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ORIGINAL RESEARCH ARTICLE

Smartphones as digital instructional interface devices: the teacher's perspective

Terrence Manyeredzi* and Vongai Mpofu

Science and Mathematics Education Department, Bindura University of Science Education, Bindura, Zimbabwe

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Globally, many nations have put in place policies on technology enhanced teaching and learning in an effort to keep abreast with the rapid advancement in technology. However, the use of technology in education has been slow in many third world countries, inclusive of Zimbabwe. COVID-19 restrictions inadvertently accelerated the adoption of digital instructional interface devices (DIIDs). Smartphones are preferred DIIDs because of their popularity amongst children as well as teachers. However, their successful penetration as DIIDs is largely dependent on teachers' dispositions as key agents of curriculum implementation. Zimbabwe is known to have a 52% smartphone penetration rate for all citizens. The study was therefore carried out to determine the penetration rate of smartphones in science teachers, and also to probe teachers' views on learners being allowed unlimited access to smartphones. The study adopted descriptive survey design from a quantitative research approach. Data was collected from 179 science teachers through a self-developed electronic questionnaire that was administered through the Kobo Toolbox online survey application. Results show that the smartphone penetration rate in science teachers is 87%. Multitasking and indecent exposure are the main forms of learner deviance that make teachers more reluctant to accept smartphones as DIIDs. In the presence of school-wide and classroom policies that cater for both merits of smartphone use and ease of policy enforcement, Zimbabwe science teachers are however ready to fully embrace smartphones as useful DIIDs.

Keywords: nomophobia; technophobia; online teaching; digital instructional interface

Introduction

Globally, many nations have put in place policies on technology enhanced teaching and learning in an effort to keep abreast with the rapid advancement in technology. However, the uptake of technology in science education has been slow in many third world countries inclusive of Zimbabwe. This comes against the backdrop of the COVID-19 pandemic that challenge schools to remodel instructional design models to uphold the COVID-19 social distancing regulations (Jandrić *et al.* 2020). COVID-19 spreads, mainly airborne, amongst people who are in close contact for

*Corresponding author. Email: tmanyeredzi@gmail.com

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a prolonged period hence the need for social distancing (Bazant and Bush 2021). Social distancing, also known as physical distancing, is therefore a widely recommended mitigating strategy for reducing the risk of contracting the disease, especially in closed up spaces. In recognition that a complete eradication of the long standing in-person teaching and learning is difficult, particularly in most African countries, a minimum of one meter distancing is recommended should teaching and learning take place (Draisin and Vincenten 2020). However in this COVID-19 era, remote teaching, which occurs through a spatiotemporal separation of the teacher and learner outside the physical spaces of school classroom, becomes a preferred alternative (Espino-Díaz *et al.* 2020; Mpungose 2020). Remote teaching is typically facilitated through personal electronic devices (PEDs) such as laptops, desktops, cell phones and tablets. Remote teaching and learning is either in the synchronous or asynchronous. Whilst, remote synchronous teaching is a live interaction between the teacher and learner, in asynchronous teaching, learners watch lesson recordings at a later point in time (Fernando, Patrizia, and Tiziana 2020; Hodges *et al.* 2020). Remote teaching is conducted through online platforms. Thus, it took the eruption of COVID-19 for schools to abruptly shift from in-person to online teaching. The PEDs have therefore become indispensable in remote teaching and learning.

