The role that access and attitudes toward tablets have on learners' achievement in a Johannesburg school

Samantha Anne Hart (iD) **and Sumaya Laher** (iD)
Department of Psychology, University of the Witwatersrand, Johannesburg, South Africa
samantha.anne.hart@gmail.com

One of the central themes across education policies in South Africa is ensuring equal access to education in a context of diminishing resources. The roll-out of technology in schools plays a pivotal role in achieving equity. With the emphasis on technology integration, it is imperative to fully understand the factors that influence this process. Thus, this study investigated the role of access to tablets, and learners' attitudes towards tablets, on learner achievement. A convenience sample of 276 learners from an independent high school in Johannesburg, where tablets were used in the learning environment, completed a cross-sectional survey consisting of a demographics section, a section on access to technology, and a scale on attitudes towards the use of tablets. The results indicate that learner achievement is largely influenced by learner attitudes towards tablets, and in particular, enjoyability of use. Findings provide evidence that tablet provision, while necessary, is not sufficient for the successful integration of tablets and subsequent redress of equality in education in South Africa.

Keywords: access; attitudes; educational technology; enjoyability; Information and Communication Technology (ICT); learner achievement; tablets

Introduction
Despite South Africa being ranked among the highest emerging economies in Africa (Teso, Kondo & Dormido, 2018), the country still lags behind other emerging economies in terms of education. For example, the Trends in International Mathematics and Science Study found that the average mathematics performance of Grade 9 learners in South Africa to be well below the international benchmark of 500 points. South African learners achieved an average of only 372 points for Mathematics and 358 points for Science (Reddy, Visser, Winnaar, Arends, Juan, Prinsloo & Isdale, 2016). This poor performance is exacerbated by high teacher-learner ratios. In 2015 there were 61,597 teachers for 1,998 million learners in ordinary public schools in Gauteng, which resulted in a highly unbalanced teacher-learner ratio (Gauteng Province Treasury, Republic of South Africa, 2016). It is assumed that technology may augment sparse resources and allow access to the internet, e-textbooks, and educational applications, creating equal educational opportunities. Various forms of technology, ranging from interactive smartboards and mobile phones to tablets and the internet, are used in classrooms to engage learners in different modes of learning.

Using technology in a combination of online and face-to-face modes of instruction is known as blended learning (Graham, 2006). Tablets offer a convenient way to engage learners in a blended learning environment. Tablets are perceived to have numerous advantages over traditional pen-and-paper methods as they contribute to a more interactive and collaborative learning environment, which is thought to be a more effective pedagogy (Enriquez, 2010; Lee, Yoon & Lee, 2009; Ludwig & Mayrberger, 2012). Tablets have also been found to improve performance, attentiveness, and organisation of learning materials (Enriquez, 2010; Liaw & Huang, 2016; Ludwig & Mayrberger, 2012; Ongoz & Baki, 2010). Furthermore, the provision of e-textbooks eliminates the need to carry multiple heavy textbooks and is also a more cost-effective and convenient solution in the long term (Liaw & Huang, 2016; Ludwig & Mayrberger, 2012). Lei (2000) suggests that, while there is a strongly held premise that technology can help learners improve academic achievement, researchers have not yet developed a comprehensive model of variables that predict learner achievement, and much of the evidence is contradictory (see Clark & Mayer, 2011; Haßler, Major & Hennessy, 2015; Tamim, Borokhovski, Pickup, Bernard & El Saadi, 2015).

While tablets are perceived as being increasingly valuable in improving the quality of education and offering a solution in the high teacher-learner ratios in South Africa, it is possible that this may not be the case. The value (or lack thereof) of using tablets needs to be empirically investigated. Consequently, there is a need to determine whether the access to, and use of tablets affect learners' academic achievement, and what role learners' attitudes towards tablets play.

Understanding Access and Attitudes in Relation to Technology Adoption
Models on the use of technology suggest that, for technology to have an impact, learners should have access to tablets, and should also be positive towards the use of tablets in classrooms (Thatcher & Ndabeni, 2011). Access to technology is generally defined as physical access to technology at home, school, and other places, and is determined by how frequently technology is used (Albirini, 2006; Tsai & Tsai, 2010).

Davis (1989) developed the Technology Acceptance Model (TAM), which has been well established as a theoretical framework for studying attitudes towards technology in education (Cheung & Vogel, 2013;

Edmunds, Thorpe & Conole, 2012). Like many other attitude theories, it draws on the Theory of Planned Behaviour (TPB) (Fishbein & Ajzen, 2010) to explain the antecedents of behavioural intentions, which in turn determine actual behaviour. The TPB has been used as a theoretical basis in numerous studies regarding technology integration in schools (Albirini, 2006; Edmunds et al., 2012; Teo, 2008).

The initial TAM consisted of two factors, perceived usefulness (PU) and perceived ease of use (PEU). PU is defined as the degree to which the technology will improve performance while PEU refers to how much effort is required for the use of such technology. Current research indicates that substantial support exists for the TAM when investigating learner attitudes towards technology, in that PEU and PU predict learner attitudes towards technology (Cheung & Vogel, 2013; Edmunds et al., 2012; Liaw & Huang, 2015; Manochehri & Sharif, 2010).

