania. There are various obstacles to student learning gains in Tanzania, and it is clear from evidence such as Hardman et al. (2011) and Mgaiwa (2018) that one of these is the lack of a continuous, quality TPD provision. Once TPD is systematically provided in a context-specific way — led in and by schools — it is hoped that improved teaching practices will lead to student learning gains. The soon-to-be-implemented government programme aims to meet this challenge and the outcomes will be crucial in determining the route forward for the Tanzanian education system.

CONCEPTUAL FRAMEWORK

This study is built upon the notion that teachers are central cogs within the education ecosystem. As such, understanding

their beliefs, practices, and needs is crucial to producing relevant and effective TPD. As we saw from the literature, once TPD *is* relevant and effective — and therefore adaptive to teachers' contexts — positive impacts on student learning are generally seen. Surveys are one way of developing this nuanced, teacher-level picture.

In more detail, Hennessy et al. (2022) posit the idea of a coherent education ecosystem, which has actors and processes situated within its three levels (the macro, meso, and micro). The current study has used this conceptualisation and adapted it to the Tanzanian context (Figure 1).
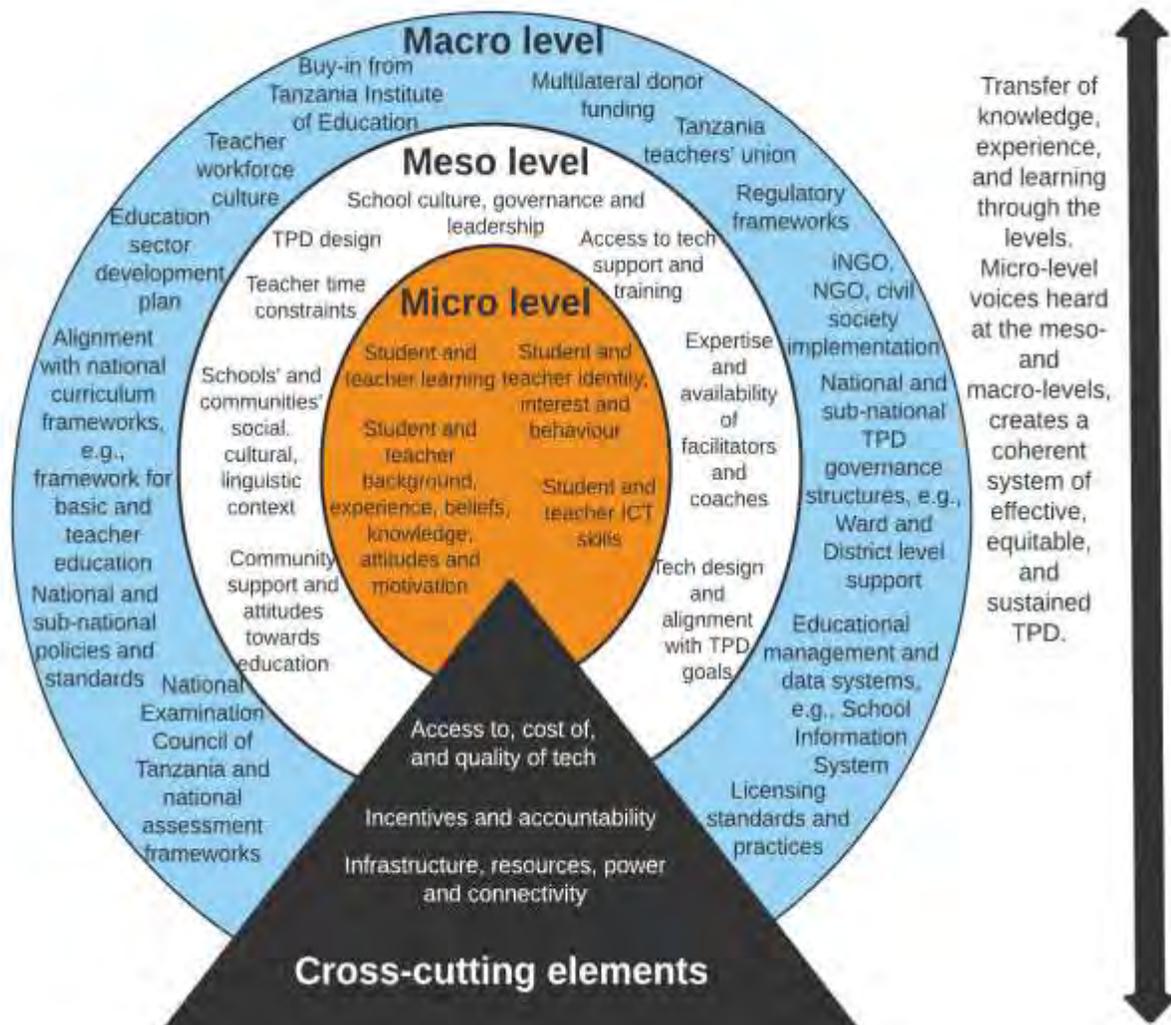

Figure 1. A coherent education system in Tanzania.

The survey findings from this paper speak directly to the cross-cutting elements concerning access to technology, and to the elements in the centre of Figure 1, with insights gathered on: student and teacher learning; teachers' identities, interests and behaviours; teachers' ICT skills; and teachers' backgrounds, experiences, beliefs, attitudes, and motivations. It is believed that these insights can contribute to a fuller picture of the realities which exist at the micro level in Tanzania. Going further, ensuring that the voices of micro-level actors are heard at the meso and macro levels underpin this conceptualisation. Thus, this paper aims to contribute to elevating these micro-level voices to be heard by actors at the outer levels of the ecosystem — by those ward-, district- and national-level actors.

RESEARCH FOCUS

The overarching focus of this paper is centred on the experiences and needs of Tanzanian teachers. Our particular interest is on:

1. Teachers' access to, and use of, technology tools and resources.
2. Teachers' perceptions of student learning progress.
3. The TPD that teachers engaged in.
4. Whether there were any major differences across teacher groups by demographic factors.

By exploring these four key areas, the research aimed to gain insight into Tanzanian teachers' professional needs moving forward, whether these differ by demographic group, and how to ensure that student learning is central to any future shaping of TPD provision.
    The detailed aims and objectives of this paper are summarised through the following research questions (RQs).

RQ1: How did teachers in Tanzania use technology during the preceding year?

RQ1A: What access to technology did teachers and their students have?
RQ1B: Which teachers were most encouraged by their schools to use technology?
RQ1C: How did teachers use technology devices and digital resources to teach?
RQ1D: What were the factors that hindered teaching with technology?

RQ2: What were Tanzanian teachers' perceptions of student learning progress during the preceding year?

RQ2A: What levels and kinds of learning gains or losses did teachers observe among their students?
RQ2B: Did teachers assess student learning? In what ways?
RQ2B: What are teachers' views about how these gains or losses should be addressed by schools and governments?

RQ3: What kinds of training and/or professional development did teachers receive during the preceding year?

RQ3A: What was the frequency, focus, and cost of training or professional development opportunities?
RQ3B: To what extent did the training and/or professional development improve teaching practices?
RQ3C: What are teachers' professional development needs going forward?

RQ4: How do teachers' perspectives on the above RQs vary by teaching experience; teaching qualification; the age of the learners they teach; gender; whether they identify as having a disability and/or long-standing illness; and location of the school?

METHODOLOGY

Participants

The survey in Tanzania had 774 respondents from 105 schools, spanning 22 of the 31 regions of the country: Arusha DC, Babati TC, Muleba, Serengeti, Kigoma, Geita, Kilosa, Bariadi, Ukerewe, Tunduru, Masasi, Kilwa, Mkuranga, Moshi DC, Korogwe DC, Njombe, Mbeya City, Sumbawanga DC, Tabora MC, Mpwapwa, Iramba, and Musoma MC. One district in each of the 22 regions was surveyed (Figure 2). As noted above, just 16 respondents in Tanzania completed the original global survey, so a concerted data collection effort was needed to increase the sample.

Figure 2. Map of Tanzania, showing regions and districts of survey data collection (orange areas are regions where data was collected).

Data collection procedure

The T4 Teachers and Technology Global Survey was open between April 7 and May 23, 2021, and included 44 questions, many of which were detailed items (Appendix). It was intended to take approximately 25 minutes to complete, although it often took longer, which caused issues for some teachers. The online survey was available in 18 languages, including Kiswahili and English. For Tanzania, the survey deadline was extended to November 26, 2021.

Beyond the publicly accessible Global Survey, EdTech Hub's Tanzanian partner HakiElimu[2] used volunteers to collect data across their network of schools. HakiElimu oriented volunteers on how to access and introduce the survey to teachers. Volunteers were facilitated by transport costs being covered. They visited schools and introduced the survey, sharing a link for teachers to complete it online in their own time and space. HakiElimu designed the survey using the electronic data collection platform Mobenzi[3]. Mobenzi has offline functionality and runs on Android smartphones. Volunteers collected data in person from 6 schools in Kilosa, Mkuranga, and Masasi. These are districts where HakiElimu has worked for more than 10 years. They were selected largely based on geographical representation across Tanzania and known education challenges e.g., educational performance, gender-based violence, dropout rates, etc.