Smartphones are the most common PEDs used for online teaching as digital instructional interface devices (DIIDs). Through DIIDs, teachers can remotely interact with their learners by posting learning material and providing feedback for learners to access. Smartphones are a preferred choice of DIIDs because they are quite popular amongst people, inclusive of children and teachers (Baticulon *et al.* 2021; Darko-Adjei 2019). The smartphones are acknowledged for improving learners' understanding of abstract concepts, in particular those of science (Twum 2017). In addition, smartphones are fairly cheap and therefore affordable. In Zimbabwe, the use of smartphones as DIIDs has accelerated nomophobia, an inert fear of being without a phone (Atarodi, Rajabi, and Atarodi, 2020). Nomophobia has in turn fostered a growth in demand and use of smartphones in communities and educational institutions. Warnich and Gordon (2015) underscored that smartphones are indispensable mobile tool in the lives of 21st century teachers and learners. In schools, smartphone use, however, has stirred conflicts and tensions as teachers and leaners struggle to manage smartphones within the boundaries of school practice (Ott 2017). For instance, most learners concede to the use of smartphones for schooling but at the same time they view them as distractions that the teachers always pursue (Ott 2017; Ott *et al.* 2018). Similarly, teachers view smartphones as sources of deviance amongst students as they may access inappropriate content, get involved in cyber bullying and cheating (O'Bannon and Thomas 2015). Deviance destabilises learning processes, which in turn becomes the main source of teacher-learner conflicts (Hanımoğlu 2018). In contradiction, teachers also view smartphones as a supplement to off-campus and after school hours schooling, that increases contact time for learners (Ngesi *et al.* 2018). O'Bannon and Thomas (2015) assessed pre-service teachers' views on mobile phone use in the classroom. Out of the 245-sample space, 45% supported the use of smartphones, 25% did not support whilst 30% reported uncertainty. Thus, the smartphone is a popular resource in the students' infrastructure for learning (Ott *et al.* 2018), if left unchecked, this tool can negatively impact on the teaching-learning process (Maphalala and Nzama 2014).

The penetration rate is a key indicator of popularity of PEDs, and a measure of adherence to digital living. According to Gerede (2020), Zimbabwe's

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smartphone penetration rate is 52%. Compared to other regional partners like Nigeria and Kenya with an 80% smartphone penetration rate and South Africa at 90%, this shows that Zimbabwe is underperforming in the digital world. The underperformance is also evident on the World Economic Forum's Network Readiness Index (NRI), that ranks Zimbabwe 122nd out of the 134 economies in the NRI statistics of 2020 (Portulans Institute 2020). The NRI is a performance key indicator on how countries fare in the digital world (Kiseleva 2018). The NRI is also an indicator of the performance of a country's digital economy. Thus, increasing the penetration rate of PEDs, particularly smartphones in schools has a positive impact on the country's digital economy. This is because of the very strong correlation between education and skills and the uptake and use of digital technologies in various facets of life (OECD 2016). Schools are, therefore not only effective for learning, but also a convenient port of call-in promoting technologies such as the smartphone. The successful penetration of such technologies in a school setup is, however, dependent on the perception of the technology by immediate stakeholders especially teachers who Nevenglosky, Cale and Aguilar (2019) identified as central to curriculum implementation.

Literature on PED use in Zimbabwe is silent on the penetration of the devices in schools. The smartphone penetration rate in Zimbabwe's science teachers is therefore unknown. This article thus, explores smartphone penetration in science teachers with the aim of determining whether smartphones can be fully integrated as DIID for science instruction in Zimbabwean schools, as well as to assess teachers' views on smartphones as potential conduits for learners' moral degeneracy. The findings may be useful as a reference in assessing the readiness of science teachers to remodel their instructional design models in compliance with COVID-19 regulations in the global fight against the pandemic. The study pursued three research questions: (1) What is the average smartphone penetration rate in schools? (2) How do science teachers view smartphone use in schools? (3) How can smartphones be effectively used as DIIDs?

Concerns-based adoption model

The Concerns-Based Adoption (CBA) model developed by Hall, based on Fuller's work (Straub 2009) guided this study. The theory of CBA frames change and adoption of technology from the adoptee's perspective. The adoptee is the teacher, whose use of technology is largely determined by how he/she responds to and absorbs technological initiatives. The adoptee is assumed to respond to new technological initiatives with a unique attitude that is characteristic of his/her beliefs, and such beliefs are also reflected by how the adoptee uses the new technology in the event he/she absorbs it. For example, if a teacher harbours negative beliefs towards smartphone use, such as a belief that smartphones are conduits of learners' moral degeneracy, they can be reluctant to adopt them as DIIDs. Similarly, if a teacher sees smartphones as a useful tool for teaching-learning, such a positive belief leads to absorption and will be evident in the teacher's instructional design model where the smartphone will likely be utilised as a DIID.

