

Learners and caregivers barriers and attitudes to SMS-based mobile learning in Kenya

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ABSTRACT

The use of mobile phones has been identified as a potential way to bring the benefits of educational technology to a wider audience, including in low-connectivity settings. This is a topic that has received renewed interest recently as a result of the COVID-19 pandemic and school closures. While a number of recent studies have demonstrated good potential for mobile phones and SMS to be used to support learning, there are also questions about how equitable this medium is in practice. We conducted a telephone survey with learners (n = 122) and their caregivers (n = 124) who use M-Shule, an SMS-based educational platform in Kenya, in order to understand their attitudes towards mobile learning, and the benefits and constraints. In particular, we consider whether there are differences in responses according to gender and/or location, to shed light on whether use is equitable. We find that girls and boys face similar barriers to use, and the technology is perceived to be equally beneficial. We identify some areas for potential further support for all learners through mobile learning.

Keywords: Educational technology, equity, mobile learning, SMS.

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INTRODUCTION

One of the main potential benefits of the use of mobile phones to support learning - through 'mobile learning', or 'm-learning' (Traxler, 2005) - relates to equity. As mobile phones have lower connectivity requirements and data costs, and levels of device ownership are often higher in low-income contexts, in comparison with computers and other devices, they arguably represent a more equitable way to digitally access education (GEEAP, 2022; Sharples and Pea, 2014). This is potentially particularly important in the context of Kenya, where levels of mobile phone ownership (particularly feature phones) are high in comparison to computers (Cotter Otieno and Taddese, 2020).

The role of m-learning has received renewed attention recently, as a result of school closures and the need to support learners remotely due to the COVID-19 pandemic (GEEAP, 2022). However, the pandemic has also highlighted the digital divides that exist which means that seemingly ubiquitous technologies may not be equitable in practice (Crompton et al., 2021; Young Lives, 2021).

In this study, we report findings from a telephone survey undertaken with learners and caregivers who use M-Shule, an SMS-based mobile learning platform, in Kenya (UNESCO, 2022). Content delivery and quizzes are facilitated through SMS, and learners' progression through the content is determined by their performance on quizzes. This combination of SMS and personalised learning represents the next step in the wider research agenda around SMS-based education, with the potential to apply these principles at scale. Furthermore, it also contributes to addressing a gap in the literature in relation to the use of educational technology with school-aged learners in low- and middle-income country contexts, as the existing literature tends to focus on the level of higher education (Mitchell and Jordan, 2021; Myers et al., 2021).

Recent SMS implementations in M-learning

The use of mobile phones - and specifically SMS-based

messaging - to support education dates back to the early 2000s, with the advent of the term 'mobile learning' (Traxler, 2005). A key affordance of m-learning has been its relative ubiquity, and high uptake of mobile devices in low-income and low-connectivity settings (Sharples and Pea, 2014). A range of initiatives have applied this form of technology to support education at various levels, from teacher networks to a means of delivering educational content to learners (Jordan, 2023).

As the COVID-19 pandemic took hold in 2020, school closures were one of the most widely and quickly implemented policy responses across the globe (Hale et al., 2021). The use of mobile phones became part of many responses to continue education remotely, informally or formally, and the focus of a number of research projects and recent publications (Jordan et al., 2023). Recent studies comprise three main ways in which SMS has been used to support education since the advent of the COVID-19 pandemic: to provide 'nudges' for participation or re-enrolment in school; to support caregivers in facilitating learning at home; or to support learners directly (ibid.). The present study aligns primarily with the third category, as M-Shule is an SMS-based platform to deliver educational content to learners, but also with the second category to an extent, as caregiver support is also required for young learners to access and make use of mobile devices.

Kizilcec et al. (2021) present a study based on an analysis of platform usage data from a different SMS-based system, Shupavu291. Developed by Eneza Education, Shupavu291 delivers curriculum-linked educational materials and quizzes to learners and allows questions to be submitted to teachers, via SMS (Kizilcec and Goldfarb, 2019). The study sought insights into educational disruption and mobile learning through the analysis of usage data from a previous period of school closures in Kenya in 2017, relating to political unrest. It showed that use of the platform increased during periods of disruption, and there was slightly different user demand; for example, learners often make greater use of quizzes in the run-up to exams, but during disruption, there was more emphasis on accessing content (Kizilcec et al., 2021).

In the context of COVID-19 pandemic responses, two studies present evaluations of the efficacy of SMS-based initiatives, both focusing on numeracy. In Botswana, Angrist et al. (2022) assigned households to either a control group or one of two treatment arms; the first group received numeracy 'problems of the week' by SMS messages, while the second received the messages and additional support via phone calls from teachers. While SMS showed initial promise, the gains overall were limited; the SMS and phone call arm showed substantial improvement, and the targeting of messages to the students' level was also associated with increased learning gains. Schueler and Rodriguez-Segura (2021) report on a similar intervention - using SMS assignments and teacher phone calls - undertaken in Kenya, but later in the course of the pandemic when schools had begun to reopen. They report positive short-term numeracy gains, particularly for children who did not return to school. However, in the months following

the intervention, the benefits were not maintained for children who returned.

There is a further notable study undertaken during the COVID-19 pandemic which reached learners and addressed socio-emotional support through SMS (Lichand et al., 2022). The intervention involved sending SMS messages to high school students in Brazil, which "targeted students' socio-emotional skills; in particular, messages tried to motivate students to stay engaged with school activities during remote learning, to support them in regulating negative emotions, to foster a growth mindset, and to develop grit" (Lichand et al., p.4-5). Although the intervention did not tackle the subject matter directly, it was associated with significant learning gains in maths and Portuguese. This also reflects findings from a previous study on the Shupavu291 platform prior to the pandemic, which found a growth mindset to be associated with higher test scores (Kizilcec and Goldfarb, 2019).

Mobile learning and equity

Mobile learning has long been associated with potential equity benefits, as a cheaper, more widely available medium than computers or high-speed internet connections. However, it is also necessary to take a closer look to consider whether this potential is realised in practice. In the context of Kenya, overall levels of mobile phone subscription are much greater than levels of internet access (117% of the population - meaning that it is common to have more than one - compared to 33% of the population being internet users; DataReportal, 2023). Household device ownership does not necessarily equate to use by learners or for educational purposes. Furthermore, there is variation within this related to socio-economic factors and urban/rural divides. For example, in a study of low-tech educational delivery during the pandemic, Amenity et al. (2021) reported that girls in more rural Arid and Semi-Arid Lands (ASAL) within Kenya often experienced a higher level of chores or other household members were prioritised in terms of usage of radios and televisions, which created barriers to engagement.