According to Ajzen's TPB (Fishbein & Ajzen, 2010), attitudes consist of an affective, cognitive, and behavioural dimension. The original TAM considers only the cognitive (perceived usefulness) and behavioural (perceived ease of use) dimensions. While these factors explain some of the extent of variance in people's attitudes, they do not explain variance in totality, suggesting that other factors should also be investigated (Thatcher & Ndabeni, 2011). One such variable is enjoyability – the fun or pleasure derived from using technology. Enjoyability encompasses the affective component in Ajzen's TPB. Thatcher and Ndabeni (2011) argue for an extended TAM, which includes the addition of enjoyability alongside perceived usefulness and perceived ease of use as important determinants of learner attitudes. This has also been supported by several studies (Bere & Rambe, 2013; Ernst, Pfeiffer & Rothlauf, 2013; Hu, Poston & Kettinger, 2011; Sledgianowski & Kulviwat, 2008; Venkatesh, Thong & Xu, 2012). In investigating attitudes towards tablets, this study considered overall attitudes as well as subcomponents of PU, PEU and enjoyability. This study also considered the impact of access and attitudes towards technology on the learner achievement.

Access and Attitudes to Technology and Academic Achievement

Despite the increased prevalence and use of tablets in schools, many of the studies in current literature yield mixed results. Garcia (2011) compared the performance of two groups of learners – one group who used tablets in learning, and the other group who used traditional pen-and-paper methods. The research identified a non-significant improvement in academic achievement among the group who used tablets. Kiger, Herro and Prunty (2012) investigated the use of technology on mathematics

achievement, and the results from their study pointed towards an improvement in student achievement, while Carr (2012) found that technology could be used to promote student learning, engagement and achievement. Bester and Brand (2013) investigated the application of technology instruction and found significantly higher learner achievement in English, Mathematics and Geography. A more recent study found that access to technology is a strong predictor of academic achievement (Skryabin, Zhang, Liu & Zhang, 2015). Conversely, Lowther, Ross and Morrison (2003) found that when tablets were used to supplement traditional instruction, learner achievement in Mathematics did not increase significantly.

According to Ajzen's Theory of Planned Behaviour, attitudes predict behaviour (Fishbein & Ajzen, 2010), which was confirmed by various studies. Selwyn (1997) concluded that attitudes towards technology were important for initial acceptance and subsequent ways of using computers. Other studies that investigated learner achievement in conjunction with the use of technology in education found that learner attitudes towards technology were predictors of learner achievement. Hsu and Hsieh (2011) found that the frequency and duration of internet use and, most importantly, attitudes, predicted learner achievement. This is supported by López-Pérez, Pérez-López and Rodríguez-Ariza (2011) who found that the use of technology reduced dropout rates and improved learner performance. They also found that attitudes towards technology influenced this relationship. Mahmoudi, Samad and Razak (2012) ascertained that attitudes and performance were positively related. Van Deursen and Van Dijk (2015) argue that improving attitudes towards technology increases the likelihood of improving material access (the skills required to effectively use technology), which can translate into improved learner achievements. Adhikari, Mathrani and Parsons (2015) found that attitudes, more than access to technology, influence learner achievement. In line with models that suggest both access and attitudes towards technology can predict academic achievement, this study explored the following research questions:

1. What is the degree of accessibility to tablets and other forms of technology for the sample?
2. What attitudes do learners hold towards the use of tablets?
3. To what extent do attitudes towards tablet use and access predict academic achievement?
4. To what extent do overall attitudes and access predict learners' eagerness to continue using tablets in a blended learning environment?
5. What are learners' reasons for wanting to continue or discontinue using tablets in a blended learning environment?

Method
This study used a quantitative, correlational design

to explore the relationships between learners' attitudes towards using tablets, access to technology, and academic achievement. Correlational designs are used when a need exists to determine trends in the field to aid intervention (Babbie & Mouton, 2010). As the learners completed the questionnaires at a specific point in time, the design can also be described as cross-sectional (Stangor, 2011).

Sample

The sample in this study, as indicated in Table 1, consisted of learners from a high school in the Johannesburg area. As the school and the learners participated voluntarily, non-probability convenience sampling was used. The sample consisted of 276 learners from Grades 8 to 12 who were, at the time, using tablets in the classroom. Just over half of the learners in the sample were female and the majority were in Grades 8 and 9. Learners ranged from 12 to 20 years of age with a mean age of 15.6 years ($SD = 1.7$).

Table 1 Gender, grade, and age distribution of the sample

Variable	Level	f	%
Gender	Male	71	37.6
	Female	118	62.4
Grade	8	47	25.3
	9	30	16.1
	10	30	16.1
	11	47	25.3
	12	32	17.2
Age	12	1	0.5
	13	19	10.3
	14	28	15.2
	15	38	20.7
	16	33	17.9
	17	36	19.6
	18	24	13
	19	4	2.2
	20	1	0.5

Instruments

The questionnaire used in this study was pilot tested with 30 learners in Grades 6 to 12, and was reviewed by three experts in the field. The questionnaire consisted of three sections, namely, a demographics section, a section on access to technology, and a scale on attitudes towards technology.

