Journal of Education and e-Learning Research
Vol. 11, No. 3, 578-587, 2024
ISSN(E) 2410-9991 / ISSN(P) 2518-0169
DOI: 10.20448/jeelr.v11i3.5925

Aspects of mobile phone use and behavioural intentions for learning in rural South African schools

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Abstract

This paper focuses on a study conducted in two historically disadvantaged schools (deep-rural and semi-urban) in South Africa where the rising access to mobile technology implies that the long-standing promise of mobile learning is becoming accessible despite the lack of recent research. This research aims to investigate the relationship between the type of school and various aspects of mobile phone use as well as differences in behavioural intention constructs to use mobile phones for learning. After a literature review, several hypotheses were developed. Using non-probability sampling techniques and the survey method, data was obtained from 128 participants, 79 from the deep-rural school and 49 from the semi-urban school. The semi-urban school exhibited slightly higher percentages in all aspects of cell phone use. Outside of mobile phone ownership and Internet access, all associations were significant. Significant differences were reported in favour of the semi-urban school for all constructs regarding the behavioural intention to use mobile phones for learning. However, the future of m-learning appears to be more promising than reported in earlier research by reporting positive behaviour from students in both schools. Critical stakeholders in education should take note and move from the goals of improving broad access to explicit objectives to implement m-learning in rural schools.

Keywords: Behavioural intention, Deep-rural, Marginalised students, Mobile learning, Mobile phone use, Semi-urban.

Citation | Merwe, M. D. V. D., & Bonyongwa, T. (2024). Aspects of mobile phone use and behavioural intentions for learning in rural South African schools. *Journal of Education and E-Learning Research, 11*(3), 578–587. 10.20448/jeelr.v11i3.5925
History:
Received: 12 December 2023
Revised: 5 June 2024
Accepted: 2 July 2024
Published: 30 August 2024

Publisher: Asian Online Journal Publishing Group

Funding: This research is supported by University of South Africa study bursary awarded to Tariro Bonyongwa in 2021.
Institutional Review Board Statement: The Ethical Committee of the College of Science, Engineering and Technology, University of South Africa has granted approval for this study on 13 May 2016 (Ref. No. 030/TB/2016/CSET_SOC).
Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

Contents

Contribution of this paper to the literature
Although the use of mobile phones for learning in historically disadvantaged rural and urban schools in South Africa has received attention, this research updates our current knowledge on the relationship between aspects of the use and the drivers influencing behavioural intention.

1. Introduction

Technology development has provided opportunities for underprivileged students worldwide who have historically lacked access to education (Nikou & Economides, 2017). The empirical evidence indicates that mobile learning has huge potential in both developed and developing countries to meet the need for high-quality education in the twenty-first century (Crompton & Burke, 2018; Kaliisa, Palmer, & Miller, 2019). For example, research in African higher education contexts has shown that mobile learning increases collaboration. Student participation and engagement enable authentic knowledge and reflective practice and build learning communities (Kaliisa & Picard, 2017).

However, most of the poor population lives in historically disadvantaged rural communities that leave them without access to computers and the Internet in South Africa (Chetty-Mhlanga et al., 2020; Rey-Moreno, Blignaut, Tucker, & May, 2016). For example, recent statistics revealed that only 1.7% can access the Internet from home using computers and laptops (ICASA, 2020) making it challenging to introduce technology into education. However, the growth in access to mobile services particularly among young people (Dalvit & Gunzo, 2014; Rey-Moreno et al., 2016) suggests that mobile phones are a critical technology for creating educational opportunities in these communities (Grimus & Ebner, 2013).

Device ownership is a known critical success factor that affects the willingness and use of technology (Alrasheedi & Capretz, 2015; Naismith, Sharples, Vavoula, & Lonsdale, 2004). M-learning opportunities are limited because most students own basic mobile phones (Brown & Mbati, 2015) with the sharing of phones becoming a common practice due to poverty in low-income rural areas (Porter et al., 2020). The frequency of using mobile phones for educational purposes also depends on whether a school task fits the format of these devices while a lack of training on integrating phones into the curriculum results in low usage for school-related work (Ott, Haglind, & Lindström, 2014). Although most students perceive a mobile phone only to be socially valuable (Hamidi & Chavoshi, 2018; Kim, Lee, & Rha, 2017), there is a relationship between awareness and the use of a mobile phone for learning (Gnewuch, Haake, Mueller, & Maedche, 2016).