Watson et al. (2023) provide a detailed analysis of the barriers to engagement with educational technology faced by girls in Kenya. Through interviews with caregivers, quantitative and qualitative data were collected in order to understand household demographic factors and attitudes toward girls' use of technology for education at home. 'Caregiver permission' clearly emerged as the most influential factor for access. Four themes were identified in the qualitative analysis: "the risks to the child posed by EdTech (risks); the dependability of EdTech content (rigour); the convenience of EdTech learning (convenience) and the opportunity that EdTech presented for co-learning (co-learning)" (Watson et al., 2023, p.1016). The sample was deemed to be representative of Kenyan households, due to its comparability with the Demographic and Health Surveys' Malaria Indicator Survey (Watson et al., 2023).

Given that households in the sample have good levels

of ownership of devices, and caregiver permission is the main barrier, they conclude that it would be useful to raise awareness about the potential benefits of girls' use of technology alongside the risks. The analysis raises further questions about the extent to which the issues identified are particular to girls or also applicable to boys in this context.

Finally, in a review of effect sizes of learning outcomes - specifically for girls - from a range of educational technology interventions undertaken in low- and middle-income country settings, software applications that use personalised learning were shown to be relatively more effective than other forms of software or hardware (Jordan and Myers, 2022). However, it is also notable that relatively few evaluations of educational technology provide findings and results disaggregated by gender, and that gender gaps are also intersectional in nature (Myers et al., 2023). Furthermore, no studies were found that used SMS, yet this represents a potentially effective way to apply personalised learning at scale. As such, there is a unique contribution to be made by understanding learners' and caregivers' perspectives on the use of the M-Shule platform. M-Shule uses rule-based artificial intelligence to offer personalised learning experiences to Kenyan children and deliver educational content through SMS. M-Shule is based on offering personalised educational content by using quizzes to assess and support learners' progression. We adopt an intersectional view of equity as an analytical lens for the study, to focus on whether there are any differences according to gender or location.

Research questions

The telephone survey was undertaken in order to help address the following overarching research goal, of understanding whether the experiences of girls and boys differ when taught through this form of EdTech, and if so, why is this the case. In order to address this overall goal, the following research questions guided the study:

- Are there any perceived differences in benefits and constraints of using m-learning through SMS according to learners' gender and location?
- How do caregivers' attitudes to m-learning vary according to gender and location?
- Do learners' beliefs about education vary according to gender and location?

The third question here relates specifically to questions of learner self-efficacy and growth mindset, which are correlated with academic achievement across a range of contexts and could be a focus for designing additional support for learners through messages.

METHOD

In order to address the research questions, a telephone survey was conducted with a sample of both learners who use the M-Shule platform and their caregivers. The

survey utilised Likert scales and multiple-choice questions. As such, it generated quantitative and categorical data. The survey was administered by phone calls, in order to access a relatively large sample of participants in locations dispersed across the country, while achieving a higher response rate than an SMS survey, for example (Busara Centre, 2022).

Survey design

A two-stage approach was used in order to design the survey. First, we collated questions and instruments used in a range of recent studies which also focused on the use of SMS for education and/or gender in LMIC contexts (Aurino et al., 2022; Beam et al., 2021; Chapman, 2010; Kizilcec and Goldfarb, 2019; Waszak et al., 2001; Wolf and Aurino, 2021). The pool of questions was arranged into groups reflecting the goals of the survey, and additional questions were drafted where required. Second, the EdTech Hub and M-Shule teams then organised a co-creation workshop aiming at selecting, refining and contextualising a maximum of 10 questions to be used as part of the survey. In order to promote openness and replicability in research processes, the survey questions have been openly published in full (Myers et al., 2022).

The survey was designed to be relatively short, in order to increase participation rates (Angrist et al., 2020; Busara Centre, 2022). It comprised ten questions for caregivers and nine for learners. The questions are shown in full in the Annex. In addition to background and demographic questions, research question 1 was mainly addressed through questions 4, 5 and 6 of the learners' survey, while research question 2 was addressed through questions 6 to 10 in the caregivers' survey. Furthermore, questions 7, 8 and 9 in the learners' survey addressed research question 3.

Before full data collection, the survey was pilot-tested, and the phrasing of some questions was adapted based on participant feedback. An incentive of 250 KSh airtime was offered, to increase participation rates (Busara Centre, 2022).

Sampling and data collection

Potential households were identified from a pool of users of the M-Shule platform, with sampling stratified to ensure a balanced representation of girls and boys, and across a range of locations within Kenya in order to try to gain insight from a range of perspectives. As the sample was drawn from the existing users of the platform, it was not nationally representative and spanned ten of the 47 counties of Kenya. Due to differences in response rates, three counties accounted for a majority of the responses: Kajiado (33.9%), Nakuru (25.8%) and Nairobi (12.1%). Counties were categorised according to whether they are located in Arid and Semi-Arid Lands (ASAL) or non-ASAL regions (Birch, 2018) as access to education may also vary according to location, with lower school attendance and greater gender gaps

in counties in ASAL counties (UNICEF Kenya, 2018).

Seven of the ten counties included in the sample were ASAL counties. Responses were recorded from 124

caregivers and 122 learners (children in Grades 3 to 6, typically between nine and twelve years of age). An overview of the sample is shown in Table 1.

Table 1. Overview of the sample of telephone survey participants.