The demographics section of the questionnaire requested information on age, gender, grade, access, and use of tablets and other technology. Access to tablets and internet connectivity at home and at school was measured by 12 closed-ended questions in a Yes/No format. The measure of internal consistency of the items in the scale yielded a value of 0.58. An open-ended question, "How do you use the tablet/iPad?" was also asked to explore how learners used the tablets at their school.

The scale on the attitudes towards the use of tables was adapted from two scales, namely, the Computer Attitude Questionnaire (Knezek & Christensen, 1996) and the Computer Attitude Measure for Young Students (Teo & Noyes, 2008). The adaptation for this study was necessary, as many different attitude scales consisting of similar items exist, but no single scale covered all the variables necessary for examining attitudes. Upon examination of the scales, the appropriate items were selected based on the theoretical underpinnings of this study. Thus, items pertaining to perceived enjoyability, perceived usefulness, and perceived ease of use were selected. The attitude scale that was developed consisted of 23 Likert-type questions ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), with higher scores indicating more positive attitudes. The measure of internal consistency of the items in the questionnaire respectively yielded alpha values of 0.80, 0.72, 0.83, and 0.82 for perceived enjoyability, perceived usefulness, perceived ease of use, and overall attitude.

The questionnaire concluded with a single open-ended question to determine whether learners would like to continue using tablets at school and what the reasons for doing so would be. The questionnaire took approximately 40 to 45 minutes to complete.

Academic achievement was measured using learners' mid-year marks obtained from the school with permission by the learners, the learners' parents/guardians, and the school. An average mark for all subjects was used to represent overall learner achievement.

Procedure

Ethical clearance for this study was obtained from the researchers' university (Protocol number: H15/05/16). Permission to conduct this study was also obtained from the Gauteng Department of Education. To gain access to the learners, consent was obtained from the school principal. Parental consent and learner assent were obtained, and it was explained that participation in this study was strictly voluntary and that confidentiality was guaranteed. Data from the questionnaires was analysed using SPSS Version 23 (IBM Corp., 2015).

Data Analysis

Descriptive statistics were used to analyse demographic information, overall attitudes towards the use of tables, each of the three attitude subscales, and academic achievement.

Multiple regression analyses were performed to determine whether access and attitudes predicted learners' academic achievement. The assumptions for a regression analysis were checked in terms of normality, multicollinearity, homoscedasticity, and independence (Field, 2009). None of the assumptions were violated.

The open-ended question, "Would you like to continue using the tablet/iPad at school? Please provide reasons for your answer", was analysed in two ways. In order to determine whether attitudes predicted behavioural intentions, a binary logistic regression analysis was conducted. None of the assumptions for the binary logistic regression were violated (Field, 2009). The reasons for wanting to continue or discontinue using tablets in the classroom were coded using content analysis methods as outlined by Braun and Clarke (2006). The frequency of the various reasons was examined.

Results
Access
As is evident from Table 2, in excess of 90% of students had access to the internet, a tablet, and a mobile phone. The proportion of students with access to the internet and various forms of technology far outweighed those who did not have access. Most learners had access to the internet and computers at home. Almost all learners possessed mobile phones and had access to tablets at home, while all learners had access to, and used tablets during classes. The majority of learners used their tablets for assignments at school, for homework, and for studying. Responses also indicate that tablets were used predominantly as e-textbooks while learners also mentioned that they used tablets to take photos of the board when teachers were explaining difficult concepts. Furthermore, learners used the tablets to look for educational videos on YouTube on topics that they did not understand. They also referred to the use of portals where they could access additional educational resources and assignments.

Table 2 Frequency of learners who have (or don't have) access to various forms of technology and how they use it

Access to forms of technology	*f*	%
Internet access at home	172	90.5
No internet access at home	18	9.5
Computer at home	151	79.9
No computer at home	37	19.6
Tablet at home	179	94.2
No tablet at home	11	5.8
Mobile phone	171	90
No mobile phone	8	9.5
Tablet used during class	190	100
Tablet not used during class	0	0
Tablet used for assignments at school	171	90
Tablets not used for assignments at school	19	10
Tablet used for homework	187	98.4
Tablet not used for homework	3	1.6
Tablet used to study	183	96.3
Tablet not used to study	6	3.2
Tablet used to contact classmates about schoolwork	95	50
Tablet not used to contact classmates about schoolwork	95	50
Tablet used to contact classmates socially	118	62.1
Tablet not used to contact classmates socially	72	37.9
Tablet used to contact teachers for schoolwork	32	16.8
Tablet not used to contact teachers for schoolwork	157	82.6
Tablet used for social media	80	42.1
Tablet not used for social media	110	57.9

Attitudes
The results in Table 3 show that learners' attitudes towards using tablets were relatively positive; the overall mean score for learners' attitudes was 3.84 (*SD* = 0.65), and 68.8% of learners were found to have positive or highly positive attitudes towards the use of tablets. Perceived enjoyability associated with the use of tablets was relatively neutral with a mean score of 3.66 (*SD* = 0.86). Perceived usefulness yielded a slightly more positive mean score of 3.89 (*SD* = 0.80) while perceived ease of use yielded the highest mean score of 3.97 (*SD* = 0.72).