However, the expected benefits related to m-learning are not ensured by simply owning or having access to a mobile phone.

Effective use of technology is influenced by the user's intentions (Gnewuch et al., 2016). To gauge the likelihood of success when introducing new technology to populations that might be resistant, it is therefore essential to assess their intentions (Venkatesh, Morris, Davis, & Davis, 2003). According to Ajzen (1991); Teo and Zhou (2014) and Yeap, Ramayah, and Soto-Acosta (2016) BI predicts actual usage.

Several theories and models for measuring BI to use new technologies have been proposed and applied in m-learning. Despite its age, the Unified Theory of Acceptance and Use Technology (UTAUT) model proposed by Venkatesh et al. (2003) is used to provide an understanding of the drivers of BI. The five fundamental constructs of the UTAUT are facilitating conditions, social influence, performance and effort expectations. Therefore, identifying the influencers of BI before implementing m-learning is a key step to benefit from its advantages (Gnewuch et al., 2016).

Research has been conducted into the feasibility of m-learning in local rural schools (e.g. (Bahamóndez, Del, & Schmidt, 2011; Ford & Botha, 2009; Ford & Leinonen, 2009) as well as on the drivers that influence students' behavioural intention (BI) to use mobile phones for learning (Ford, Botha, & Herselman, 2014; UNESCO, 2012). Such research was conducted a decade or more ago. A recent report by ICASA (2020) has shown that mobile phones have become more ubiquitous in rural areas of South Africa. For this reason, renewed research is needed.

This paper reports on research carried out in two rural South African secondary schools with the dual purpose of (a) identifying aspects of mobile phone use that can affect the feasibility of m-learning and (b) investigating the BI drivers that influence students in both schools to use mobile phones for learning. Rurality can be defined as territories located at a minimum distance of 8 km or more from a central city (Leibowitz, 2017). The first school located in a deep-rural area in the Eastern Cape province was included in the research done by Ford et al. (2014) who classified the school as representative of many marginalized deep-rural realities. The second school located in a semi-urban area within the Gauteng province of South Africa was included in the MobilED project by Ford and Leinonen (2009) who examined the use of mobile phones in a historically disadvantaged school where most students did not own a mobile phone. Several students were of poor backgrounds and travelled daily from outlying rural areas despite its proximity to a large urban area (Tshwane).

Since the publication of the results of these two studies, authors have been unable to source newer data sets on the topic of interest. Based on the evidence, it appears that students in these two schools are more exposed to mobile technologies due to increased ownership. As a result, they are more likely to show increased behavioral intentions to use their phones for learning purposes.

From the above discussion, our research attempted to find answers to the following two questions:

1. What relationship exists between the type of school (deep-rural and semi-urban) and (a) ownership of mobile phones or having access to them, (b) accessing the Internet using mobile phones, (c) awareness of m-learning, (d) use of mobile phones for school-related work and (e) frequency of use of mobile phones for school-related work?
2. What differences exist between the types of schools (deep rural and semi-urban) for the following constructs: performance expectancy, effort expectancy, social influence, facilitating conditions and behavioural intention?

This research's consideration of both schools will give important educational stakeholders a more comprehensive, current and balanced understanding of the present condition of mobile phone use in rural schools.

2. Review of the Literature and Development of Research Hypotheses

The subsequent sections focus on the limited studies conducted in South Africa or in the absence of such data, in other (mostly developing) countries to formulate relevant hypotheses.

2.1. Factors Influencing the Feasibility of M-Learning

This section reviews the literature related to research question 1 and covers (a) ownership or having access to them, (b) accessing the Internet using mobile phones, (c) awareness of m-learning, (d) use of mobile phones for school-related work and (e) frequency of use of mobile phones for school-related work.

2.1.1. Mobile Phone Ownership in Rural South Africa

Among South African youth, mobile devices are more prevalent than landlines and computers in most rural households (Dalvit & Gunzo, 2014; Jantjies & Joy, 2016). As a result of reduced handset costs and network expansion in recent years, the number of young people aged 9 to 18 who own mobile phones has increased (Porter et al., 2020). This increase in mobile phone ownership has been confirmed worldwide (ITU, 2017). The following hypothesis is forwarded:

H_{1null}: There is no significant relationship between mobile phone ownership and type of school.