The CBA model caters to phases that the individual undergoes as she/he gradually adopts the innovation, while considering options on how best to facilitate the change. The model was modified into a conceptual framework that specifically speaks to this study as summarised in Figure 1.

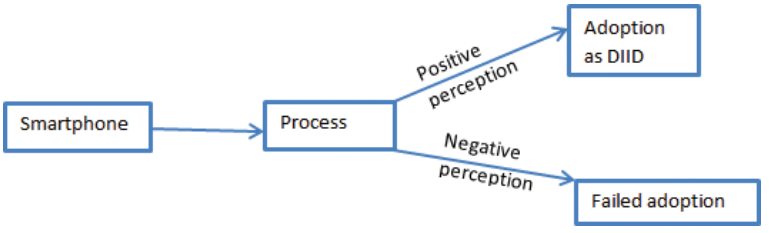

Figure 1. Theoretical framework for the study.

According to Figure 1, the potential adoptee encounters a smartphone, a device that he/she can adopt as a DIID but is unconcerned of it. The potential adoptee now undergoes a gradual process of change that may lead to adoption of the smartphone, or failure thereof, depending on whether the change process led to either a positive or negative perception. The success or failure of cultivating a positive perception towards the innovation therefore depends on how the potential adoptee responds to the new technological initiative as guided by his/her attitude that is characteristic of their beliefs. Through an understanding of such underlying beliefs an adoptee upholds, a deeper insight into why teachers either adopt or reject smartphones as DIIDs can therefore be obtained. The CBA was therefore adopted in this study as it allows researchers to probe the processes underlying change of perception towards a given technological innovation in greater depth.

Methodology

The study utilised descriptive survey design from a quantitative research approach. A self-developed electronic questionnaire was administered through the Kobo Toolbox online survey application to snowball sampled subjects. The electronic link to the questionnaire was optimised for mobile phone access, and randomly distributed through online platforms that included e-mail and interactive social platforms like WhatsApp, Twitter, and Facebook. The initial snowballing sample was made up of 20 professionally qualified science teachers drawn from across the country for the Teacher Capacity Development Program (TCDP) at Bindura University of Science Education (BUSE). As a result of the on-going COVID-19 induced travel restrictions, the TCDP group was convenient to initiate the snowballing exercise because of proximity. Also, since the TCDP candidates were drawn from across the country, using them to initiate the snowballing exercise optimised spread of the questionnaire to various communities in the country. Data from such a well spread sample space was therefore, considered to be representative of a wider spectrum of community views and learner deviance.

The questionnaire was tailored to capture intimate details on the respondent's disposition on smartphone use by learners. This included the highest level which the respondent was teaching, views on smartphone use by learners and type of deviance that may justify reservations/reluctance towards learners accessing the devices. The respondents were also requested to identify themselves with an age group namely: age group 1 (below 30 years, the early career teachers), age group 2 (30 to 40 years, early mid-career teachers), age group 3 (40 to 50 years, mid-career teachers), and age group 4 (above 50 years, late career teachers). Close-ended questions were used where, in some cases, respondents could select multiple responses. In such cases, percentages were calculated over the whole sample space pertaining to the particular category. A case in point are the multiple choice responses on common learner deviance

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that were categorised as: multitasking, indecent exposure and cyber bullying where respondents could even pick all the options as forms of deviance depending on the respondents' disposition towards the devices. Percentages were then calculated over the whole sample space pertaining to the teacher/learner category. Findings were presented in tabular and graphical (bar graphs) forms, from where both descriptive and inferential analysis were carried out culminating in conclusions being drawn.

Results and discussion

A total of 179 subjects participated in the survey. The results reveal that 155 of the 179 participants possess smartphones, which translates to an average of 87% smartphone penetration rate in science teachers. This answers the first research question on the average smartphone penetration rate in science teachers. Table 1 provides a summary of statistical results from the survey.

Table 1. Summary of smartphone penetration in schools and the corresponding usage patterns.