Table 3 Minimum and maximum values, means, standard deviations, and skewness measures for the scale on the attitudes towards the use of tablets

	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)	*M*	*SD*	Skewness Statistic	*SE*	Kurtosis Statistic	*SE*
Overall attitudes	40.4	28.4	22.0	6.9	2.3	3.84	0.65	-0.388	0.147	-0.026	0.292
Perceived enjoyability	44.9	23.1	23.0	5.8	3.2	3.66	0.86	-0.321	0.147	-0.055	0.292
Perceived ease of use	39.5	33.4	18.2	7.1	1.9	3.97	0.72	-0.499	0.147	-0.049	0.292
Perceived usefulness	36.8	28.7	24.7	8.0	1.8	3.89	0.8	-0.301	0.147	-0.436	0.292
Age	.	.	.	.	.	15.7	1.7	-0.182	0.188	-0.554	0.374

Access and Attitudes as Predictors of Academic Achievement

The backwards stepwise regression analysis was used to determine whether access and attitudes predict academic achievement in a learning environment where technology is used. As indicated in Table 4, overall attitudes towards tablet use and access was statistically significant (F 1.120 = 4.237, p < 0.05), with the model explaining 2.6% of the variance. Overall attitude was the only significant predictor (b = 0.184, t = 2.059, p = 0.037). As such, a separate regression analysis was run with the three attitude subscales.

The results from the regression analyses that explored the three attitude subscales and access to technology appear in Table 5. The final model was significant (F 1.120 = 4.999, p < 0.05) and explained 2.9% of the variance. Enjoyability was the only significant predictor of academic achievement (b = 0.191, t = 2.145, p = 0.034).

Table 4 Backward stepwise regression summary: Access and attitudes as predictors of academic achievement

Model		B	SE	t	F	Adjusted R^2
1	Access	6.642	7.313	0.908	2.528	0.024
	Overall attitudes	3.118	1.671	1.866		
2	Overall attitudes	3.384	1.644	2.059*	4.237*	0.026

Note. *p < .05, **p < .01, ***p < .001. Dependent variable: Average across subjects.

Table 5 Backward stepwise regression summary: Access, enjoyability, ease of use, and usefulness as predictors of academic achievement

Model		B	SE	t	F	Adjusted R^2
1	Enjoyability	1.916	1.644	1.166	1.338	0.011
	Ease of use	0.88	1.819	0.484		
	Usefulness	0.103	1.393	0.074		
	Access	5.899	7.485	0.788		
2	Enjoyability	1.931	1.625	1.188	1.797	0.019
	Ease of use	0.905	1.78	0.509		
	Access	5.887	7.452	0.79		
3	Enjoyability	2.434	1.285	1.895	2.582	0.025
	Access	5.653	7.414	0.762		
4	Enjoyability	2.67	1.245	2.145*	4.599*	0.029

Note. *p < .05, **p < .01, ***p < .001. Dependent variable: Average across subjects.

Learners' Eagerness to Continue Using Tablets

Learners were asked whether they wanted to continue using tablets at school. A binary logistic regression revealed that attitudes towards tablet use strongly predicted whether or not learners wished to continue using tablets. As shown in Table 6, the overall statistic was significant (p < 0.01), therefore adding variables to the model does improve the model prediction. The Nalgelkerke R^2 value indicates that 5.4% of the variance is explained by the model. Roa's efficient score statistic shows that adding perceived usefulness to the model will improve it significantly (Wald χ^2 (1) = 4.336, p < 0.01) while adding enjoyability, ease of use or access did not improve the model significantly (p > 0.05). The perceived usefulness of the technology had a substantial impact (Exp (B) = 1.903) on learners' intentions to use educational technology in future, producing a change of 1.903 units in behavioural intention for each unit change in perceived usefulness.

Table 6 Binary logistic regression summary: Access, enjoyability, ease of use, and usefulness as predictors of wanting to continue/discontinue using tablets in a blended learning environment

		B	SE	Wald	df	Sig.	Exp(B)	Nagelkerke R^2
Step 4a	Perceived usefulness	0.643	0.309	4.336	1	0.037	1.903	0. 054

The reasons for learners wanting to continue or discontinue using tablets were also explored through content analysis. The results, as shown in Table 7, indicate that the majority of learners (86.3%) were in favour of continuing the use of tablets at school. The most common response given by learners was that tablets were better or easier to learn from. Learners indicated that they used the school portal to get information, watched videos when they did not understand a concept, and took photos/videos of the teacher explaining difficult concepts to watch again later.

Learners also cited ease of use as a reason for wanting to continue using the tablets. The most common reason was the physical benefit of tablets being lighter to carry. However, very few students noted the benefit of mobility, which provided the opportunity to learn anywhere at any time. Another common reason to continue using tablets was that it was easier to find information on a tablet and that it provided more efficient/faster access to information than hardcopy textbooks. Learners' responses to the open-ended question, "How do you use your tablet?," revealed that the tablets were used

primarily as e-textbooks, to create PowerPoint presentations for projects, to find educational videos, and to access educational resources on the school's educational portal.