Caregivers (n = 124)	n	%
<i>Gender</i>		
f	81	65.32
m	42	33.87
Missing	1	0.81
<i>Location</i>		
ASAL counties	89	71.77
Non-ASAL counties	35	28.23
Missing	0	0
Learners (n = 122)		
<i>Gender</i>		
f	61	50
m	58	47.5
Missing	3	2.5
<i>Location</i>		
ASAL counties	52	42.6
Non-ASAL counties	25	20.5
Missing	45	36.9
<i>Year born</i>		
2010 or earlier	22	18.0
2011 to 2013	87	57.2
2014 or later	9	7.4
Missing	4	3.3

The survey data were collected during July and August 2022. The dataset is approximately evenly distributed in terms of children's gender (50% female, 47.5% male, and 2.5% missing data). For learners whose location was available, most were based in ASAL counties (43% compared to 21% in non-ASAL counties). Note that location data were missing for a substantial proportion of learners (37%), due to instances where the survey was completed in two separate calls (one to learners, and one to caregivers, instead of a single session). The year of birth of learners ranged from 2005 to 2015, although the majority (71%) were born between 2011 and 2013. The majority of learners attended school five days a week (71%), with no significant differences in terms of learners' gender ($\chi^2 = 2.686$, $df = 3$, $p = 0.443$, $n = 119$) or location ($\chi^2 = 2.269$, $df = 3$, $p = 0.519$, $n = 77$).

A total of 124 caregivers completed the survey. The majority of respondents were female (65%). Approximately three-quarters were located in ASAL counties (72%, compared to 28% in non-ASAL counties). The modal number of children per household was three (28% of respondents). There were no significant differences in the number of boys or girls that caregivers cared for based on either gender (girls, $\chi^2 =$

3.238 , $df = 5$, $p = 0.663$, $n = 117$; boys, $\chi^2 = 9.605$, $df = 6$, $p = 0.142$, $n = 117$) or location (girls, $\chi^2 = 4.645$, $df = 6$, $p = 0.59$, $n = 118$; boys, $\chi^2 = 7.394$, $df = 7$, $p = 0.389$, $n = 118$).

Data analysis

The approach to data analysis included generating descriptive statistics in order to look for trends within the data, and the use of further statistical analyses in order to examine key factors in relation to the research questions, specifically to consider whether there are any differences in responses based on gender and/or location. Location data were collected at the county level and categorised for analysis according to whether the location is within the arid and semi-arid lands (ASAL) (Birch, 2018). Since the survey generated categorical data, chi-squared tests were applied (Field, 2009).

Ethics

An application was approved by the EdTech Hub ethics

panel. Furthermore, an application was made to the ethical review board of Maseno University, Kenya, and NACOSTI for a research permit (Laterite, 2021). Sensitisation messages were sent to platform users identified as potential participants ahead of telephone calls. At the start of calls, participants were briefed about the project and asked to confirm whether they gave consent to take part, for themselves and on behalf of their child. Participants were free to decline to answer any questions and could withdraw at any time.

RESULTS

In this section, we present an overview of the data collected and key findings from the analysis.

RQ1: Benefits and constraints

The first research question focused on learners' experiences, asking '*Are there any differences in perceived benefits and constraints of using m-learning through SMS according to learners' gender and location?*' Three of the survey questions focused on how easy or hard it is for learners to access mobile learning at home, and if so, the reasons why. The resultant data were stratified by gender and location to answer the research question. The first of these questions asked learners '*How easy/hard is it to find time to use M-Shule at home?*' Approximately half (54%) of students surveyed found it to be either easy or very easy to find time to use M-Shule at home, however, approximately a

quarter (23%) stated that it was hard or very hard to find time (Figure 1). Note that while there was a slightly different profile of responses from boys and girls - the modal response from boys was 'very easy' while for girls it was 'easy' or 'neutral' - there were no significant differences in this pattern of responses in relation to learners' gender ($X^2 = 3.435$, $df = 4$, $p = 0.488$, $n = 109$) and/or location ($X^2 = 1.001$, $df = 4$, $p = 0.91$, $n = 68$).

Learners were then asked which factors prevent them from using M-Shule. The chief reason was because they did not have access to a phone (Figure 2). Notably, whilst the percentages associated with each reason were not significantly different for boys and girls ($X^2 = 0.748$, $df = 3$, $p = 0.862$, $n = 72$), this was not the same for students based in different locations. The chi-square test revealed a significant difference in the reasons given by students based on where they live ($X^2 = 8.885$, $df = 3$, $p = 0.03$, $n = 42$).

All except one student (96%) in ASAL countries were unable to use M-Shule as much as they would like to because they did not always have access to a phone. However, the reasons provided by those in non-ASAL countries were more varied, with only 63% reporting phone access as a concern, and 19% highlighting a poor phone signal as a barrier.

The learners who indicated that they found it hard or very hard to find time to use M-Shule were also asked to give more information about why this is the case. Of these responses, the most frequent was 'You don't have time after finishing your homework' (8) followed by 'By the time you have free time, you feel tired and need to sleep' (6). Caring responsibilities and work were only reported in a few cases (<3).

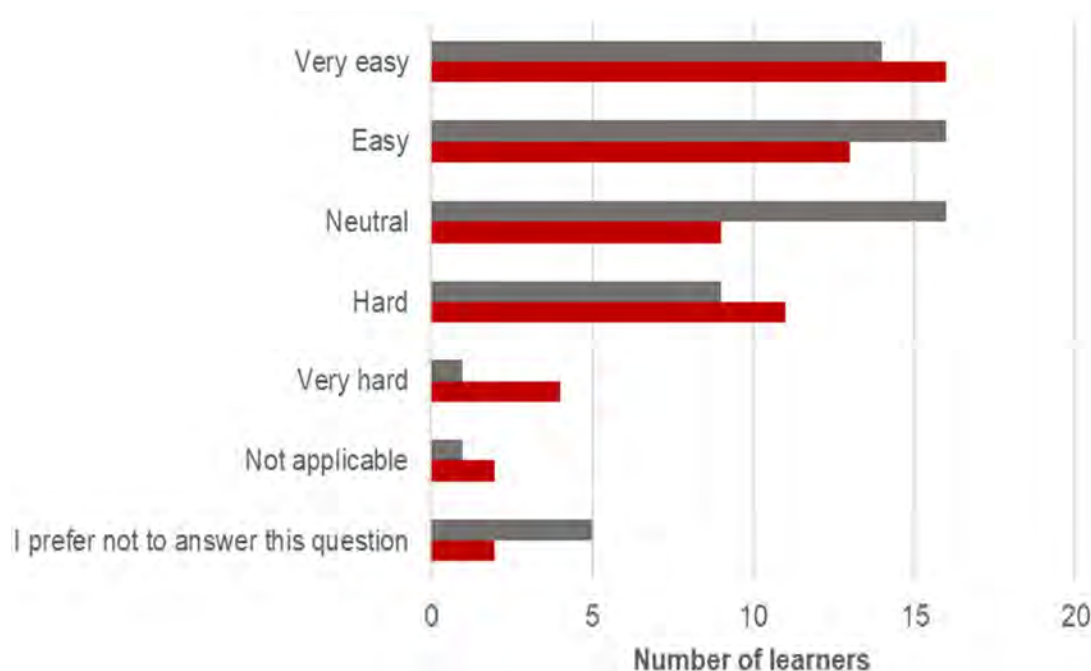


Figure 1. Frequency of levels of difficulty to access the platform at home considering the children's gender. Girls' responses are shown as grey bars, and boys are shown as red bars.