2.1.2. Access to the Internet through Mobile Phones

In the Eastern Cape (deep-rural school), only 4.1% of the rural population has access to the Internet at home compared to 55% through other means (ICASA, 2020). In Gauteng (a semi-urban school), access increases to 16.7% and 74.6%, respectively. Although 36.9% of the rural population in the eastern Cape uses a mobile device to access the Internet, it ranges between 34.6% and 68.6% in the rural and urban areas of Gauteng. The coverage of the mobile phone network is 100% (2G), 99% (3G) and 79% (4G/LTE) in the Eastern Cape and 100% and 99% in Gauteng.

H_{2null}: There is no significant relationship between accessing the Internet using a mobile phone and the type of school.

2.1.3. Awareness of M-Learning

Choice and Akudo (2019) and Fakokunde (2017) reported that in two other sub-Saharan high schools, students' awareness of m-leaning was positive which motivated them to use mobile phones for e-learning. The hypothesis tested is as follows:

H_{3null}: There is no significant relationship between awareness of m-learning and the type of school.

2.1.4. Using Mobile Phones for School-Related Work

An increase in mobile phone use in sub-Saharan countries has been attributed to ownership and sharing (Porter et al., 2020). Internationally, Hamidi and Chavoshi (2018) and Kim et al. (2017) reported a lack of interest by students in using mobile phones for learning which Ott et al. (2014) attributed to the unsuitability of the mobile phone format for m-learning approaches. The following hypothesis is forwarded:

H_{4null}: There is no significant relationship between the use of a mobile phone for school-related work and the type of school.

2.1.5. Frequency of Using Mobile Phones for School-Related Work

A frequent use factor that influences students' BI for m-learning in a developing country is the limited use of mobile devices for school-related work (Alghazi, Kamsin, Almaiah, Wong, & Shuib, 2021) which they attribute to technical factors such as device connectivity, compatibility, memory, performance, network coverage and network speed. In rural areas, unreliable electricity availability impacts the frequency of use (Fakokunde, 2017; Grimus & Ebner, 2015) which identified students' low awareness of using mobile phones for learning as an additional factor. The following hypothesis is being tested to see if there is a relationship between the type of school and the frequency of using mobile phones for school-related work:

H_{5null}: There is no relationship between the frequency of using a mobile phone for school-related work and the type of school.

2.2. Influencers of BI

This section reviews the literature related to research question 2 and covers BI, performance expectation, effort expectation, social influence and facilitating conditions. The use of mobile phones for learning is considered an ICT-based learning modality in education (Marcolino & Barbosa, 2017). To assess BI to use of new technology in m-learning, several theories and models have been proposed, namely the theory of planned behaviour (Azizi & Khatony, 2019), the technology acceptance model (Almaiah, Jalil, & Man, 2016; Saroia & Gao, 2019), diffusion of innovation (Kim et al., 2017; Mwapwele & Roodt, 2016), the decomposed theory of planned behaviour (He, Huang, Yu, & Li, 2021) and the UTUAT (Garcia, Aunario, & Handriyantini, 2019; Mosunmola, Mayowa, Okuboyejo, & Adenjiji, 2018). The basic concept of all these theories is that the actual use of new technology is directly influenced by an individual's reaction (attitude) to the technology hence, their BI to use it (Venkatesh et al., 2003). In our opinion, the UTAUT, a synthesis of several other root theories related to the popular technology acceptance model offers the best research lens. This decision is underscored by many studies that have proven its robust construct reliability and high internal consistency (Alshahrani & Walker, 2017).

We excluded the UTAUT-dependent variable use behaviour from our theoretical framework because usage is already covered in issues that impact the feasibility of m-learning.

Since usage is already covered in aspects that influence the feasibility of m-learning, the UTAUT-dependent variable use behaviour is excluded from our theoretical framework.

2.2.1. Performance Expectancy (PE)

In this study, PE is the degree to which students believe using mobile phones for learning is valuable and may lead to better grades. The positive impact of student perceptions of the usefulness of using mobile phones for learning on their BI has been highlighted by several researchers (Alghazi et al., 2021; Chao, 2019; Garcia et al., 2019; Kademeteme & Dehinbo, 2015; Liebenberg, Benade, & Ellis, 2018; Mosunmola et al., 2018; Thomas, Singh, & Gaffar, 2013). Thomas et al. (2013) showed that PE is more important than the ease of use of technology, a sentiment with which Mosunmola et al. (2018) agreed when they found it to be the strongest influencer of BI. The following hypothesis is offered:

H_{6null}: The perception of performance expectancy does not differ significantly between the two schools.