Enjoyment and importance for the future were less common responses, with few learners mentioning that they found tablets to be enjoyable, fun, or interesting to use. The few learners who did mention the importance of using tablets in the future included reasons such as needing to learn about technology in the current technological era, being aware that universities used technology, thus it was helpful for them to learn how to use it at school, that being technologically proficient could provide career opportunities, and that tablets were more environmentally friendly than hardcopy books. The least mentioned reasons were that learners felt that the use of tablets improved their concentration/focus, and that tablets provided effective communication channels.

While the majority of learners wanted to continue using tablets, it was important to consider why some learners reported not wanting to continue using tablets, as their responses provided valuable information about what could be improved. Learners mentioned that tablets were a distraction and, in some cases, even stated that their marks had dropped as a result of using them. The distractions were described as games, music, social media, and non-educational videos. The fact that tablets were not easy to use and were not efficient was also given as a reason for not wanting to continue using tablets. Learners stated that it was difficult to write notes on the tablets and that they caused eye strain. Other reasons for not wanting to continue using tablets included that not all learners were knowledgeable about the correct use of tablets, and that the tablets were slow and contained viruses. Physical limitations of tablets mentioned by learners included that tablets broke easily, had battery issues and that, during load shedding, they could not charge their tablets.

Table 7 Summary of responses given for wanting to continue or discontinue using tablets

Reasons given	Number (%)
Yes, I want to continue using tablets	**138 (86.3%)**
Efficient/faster	30 (18.8%)
Easy to use	25 (15.6%)
Mobility	4 (2.5%)
Physical benefits	41 (25.6%)
Better/easier learning	56 (35%)
Enjoyment	17 (10.6%)
Improved marks	4 (2.5%)
Importance for the future	21 (13.1%)
Communication	1 (0.6%)
Increased focus	2 (1.3%)
No, I do not want to continue using tablets	**22 (13.75%)**
Distraction	16 (10%)
Physical limitations	4 (2.5%)
Not easy to use	4 (2.5%)
Not efficient/faster	9 (5.6%)
Poorer marks	0 (0%)

Discussion

Traditionally, access to technology was considered key to dealing with resource constraints and providing equal access to education (Van Deursen & Van Dijk, 2015). The results from this study indicate that access to technology does not predict learner achievement but rather that attitudes towards technology – enjoyability, in particular, predict learner achievement. However, it is important to note that access in this study was measured in terms of quantity (frequency) of use and not quality of use. As such, this study supports previous research that found that the quantity of usage does not predict learner achievement (Lei, 2000). Manochehri and Sharif (2010) also found that previous experience or access to technology did not necessarily influence attitudes towards technology, and that interest and motivation were fundamental conditions for learning rather than the use of technology.

This could explain why enjoyability was the single attitudinal component that predicted academic achievement. Malone and Lepper (1987) state that mobile technologies enhance learning through challenge, curiosity, recognition, competition and co-operation and that this, in turn, makes learning more fun. If learners perceive their experience with tablets as enjoyable, they may be more motivated and achieve better.

Neither the logistic regression results nor the qualitative analysis indicate that enjoyability was significantly related to the intention to use tablets for learning in future. The logistic regression showed that learners' perceptions of how useful and important it is to use tablets for learning predicted their eagerness to continue using tablets. The most common reason that learners provided for wanting to continue using tablets was the ease of use, physical benefits, and easy access to information associated with the use of tablets. The af-

fective component of enjoyability of use was not top of mind, and it is possible that learners were more aware of the tangible, behavioural aspects linked to ease of use as well as the more overt, cognitive information on the benefits of technology. Learners are often subjected to discourses on the ills of social media and the participants may also have thought it socially more desirable to refer to aspects linked to ease of use or perceived usefulness as opposed to enjoyability.

It is also possible that enjoyability was determined by how the tablets were being used at school. Previous research revealed that most teachers in South Africa were not sufficiently skilled and did not use technology in a way that engaged learners (Ertmer & Ottenbreit-Leftwich, 2010).

Either way, the results of this study concur with Grasha and Yangarber-Hicks (2000), Hsu and Hsieh (2011) and Mahmoudi et al. (2012) who found that positive attitudes towards technology like computers and the internet were associated with learner achievement. López-Pérez et al. (2011) discovered that the relationship between the use of technology and achievement could be attributed to attitudes towards technology. However, the findings suggest that it is necessary to not only consider attitudes as a unitary concept. It is necessary to study the components of attitudes in terms of the behavioural, cognitive, and affective domains as postulated by Fishbein and Ajzen (2010) as these suggest a more nuanced approach to educational technology integration. It is recommended that particular attention be paid to increasing the perceived enjoyability as well as the perceived usefulness of tablets in the classroom. This can be done through a more transformative blend and a course design approach which will promote autonomy for learners.