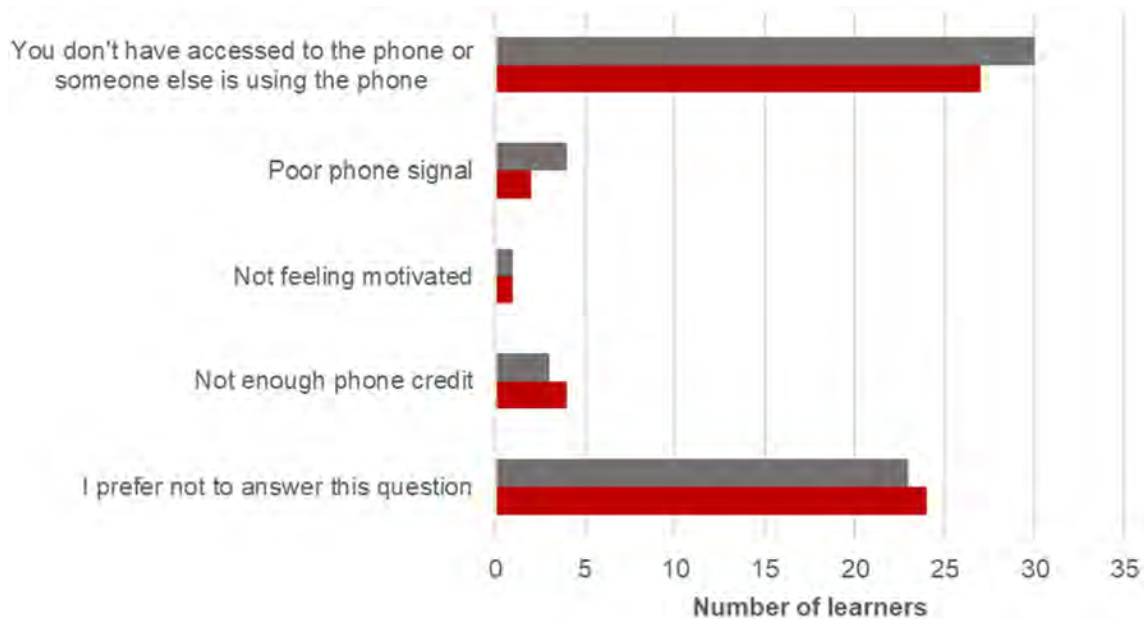


Figure 2. Frequency count of children's reported reasons that might prevent them from using the platform at home. Girls' responses are shown as grey bars, and boys are shown as red bars.

The final question concerning barriers to the use of m-learning touched upon learners' digital literacies, through the question 'How comfortable are you to use a phone without any help?' The majority of learners were either comfortable or very comfortable using a phone (61%), and no significant differences were seen according to learners' gender ($X^2 = 3.928$, $df = 4$, $p = 0.416$, $n = 119$) or location ($X^2 = 6.972$, $df = 4$, $p = 0.137$, $n = 77$).

RQ2: Caregivers' perspectives

The second research question addressed caregivers' perspectives on the use of mobile phones for learning, through 'How do caregivers' attitudes to m-learning vary according to gender and location?' It was very common (42%) for caregivers to report having 2 phones in the home. However, there were significant variations in the number of phones present, based on a caregiver's gender ($X^2 = 13.928$, $df = 3$, $p = 0.003$, $n = 120$). Men tended to have more phones than women. Specifically, men were more likely than women to report having 3 or 4 phones, and women were more likely than men to report having only 1 phone. Despite these differences in levels of ownership, there were no significant differences in perceived digital literacy. Caregivers were generally very comfortable using a phone without any help, with 71% of them stating this. There were no significant differences in responses based on gender ($X^2 = 3.467$, $df = 4$, $p = 0.483$, $n = 123$) or location ($X^2 = 5.927$, $df = 4$, $p = 0.205$, $n = 123$).

Female caregivers were more likely to report using the M-Shule platform with their children. There were significant differences in how often caregivers used M-Shule with their children, based on whether the caregiver was male or female ($X^2 = 14.668$, $df = 5$, $p = 0.0119$, $n =$

121). This was addressed through the question 'How often do you use M-Shule with your children at home?' The majority of caregivers (who answered this question) - 55% - reported using the platform either 2 to 3 times per week or once a week with their children. A follow-up question asked 'How easy or hard is it to find time to use M-Shule at home with your children?' Most respondents either had a neutral view (31%), or they agreed that it was very easy (26%). There were no significant differences in responses based on gender ($X^2 = 7.338$, $df = 4$, $p = 0.119$, $n = 121$) or location ($X^2 = 4.669$, $df = 4$, $p = 0.323$, $n = 122$).

Caregivers were very positive in their opinion of using M-Shule, as shown by their responses to a 'net promoter score' question, which is a question type used as a general indication of the level of user satisfaction ('How likely are you to recommend using the M-Shule platform to other parents?') (Kizilcec and Goldfarb, 2019). Whilst generally speaking, caregivers were more likely than not to recommend M-Shule to other parents, female caregivers were much more likely than male caregivers to recommend it ($X^2 = 16.691$, $df = 4$, $p = 0.002$, $n = 122$). 79% of women stated that they were very likely to recommend M-Shule, compared to only 45% of male caregivers. There were no significant differences in responses based on location ($X^2 = 3.383$, $df = 4$, $p = 0.496$, $n = 122$). It is not clear why significant differences were found in relation to caregivers' gender in this instance. It may be related to the gender differences reported in terms of how likely caregivers are to use the platform - that is, given that male caregivers are less likely to use the platform, they may also not have seen the benefits. It is also important to note that female caregivers were represented to a greater extent within the sample.