2.2.2. Effort Expectancy (EE)

In the current context, EE is the ease associated with students' use of mobile phones for learning. Several authors found that EE has a direct effect on BI (Alghazi et al., 2021; Chao, 2019; Kademeteme & Dehinbo, 2015; Liebenberg et al., 2018; Mosunmola et al., 2018; Venkatesh et al., 2003). However, Thomas et al. (2013), Garcia et al. (2019) and Thongsri, Shen, and Bao (2019) reported contradicting results that suggest that EE does not affect an intention to accept m-learning. These differences have been attributed to different countries and cultures (Thomas et al., 2013) and cultural differences that impact technology acceptance (Liebenberg et al., 2018; Mosunmola et al., 2018). Although not a specific focus, the deep-rural school is located in the traditional homeland of the Xhosa ethnic group while the semi-urban school is culturally more diverse with all 11 recognised native languages spoken. The following hypothesis is advanced:

H_{7null}: The perception of EE does not differ significantly between the two schools.

2.2.3. Social Influence (SI)

Empirical evidence that SI has an impact on BI has been provided by Venkatesh et al. (2003), Mosunmola et al. (2018), Garcia et al. (2019), Thongsri et al. (2019) and Thomas et al. (2013). The following hypothesis is proposed:

H_{8null}: The perception of SI does not differ significantly between the two schools.

2.2.4. Facilitating Conditions (FC)

In the domain of this study, FC refers to the degree to which students believe there is training, skills and educational ICT infrastructure to support learning with mobile phones. Venkatesh et al. (2003) found no significant effect of FC on BI. Several other authors (Alghazi et al., 2021; Garcia et al., 2019; Mosunmola et al., 2018; Thomas et al., 2013) have studied in high schools serving historically disadvantaged communities. Phone ownership has been identified as a critical success factor (Alrasheedi & Capretz, 2015; Moya & Camacho, 2021) in which m-learning users are responsible for mobile phone and Internet access costs. A lack of employment also forces most rural South African dwellers to purchase more expensive prepaid Internet packages with urban areas having more (885 000 vs. 13.7 million) postpaid subscriptions (ICASA, 2020). Basic mobile phone functionality also limits access to resource-rich educational content such as videos and audio streams (Brown & Mbati, 2015) while the inaccessibility of reliable broadband connections in rural areas affects connectivity (Kaliisa & Picard, 2017). Based on all the above discussion, the following hypothesis is advanced:

H_{9null}: The perception of FC does not differ significantly between the two schools.

3. Method

3.1. Research Paradigm

One recommendation to address the issue of learning material scarcity that high school students in marginalized communities in South Africa confront is to encourage them to use their phones for educational purposes (Ford & Botha, 2009; Ford et al., 2014). Therefore, it offers an approach that evaluates theories or beliefs about the success of their practical application. For this reason, the researchers decided to adopt pragmatics as a philosophical underpinning. The strategy is based on inductive reasoning and an understanding of the researcher's phenomenon.

3.2. Research Design

In this study, a multiple-case study (Yin, 2003) was adopted. The contemporary phenomenon in this research is the use of mobile phones for learning in the context of two schools serving marginalized communities.

3.3. Population and Sample

This research used two non-probability sampling techniques: convenience and purpose, as researchers' time and resources were limited (Etikan, Musa, & Alkassim, 2016). Convenience sampling was based on participants' ease of access. It was planned because the two schools serve as great examples of the issue being studied and because they represent historically underprivileged and marginalized communities. (Durrheim, 2006; Etikan et al., 2016).

3.4. Research Instrument

Section 1 of the survey instrument covered demographic data (age, grade, gender and ethnic grouping). Answers to mobile phone ownership, accessing the Internet using a mobile phone and awareness of m-learning and frequency of using mobile phones for school-related work, required simple "yes" or "no " answers. To collect data on student opinions in terms of UTAUT BI predictors, section 2 contained five-point Likert scale rating questions (1.*Never*, 2. *Rarely*, 3. *Sometimes*, 4. *Often*, and 5. *Always*). Validated items employed by Thomas et al. (2013) were used but slightly modified to reflect the m-learning environment to suit the m-learning environment in a resource-constrained educational context.