Respondents were asked about demographic factors, such as their age, gender, number of years of teaching experience, highest teaching qualification level, whether they identified as having a long-term disability or illness, the location and type of school at which they taught, the age of children in their class or classes, and the subjects they taught.

A total of 785 responses were logged; of these, 743 (95%) were collected through online responses[4] and 42 (5%)

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[2] https://www.hakielimu.or.tz/

[3] https://www.mobenzi.com/

[4] This was a combination of online responses collected from the original global online survey (n = 16), and where HakiElimu volunteers visited schools to introduce and orient teachers to fill the online survey (n = 758). Of the online survey forms, 644 or 91.24% were fully completed; this is almost double the 47% completion rate in the global survey where no-one visited schools to encourage participation.

were collected in person. The completion rate for the online survey was 91.24%. Of the online responses, 11 (or 1.5%) were excluded from analysis because either no items were completed by the respondent, or else no data was provided beyond demographic information. The analysis is therefore based on a total of 774 responses (collected both online and in person).

Data analysis

The results were disaggregated by five demographic characteristics relating to what the teacher had reported (as noted above). Overall, the team decided that any sub-demographic characteristic lower than 2% of the total sample would be combined with other categories (see Table 1 for more details). This impacted analysis of the level of teaching qualification demographic category in two ways. First, few teachers checked the "no teaching qualification" option. Therefore, for analysis purposes, the "no teaching qualification" category was combined with teachers who "trained on the job" to form a larger "unqualified" or "no formal qualification" category. Second, few teachers who completed the survey had a postgraduate diploma, a master's degree, or a doctorate; so, a "postgraduate qualification or higher" category was also created.

The EdTech Hub team analysed the data through descriptive statistics to understand any notable trends and differences across the overall sample and by demographic factors. The survey findings in Tanzania were also compared to the global survey to understand any specificities within the Tanzanian context related to teachers' experiences during the pandemic.

Limitations of the survey

A degree of selection bias is likely to be inherent since teachers required access to some form of technology with connectivity to respond to the survey in its digital form. Teachers with an interest in technology may also have been more likely to find the survey, for example on social media, and more motivated to complete it. While the data collection process did try to address the selection bias by collecting additional data from unconnected schools in person, the number of respondents in this group totalled just 42. Responses in this category are from only 6 out of 127 schools working with HakiElimu that are unconnected, hence teachers in these schools could not access the survey independently. Moreover, teachers in the in-person group reported the survey length as a challenge in engaging and completing the survey. The low number of in-person respondents rendered a comparison of in-person versus online responses difficult due to imbalanced samples.

Another limitation of the survey related to the type of school teachers work in. The overwhelming majority of responses logged were through HakiElimu introducing the survey to teachers via its volunteers. These volunteers visited schools that HakiElimu works in, which are all government schools and have relatively similar characteristics. Therefore, unlike the Global T4 Survey — which looked at differences between different types of schools — this paper does not do this, as 99%[5] of survey respondents taught in government schools. That said, the concentration of teachers working in government schools does ensure pertinent findings and recommendations for the government education system. Future research could cover more school types.

There was no clear method of disaggregating participants by educational level. Data were captured based on learner age, as opposed to the educational level teachers worked in (because schools in each educational phase vary globally in relation to learner ages). This means we report teachers as working at a particular "learner age", e.g., teachers of 0 to 4-year-olds, become "pre-primary-age teachers".

Finally, and as stated above, school closures were limited in Tanzania, fully reopening on June 24, 2020. This might have caused differential perceptions of what the 'pandemic period' actually meant, compared to other countries in the global survey which may have experienced much longer periods of school closures. Generally, the period was intended to mean from April 2020 through to when the survey opened in April 2021. Thus, wording such as "over the past year" was used in survey items. Overall, given the specific Covid-19 context in Tanzania (i.e., limited school closures) the Tanzania survey findings are broader than pandemic-affected teaching and learning — as was the global survey focus. So, this survey is considered more of a general snapshot of teachers' experiences over the past year related to technology, student learning, and TPD.

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[5] One respondent noted that they teach at a private school and a government school; three respondents selected low-cost private school (one of whom selected government school as well); three teachers selected religious schools (two of whom selected government school as well); and two teachers selected both charity / non-governmental and government schools.

Positionality statement

Four of the five authors are EdTech Hub researchers from the global North. The other author is Tanzanian, based in Tanzania. It is nevertheless hoped that the nature of this research — presenting findings from a teacher survey and therefore relating to elevating teachers' voices in Tanzania — effectively captures the diversity of teachers' voices. That said, given the large amount of data collected from what was an extensive survey, the findings presented below are not exhaustive, and pertain to the key issues the research team believed to be priority areas from our perspective and for the wider sector.

FINDINGS

The following section details the findings from the survey. First, demographic data are outlined. Beyond this, findings are organised by RQ1–RQ3. RQ4, pertaining to how teachers' perspectives on RQ1–RQ3 vary by teacher and school characteristics, is cross-cutting. Hence, the prominent disaggregated findings are discussed only in relation to the other RQs.

Demographics

Table 1 summarises the demographics across the sample. As noted above, the sample was disaggregated by gender, disability, years of teaching experience, level of teaching qualification, type of area, and learner age. The table presents figures relating to the total sample (n = 774).

Table 1. Survey sample, by disaggregated characteristics.

	n total	Total (%)
Disaggregation by gender		
Female	358	46.3
Male	398	51.4
Other / Prefer not to say	17	2.2
Blank	1	0.1
Disaggregation by disability		
No long-standing illness or disability	706	91.2
Long-standing illness or disability	57	7.4
Prefer not to say	4	0.5
Disaggregation by years of teaching experience		
Less than 2 years	27	3.5
3–5 years	100	12.9
6–10 years	349	45.1
11–20 years	212	27.4
21–30 years	60	7.8
More than 30 years	25	3.2
No response	1	0.1
Disaggregation by teaching qualification		
No teaching qualification	7	0.9
Training on the job	48	6.2
Certificate	226	29.2
Diploma / certificate below degree level	158	20.4
Bachelor's degree	291	37.6
Postgraduate diploma / certificate	8	1.0
Master's degree	14	1.8

Table 1. Continues.

Doctorate	3	0.4
Other	18	2.3
No response	1	0.1
Disaggregation by type of school area		
City / Urban / Metropolitan area	138	17.8
Town / Semi-dense area / Suburbs	205	26.5
Rural area	429	55.4
Other	1	0.1
No response	1	0.1
Disaggregation by age of learner taught		
0–4 years old (pre-primary age)	21	2.7
5–7 years old (lower primary age)	129	16.7
8–11 years old (upper primary age)	282	36.4
12–16 years old (lower secondary age)	494	63.8
17 years or older (upper secondary and tertiary age)	152	19.6

The majority of respondents were male (51.4%); 46.3% were female. An overwhelming majority of teachers identified as having no long-standing disability or illness (91.2%). Teachers mostly had 6 to 10 (45.1%) or 11 to 20 (27.4%) years of experience. By teaching qualification, the majority of teacher respondents had a bachelor's degree (37.6%), followed by a certificate (29.2%) and a diploma (20.4%). Few teachers who completed the survey had a postgraduate diploma (1.0%), master's degree (1.8%), or a doctorate degree (0.4%); for analysis purposes, these three categories were subsequently combined to form a "postgraduate degree or higher" category (as described in the methodology section). By location, 55.4% of respondents worked in schools in rural areas, followed by 26.5% in towns and 17.8% in urban areas — this is a different spread from the global survey demographics, where 48% worked in urban areas, 13% worked in towns and 38% worked in rural schools.[6] Finally, 63.8% of teachers taught learners aged 12 to 16 years, while 36.4% taught learners aged 8 to 11 years, 16.7% taught learners aged 5 to 7 years, and just 2.7% of respondents worked with pre-primary-age learners.

When comparing in-person respondents with those online, generally, the disaggregated proportions were aligned. However, there was a greater proportion of males (61.9%) than females (35.7%) in the in-person sample. There was also a greater proportion of teachers with a bachelor's degree (57.1% vs. 36.5%). Perhaps expectedly, given the schools were visited in person and rural schools were targeted, there was a lower proportion of urban teachers (4.8% vs. 18.6%). There were also lower proportions of teachers of primary-age children in the in-person sample (23.8% vs. 54.8%). Nevertheless, the total in-person sample was only n = 42.

RQ1: How did teachers in Tanzania use technology during the preceding year?

Access to technological devices

Figure 3 shows that by and large, schools either had no access to devices (38%), only one device per school (44%), or teachers brought their own devices to school (21%) (the latter probably being a symptom of the two former data points). When comparing these findings with the global survey dataset,[7] the proportion of teachers in Tanzania bringing their own devices to school was only half of the global average. By contrast, more teachers in Tanzania reported that their school had one device (13% more than the global average). However, this may be due to teachers in the global dataset reporting far greater access to multiple devices (24% on average), compared to just 3% in Tanzania. This gap is also reflected in the devices per class and per teacher, down 12 and 8% respectively compared to what teachers reported globally.