Finally, caregivers were asked about their perceptions

of whether m-learning is more interesting for girls or boys (*'We know that education is important for all children but in your opinion do you feel that boys or girls could be more interested in using M-Shule?'*). There was broad agreement (60%) that boys and girls are equally interested in using M-Shule. There were no significant differences in this consensus based on either caregivers' gender ($X^2 = 1.573$, $df = 2$, $p = 0.455$, $n = 116$) or location ($X^2 = 0.019$, $df = 2$, $p = 0.991$, $n = 116$). Notably though, in the case of caregivers who expressed a bias toward one gender, it was that M-Shule is more interesting for girls. Regarding reasons caregivers gave to explain potential gender-based biases, the most frequent answer was related to students' perceived capacities to learn (i.e. response: 'it is easier for girls/boys to learn').

RQ3: Learners' educational beliefs

Learners were asked three questions related to their beliefs about education more generally, which addressed the third research question *'Do learners' beliefs about education vary according to gender and location?'* The purpose of these questions was to identify potential ways of providing additional support to different groups of learners through the platform.

Two items were drawn from a previous study with learners on the Eneza Education 'Shupavu291'; one as

a precursive indicator of students' level of self-efficacy and another of intelligence growth mindset (Kizilcec and Goldfarb, 2019). Both are typically associated with greater levels of academic achievement (ibid.) and could potentially be encouraged and promoted through modified messages.

Learners were asked to what extent they agreed with the statement *'I know what I need to do to be a successful student'*, as an indicator of self-efficacy (Figures 3 and 4). Whilst the question asked is not a direct indicator of students' belief in their ability or capacity to be successful students, students' understanding of what they need to do to be successful may be the first step in them realising and believing in their capacity for success.

The results of the chi-squared test suggest that students who live in non-ASAL areas are significantly more likely to believe that they are aware of what they must do to be successful students ($X^2 = 8.391$, $df = 3$, $p = 0.039$, $n = 74$). Gender appears to have no important effect on that belief ($X^2 = 6.625$, $df = 4$, $p = 0.157$, $n = 119$). Whilst it is not clear why differences exist based on location, the result points to either a difference in the amount of information available, about how to achieve success, a difference in the self-belief of students in their knowledge of how to succeed, a difference in the definition and expectations of 'success' in different locales, or some combination of the above.

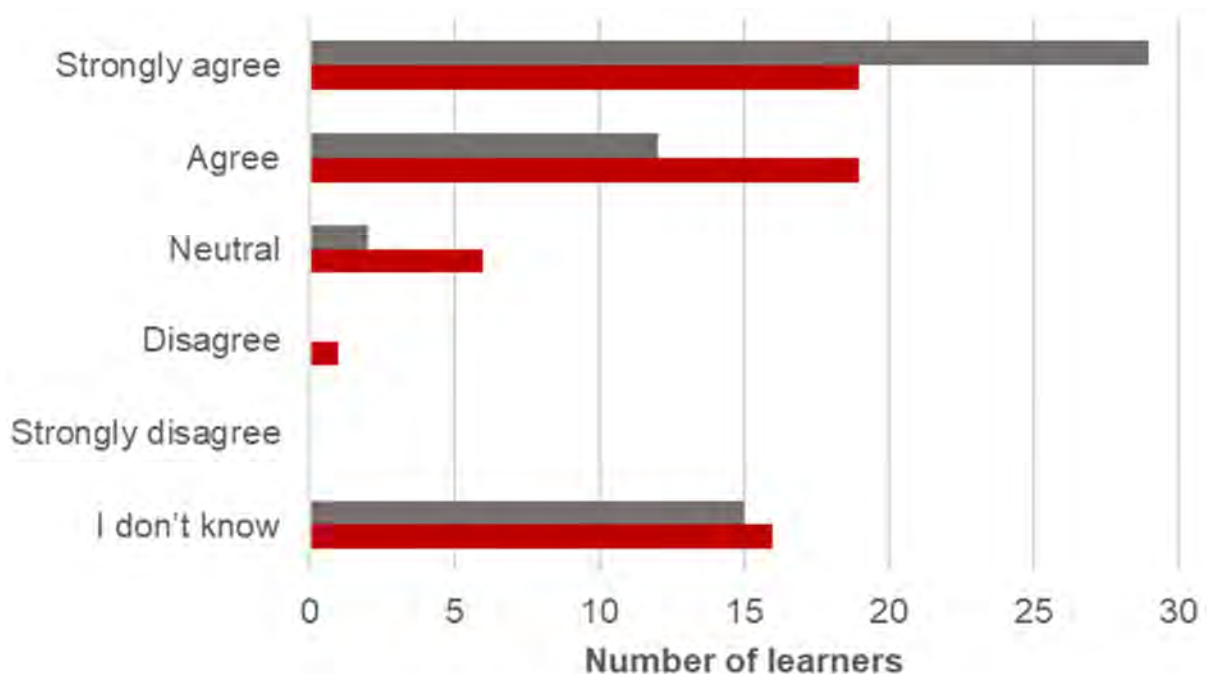


Figure 3. Distribution of responses to the item *'I know what I need to do to be a successful student'*, colour-coded according to learners' gender. Girls' responses are shown as grey bars, and boys are shown as red bars.