3.5. Reliability of BI Constructs

Using Cronbach's alpha coefficient, the reliability of each BI construct was tested to assess the internal consistency of the survey constructs. EE (0.70) and BI (0.74) returned sufficient levels. PE (0.66), SI (0.65) and FC (0.69) were very close to the threshold value of 0.7 (Hair, Wolfinbarger, Money, Samouel, & Page, 2016). Multivariate correlation analysis showed the strongest relationship between BI and PE (0.50) followed by FC (0.40), EE (0.39) and SI (0.36). Pearson's pairwise correlation revealed a significant positive relationship ($p < .0001$) between all variables except between EE and SI ($p < .0617$).

3.6. Data Analysis

An analysis of the relationship between aspects of mobile phone use and the type of school is presented using descriptive and inferential statistics. For inferential statistics, the t-test ($p < .05$) for rejection or acceptance of the null hypotheses were employed.

4. Results and Discussion

4.1. Demographics

Table 1 provides gender and age data for both schools.

Table 1. Gender and age.

Variables	Category	Deep – rural *n*=79	Semi-urban *n*=49
Gender	Female	46 (58%)	33 (67%)
	Male	33 (42%)	16 (33%)
Age	13-15	8 (10%)	38 (78%)
	16-17	71 (90%)	11 (22%)
Race	African (Black)	(97%)	48 (98%)
	Coloured	1 (1%)	1 (2%)

79 participants were from the deep-rural school and 49 from the semi-urban school. Most of the participants were female (58% and 67%). Participants in the deep-rural school were predominantly 16 years or older (90%) while most of the students in the semi-urban school were under 16 years (78%). With two exceptions, all participants were of the African ethnic group.

4.2. Results: Association Between Aspects of Mobile Phone Use and the Type of School

Research question 1 aimed to establish the relationship between aspects of m-learning (device ownership, access to the Internet use of mobile devices for school-related work, frequency and awareness of m-learning) and type of school. Table 2 presents a concise summary of the results.

Table 2. Cross-tabulation of frequencies between aspects of mobile phone use and the type of school.

Aspects	Deep-rural school (n=79)			Semi-urban school (n=49)		
	Yes		No	Yes		No
Ownership	56 (71%)		23 (29%)	40 (82%)		9 (18%)
Internet	59 (75%)		20 (25%)	40 (82%)		9 (18%)
Awareness	51 (65%)		28 (35%)	41 (84%)		8 (16%)
School-related work	45 (57%)		34 (43%)	38 (78%)		11 (22%)
Frequency	Always	Sometimes	Never	Always	Sometimes	Never
	3	60	16	4	44	1

4.2.1. Mobile Phone Ownership

Fewer students in the deep-rural school owned mobile phones (71% vs. 82%) compared to the deep-rural school. A Pearson chi-square test was performed to examine whether there was a relationship between the type of school and the ownership of the device. The results did not reveal a significant relationship between the two variables (chi square value = 1.863, df =1, p=0.1723). Cramer's V (0.12) indicated a weak effect. The test assumptions were satisfied and the null hypothesis is accepted.

H_{1null}: There is no significant relationship between mobile phone ownership and the type of school.

4.2.2. Accessing the Internet using a Mobile Phone

75 percent of students in the rural school and 82% in the semi-urban school accessed the Internet using a mobile phone. Since access to the Internet is slightly higher than the ownership of a mobile phone in a deep-rural school, it confirms the notion that the mobile phones of friends, relatives or siblings can be used. However, the results of a Pearson chi-square test did not provide evidence to support a relationship between Internet access and school type (chi-square value = 0.833, df =1, p=0.3613) with Cramer's V (0.08) indicating a weak effect.

H_{2null}: There is no significant relationship between accessing the Internet using a mobile phone and the type of school accepted.

4.2.3. Awareness of M-Learning

A higher percentage (35% vs. 16%) of students in the deep rural school indicated that they are not familiar with m-learning. Although the effect was small (Cramer's V value = 0.21), the relationship was significant (chi-square value = 5.467, df =1, p=0.0194).