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[6] It was not possible to compare all demographic data with the global survey, as the global survey data were not disaggregated by gender, disability or long-standing illness, teaching qualification, or learner age.

[7] This section will continually refer to analysis of the global dataset, reported by Pota et al. (2021).
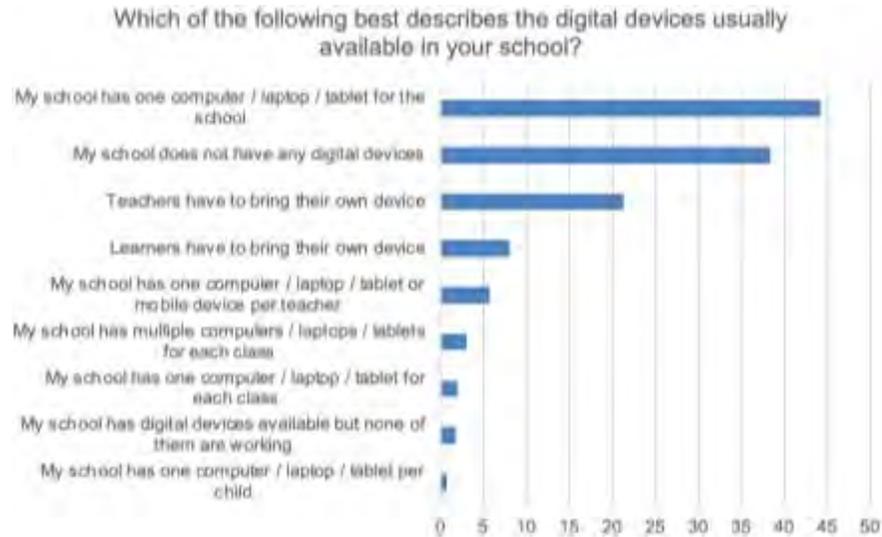
Figure 3. Teacher and school-level access to technological devices.

Looking at the disaggregated data, the less qualified a teacher was, the greater the likelihood of there being no digital devices available at the school level (Figure 4). A majority (62%) of unqualified teachers reported that their school did not have any digital devices, compared to 29% of teachers with a bachelor's degree. This is because the less qualified teachers generally worked with younger learners, while those with a bachelor's degree generally worked with learners aged 12 and above.
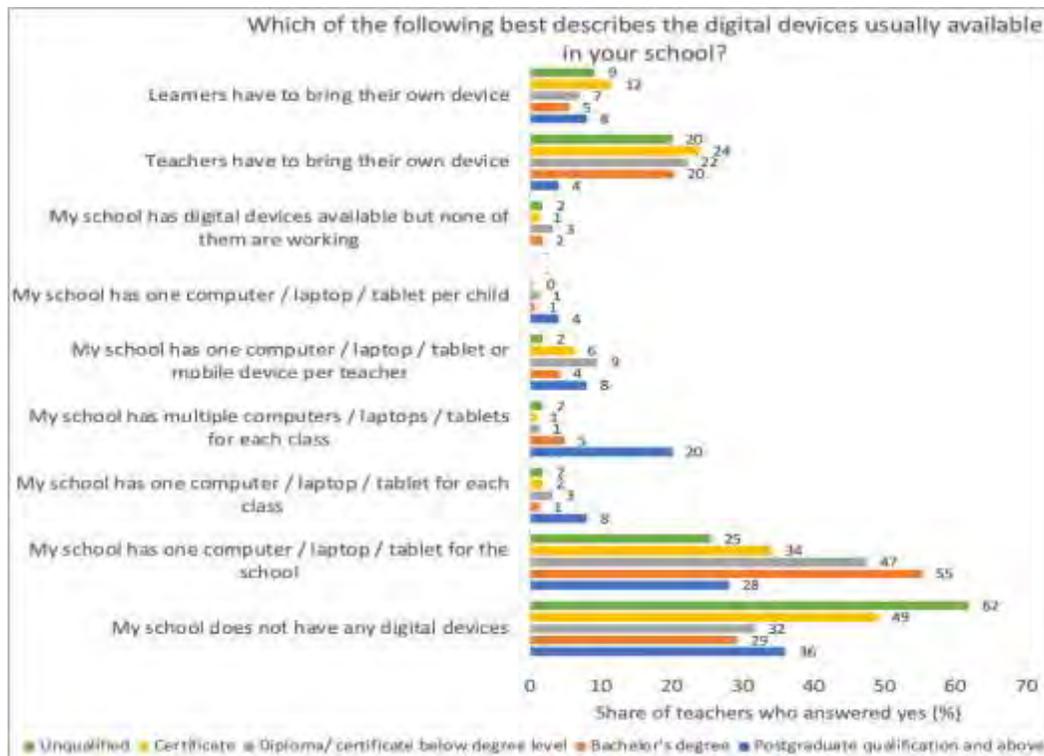

Figure 4. Access to technological devices, by teacher qualification.

Location also played a major role; less than a quarter (21%) of teachers from urban areas reported that their school did not have any digital devices, compared to almost half (47%) of teachers from rural areas.

Access to the Internet

The majority of teachers responding to the survey reported either having access to the internet at home (75%) or school (79%). Thus, internet access in Tanzania somewhat mirrored the global data, with around one-fifth to one-quarter of teachers also reporting no access to the internet. While the difference between male and female teachers accessing the internet at home was insignificant, a larger difference was apparent between female (87%) and male (71%) teachers accessing the internet at school. Interestingly, urban teachers reported the lowest levels of internet access at school (73%) compared with 84% in towns/suburbs; rural teachers sat in the middle with 78% reporting internet access at school. Although the differences are small, they are notable and run contrary to assumptions that there may be greater internet access in urban areas.

Other large variations relating to access depended on years of teaching experience. Teachers with between 21 and 30 years of teaching experience were much more likely to report having access to the internet at home (88%) and school (98%) compared with teachers with less experience. An inverse relationship between access to the internet at school and teachers' qualifications also exists. While 84% of unqualified teachers reported that their school had access to the internet, this fell to 68% of teachers with a postgraduate qualification or above. These findings could be due to perceptions of what "internet access" actually means, in that some teachers may have viewed access as having a mobile network signal at school, while some may have viewed this as access to Wi-Fi. The survey did define key terms throughout, but these may have been missed at certain points when teachers took the survey.

Technology use

Half of the teachers responding to the survey indicated that their school encouraged them to use technology. Slightly more male teachers (55%) reported being encouraged by their school to use digital resources, compared to their female counterparts (46%). Moreover, more teachers without a disability were encouraged by schools to use technology (51%), an 8-point gap compared to those with no long-standing disability or illness. That said, there were no significant differences in frequency of use between those with or without a disability or long-standing illness. Hence, despite those with no disability or long-standing illness being encouraged more by their schools to use technology, when reporting frequency of usage, it would seem this increased encouragement did not lead to increased use. When it comes to experience, teachers with less than 2 years of teaching experience were among the most likely to indicate that their school encouraged them to use technology (63%) (Figure 5).
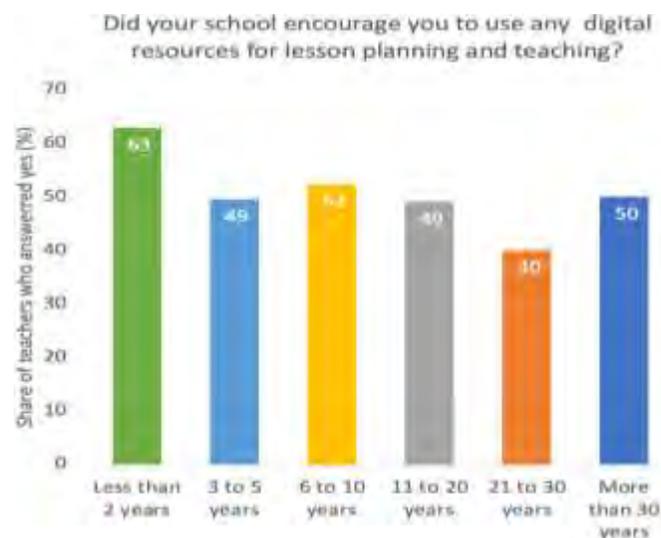

Figure 5. Teachers encouraged by schools to use technology, by length of teaching experience.

For comparison, teachers with 21 to 30 years of teaching experience were the least encouraged to use technology (40%). However, the lower sample size for the "less than 2 years" group (3.5% of the total population) should be noted here (Table 1).

The survey results also show a positive trend between higher teaching qualifications and schools encouraging teachers to use technology more. Just 36% of teachers with either no teaching qualification or a certificate were encouraged to use technology. This was compared to 70% of teachers with a postgraduate qualification or higher. Finally, teachers residing in urban areas were much more likely to have been encouraged to use technology (63%), compared to teachers in rural areas (43%). This could partly be attributed to schools in rural areas being less likely to have access to technological devices (see 'Access to technological devices' section).

Figure 6 shows that almost half of the teachers surveyed used digital resources "never or almost never" for the listed activities (with a greater share of female teachers reporting this). Likewise, daily use of technology was uncommon. Compared to the same global survey item, the findings are reversed. Globally, the daily option was most commonly selected, ranging between 27–47% for each category. The range for the "never or almost never" option was 4–17%.

