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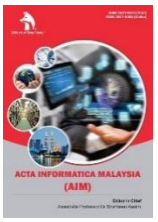

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RESEARCH ARTICLE

AN EMPIRICAL INVESTIGATION INTO THE EXTENT UNIVERSITY STUDENTS UTILISE MOBILE EDUCATIONAL APPLICATIONS FOR LEARNING

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ABSTRACT

The purpose of the study is to determine the extent and frequency with which university students use Mobile Educational Applications, the knowledge concerning their availability, challenges students experience in using them, and the effect of these apps on students' learning processes and performance. The research adopted a quantitative method of investigation and was conducted at a university in South Africa. A total of 280 questionnaire responses were completed and returned compared to the envisaged sample size of 375, representing a 75% response rate. The results revealed that students have properly incorporated mobile devices and applications into their daily lives and use mobile apps for personal, social, and academic activities on varying scales. A vast majority of students have acknowledged the affirming utility of mobile educational apps in their studies. It was concluded that Mobile Educational Applications are tools that enhance students' learning in a university environment.

KEYWORDS

mobile educational applications, mobile learning, university students, quantitative research

1. INTRODUCTION

South African government has prioritised the use on Information, Communication and Technologies in the field of education across all levels (Cross and Adam, 2007). South African higher education environment is infamous for its lack of personal contact between lecturers and students, limited opportunities for students to integrate and apply knowledge from various fields, and other more deep-rooted issues of economic and racial diversity (Jaffer et al., 2007). The same authors have noted that, the appropriate use of educational technology can leverage and improve learning outcome and that, mobile educational technology can afford both lecturers and students with an entire continuum of possibilities beyond the physical and geographical boundaries. Mobile technologies and applications provide possibilities of anytime-anywhere learning probable. The mobile learning applications are viable tools that support interaction and engagement among students, learning contents and context (Naismith et al., 2004).

This support has become increasingly possible as the mobile phones and data have become cheaper with time. As was stated by mobile learning systems when correctly used can enhance communication and enrich students' learning experiences (Al-Fahad, 2009). The characteristics of the mobile learning paradigm allow individual learners to personalise the learning content by merging knowledge from various sources to suit their circumstances (McLoughlin and Lee, 2010). Importantly, mobile learning favours students when used effectively (Al-Shehri, 2011). Availability and adaptability of these applications, through the functions of smartphones and other mobile devices among university students, presents a good opportunity to make use of these devices to better their studies. The outcomes of a study on the mobile use patterns by university students in South Africa have shown that students spent most of their phone time on social networking using various social platforms (Uys et al., 2012).

The study results also have shown that, though about 60% of the students surveyed use their smartphones for academic needs, only 10% of them use their smartphones to consult with their lecturers. Students accept that, mobile educational applications afford them with increased flexibility to access a variety of resources for independent learning (Jaradat, 2013). The same survey also established that, use of mobile learning applications will enhance learning experiences beyond the classroom boundaries. Despite having the knowledge, the stated facts, it was observed that, 'students used their mobile devices and applications (mainly) for surfing the web and to engage in entertainment activities such as playing mobile games and for social networking activities' (Jaradat, 2013). Thus, the aim of this study was to investigate the extent with regard to the use and adoption of mobile educational applications by students at a university in South Africa.

2. STUDENTS' KNOWLEDGE ABOUT EDUCATIONAL APPLICATIONS

Mobile learning can deliver multimedia content on lightweight devices with enhanced communication capabilities continuously that support situated learning (Mehdipour and Zerehkafi, 2013). Mobile learning is available anytime, anywhere and provides self-learning, feedback and support, and interaction between students and lecturers and among students on course content and academic-related matters (Gure, 2015). Quinn states that the use by students of what is provided by mobile technology and applications for learning is relatively poor compared to what is offered by social networking and informal communication (Quinn, 2011). This points to the need for lecturers to assume a leading role in guiding students with information on educational applications that are beneficial to them in their learning and to use their mobile gadgets, such as smartphones, as tools for learning 'anytime and anywhere'. "The affordance of mobile technologies and appropriate theoretical frameworks have the potential to enable teachers to adopt mobile learning in sound and significant ways and to ensure that it survives beyond

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novelty and convenience value" (Herrington and Herrington, 2007). The time to move away from the traditional fixed time and fixed space learning thought to an open space anytime learning is upon us. If all role players are not up to speed with this in development, this may reduce to a big-time missed opportunity.