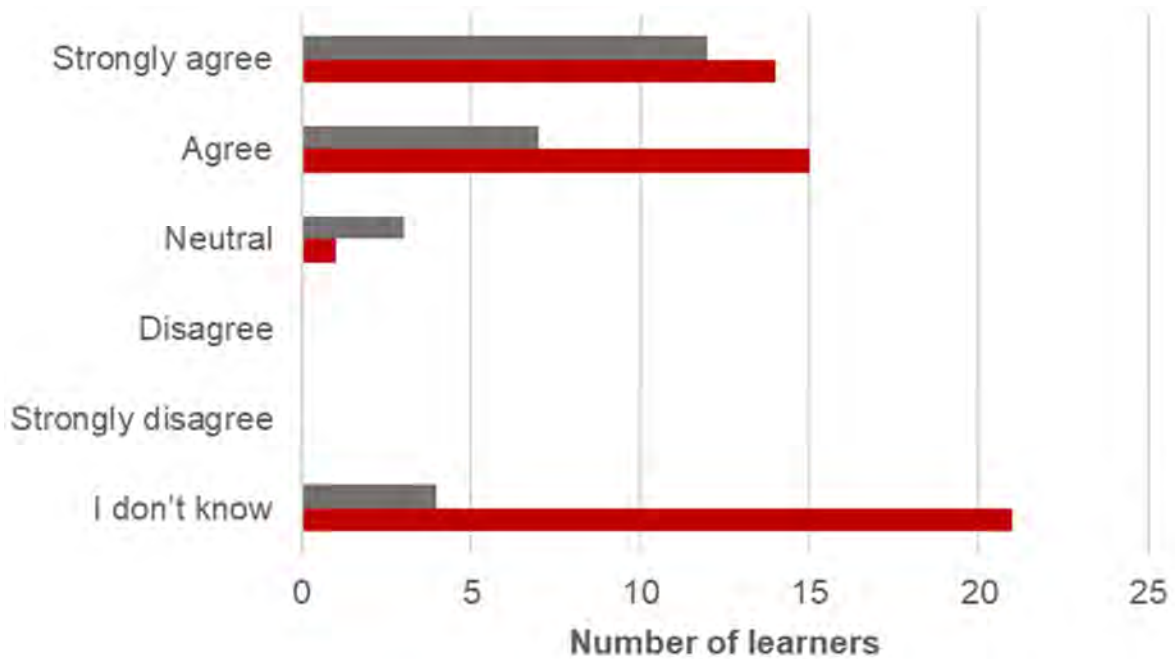


Figure 4. Distribution of responses to the item 'I know what I need to do to be a successful student', colour-coded according to learners' location (red, ASAL; grey, non-ASAL counties).

Learners were also asked to what extent they agreed with the statement 'Your intelligence is something about you that you cannot change very much', as a reflection of their attitudes in relation to an intelligence growth mindset (Figures 5 and 6). In this instance, disagreement would reflect a greater openness to a growth mindset. 42% of students either agreed or strongly agreed with the statement that their intelligence was something that

you cannot change very much, compared with only 19% who either disagreed or strongly disagreed. There were no significant differences in the pattern of responses based on gender ($X^2 = 6.521, df = 5, p = 0.259, n = 118$) or location ($X^2 = 3.922, df = 5, p = 0.561, n = 76$). This suggests that actively promoting and supporting a growth mindset may be useful for all learners.

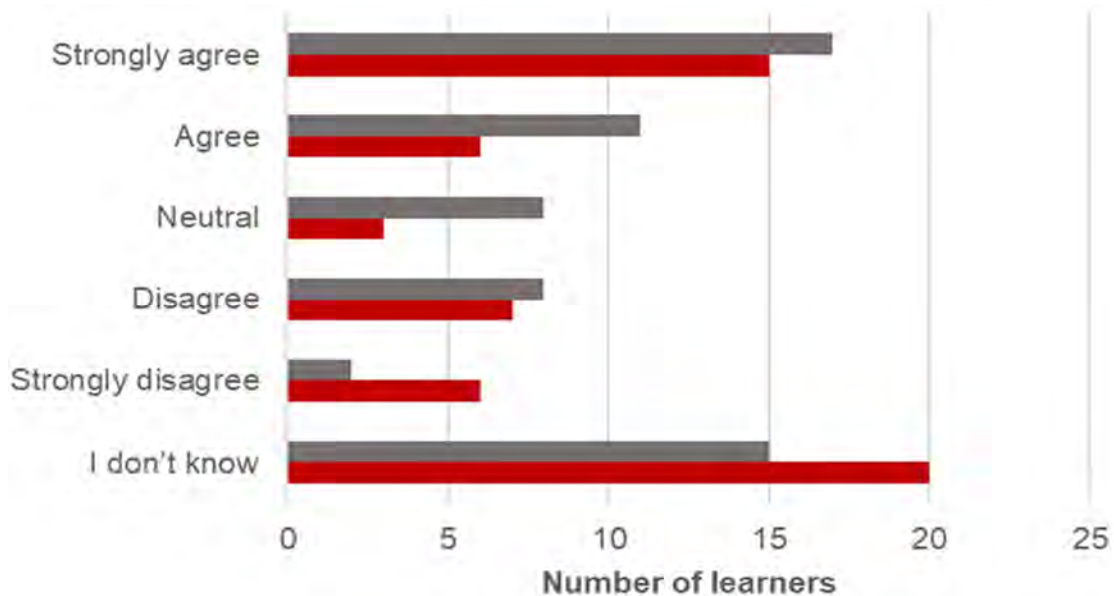


Figure 5. Distribution of responses to the item 'Your intelligence is something about you that you cannot change very much', colour-coded according to learners' gender. Girls' responses are shown as grey bars, and boys are shown as red bars.