During the last 12 months how often did you use digital resources to....

Activity	Never or almost never	About once or twice a month	About once or twice a week	Every day or almost every day
...take part in professional communities of...	53	15	11	7
...share ideas or resources with colleagues	45	15	14	12
...assess students' learning	55	16	9	7
...communicate with parents or guardians	47	19	14	8
...provide students who cannot physically...	59	14	9	5
...provide feedback to students	52	17	11	6
...enable student collaboration	52	16	12	7
...assign learning tasks	49	15	15	7
...explore new teaching methods	42	18	15	13
...find instructional materials	45	19	12	11
...design tasks	47	18	12	8
...create lesson plans	50	15	12	7

Share of teachers (%)

■ Never or almost never ■ About once or twice a month ■ About once or twice a week ■ Every day or almost every day
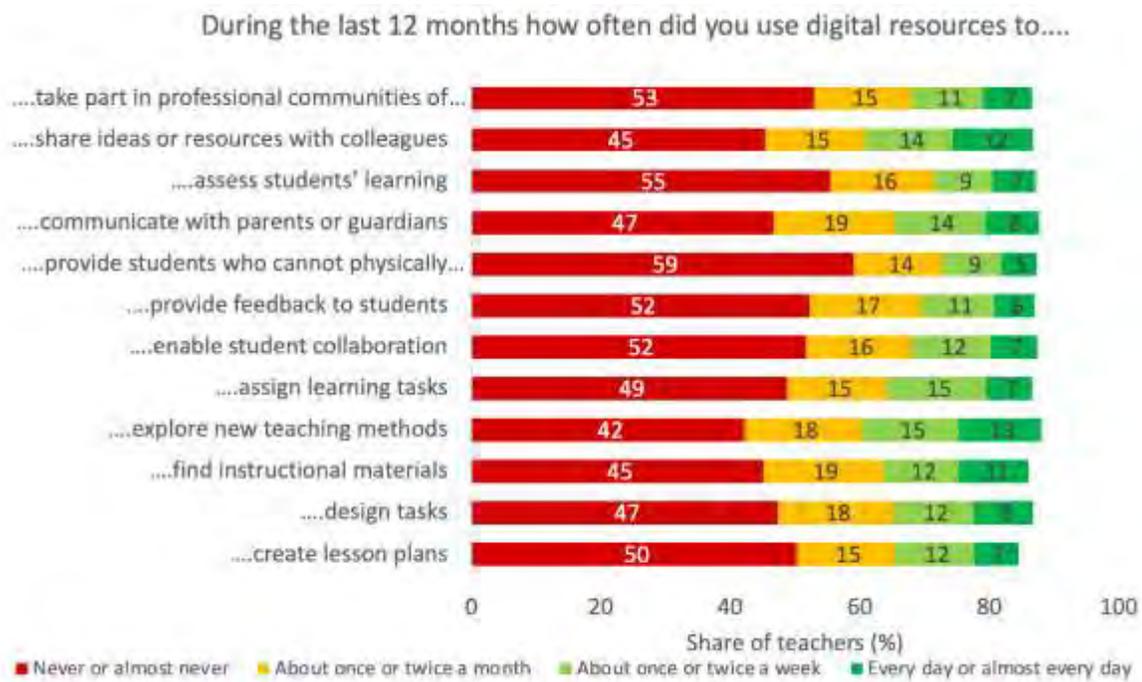
Figure 6. Frequency of use of digital resources.

Although a separate survey item found that teachers did contact parents by phone (29% of respondents) or by messaging services (27%) at some point, the data from Figure 6 show that the *frequency* of these practices was low — 47% of teachers reported communicating with parents or caregivers "never or almost never". The low frequencies in this item perhaps speak to the limited time that schools were fully closed in Tanzania, reflecting the limited opportunities for remote teaching and learning to become established practices. However, the finding that 12% of teachers *shared ideas or resources digitally* and that 13% *explored new teaching methods* "every day or almost every day" is somewhat promising for TPD promoting peer learning (a core component of the current government plans), particularly as this figure rises to 26 and 28% respectively when combining daily and weekly frequencies.

Some moderate gender differences did exist when teachers looked to deliver remote teaching and learning. For example, 32% of male teachers contacted parents by phone, compared to 26% of female teachers. Likewise, more male teachers (31%) used messaging services to contact parents, 9 percentage points above female teachers. Elsewhere, differences emerge when looking at the years of experience a teacher has. Of teachers with 21 to 30 years of experience, 40% did not use technology to teach remotely. This is far higher than any other group; as a comparison, 22% of teachers with less than 2 years of teaching experience did not use technology to teach remotely. Interestingly, these data are in opposition to the global dataset, where it was found that teachers with 21 to 30 years of experience actually made the most use of technology.

Generally, the lower the levels of qualification that teachers had, the less technology was reported as being used; this may well be related to lower technological access as reported above. In the case of teachers with a certificate, for example, 42% reported not using any technology. This compares to 20% of teachers with a postgraduate qualification or higher. Teachers with higher qualification levels also engaged in more complex — learner-focused — activities in relation to technology, such as making printed copies of digital materials or using audio or visual materials to share with learners. Comparatively, teachers with lower qualification levels tended to contact parents or caregivers more.

Finally, large differences exist between rural and urban teachers in whether technology was used to undertake remote teaching. While 12% of teachers living in urban areas reported not using technology, this rose by 25% for teachers living in rural areas, meaning 37% of rural teachers did not use technology to support their teaching.

When determining factors that hindered a school's capacity to provide quality instruction, 30% of teachers reported the shortage or inadequacy of digital technology for instruction hindered them "a lot". At the other extreme, 25% of teachers indicated that the shortage or inadequacy of digital technology was "not at all" a hindering factor. However, this varies when taking into account teacher characteristics. For example, teachers with 30 years or more of teaching experience were more likely to indicate that the shortage of digital technology was *not* a hindering factor (46%) compared to teachers with less than two years of teaching experience (19%). This may in some way be linked to schools' differential encouragement of teachers to use technology, as per Figure 6, while also potentially being a symptom of more experienced teachers feeling more confident teaching without technology. Perhaps surprisingly, there was no significant difference between teachers reporting inadequacy of digital technology being a hindering factor for urban (24%) versus rural (26%) teachers. Contrastingly, 40% of peri-urban teachers reported shortages or inadequacies of digital technology were a hindrance.

RQ2: What were Tanzanian teachers' perceptions of student learning progress during the preceding year?

Learning progress and assessment

Income inequality was a key determinant of learning progress during the preceding year — 62% of teachers reported that learners from the financially poorest households suffered the greatest learning losses (Figure 7). Regarding gendered learning losses, almost half of the sample reported girls suffered more learning losses than boys (48%), a notable difference of 32% from the global average.
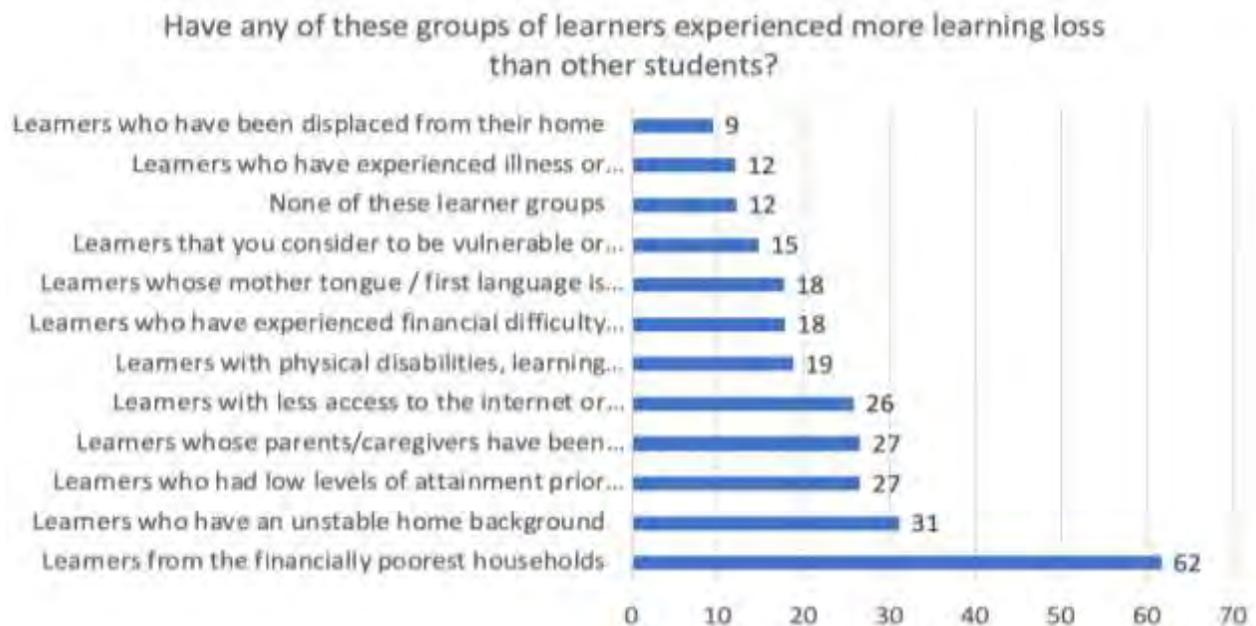

Have any of these groups of learners experienced more learning loss than other students?