3. The Extent of Regular Use of Mobile Educational Applications By Students

Mobile technology assists in developing new cooperative learning methods, facilitation of communication, exploration of learning outside lecture rooms, problem-solving, and improvement of students' academic performance (Kadry and Ghazal, 2019). Globally, many educational institutions are using smart devices and platforms for student communication and delivery of courses, which helps students use their favourite electronic mobile tools for studies. Mobile technology and mobile applications have the leverage to develop innovative educational methods, better communication mechanisms, and advanced skills and techniques to effectively surge higher-order thinking abilities among students, both in and out of the university environment (Greenwood et al., 2000). There are a variety of free educational mobile applications made available and accessible to the public by different service providers that are subject-specific and others for general utility for university students. Apple's app store alone has more than 80000 applications classified as education and learning-based (Apple, 2015). It is a fact that young people spend a lot of time with digital media, and that in the last couple of years, educational apps have gained popularity among the public, in general. Based on the above realities, it is within anybody's reasonable expectation that, at least, there should be some degree of usage of educational applications among university students (Hirsh-Pasek, 2015).

4. Challenges Faced By Students in The Regular Use of Mobile Applications

Students' ownership of mobile devices (smartphones) is comparatively low and was identified as a challenge to the smooth implementation of mobile learning, specifically in the African context. This is mainly due to the relatively high cost of mobile data, mobile devices, and relatively poor access to a communication infrastructure (Aheto, 2018). Expenditure on data for an average university student in South Africa is exponentially disproportionate to the disposable amount of money available to him or her for personal needs/expenses. Reports show that the average monthly expense comprehensive for mobile data and airtime is R260.00, based on an average expendable income of R1000.00 for a month. This is about 25% of funds available to an average university student for personal expenses per month (Ngaleka and Uys, 2013). An over-stretched budget makes it impossible for many to use mobile learning facilities fruitfully when away from the university environment.

5. The Impact of Mobile Applications on The Academic Performance of Students

Developments in mobile technology have made it possible for students to continue learning outside the traditional classroom with the help of mobile devices and using educational applications available on mobile platforms. It has also been established that mobile devices can deliver learning to people, communities, and institutions where other educational interventions have proved to be expensive and impractical (Traxler, 2013). This also gives students the leverage to meet, collaborate, communicate, create and share knowledge across the geographical divide. The use of mobile technology and supported applications have the potential to harness creativity, collaboration, construction of knowledge and inquiry approach to learning in students (Chisholm et al., 2009). According to students generally believe that the use of mobile applications increases their overall educational accomplishment and assists them in staying competent, organised, and motivated (Kay and Lauricella, 2011). With a variety of new tools and resources being made available daily, such as new applications and smartphones with multiple capabilities, learning becomes customised and personalised.

In order to evaluate the extent university students in the South African context utilise mobile educational applications for learning, four research questions were devised which are captured below:

(1) What is the level of knowledge of university students with regard to educational applications on mobile platforms?

(2) What is the extent of the regular use of mobile educational applications by university students?

(3) What are the challenges faced by students with regard to the use of mobile educational applications? and

(4) What are the effects of the use of educational applications on students' education, performance, and advancement?

6. Methods

Quantitative research seeks to develop universal explanatory laws in social behaviour by numerically measuring what it assumes to be a static reality (Yilmaz, 2013). In general, a quantitative method of investigation allows the researcher to obtain a broad and generalisable set of findings. The researcher develops instruments that provide participants with pre-determined response classifications from which appropriate choices are made by the participants. The advantage of this method is that it allows one to measure the responses of a number of contributors on a set of questions based on which the researcher is able to draw up a broad and generalisable set of conclusions (Yilmaz, 2013).

This study is both descriptive and exploratory in nature. The purpose of the study was to shed some light on aspects such as the general patterns of usage of mobile educational applications among students, how much time on average they spend on the web, types of mobile applications used by students, types of activities performed by students using mobile web applications, and cost of accessing the web using these devices. All the above-mentioned issues were intended to throw light on the descriptive characteristics of the study. At the same time, the purpose of the study was to find answers to concerns such as the reasons for the poor appeal for mobile educational applications and challenges faced in accessing such apps.