$H_{3alternative}$: There is a significant relationship between awareness of m-learning and the type of school accepted.

4.2.4. Mobile Phone Use for School-Related Work

For participants in the deep-rural and semi-urban schools, the use was 57% and 78%. While the effect was weak (Cramer's V value = 0.21), a Pearson chi-square test returned a significant association (chi-square value = 5.624, df =1, p=0.0177, p < 0.05).

$H_{4alternative}$: There is a significant relationship between using a mobile phone for school-related work and the type of school accepted.

4.2.5. Frequency of Using Mobile Devices for School-Related Work

Very few participants used mobile devices all the time while most used them occasionally. A Pearson chi-square test returned a significant relationship between the two variables (chi-square value = 9.320, df =1, p=0.0095, p < 0.05). A Pearson value of 0.0095(p<0.05) provided evidence that the frequency of use of a mobile phone for school-related work is strongly associated with the type of school and Cramer's V (0.27) indicated a medium effect.

$H_{5alternative}$: A significant relationship exists between the frequency of using a mobile phone for school-related work and the type of school accepted.

4.2.6. Influencers of BI to use Mobile Phones for M-Learning

Research question 2 aimed to establish the differences between the types of schools for the following constructs PE, EE, SI, FC and BI. The cross-tabulations for each school and the constructs are presented in Table 3.

The mean scores for all constructs were consistently lower for the deep-rural school. The smallest mean difference for SI was 0.3 (see Table 4). EE and FC returned the same mean difference (0.5) while PE (0.6) and BI (0.7) had the largest differences. Cohen's D returned the largest effect for PE and BI and all other constructs returned a medium effect. Taking into account the scale from 1 (strongly disagree) to 5 (strongly agree), the mean deep-rural responses for all constructs fell at least halfway between "neither agree nor disagree" and "agree" but leaned more towards the latter. Except for FC, which was very close to" agree", the rest of the semi-urban responses fell between "agree" and "strongly agree" but leaned towards "agree". Outside FC, the standard deviations for the deep-rural school are higher for the constructs indicating greater variance in the data.

Table 3. Cross tabulations for aspects of mobile phone use.

Constructs	Level	Mean	Std. dev.	Std. err mean	Lower 95%	Upper 95%
PE	Deep rural school(n=79)	3.78	0.75	0.08	3.59	3.92
	Semi-urban school (n=49)	4.38	0.51	0.07	4.24	4.53
	Cohen's D = 0.93 large effect					
EE	Deep rural school (n=79)	3.81	0.75	0.08	3.64	3.97
	Semi-urban school (n=49)	4.27	0.60	0.09	4.09	4.44
	Cohen's D = 0.67 medium effect					
FC	Deep rural school (n=79)	3.40	0.81	0.09	3.22	3.58
	Semi-urban school (n=49)	3.92	0.86	0.12	3.67	4.16
	Cohen's D = 0.63 medium effect					
SI	Deep rural school (n=79)	3.81	0.70	0.08	3.64	3.96
	Semi-urban school (n=49)	4.09	0.57	0.08	3.93	4.25
	Cohen's D = 0.43 medium effect					
BI	Deep rural school (n=79)	3.76	0.79	0.09	3.59	3.94
	Semi-urban school (n=49)	4.43	0.47	0.07	4.29	4.56
	Cohen's D = 0.98 large effect					

Except for BI (p=0.0022 < 0.01), Levene's test for equal variances returned p-values greater than 0.01: PE (p=0.0175 > 0.01), EE (p=0.215 > 0.01), SI (p=0.881 > 0.01), and FC (p=0.1911 > 0.01). The t-test was employed for BI and hypothesis testing and the pooled t-test which assumes equal variances was used for the remaining structures. The results are presented in Table 4.

Table 4. t-test results.

Variability	PE	EE	SI	FC	BI
Difference	0.63	0.46	0.52	0.28	0.66
Std err dif.	0.12	0.13	0.15	0.12	0.11
Upper CL dif.	0.87	0.71	0.82	0.52	0.89
Lower CL dif.	0.39	0.21	0.22	0.05	0.44
Confidence	0.95	0.95	0.95	0.95	0.95
t ratio	5.17	3.61	3.44	2.41	6.00
DF	126	126	126	126	125.84
Prob > |t|	<.0001*	0.0004*	0.0008*	0.0176*	<.0001*
Prob > t	<.0001*	0.0002*	0.0004*	0.0004*	<.0001*
Prob < t	1.0000	0.9998	0.9996	0.9996	1.0000

Note: * p < .005.