Learner group	Value
Learners who have been displaced from their home	9
Learners who have experienced illness or...	12
None of these learner groups	12
Learners that you consider to be vulnerable or...	15
Learners whose mother tongue / first language is...	18
Learners who have experienced financial difficulty...	18
Learners with physical disabilities, learning...	19
Learners with less access to the internet or...	26
Learners whose parents/caregivers have been...	27
Learners who had low levels of attainment prior...	27
Learners who have an unstable home background	31
Learners from the financially poorest households	62

Figure 7. Learner groups experiencing greater learning losses.

Most teachers did believe learning had progressed to some degree (63% disagreed that *none* of their students had made progress). However, assessment of student learning levels was varied, with only 51% of rural teachers assessing

student learning levels after schools reopened. Relatedly, and as we saw above (Figure 6), assessing learners through digital means was even less common, with 75% of rural teachers stating they never did this. Therefore, a true understanding of the learning progress made in rural schools may be clouded by limited learner assessment.

When asked what the government should do about learning losses, 45% of teachers believed the government should promote the teaching profession in order to increase the number of teachers. Almost a third of teachers also wanted more of a focus on their own professional development (31%) and well-being (32%); these two particular issues are discussed in more detail in the section presenting findings related to them. Globally, 45% of teachers expressed a need for more of a focus on TPD and 44% said supporting their well-being was needed — higher figures than in the Tanzania sample. Teachers also expressed support for the current assessment framework, with just 5% believing exams should be cancelled and replaced with regular assessment and monitoring. However, this perhaps ties into related issues regarding a lack of systematic assessment.

RQ3: What kinds of training and/or professional development did teachers receive during the preceding year?

Engagement in teacher professional development

Just 24% of the 774 teacher respondents indicated they had taken part in any form of TPD or training (organised or self-initiated) over the previous 12 months. Little difference was observed between male and female teachers, or between teachers with different qualifications. A notable difference, however, was observable between the years of teaching experience a teacher had and whether they engaged in TPD. Teachers with less than 2 years of teaching experience were most likely to have indicated that they had taken part in some form of TPD (46%), perhaps due to specific provisions for newly qualified teachers (Westbrook and Croft, 2015). Another factor influencing how likely a teacher was to have engaged in TPD was the type of location the teacher worked in. While 43% of teachers living in urban areas engaged in TPD, the equivalent for teachers living in rural areas was just 17% (Figure 8).
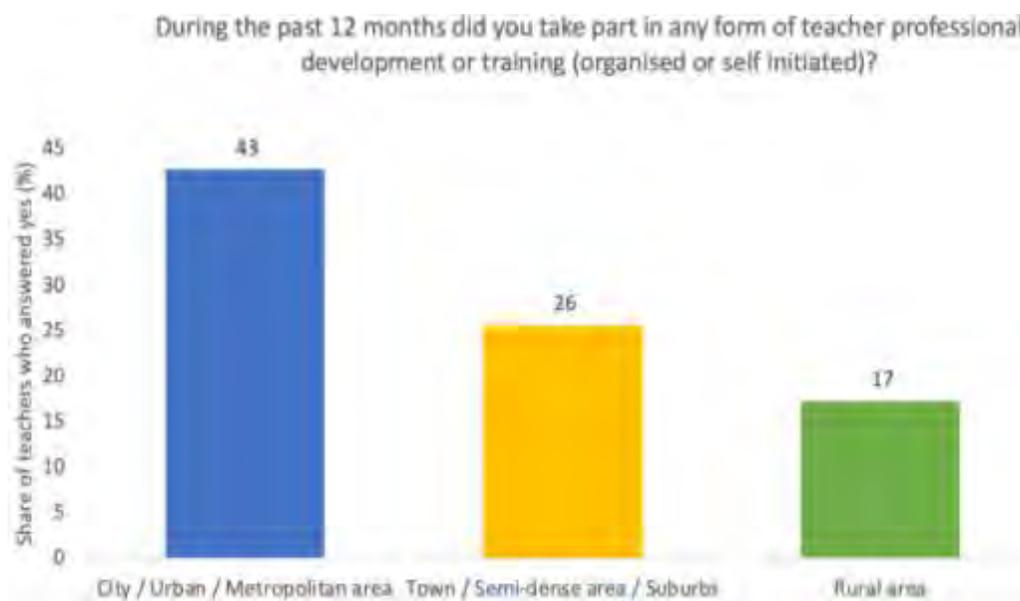

Figure 8. Engagement in TPD, by school location.

Cost of teacher professional development

The majority of teachers who had participated in some form of TPD indicated there was no cost attached to the TPD (56%) — 28% said they or their family paid for it and 9% said their school paid. Similarly, 24% of teachers in the global survey indicated they or their families paid for the cost of the TPD. A higher proportion of male teachers (30%) compared to female teachers (23%) reported that they or their families paid for the cost of TPD. There was no significant difference between teachers who identified as having a long-term disability or illness and those who did not. Differences in how TPD

was funded also depended on teachers' professional qualifications. Just 31% of teachers with no teaching qualifications reported that their TPD had been free. This was compared to 67% of teachers with a postgraduate qualification and above (though the sample was smaller for this group). Similarly, 67% of teachers living in urban areas who took part in some form of TPD were much more likely to indicate this as coming at no cost, dropping to 50% for teachers living in rural areas.

Finally, there is a general trend that the older their learners, the more TPD was offered to teachers for free and the cost teachers or their families had to cover themselves was lower (Figure 9).

Figure 9. Cost of TPD, by learner age.

Focus of teacher professional development

Of those who engaged in TPD, 35% indicated that the TPD focused on "*engaging with parents and caregivers during remote learning*" — the most frequent response. This was followed by 34% of teachers indicating that TPD focused on online and remote teaching and learning pedagogies. 20% of teachers reported that the TPD focused on "*safe online behaviour for teachers.*"[8] Despite the relatively limited school closures in Tanzania, it seems that the focus of TPD offered during the previous year follows other countries' Covid-19 education response as reported in the global findings.

Across the nine TPD focus options — excluding training focused on *"pedagogies for online or remote teaching and learning"* — female teacher respondents were more likely to participate in varied TPD activities compared to their male counterparts. Indeed, 40% of female teachers reported taking part in TPD on *"teachers' physical, mental and/ or emotional well-being"*, compared to 22% of male teachers.

Elsewhere, teachers living in rural areas stood out, as they were less likely to report engaging in varied TPD topics, compared to their peri-urban or urban counterparts. Rural teachers' professional development mainly focused on engaging parents and caregivers (29%) or pedagogies for online or remote teaching and learning (28%).

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[8] Other options relating to the type of TPD included: (a) teachers' physical, mental and/or emotional learning, (b) progress monitoring during remote learning, (c) understanding online learner behaviour, (d) learner safeguarding online and during remote learning and (e) engaging in teacher communities of practice.

Impact of teacher professional development

Notwithstanding the low levels of engagement in TPD, of the teachers that did engage, two-thirds (67%) said that it changed their practice a lot, while just 3% said their practice did not change (Figure 10).
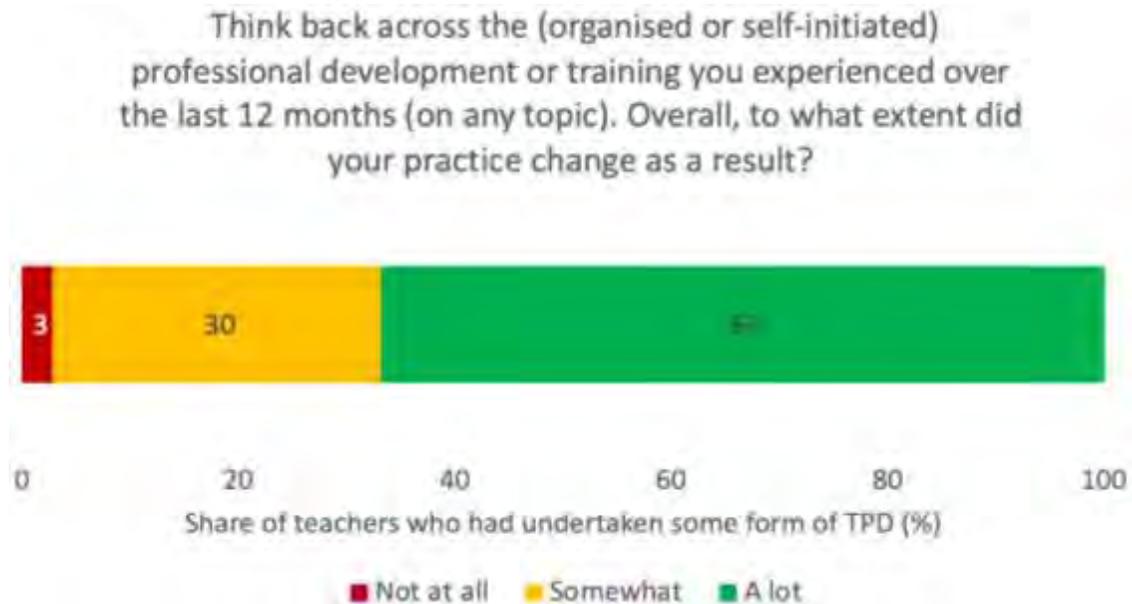

Figure 10. TPD resulting in change in teachers' practices.