Limitations of the Study
It should be acknowledged that the sample size used in this study was relatively small. Furthermore, non-probability convenience sampling was used, which only focused on a specific region. This affects the extent to which these results may be generalised. It should also be noted that the group sizes for the binary logistic regression were unequal, with 86.3% of learners expressing the wish to continue using tablets, which was not ideal for inferential analysis.

Due to the fact that this was a cross-sectional design and the questionnaire was only administered at one point in time, it was not possible to track learner attitudes over time. It was also not possible to explore whether or not academic achievement improved or diminished as a result of the integration of tablets. The qualitative portion of this study yielded some evidence to suggest that this may be the case as a few of the learners indicated

that they believed that their marks had improved as a result of using tablets. The opposite affect may occur for other learners, as some learners in this study reported difficulty in concentrating while using tablets, and that this did not have a positive impact on their marks.

Conclusion
It is evident that the use of technology is an important aspect in education today. This study found that attitudes towards tablets, particularly as they pertain to perceived enjoyability, predict learner achievement. Moreover, perceived usefulness was found to predict learners' eagerness to continue using tablets. As indicated in the limitations, the sample on which this argument is based was a relatively small convenient sample from a single sector of society. Hence it is recommended that a bigger and more diverse sample be obtained in future research endeavours. It would also be beneficial to gain an in-depth understanding of the quality of technology use rather than the quantity. This would provide the information needed to evaluate access more meaningfully. A further recommendation would be to use a longitudinal cohort design so that the variables may be tracked over a period to determine the long-term influence of the use of devices on academic achievement.

It is imperative to improve educational outcomes (i.e. learner achievement) in South Africa to achieve the current transformation goals (Gauteng Province Treasury, Republic of South Africa, 2016), and ultimately to ensure continued transformative growth that marks South Africa as one of the leading emerging economies in Africa (Teso et al., 2018). Learner achievement is often regarded as an indication of the success of an innovation (Torrisi-Steele & Drew, 2013). Learner attitudes towards tablet use were found to influence learner achievement. This supports the idea that there is more to successful integration of technology than the mere provision of technology itself. Thus, while access is certainly a necessary component of successful integration, it is not sufficient. It would be important for models that seek to integrate technology effectively in classrooms to acknowledge the role of attitudes and the enjoyment associated with using tablets, in particular.

Authors' Contributions
SAH wrote the manuscript and provided data for Tables 1 to 7, SL contributed to the writing of the literature review and discussion, SL and SAH conducted all statistical analyses. Both authors reviewed the final manuscript.

Notes
i. Published under a Creative Commons Attribution Licence.

References

Adhikari J, Mathrani A & Parsons D 2015. Bring your own devices classroom: Issues of digital divides in teaching and learning contexts. In *Proceedings of the 26th Australasian Conference on Information Systems*. Adelaide, Australia: University of South Australia. Available at https://arxiv.org/ftp/arxiv/papers/1606/1606.02488.pdf. Accessed 25 June 2019.

Albirini A 2006. Teachers' attitudes toward information and communication technologies: The case of Syrian EFL teachers. *Computers & Education*, 47(4):373–398. https://doi.org/10.1016/j.compedu.2004.10.013

Babbie E & Mouton J 2010. *The practice of social research* (10th ed). Cape Town, South Africa: Oxford University Press Southern Africa.

Bere A & Rambe P 2013. Extending Technology Acceptance Model in mobile learning adoption: South African University of Technology students' perspectives. In E Ivala (ed). *Proceedings of the 8th International Conference on e-Learning* (Vol. 1). Reading, England: Academic Conferences and Publishing International Limited.

Bester G & Brand L 2013. The effect of technology on learner attention and achievement in the classroom. *South African Journal of Education*, 33(2):Art. #405, 15 pages. https://doi.org/10.15700/saje.v33n2a405

Braun V & Clarke C 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2):77–101.

Carr JM 2012. Does math achievement h'APP'en when iPads and game-based learning are incorporated into fifth-grade mathematics instruction? *Journal of Information Technology Education: Research*, 11(1):269–286. Available at https://www.learntechlib.org/p/111505/. Accessed 22 June 2019.

Cheung R & Vogel D 2013. Predicting user acceptance of collaborative technologies: An extension of the technology acceptance model for e-learning. *Computer & Education*, 63:160–175. https://doi.org/10.1016/j.compedu.2012.12.003

Clark RC & Mayer RE 2011. *E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning* (3rd ed). San Francisco, CA: Pfeiffer.

Davis FD 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3):319–340. Available at https://www.jstor.org/stable/pdf/249008.pdf?casa_token=oi0bVS2iy-IAAAAA:ZblZ5qhfoOSdhiFtrt3twh_yAQHEtRbjEyD5WhL-opnNZIkDSkDUtfeFNIpMv0zN8s7-mfc6O2f4R0LxYKi7zigkaxa90Cz0PB9nzyg4UdDMBdKskg. Accessed 12 June 2019.