With p values below 0.05 (PE (t (126)=5.17, p=0.0001 < 0.05, EE (t(126)=3.61, p = 0.0004 < 0.05, SI (t(126)=3.44, p = 0.0008 < 0.05, FC (t (126)=2.40, p = 0.0176 < 0.05 and BI (t(126)=.5.6, p = 0.0001 < 0.05, the test results revealed significant differences between the mean scores of the two schools for all constructs. The net result is that the null hypotheses for **H6** to **H9** are rejected with the assumptions of normality, independence and homogeneous variances not being satisfied. Therefore, for all constructs, there are significant differences between the two schools.

Although within-school analysis was not the purpose of the study, the F test ($p < 0.05$) was used to obtain more information on the significance between each construct and BI. PE, EE, and FC were found to be significant constructs of BI in both schools. Although SI was also a significant construct for the deep-rural school, it was not for the semi-urban school.

To conclude the results, Table 5 shows the total scores, summed and grouped for each BI construct per school.

Table 5. Behavioural intention constructs per school.

Constructs	No intention		Moderate intention		High intention	
	Semi-urban n=49	Deep-rural n=79	Semi-urban n=49	Deep-rural n=79	Semi-urban n=49	Deep-rural n=79
PE						
Not useful	0%	2.5%	0%	3.8%	0%	8.9%
Averagely useful	0%	2.5%	0%	7.6%	8.2%	12.7%
Very useful	0%	2.5%	2%	13.9%	87.8%	45.6%
EE						
Difficult to use	0%	0%	0%	1.3%	0%	0%
Easy to use	0%	1.3%	2%	11.4%	6.1%	17.7%
Very easy to use	0%	6.3%	2%	12.7%	89.8%	49.4%
SI						
Low-level belief	0%	0%	0%	1.3%	4.1%	0%
Moderate belief	0%	3.8%	4.1%	16.5%	14.3%	30.4%
High-level belief	0%	3.8%	0%	7.6%	77.6%	36.7%
FC						
Disagree	0%	0%	0%	2.5%	0%	1.3%
Neutral	0%	2.5%	0%	5.1%	8.2%	2.5%
Agree	0%	5.1%	4.1%	17.7%	87.8%	63.3%

Table 5 shows that in the deep rural school, less than half (ranging from 37% to 49% across the constructs) of students perceive using mobile phones for learning to be very useful for improving grades (PE). It is very easy to use mobile phones for learning (EE) and that they have a high belief in the importance of others to use mobile phones for learning (SI). However, a higher percentage of students in the deep rural region (63%) agreed that there is support, training and ICT infrastructure (FC) in place. However, in the semi-urban school, most students (ranging from 78% to 90%) perceive the use of mobile phones for learning to be very useful for improving grades (PE). It is very easy using mobile phones for learning (EE), strongly believe in the importance of others to use mobile phones for learning (SI) and agree that there is support, training and ICT infrastructure (FC). It should be noted that except for SI (4.1%), no semi-urban students responded negatively to any of the questions.

5. Discussion

This study first aimed to investigate the relationships that exist between various aspects of mobile phone use and the type of school (deep rural and semi-urban) that underlie the feasibility of m-learning and explored BI constructs to use mobile phones for m-learning.

Although fewer deep-rural students (71% vs. 82%) own mobile phones, this ownership was found to be non-significant and thus independent of the type of school. The result not only confirms reports that mobile phones are ubiquitous in rural populations in South Africa (Dalvit & Gunzo, 2014; Gabriels & Horn, 2014; ICASA, 2020; Jantjies & Joy, 2016) but also that youth ownership is increasing (Porter et al., 2020). Here, it is noted that ownership in both schools is higher than the 61% ownership reported in Africa (ITU, 2022a). As with mobile ownership, Internet access percentages (75% and 82%), although insignificant relationship between the two schools are higher than the 36% reported by the ITU (2022b) for African rural youth between 15 and 24 years of age and the 66% worldwide who access the Internet. Furthermore, it authenticates the high coverage of mobile phone networks available in the two provinces as reported by the ICASA (2020) suggesting that poor infrastructure and a lack of reliable Internet access as noted by Chetty-Mhlanga et al. (2020) and Kaliisa and Picard (2017) have become a lesser factor. It is noted that more students from the deep-rural school had access to the Internet than ownership (75% vs. 71%) which suggests that some students access the Internet through other means.