Age group		1	2	3	4	Average
Number of respondents		77	54	35	13	
Percentage using a smartphone		100	73	57	54	87
Respondents' age group (%)	Multitasking	91	96	89	85	92
	Cyber bullying	22	17	6	8	16
	Indecent exposure	94	100	94	92	96
Views on smartphone use by learners (%)	Yes	97	67	51	45	65
	No	0	2	18	43	16
	Not decided	3	31	31	13	19

Smartphone penetration rate varies with age, with early carrier teachers having the highest rate as compared to later carrier teachers. Figure 2 presents the variation of penetration rate with age.

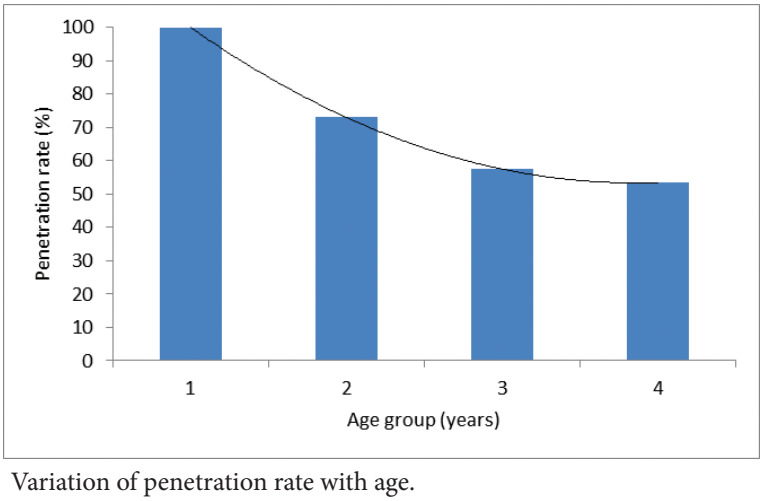

Figure 2. Variation of penetration rate with age.

The trendline in Figure 2 is quadratic, showing that smartphone penetration rate trends quadratically with age group of the teacher. That is, smartphones are very popular with early career teachers, at a penetration rate of 100% that decays quadratically to 54% for late career teachers. This shows that late career teachers are the most reluctant group to use smartphones since the penetration rate is lowest in this age group. This agrees with findings of Osiceanu (2015) and Khasawneh (2018) who went on to explain the reluctance by older generations to adopt digital technology in terms of technophobia, the morbid fear of technology. Technophobia reflects on the level of technological competency that Jabbari and Azarfam (2012) identified as having a positive correlation with attitude (view) towards the particular technology.

Teachers' attitude towards smartphone use by learners is also age dependent. Figure 3 presents the teachers' view towards learners accessing smartphones against age group, where yes represents a positive attitude and no represents a negative attitude.

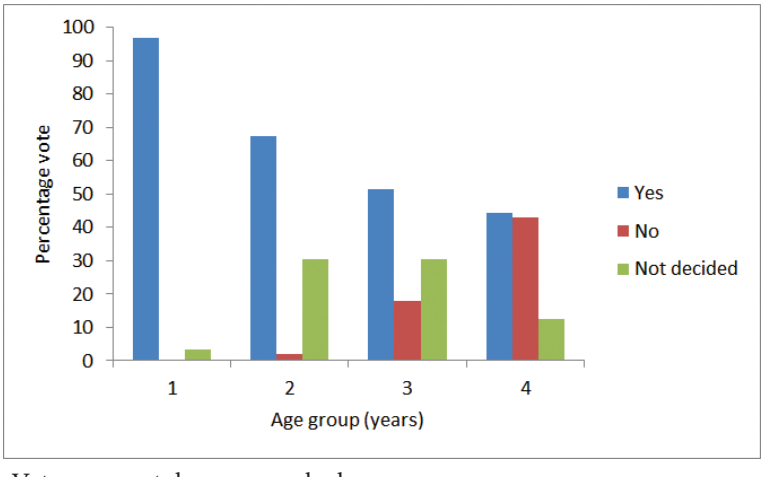

Figure 3. Vote on smartphone access by learners.