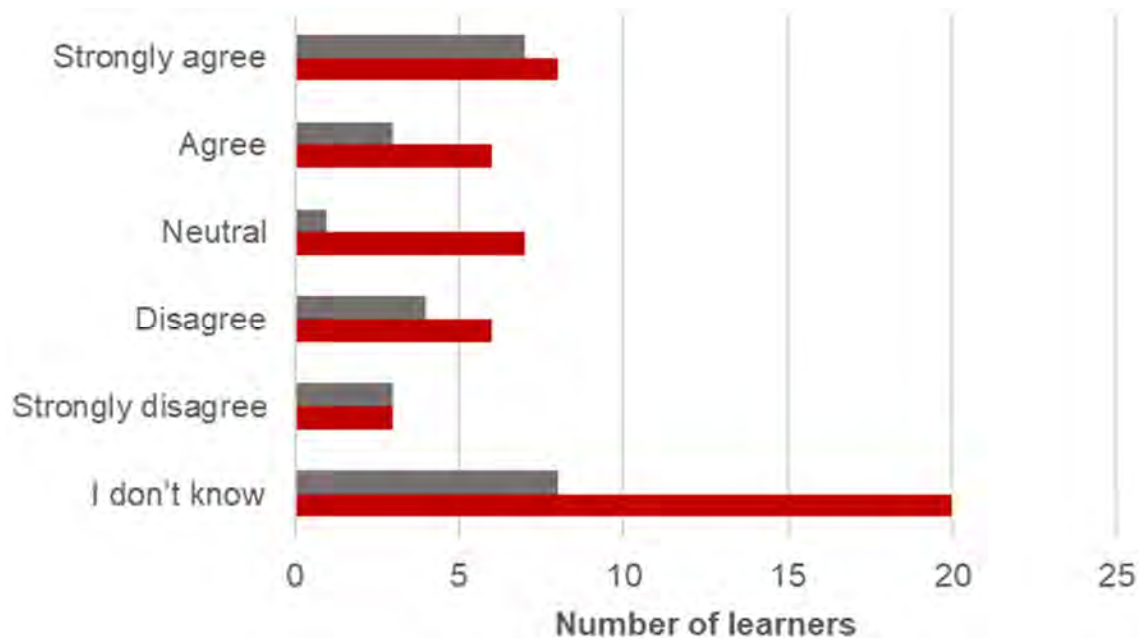


Figure 6. Distribution of responses to the item 'Your intelligence is something about you that you cannot change very much', colour-coded according to learners' location (grey, non-ASAL; red, ASAL).

Finally, learners were also asked about whether they viewed m-learning as being more or less interesting for learners of different genders. Responses showed significant differences according in both gender ($X^2 = 17.489$, $df = 2$, $p = 0.000$, $n = 99$) and location ($X^2 = 9.996$, $df = 2$, $p = 0.007$, $n = 61$) (Table 2). In relation to learners' own gender, there are two notable findings. First, a substantial proportion of both girls (41%) and boys (48%) perceive m-learning to be equally useful to girls and boys. Second, the other most frequent position is that learners perceive m-learning to be useful to

learners of their own gender. This finding supports the idea that the medium is equitable; there is not an overall bias toward boys, for example. This result further suggests that students who do not agree that boys and girls are equally interested in using the platform tend to perceive children of their own gender as more interested in using the platform than others. However, the findings are different when considering learners' location, with a bias toward boys in non-ASAL counties, and toward girls in ASAL counties.

Table 2. Frequency of responses to the item 'We know that education is important for all children but in your opinion do you feel that boys or girls could be more interested in using M-Shule?' according to learners' gender and location.

	Boys more interested	Boys and girls equally interested	Girls more interested
<i>Gender</i>			
Girls (n = 51)	5 (9.8%)	21 (41.2%)	25 (49%)
Boys (n = 48)	18 (37.5%)	23 (47.9%)	7 (14.6%)
<i>Location</i>			
ASAL (n = 39)	4 (10.3%)	18 (46.2%)	17 (43.6%)
Non-ASAL (n = 22)	10 (45.5%)	7 (31.8%)	5 (22.7%)

Learners who had indicated that m-learning was more useful to girls or boys were also asked to select from a list of possible reasons why they held that belief. While the number of responses to each of the reasons in this question was low, two notable points of contrast were observed. Participants who indicated that m-learning is more suitable for boys compared to girls were more likely to attribute this to boys having greater access to phones than girls ($n = 7$ and 3 , respectively). Conversely,

participants who indicated that m-learning is more suitable for girls compared to boys were more likely to believe that girls have more time to learn at home than boys ($n = 8$ and 2 , respectively).

CONCLUSIONS

The survey was undertaken with a sample of learners

who use the M-Shule platform and their caregivers, with an overall goal of helping to understand whether the experiences of girls and boys differ when taught through this form of EdTech, and if so, why is this the case. The study contributes to the wider literature by helping to address research gaps in relation to the benefits of, and barriers to, mobile learning. While the findings overall suggest that using SMS is equitable and reaching learners across Kenya, some barriers to increased use remain.

Within this overall goal, we focused on three specific research questions. The first research question asked '*Are there any differences in perceived benefits and constraints of using m-learning through SMS according to learners' gender and location?*' Overall the experiences of boys and girls are similar, and learners and caregivers both view this form of education as positive for girls as well as boys. This was demonstrated by the responses from learners and caregivers to several of the survey questions. Although learners tend to perceive it to be more useful for learners of their own gender, this is similar for both boys and girls. Furthermore, while children face some barriers to use - principally, accessing a mobile phone - no significant differences were found in relation to gender. This suggests that non-structural factors, such as caregivers' permission, which were shown to be barriers for Kenyan girls in the study by Watson et al. (2023) and in the study of Khlaif et al. (2020) in Afghanistan for example, may also be experienced by boys. As recommended by Watson et al. (2023), this finding suggests that raising awareness among caregivers of the educational potential of mobile phone usage would be beneficial to learners generally. This finding also reinforces the importance of considering intersectionality as well as socio-cultural and attitudinal norms when designing educational technology interventions, which was illustrated by Myers et al. (2023).

The second research question focused on the role of caregivers, '*How do caregivers' attitudes to m-learning vary according to gender and location?*' Caregivers perceive the platform to be equally of interest to boys and girls. Participants typically have multiple mobile phones in their household, but having access to the phone may limit the amount of time learners can use to engage. However, female caregivers are more likely to use M-Shule with their children and are more likely to only have one mobile phone than male caregivers. This echoes differences seen in other contexts - notably India - which also show that it is much more likely that female caregivers will allow their phones to be used by children (Gupta et al., 2023). A study conducted by the Malala Fund in Nigeria presented similar findings, by illustrating that during Covid-19 mothers tended to support their sons and daughters almost equally with online and at-home learning, while fathers were 36% more likely to assist their sons' education than their daughters (Malala Fund, 2020). This underscores that access to devices can still be unequal, and that provision of access to shared mobile devices at community centres, and further raising awareness of the importance of equal education for girls and boys, may help improve this.

Finally, the third research question asked '*Do learners' beliefs about education vary according to gender and location?*' with a view to identifying areas for further support. The findings suggest that tailoring messages to promote a growth mindset and growing students' knowledge so they may develop self-efficacy may be useful for future research to focus upon. A growth mindset and greater self-efficacy have been shown to be associated with higher attainment in a wide range of settings (Kizilcec and Goldfarb, 2019). Supporting self-efficacy may be particularly useful for learners in ASAL counties, and promoting a growth mindset may be useful for all learners, regardless of gender. This is an area that could be a focus for message design, alongside educational content. It may also be useful to conduct a future study to explore why the differences in self-efficacy manifest as it may shed light on how self-belief, self-esteem and self-efficacy are and can be encouraged across different regions, and how encouragement and inspiration can be given so that all students feel capable of success.