This pattern of slightly higher percentages favoring the semi-urban school was repeated in the rest of the aspects. The only difference in ownership was that all results returned significant associations.

In terms of awareness of m-learning, the results approximate research done elsewhere in Africa where high and positive levels of awareness were reported by high school students (Choice & Akudo, 2019; Fakokunde, 2017) or moderate awareness to HEI students in rural South Africa as reported by Taiwo, Uleanya, and Ayandibu (2022). However, the difference in awareness between schools (84% vs. 65%) was much larger. This corroborates our notion that semi-urban students are more likely to be exposed to mobile technologies.

Owning a mobile phone does not mean that the device will be used for school-related work (Hamidi & Chavoshi, 2018; Kim et al., 2017). Although the unsuitability of school-related work for the mobile phone format has been raised as a cause for lack of interest (Ott et al., 2014), recent research has shown that students' interests and usages of mobile phones for learning are not as high as expected (Alghazi et al., 2021; Hamidi & Chavoshi, 2018; Kim et al., 2017). The high percentage (78%) in the semi-urban schools points to elevated use. Students are known to collaborate outside of class time through social media tools (Albers, Davison, & Johnson, 2017), while the quality of experience or user satisfaction in rural areas is limited to lightweight applications like WhatsApp (Schwind, Wamser, Wunderer, Gassner, & Hoßfeld, 2019). The latter may explain the lower percentage of rural students (57%) who use their mobile phones for school-related work.

Ott et al. (2014) and Fakokunde (2017) found the frequency of mobile device use for school-related work to be limited but the high use at both schools is encouraging (80% and 98%) with the significance of the difference in use perhaps partly attributed to the semi-urban and deep-rural dichotomy that not only exists in the other aspects but in deep-rural factors such as lower ICT literacy, poverty and electricity (Sharehu & Achor, 2015). It is noted that the high frequency of use by deep rural learners must be weighed against their much lower overall use of mobile phones for school-related work.

Regarding BI, the results showed significant differences between the two schools for all constructs. The higher means generally lower standard deviations and higher intention percentages reported for the semi-urban school constructs once again support our notion that semi-urban students are more exposed to mobile technologies. The net result is that they have higher expectations are more influenced by others and experience better facilitating conditions resulting in greater use of mobile phones for learning by BI. Although the deep-rural data (generally a medium effect) leaned towards higher BI which indicates ample scope to exist for using mobile phones for learning, the results nevertheless suggest that many rural students are still subjected to low income and poverty (Brown & Mbati, 2015; Chetty-Mhlanga et al., 2020; Dalvit & Gunzo, 2012) which may result in lower BI to use mobile phones for learning. Furthermore, the difference in BI could be attributed to the differences between the students in psychological readiness which in an e-learning context is defined by Coopasami, Knight, and Pete (2017) as the individual's state of mind towards e-learning. According to Vladimirovna and Nikolayevna (2019) this readiness is influenced by the personalities, opinions, views, relations, reasons, will, intellectual qualities, knowledge, skills and attitudes of students.

6. Conclusion

The current study contributes to the current body of knowledge in two ways. First, as stated, the two schools selected for this study were part of Ford and Leinonen (2009) and Ford et al. (2014) research projects. Both studies reported positive behaviour when provided with mobile technologies. In this investigation, most of the students owned mobile phones. The future of m-learning at the rural school level appears to be much more positive than in the previous results despite the significant differences between the BI of students in the two schools to use mobile phones for learning generally in favour of the semi-urban school as expected. Second, and by extension, key educational stakeholders should note the results. Although there is a national framework for rural education in place, the Department of Basic Education appears to be singularly focused on improving broad access to quality education in disconnected and isolated areas. The absence of explicit objectives related to m-learning is noticeable and requires attention.

7. Suggestions and Future Implications

Although the study was conducted in two schools, the results cannot be generalized until larger populations with different demographics are considered. In addition, the opinions of teachers and parents should also be measured. Finally, the technological readiness (fit) of student mobile phones to available m-learning tools and approaches should also be measured.

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