It is evident from Figure 3 that 97% of early career teachers have a positive attitude and the attitude, as reflected by the percentage who voted yes, gradually decreases to 45% for late career teachers. The percentage of participants who were undecided is relatively high for mid-career teachers at 31%, while it is 0% for early career teachers and 13% for late career teachers. On average 19% of the respondents were undecided meaning that their perception towards smartphones can neither be classified as positive nor negative. Such teachers acknowledged the merits of using smartphones by learners; however, learner deviance is the main reason behind their scepticism. Some respondents noted that, in the presence of school-wide and classroom policies that cater for both merits of smartphone use and ease of policy enforcement, those sceptical can change their attitudes and become willing adoptees of smartphones as DIIDs.

Using the average yes vote for all age groups, 65% of science teachers are ready to accept smartphones as compared to 22% who expressed reservations. This shows that the majority of respondents view smartphones as a handy tool for teaching and learning, hence integrable into the school system as DIIDs. This addresses the second research question. These findings agree with the views by Warnich

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and Gordon (2015) who appraised smartphones as indispensable mobile tools in the lives of 21st century teachers and learners. Besides technophobia, learner deviance is another major setback to the adoption of smartphones as DIIDs. Figure 4 presents teachers' view on deviance facilitated by smartphones.

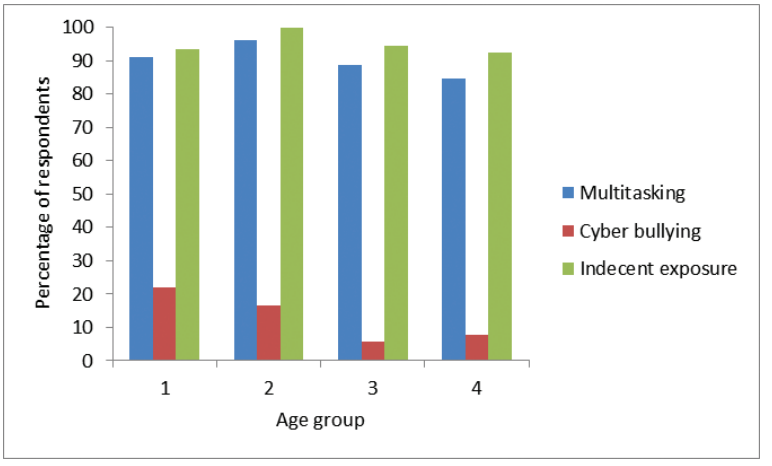

Figure 4. Deviance distribution profile.

Figure 4 shows that the majority of teachers showed reservations on learners accessing smartphones citing multitasking as the main form of deviance followed by indecent exposure and lastly cyber bullying. The average percentages of respondents citing learner multitasking, indecent exposure and cyber bullying are 96%, 92% and 16%, respectively. The prevalence of multitasking as a form of learner deviance, hence a possible source of teacher-learner conflicts, is in line with reports available in literature (Ngesi *et al.* 2018; Ott 2017; Ott *et al.* 2018; Torbert 2021). As for cyber bullying and indecent exposure, children always try to experiment on new things hence they experiment on immoral content like pornography and/or violence that they access through smartphones. Therefore, the use of smartphones by learners may facilitate learners' access to immoral content thereby increasing cases of deviant behaviour. However, completely disqualifying the devices contrasts classroom evolution considering the rapid proliferation of the devices in our daily lives. Therefore, schools may need to come up with effective policies to curb access to immoral content. Such policies should however cater for both merits and demerits of smartphone use and the ease of policy enforcement, a view also shared by other researchers (Morris and Sarapin 2020; Mupinga 2017). This addresses the third research question.

Conclusion

The smartphone penetration rate in Zimbabwean science teachers is 87%, 65% of whom are ready to embrace smartphones as DIIDs. Learner deviance, mainly in the form of multitasking and indecent exposure facilitated through access to the devices, is however the major setback for teachers to fully adopt smartphones as DIIDs. On average 96%, 92% and 16% of the science teachers identified multitasking, indecent exposure and cyber bullying, respectively as the common forms of deviance to justify their negative perception towards smartphone use by learners. Weighing in between

deviance and handiness of smartphones as DIIDs, there is need to strike an equitable balance between merits and demerits of integrating the technology such as DIIDs. This can be achieved by moderating smartphone use, where school-wide and classroom policies on smartphone use are tailored in a way that takes into account the benefits of the technology and ease of enforcement.

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