However, Figure 10 does not tell the full story. By teacher characteristics, the extent to which TPD changed practices varied. For example, just 53% of teachers with a disability or long-standing illness reported that the TPD changed their practice a lot, compared to 68% of teachers with no disability or illness. Indeed, 24% of those with a disability said the TPD did not change their practice at all (Figure 11).
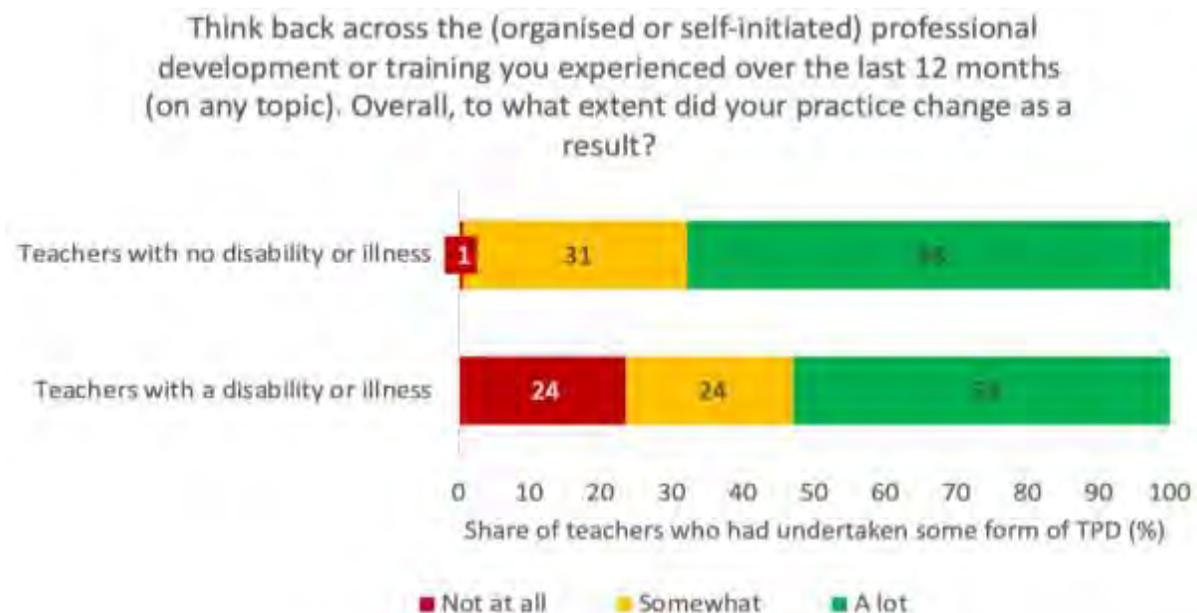

Figure 11. TPD resulting in change in teachers' practices, by disability or illness.

By location, urban teachers were much more likely to indicate that TPD programmes that they took part in changed their teaching practices a lot (84%), compared to their rural counterparts (56%). Of teachers in towns, 63% found the TPD very useful.

Teacher professional development needs

The support areas[9] most identified by teachers to improve their practice over the next 12 months included *"developing skills and confidence in using digital technologies in teaching"* (57% [54% globally]), *"caring for my mental health and well-being"* (51% [39% globally]) and *"pedagogy/teaching methods for my own professional development"* (37% [38% globally]) (Figure 12).

Which of the following areas could support your teaching in the next 12 months?

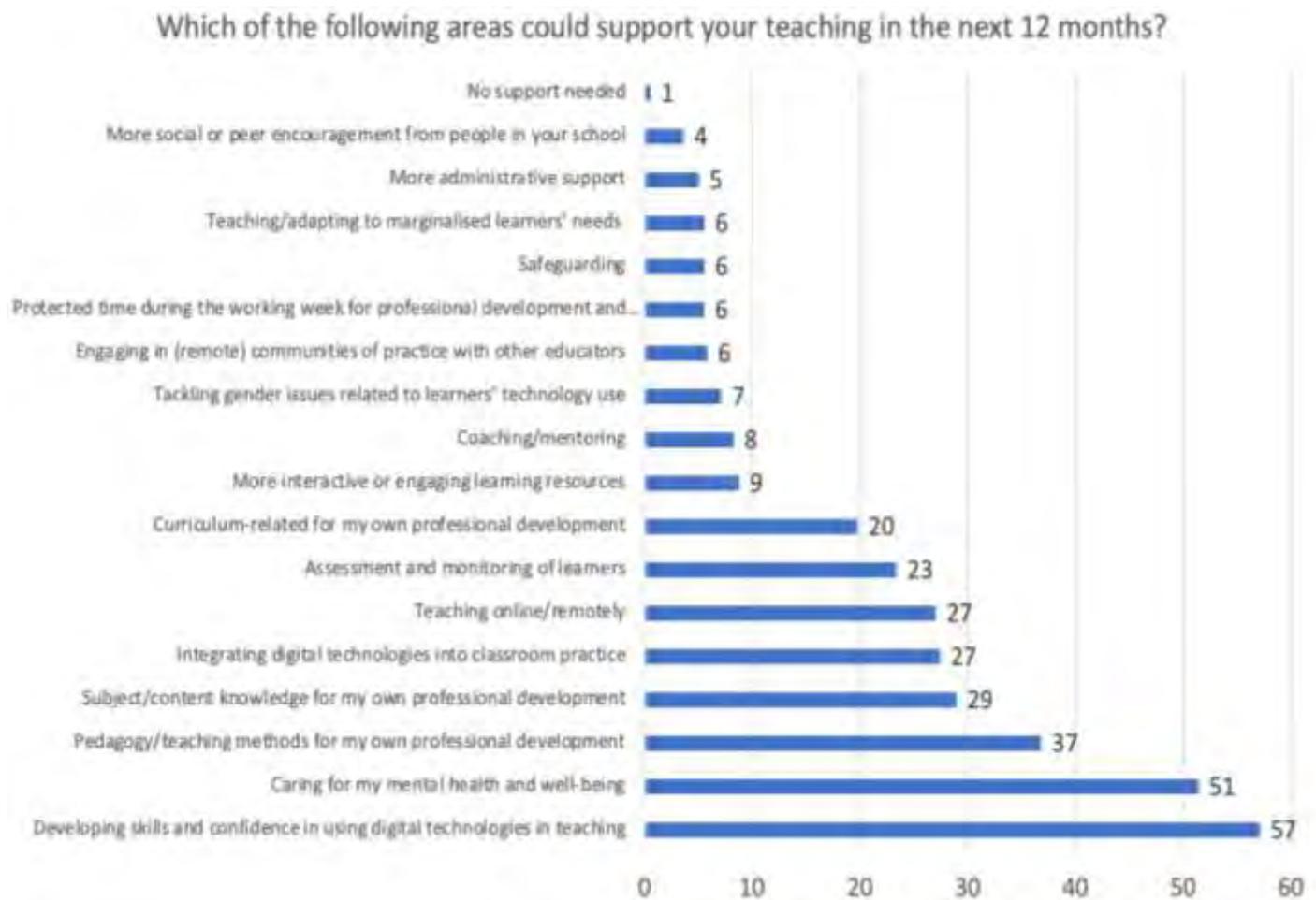| Area	Value
No support needed	1
More social or peer encouragement from people in your school	4
More administrative support	5
Teaching/adapting to marginalised learners' needs	6
Safeguarding	6
Protected time during the working week for professional development and...	6
Engaging in (remote) communities of practice with other educators	6
Tackling gender issues related to learners' technology use	7
Coaching/mentoring	8
More interactive or engaging learning resources	9
Curriculum-related for my own professional development	20
Assessment and monitoring of learners	23
Teaching online/remotely	27
Integrating digital technologies into classroom practice	27
Subject/content knowledge for my own professional development	29
Pedagogy/teaching methods for my own professional development	37
Caring for my mental health and well-being	51
Developing skills and confidence in using digital technologies in teaching	57

Figure 12. Needs in the next 12 months identified by teachers.

While TPD focusing on using digital technologies in teaching and on well-being are clear priorities, it is also noticeable from this multiple-choice item that issues such as safeguarding, teaching to learners' needs, and gender-responsive pedagogies were lower priorities for teachers. TPD on parental and/or caregiver engagement was missed as a response option for this item, which is a limitation, particularly as this was reported as the largest focus of TPD in this survey.