While the study does have its limitations, the findings contribute to the research literature in relation to mobile learning and provide areas for further research. The sample was intentionally balanced in terms of gender and includes learners and caregivers from across Kenya; however, the sample was drawn from the existing user base of the platform, so will be biased towards households that have mobile devices available more readily. The high level of school attendance reported by learners may suggest that more marginalised or out-of-school children are not being reached. Other marginalisation factors, such as disability and special educational needs, would also be important to consider.

Within the bounds of the sample, however, the overall lack of differences according to gender suggests that the use of this medium is broadly equitable. Although there were no stark gender differences, the findings highlight potential areas for further research and development to potentially benefit all learners. First, the findings expand those of Watson et al. (2023) to show that boys face similar issues in relation to caregiver permission as those highlighted for girls. As such, their recommendation in relation to raising awareness of the benefits of educational technology would also stand here but could be extended to all learners. In relation to mobile learning applications, there is a wider challenge in terms of sustained engagement (Kizilcec and Chen, 2020). The findings on self-efficacy and growth mindset are an area that could be examined for future research and development, as this may enhance engagement and learning outcomes.

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ANNEX**Part 1 - Questions for Caregivers**

1. What is your gender? (Select one)

1. Male
2. Female
3. Other
4. I prefer not to say

2. Where do you live? (Type the county where you live)

3. Please enter the number of phones in your household (Select one)

1. 1 phone
2. 2 phones
3. 3 or 4 phones
4. More than 4

4. How many female children under your care do you have? (Enter a number)

5. How many male children under your care do you have? (Enter a number)

6. How often do you use M-Shule with your children at home? (Select one)

1. Every day
2. 2 to 3 times per week
3. Once a week
4. Rarely
5. Never
6. I am not sure

7. How comfortable are you using a phone without any help?

1. Very comfortable
2. Comfortable
3. Neutral
4. Not comfortable
5. Not comfortable at all

8. How likely are you to recommend using the M-Shule platform to other parents?

1. Very likely
2. Likely
3. Neutral
4. Not likely
5. Not likely at all

9. How easy or hard is it to find time to use M-Shule at home with your children? (Select one)

1. Very hard
2. Hard
3. Neutral
4. Easy
5. Very easy

10. We know that education is important for all children but in your opinion do you feel that boys or girls could be more interested in using M-Shule? (Select one)

1. Boys are more interested than girls in using M-Shule
2. Girls are more interested than boys in using M-Shule
3. Boys and girls are equally interested in using M-Shule

If 1 (boys are more interested) — Why? (Select all that apply, for example, if you have 1, 2 and 3 type 123)

1. The learning content is more useful for boys than for girls
2. Boys have greater access to phones at home than girls
3. Boys have more time to learn at home than girls
4. Boys receive more support to learn at home than girls (from parents/caregivers, siblings, etc.)
5. It is easier to learn for boys than for girls
6. Other

If 2 (girls are more interested) — Why? (Select all that apply, for example, if you have 1, 2 and 3 type 123)

1. The learning content is more useful for girls than for boys
2. Girls have greater access to phones at home than boys
3. Girls have more time to learn at home than boys
4. Girls receive more support to learn at home (from parents/caregivers, siblings, etc.) than boys
5. It is easier to learn for girls than for boys
6. Other

Part 2 - Questions for Learners

1. Are you a girl or a boy? (Select one)

1. Girl
2. Boy
3. Other
4. I prefer not to say

2. What year were you born? (Type year, for example, 2006)

3. How often do you go to school? (Select one)

1. More than 5 days a week
2. 5 days a week
3. 3–4 times a week
4. 1–2 times a week
5. I do not go to school

4. How easy / hard is it to find time to use M-Shule at home? (Select one)

1. Very hard
2. Hard
3. Neutral
4. Easy
5. Very easy

If you answered 1 or 2 — Why? (Select all that apply, for example, if you have 1, 2 and 3 type 123)

1. You have to do household chores (cleaning and/or cooking)
2. You have to care for others (e.g., younger siblings or the elderly)
3. You have to work on the farm or other family business
4. You have to work for pay
5. You do not have time after finishing your homeworks
6. You don't have time after spending time playing
7. By the time you have free time, you feel tired and need to sleep
8. Other

5. What are some of the other reasons that might prevent you from using M-Shule?

1. You do not have access to the phone/someone else is using the phone
2. Not enough phone credit
3. Poor phone signal
4. Not feeling motivated
5. You do not enjoy using M-Shule

6. How comfortable are you using a phone without any help?

1. Very comfortable
2. Comfortable
3. Neutral
4. Not comfortable
5. Not comfortable at all

7. To what extent do you agree or disagree with the statement: "I know what I need to do to be a successful student?" (Select one)

1. Strongly agree
2. Agree
3. Neutral
4. Disagree
5. Strongly disagree
6. I do not know

8. Do you agree or disagree with the statement: "Your intelligence is something about you that you cannot change very much." (Select one)

1. Strongly agree
2. Agree
3. Neutral
4. Disagree
5. Strongly disagree
6. I do not know

9. We know that education is important for all children but in your opinion do you feel that boys or girls could be more interested in using M-Shule? (Select one)

1. Boys are more interested than girls in using M-Shule
2. Girls are more interested than boys in using M-Shule
3. Boys and girls are equally interested in using M-Shule

If 1 (boys are more interested) — Why? (Select all that apply, for example, if you have 1, 2 and 3 type 123)

1. The learning content is more useful for boys than for girls
2. Boys have greater access to phones at home than girls
3. Boys have more time to learn at home than girls
4. Boys receive more support to learn at home than girls (from parents/caregivers, siblings, etc.)
5. It is easier to learn for boys than for girls
6. Other

If 2 (girls are more interested) - Why? (Select all that apply, for example, if you have 1, 2 and 3 type 123)

1. The learning content is more useful for girls than for boys
2. Girls have greater access to phones at home than boys
3. Girls have more time to learn at home than boys
4. Girls receive more support to learn at home (from parents/caregivers, siblings, etc) than boys
5. It is easier to learn for girls than for boys
6. Other