Edmunds R, Thorpe M & Conole G 2012. Student attitudes towards and use of ICT in course study, work and social activity: A technology acceptance model approach. *British Journal of Educational Technology*, 43(1):71–84. https://doi.org/10.1111/j.1467-8535.2010.01142.x

Enriquez AG 2010. Enhancing student performance using tablet computers. *College Teaching*, 58(3):77–84. https://doi.org/10.1080/87567550903263859

Ernst CPH, Pfeiffer J & Rothlauf F 2013. The influence of perceived belonging on social network site adoption. In *Proceedings of the Nineteenth Americas Conference on Information Systems*. Chicago, IL: Association for Information Systems. Available at https://cdn-hochschule-heidelberg.azureedge.net/fileadmin/Ernst/PerceivedBelonging.pdf. Accessed 30 June 2019.

Ertmer PA & Ottenbreit-Leftwich AT 2010. Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*, 42(3):255–284. https://doi.org/10.1080/15391523.2010.10782551

Field A 2009. *Discovering statistics using SPSS* (3rd ed). London, England: Sage.

Fishbein M & Ajzen I 2010. *Predicting and changing behavior: The reasoned action approach*. New York, NY: Psychology Press.

Garcia ER 2011. "There's an app for that:" A study of using Apple iPads in a United States History classroom. In LP McCoy (ed). *Studies in teaching 2011 research digest*. Winston-Salem, NC: Wake Forest University, Department of Education. Available at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.362.6717&rep=rep1&type=pdf#page=35. Accessed 30 June 2019.

Gauteng Province Treasury, Republic of South Africa 2016. *Medium Term Budget Policy Statement 2016*. Marshalltown, South Africa: Author. Available at http://www.gauteng.gov.za/government/departments/provincial-treasury/Documents/Medium%20Term%20Budget%20Policy%20Statement%202016.pdf. Accessed 13 March 2017.

Graham CR 2006. Blended learning systems: Definitions, current trends, and future directions. In CJ Bonk, I Charles & CR Graham (eds). *The handbook of blended learning: Global perspectives, local designs*. San Francisco, CA: Pfeiffer.

Grasha AF & Yangarber-Hicks N 2000. Integrating teaching styles and learning styles with instructional technology. *College Teaching*, 48(1):2–10. https://doi.org/10.1080/87567550009596080

Haßler B, Major L & Hennessy S 2015. Tablet use in schools: A critical review of the evidence for learning outcomes. *Journal of Computer Assisted Learning*, 32(2):139–156. https://doi.org/10.1111/jcal.12123

Hsu LL & Hsieh SI 2011. Factors associated with learning outcomes of BSN in a blended learning environment. *Contemporary Nurse*, 38(1-2):24–34. https://doi.org/10.5172/conu.2011.38.1-2.24

Hu T, Poston RS & Kettinger WJ 2011. Nonadopters of online social network services: Is it easy to have fun yet? *Communications of the Association for Information Systems*, 29:441–458.

https://doi.org/10.17705/1CAIS.02925

IBM Corp. 2013. *IBM SPSS Statistics for Windows, Version 22.0*. Armonk, NY: Author.

Kiger D, Herro D & Prunty D 2012. Examining the influence of a mobile learning intervention on third grade Math achievement. *Journal of Research on Technology in Education*, 45(1):61–82. https://doi.org/10.1080/15391523.2012.10782597

Knezek G & Christensen R 1996. *Validating the Computer Attitude Questionnaire (CAQ)*. Paper presented at the Annual Meeting of the Southwest Educational Research Association, New Orleans, LA, 26 January. Available at https://files.eric.ed.gov/fulltext/ED398243.pdf. Accessed 15 January 2017.

Lee BC, Yoon JO & Lee I 2009. Learners' acceptance of e-learning in South Korea: Theories and results. *Computers & Education*, 53(4):1320–1329. https://doi.org/10.1016/j.compedu.2009.06.014

Lei J 2000. Quantity versus quality: A new approach to examine the relationship between technology use and student outcomes. *British Journal of Educational Technology*, 41(3):455–472. https://doi.org/10.1111/j.1467-8535.2009.00961.x

Liaw SS & Huang HM 2015. How factors of personal attitudes and learning environments affect gender differences towards mobile distance learning acceptance. *The International Review of Research in Open and Distributed Learning*, 16(4):104–132. https://doi.org/10.19173/irrodl.v16i4.2355

Liaw SS & Huang HM 2016. Investigating learner attitudes toward e-books as learning tools: Based on the activity theory approach. *Interactive Learning Environments*, 24(3):625–643. https://doi.org/10.1080/10494820.2014.915416

López-Pérez MV, Pérez-López MC & Rodríguez-Ariza L 2011. Blended learning in higher education: Students' perceptions and their relation to outcomes. *Computers & Education*, 56(3):818–826. https://doi.org/10.1016/j.compedu.2010.10.023

Lowther DL, Ross SM & Morrison GM 2003. When each one has one: The influences on teaching strategies and student achievement of using laptops in the classroom. *Educational Technology, Research and Development*, 51(3):23–44. https://doi.org/10.1007/BF02504551

Ludwig L & Mayrberger K 2012. Next generation learning? Learning with tablets as an example for the implementation of digital media in schools. In T Amiel & B Wilson (eds). *Proceedings of EdMedia 2012--World Conference on Educational Media and Technology*. Denver, CO: Association for the Advancement of Computing in Education (AACE).