While there were no significant differences between male and female teachers, more male teachers (62%) compared to female teachers (52%) indicated *"Developing skills and confidence in using digital technologies in teaching"* as being an area that could support their teaching. There was also a direct relationship between years of experience and what

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[9] The T4 survey gave teachers 18 areas from which to choose, including a response that stated "no support needed".

proportion identified "*Developing skills and confidence in using digital technologies in teaching*" as a priority — 44% of teachers with less than 2 years teaching experience identified this as a need compared to 68% of teachers with more than 30 years teaching experience. Likewise, for "*Pedagogy/teaching methods for my own professional development*", 30% of teachers with less than 2 years teaching experience identified this as a need, compared to 56% of teachers with more than 30 years teaching experience. So, teachers with more experience expressed a greater desire to engage in TPD on using technology and developing pedagogical skills. This is an encouraging sign that more experienced teachers are reflective practitioners, thirsty for new learning and skills development.

DISCUSSION AND RECOMMENDATIONS

Technology: Access and use

That 38% of respondents (rising to 47% for teachers in rural areas) reported that their school does not have access to any form of technological device is a concern, but not a surprise. This finding is supported by the Ministry of Works, Transport and Communication's (2016) National ICT policy which states that the benefits of ICT within the education system are "only evident in some schools and higher learning institutions in urban areas. Currently, few educational institutions, mostly private, have incorporated the use of ICT in education delivery" (p. 6). Thus, expanding technological access to government schools, especially those in rural areas, is necessary, particularly given the stated objectives for Tanzanian teachers to integrate technology into their classroom practice (Ministry of Education, Science and Technology, 2018: 62). Alongside expanded access to devices, though, must come the necessary wraparound support and guidance for schools, led by national-, district-, and ward-level systems to ensure that devices are properly used and maintained (Onguko, 2014).

Shared device models are growing in popularity in programmes across the global South (e.g., one tablet per school in Sierra Leone (McBurnie, 2021). This could be an area worthy of further exploration for the Government of Tanzania. Understanding the most appropriate combinations and levels of technology within this shared device model via research and practical implementation is recommended. Indeed, EdTech Hub is currently leading research partnered with Aga Khan University and TIE on this matter in schools within the Lindi region (to scale nationally from 2023). Rolling out further tests and pilots in other regions would provide a deeper understanding of regional differences in relation to the best technological combinations and levels that are both effective and cost-effective for delivery at scale.

High proportions of teachers (half the sample in certain instances) never used digital resources for teaching and learning purposes; this follows the aforementioned evidence from Mgaiwa (2018) and Swarts and Wachira (2010) regarding limited technology use in Tanzania among teachers. This is a significant finding that must be addressed if teachers are to effectively integrate technology into their practice, for improved learning outcomes. The limited time spent on TPD — and therefore TPD for tech use — may contribute to the low frequencies of tech use. As there were teachers (often those with higher levels of qualification) that used technology more frequently and in more complex ways, certain individuals could assume roles as "digital champions" within schools. Indeed, a study in South African schools by Dlamini and Mbatha (2018) noted that championing teachers were crucial to ensuring proper technology integration in the classroom. Following such a model, these individuals could provide peer support, either formally or informally to their colleagues, through methods such as coaching or mentoring. Beyond this, modelling good practice within their own classroom settings would also be an effective way to leverage the existing in-house tech skills within schools. Familiarity with tech tools, and indeed digital fora for communication with peers such as social networks, has been shown to help with teachers' attitudes and eventual acceptance of technology for teaching and learning purposes (Bağcı and Atar, 2018). However, a separate Bağcı and Atar (2019) study noted daily use of technology, whether time spent on the internet or social networks did not have a significant effect on teachers' self-efficacy levels; interestingly, in this study, the teacher's grade level was the only variable that had a significant effect on self-efficacy levels, in that teachers from higher grades had higher self-efficacy (Bağcı and Atar, 2019). Thus, the findings are somewhat mixed with respect to the integration of digital technologies in the classroom, demonstrating the importance of acknowledging and responding to teachers' perceptions, skill levels and needs in relation to technology integration in the classroom.

Teachers perceived that schools offered different levels of encouragement to use technology. Significant differences existed across teacher characteristics as well. Teachers with 21 to 30 years of teaching experience were the least encouraged to use technology by experience level, while the least qualified teachers were also less likely to be encouraged by their schools to use technology. The school leader is crucial in encouraging teachers to use technology, and generally, in setting the culture within a particular school (Hennessy et al., 2022). Of course, when considering the use of technology in the classroom, there are infrastructural / device availability issues that sit more at the macro level. Nevertheless, school leaders should champion appropriate technology usage — when it is available — to promote the improved practice and broader cultural shifts within schools.

Learning: Progress and assessment

Almost half of the teachers surveyed believed that girls suffered more learning losses than boys — 50% higher than the global average. Moreover, 62% believed learners from the financially poorest households suffered the greatest learning losses. Therefore, focusing on remedial learning for girls *and* learners from low-income households is a critical issue, and, perhaps even more critically, focusing on the intersection of the two groups (i.e., girls from low-income households). Any focus on this issue, however, must take into consideration that remedial learning should be contextually specific to the learning needs within a particular school or community. As a recent UNESCO (2022) global report spanning 140+ countries notes, boys in many contexts are at greater risk than girls of repeating grades or generally having poorer learning outcomes at school; economic pressures within families mean they may be pushed into employment early, rather than continuing with their studies. Therefore, gender-responsive pedagogies are perhaps more appropriate and should be included within TPD opportunities provided to teachers. Although this area was not identified by teachers as a key priority for them (Figure 12), TPD must also be designed with student learning needs in mind (students being the other, crucial micro-level actors); a deeper understanding of their precise and varied learning needs can help TPD designers consider this vital group.

Importantly, assessment of learning was not consistent or systematic in Tanzania, with just half of the teachers in rural areas stating that they assessed their students' learning levels. This must be investigated, with connected rural issues such as larger class sizes (Uchidiuno et al., 2021) forming part of this problem analysis. Almost half of the sample urged the government to promote the teaching profession; recruiting more teachers and support staff (e.g., "para-teachers") is certainly a way of reducing pupil-teacher ratios, thus ensuring teachers have more focused time with learners (Kingdon et al., 2013). The ways in which technology could expand assessment modalities — both formative and summative — should also be explored. However, it must be noted that ensuring the take-up of technology by teachers can often be a prerequisite to students effectively using the technology themselves in classroom settings.

Teacher professional development: Access, engagement, impact

Teachers in Tanzania engaged in very little TPD over the period 2020–2021. Just a quarter of teachers engaged in any form of professional development or training. The global survey findings tell a very different story, with a remarkable 42% of teachers engaging in more than ten full days of professional development. Regionally, around a third of teachers from sub-Saharan Africa (34%) engaged in more than ten days and 93% had at least 1 day of training over the previous year (Kingdon et al., 2013). So, results from Tanzania are very low relative to both global and regional data. This evidence speaks to Hardman et al. (2011) and Mgaiwa's (2018) previously cited assertions that TPD in Tanzania has been inconsistent and incoherent, with irregular provision. Moreover, globally, the increased amount of TPD that teachers participated in was largely down to long-term school closures and the transition to remote teaching and learning. This is evidenced by the majority of TPD that teachers engaged in globally, focusing on either: "Using technology tools and resources for online or remote teaching and learning (53%) or "Pedagogies for online or remote teaching and learning" (43%). Therefore, the increased provision from the global data might well speak to greater impacts of long-term school closures, which did not happen in Tanzania. Even regionally, many countries in East Africa enforced much longer periods of school closure. Schools in Kenya, for example, were fully closed for 28 weeks; while schools in Uganda were closed for almost 2 years (UIS, 2022). In Tanzania, on the other hand, schools were closed for just 11 weeks.

Despite low participation rates in Tanzania, of the teachers that did engage in TPD, more than two-thirds said that TPD changed their practice a lot. As the largest reported TPD focus was on engaging with parents and/or caregivers, it would be interesting to explore teachers' effectiveness in this area, especially given the important role parents and caregivers play in learning — and particularly in remote learning (World Bank et al., 2020).

When approaching TPD opportunities from an equity lens, we see that far fewer rural teachers engaged in TPD compared to teachers in urban areas. We also find that teachers with a disability or those in rural areas reported that the TPD was less effective in changing their practice (although teachers who identified as having a disability or long-standing illness were a lower proportion of the total sample). The government has a significant role in the provision of more equitable support for marginalised teachers.

A report from the Global Partnership for Education's Knowledge and Innovation Exchange Observatory on *Covid-19 Responses in Africa's Educational Systems*, states that key emerging issues during the pandemic across the 40 African countries studied were:

1. The lack of teacher preparedness for distance education.
2. The challenges to teachers' social and economic well-being during the Covid-19 pandemic.
3. Best practices in supporting and monitoring learner progress (ADEA, AU/CIEFFA, APHRC, 2022: 2).

Similar issues related to distance teaching and learning, teachers' well-being, and learner assessment have been recurrent within this survey. Indeed, respondents identified two clear priorities to focus TPD on moving forward: using digital technologies and well-being. On well-being, more than one-third of teachers (35%) indicated that their well-being suffered during the pandemic, this must be taken into account at all levels of the ecosystem, and increased support for teacher well-being is apparent across the broader literature (Inter-agency Network for Education in Emergencies, 2022). The above priorities must reflect the TPD that teachers engage in, and the overall support they receive in and out of school.

We complete this discussion with a list of **key takeaways and associated recommendations** from the survey analysis:

Technology: Access and use

1. Thirty-eight percent of teachers (rising to 47% for teachers in rural areas) reported that their school does not have access to any form of technological device.
Recommendation: Explore shared device models, particularly for rural schools, to understand the most effective and cost-effective means for expanding the use of technology by teachers at scale.

2. High proportions of teachers — more than half the sample for certain activities (e.g., assessing student learning or engaging in professional communities of practice) — never used digital resources for teaching and learning purposes over the past year.
Recommendation: Provide support to head teachers to promote technology use for pedagogical purposes. This could include dedicated professional development opportunities for school leaders on the subject of positive culture-setting in schools.
Recommendation: Develop "digital champion" roles for teachers within schools where opportunities are presented, modelling good practices and supporting peers, to create collegial environments where collective learning, growth, and care for each other are promoted.

3. Teachers with 21 to 30 years of teaching experience were the least encouraged by their schools to use technology. The least qualified teachers were also less likely to be encouraged by their schools to use technology.
Recommendation: Ensure that **all teachers** (regardless of gender, age, experience, location, etc.) are equally encouraged and supported to use technology.

Learning: Progress and assessment

4. Almost half of the teachers surveyed believed that girls suffered more learning losses than boys. Moreover, 62% believed learners from the financially poorest households suffered the greatest learning losses.
Recommendation: Focus remedial learning efforts on girls, learners from low-income households, and possibly the intersection of the two.

5. Assessment of learning was not consistent or systematic in Tanzania; just half of the teachers in rural areas stated they assessed their students' learning levels.
Recommendation: Establish more robust mechanisms for assessing student learning continuously, particularly in rural areas; include training and support for this in TPD.
Recommendation: Ensure teachers have enough focused time with learners to build an understanding of their learning levels.

TPD: Access, engagement and impact

6. Just 24% of the 774 teacher respondents indicated they had taken part in any form of TPD or training (organised or self-initiated) over the previous 12 months.
Recommendation: Provide specific, continuous, and equitable opportunities — and dedicated time — for teachers to engage in professional development, especially reaching rural teachers and those with disabilities in ways that meet their specific needs through varied learning modules.

7. While 43% of teachers living in urban areas engaged in TPD, the proportion for teachers living in rural areas was just 17%. Urban teachers were much more likely to indicate that TPD programmes that they took part in changed their teaching practices "a lot" (84%), compared to their rural counterparts (56%).

Recommendation: Customise TPD for the needs of teachers, especially rural teachers, to make it more accessible and relevant.

8. The support areas most identified by teachers as needed to improve their practice over the next 12 months included "developing skills and confidence in using digital technologies in teaching" (57%), "caring for my mental health and well-being" (51%) and "pedagogy/teaching methods for my own professional development" (37%): Figure 12.
Recommendation: Ensure that districts and wards have sufficient resources to support teachers' well-being within the new decentralised TPD plans. Mechanisms could include embedding time for teachers to discuss issues with dedicated well-being support workers, and providing holistic support at the school and community levels.
Recommendation: Assess needs continuously: 1) Ensure programmes and policies incorporate teachers, school leaders and other practitioners' voices, for example via continuous needs assessments. 2) Ensure that needs assessments to acknowledge teachers' time constraints and attempt to align and synchronise data collection efforts to the largest extent possible. 3) Inform practitioners as to the outcomes of previous data collection exercises.

9. Issues such as safeguarding, teaching to learners' needs, and gender-responsive pedagogies were lower priorities for teachers.
Recommendation: Design TPD related to learners' needs and with student learning outcomes in mind, especially considering gender-responsive pedagogies — acknowledging both girls' and boys' obstacles to educational attainment.

CONCLUSION

We hope the insights and recommendations from this paper will inform ongoing tech-supported teaching and learning, and TPD in Tanzania. We believe these insights will also resonate with educators, policymakers, and TPD providers across East Africa and beyond, where similar issues are known to arise.

Overall, it is imperative that the education system is listening to the voices of its teachers. This is a continuous process, where surveys such as this can support the broader dialogue between national-, district-, ward-, and school-level actors. However, ensuring that the system itself can establish systematic, sustainable means of gathering teacher feedback, and then acting on this through programme design adaptations is an aspiration that all education systems should have. This can only heighten the ways in which systems can reorient to be more teacher- and learner-centred.

AUTHORS' CONTRIBUTIONS

Saalim Koomar led the journal article write-up and contributed to the survey design. Sara Hennessy provided technical oversight and contributed to the writing and survey design. Asma Zubairi analysed the quantitative data, wrote the methodology section, and contributed to writing up the findings. Robert Kindoli contributed to the methodology and led the HakiElimu data collection exercise. Adam Kreimeia contributed to the survey design and supported the write-up.

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Appendix: Survey Questions

Note: we have just listed the main survey items here, subcategories for most items have been omitted for brevity.

About you.
1. During the last 12 months, did you work as a school teacher?
2. What best describes your gender? Select one answer.
3. Do you have any long-standing illness, disability, or infirmity? (Long-standing means anything that has troubled you over a period of time or that is likely to affect you over a period of time)?
4. How many years of school teaching experience do you have?
5. What is the highest qualification for teaching you have received?
a. You told us that you do not have a qualification for teaching. What is the highest level of any qualification you have received? Select one answer.

About your school.
6. What type of area is your school located in? Select one answer.
7. What type of school do you teach at?
8. Describe the infrastructure usually available in your school.
9. Which of the following best describes the digital devices usually available in your school? Select all answers that apply to you.

About your learners.
10. What age are the learners you are teaching this year? Select all answers that apply to you.
11. If you are teaching at a secondary school or tertiary college/university, what subject(s) do you teach? Select all answers that apply to you.
12. Overall, how would you describe the socio-economic status of the learners at your school? Select all answers that apply to your school.

Teaching during the COVID-19 pandemic.
13. What happened to your school during the COVID-19 pandemic?
14. You said that your school was closed during lockdowns. Were teachers able to undertake remote learning in those times? Select one answer.
15. Did you do any of the following in the COVID-19 pandemic?
16. During the last 12 months, how often did you do the following activities?
17. Did your school encourage you to use any digital resources for lesson planning and teaching? Yes No
a. Which digital resources did your school encourage you to use? Overall, how useful was that tool?

Current teaching challenges.
18. To what extent is this school's capacity to provide quality instruction currently hindered by any of the following issues? Select one answer per row.

Learning loss and teaching post COVID-19.
19. What are your experiences with learners in your class(es)?
a. You told us that some or none of your students have progressed their learning (or you didn't know). Have any of these things been affected?
b. Have you noticed anything else has been affected as a result of your students not being able to progress their learning during this time?
20. If your school reopened following closures for the COVID-19 pandemic, which of the following has taken place? Select all answers that apply to you.
21. Have any of these groups of learners experienced more learning loss than other students?
4. In your experience over the past 12 months, are any of these true?
22. Have you noticed any other groups of learners who have had a poorer quality or reduced learning experience compared to others?
23. What should your school do post COVID-19 in teaching, pedagogies, or structurally to help learners to catch up? Select all answers that apply.
24. What should governments do post-COVID-19 to address any loss of learning experienced?

Your professional learning.
25. During the past 12 months did you take part in any form of teacher professional development or training (organised or self-initiated)?
a. You told us that you took part in teacher development or training in the past 12 months. Who paid for the cost of it?
b. You told us that you took part in teacher development or training in the past 12 months. What did it focus on?
c. You told us that the focus of your professional development or training was the use of technology tools and resources for online teaching. What kind of tools or resources did you learn about?
26. Think back across the (organised or self-initiated) professional development or training you experienced over the last 12 months (on any topic). Overall, to what extent did your practice change as a result?
27. How much time in total was spent on your professional development or training over the last 12 months? Add up the actual time you spent and answer in whole days.
28. An extensive global platform might be developed over the coming year where teachers can share classroom practices with others outside their regions. Would you consider using this to share teaching resources and lesson plans that you have created yourself?"
29. Which is NOT the type of school you teach at?

Your needs as a teacher.
30. Which of the following areas could support your teaching in the next 12 months? Select up to five (5) answers maximum.
31. What further support could help you in the next 12 months?
32. Do you need more access to software or other (non-hardware) digital resources for the following tasks? Select one answer per row.

The COVID-19 pandemic and the teaching profession.
33. Which of these statements best describes the quality of your teaching during the COVID-19 pandemic? Select one answer.
34. How do you feel about teaching since the pandemic started?
a. You told us you were more enthusiastic about teaching now. Why?
b. You told us you were less enthusiastic about teaching now. Why?
35. How would you describe the level of respect/esteem that parents/caregivers have for teachers since the pandemic started? Select one answer.
36. How would you describe what has happened to your physical, mental, and emotional well-being since the pandemic started? Select one answer.
37. Which of these statements best describes your current plans in the teaching profession?
38. How likely are you to recommend teaching to friends, family, or others?