Mahmoudi M, Samad AA & Razak NZA 2012. Attitude and students' performance in computer assisted language learning (CAELL) for learning vocabulary. *Procedia - Social and Behavioral Sciences*, 66:489–498. https://doi.org/10.1016/j.sbspro.2012.11.293

Malone TW & Lepper MR 1987. Making learning fun: A taxonomy of intrinsic motivations for learning. In RE Snow & MJ Farr (eds). *Aptitude, learning, and instruction: Conative and affective process analyses* (Vol. 3). Hillsdale, NJ: Erlbaum.

Manochehri NN & Sharif K 2010. A model-based investigation of learner attitude towards recently introduced classroom technology. *Journal of Information Technology Education*, 9(1):31–52. Available at https://www.learntechlib.org/p/111355/. Accessed 8 May 2019.

Ongoz S & Baki A 2010. E-book usage of graduate students studying educational sciences in Turkiye. *Turkish Online Journal of Distance Education*, 11(1):198–210. Available at https://files.eric.ed.gov/fulltext/EJ886462.pdf. Accessed 8 May 2019.

Reddy V, Visser M, Winnaar L, Arends F, Juan A, Prinsloo C & Isdale K 2016. *TIMSS 2015: Highlights of mathematics and science achievement of grade 9 South African learners*. Cape Town, South Africa: Human Sciences Research Council. Available at http://www.timss-sa.org.za/download/TIMSS-Grade-9-Highlights.pdf. Accessed 7 October 2018.

Selwyn N 1997. Students' attitudes toward computers: Validation of a computer attitude scale for 16–19 education. *Computers & Education*, 28(1):35–41. https://doi.org/10.1016/S0360-1315(96)00035-8

Skryabin M, Zhang JJ, Liu L & Zhang D 2015. How the ICT development level and usage influence student achievement in reading, mathematics, and science. *Computers & Education*, 85:49–58. https://doi.org/10.1016/j.compedu.2015.02.004

Sledgianowski D & Kulviwat S 2008. Social network sites: Antecedents of user adoption and usage. In *Proceedings of the Fourteenth Americas Conference on Information Systems*. Available at https://pdfs.semanticscholar.org/9b38/ad5827d3d5 960a6f0122952a1b1d7ab0cf56.pdf. Accessed 3 July 2019.

Stangor C 2011. *Research methods for the behavioral sciences* (4th ed). Belmont, CA: Wadsworth, Cengage Learning.

Tamim RM, Borokhovski E, Pickup D, Bernard RM & El Saadi L 2015. *Tablets for teaching and learning: A systematic review and meta-analysis*. Burnaby, Canada: Commonwealth of Learning. Available at http://oasis.col.org/bitstream/handle/11599/1012/2 015_Tamim-et-al_Tablets-for-Teaching-and-Learning.pdf?sequence=1&isAllowed=y. Accessed 4 July 2019.

Teo T 2008. Pre-service teachers' attitudes towards computer use: A Singapore survey. *Australasian Journal of Educational Technology*, 24(4):413–424. Available at https://www.researchgate.net/profile/Timothy_Teo/publication/252141795_Pre-service_teachers'_attitudes_towards_computer_use _A_Singapore_survey/links/0a85e53c78cac27b6e0 00000.pdf. Accessed 30 April 2019.

Teo T & Noyes J 2008. Development and validation of a computer attitude measure for young students (CAMYS). *Computers in Human Behavior*, 24(6):2659–2667. https://doi.org/10.1016/j.chb.2008.03.006

Teso Y, Kondo M & Dormido H 2018. These are 2018's most (and least) attractive emerging markets. *Bloomberg*, 21 January. Available at

https://www.bloomberg.com/news/articles/2018-01-21/emerging-market-scorecard-supports-mexico-and-turkey-over-india. Accessed 7 October 2018.

Thatcher A & Ndabeni M 2011. A psychological model to understand e-adoption in the context of the digital divide. In J Steyn & G Johanson (eds). *ICTs and sustainable solutions for the digital divide: Theory and perspectives*. Hershey, PA: Information Science Reference. Available at https://ethnosproject.org/wp-content/uploads/digital-divide-theory-perspectives.pdf. Accessed 4 July 2019.

Torrisi-Steele G & Drew S 2013. The literature landscape of blended learning in higher education: The need for better understanding of academic blended practice. *International Journal for Academic Development*, 18(4):371–383. https://doi.org/10.1080/1360144X.2013.786720

Tsai MJ & Tsai CC 2010. Junior high school students' Internet usage and self-efficacy: A re-examination of the gender gap. *Computers & Education*, 54(4):1182–1192. https://doi.org/10.1016/j.compedu.2009.11.004

Van Deursen AJAM & Van Dijk JAGM 2015. Toward a multifaceted model of Internet access for understanding digital divides: An empirical investigation. *The Information Society*, 31(5):379–391. https://doi.org/10.1080/01972243.2015.1069770

Venkatesh V, Thong JYL & Xu X 2012. Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly*, 36(1):157–178.