The research was conducted using a questionnaire-based survey and randomised sampling techniques was used on the identified population. With regard to the selection of the population size of students, the researcher identified sampling method as an efficient method of determining suitable statistical sample size for a quantitative study of this nature (Krejcie and Morgan's, 1970). This method simplifies the process of determining sample size for a known finite population as it avails the sample size according to the size of the population in a table format. The university campus chosen for this research had a student population of 12000 students for the 2020 academic year, and as per the Krejcie and Morgan table, a sample size of 375 responses is required for the fulfilment of such study (Quick statistics – NWU, 2020).

The questionnaire used for this study comprised a set of focussed closed-ended questions classified under five categories, beginning with the demographic characteristics, and followed by four other categories, each of which addressed the four research questions asked in the study. The questionnaire was designed and presented on Google form. Based on the type of questions used, the data obtained varied in type from nominal to ordinal, interval and to ratios. Each question or sub-question was given a set of pre-determined response categories from which respondents had to make their selection. The study was conducted strictly online, and the questionnaire made available to students using a web link that could be accessed through various social platforms and e-fundi.

The aim of this study was to make general and broad deductions based on findings regarding the reasons for the level of usage of mobile educational applications by students at a university in South Africa. An online survey was conducted by the researcher using a questionnaire and the data analysed using scientific statistical tests, namely, Chi-square test analysis and Pearson significance tests.

6.1 Demographical information

The first section of the discussion of the findings focused on the demographic characteristics of respondents, such as sex, age group, race, level of education and home language. The information obtained is analysed and presented graphically. The distribution of respondents according to gender shows that out of 280 respondents, 56% were females, while 44% were males. This shows that more female students participated in the study compared to males. The second item (section A of the questionnaire) solicited information with regard to the age of respondents. The majority of respondents belonged to the 20 to 22 age group, representing 43,6%, followed by 21,4% of respondents aged 17 to 19. The data revealed that most respondents aged 17-22 years were digital-native and tech-savvy. Respondents aged 25 years and above represented 17,9% of the total number, followed by 17,1% of those aged 23 to 35.

Participation across the age brackets reflects the distribution of students across age groups enrolled at the university. Out of the 280 respondents who participated in the study, 272 were Africans, representing 97,1%;

four were Asians (0.014%), three Coloureds (0.011%), and one White (0,004%). Majority of respondents were of African origin, an indication that the student population at the selected campus is predominantly African. Out of the 280 respondents, 218 (77.86%) were undergraduate students, 23 (8.2%) were registered for Honours programmes, 29 (10.4%) at postgraduate level, 7 (0,025%) at Master's level and 3 (0.011%) were registered for PhD programmes. Again, the numbers are in proportion to the total number of registered students at respective levels at the learning site. It is noteworthy that majority of respondents were undergraduate students. On home language, Majority of respondents were Setswana-speakers, 162 of the 280 who participated in the study, representing 57.9%, followed by English and Southern Sotho as the first language.

6.2 Data Analysis

Data was collected for a fitting sample size, processed, and analysed. Received data were tabulated on an excel spread sheet, and was edited to ensure accuracy, completeness, and reliability. Data was categorised into text, numerical or descriptive values. The statistical analysis package SPSS was used to carryout detailed data analysis. To ensure data validity, different measures of central tendency was used. In order to test the significance of categorical data, Chi-square test analysis was carried out. To establish the strength of direct relationship, correlation- regression analysis was conducted. In summary, the statistical analysis tools and techniques namely variance, measures of central tendency, correlation-regression and chi-square tests were appropriately used. The statistical inferences arrived are summarised in the report.

6.3 Findings

The findings are the answers received as inputs (feedback) to the questionnaire that addressed the four research questions. Each research question progressively answered the broad research topic. The first question inquired on the students' knowledge about mobile educational applications. The second research question was aimed at measuring the extent of the regular use of mobile apps by students. The third question investigated the challenges students faced in using mobile apps regularly. The effects of the use of mobile applications on the academic performance of students was examined in the fourth question.

6.3.1 Research Question 1: What is the level of knowledge of university students with regards to educational applications on mobile platforms?

A majority 264 (94.3%) of university students who participated in the survey indicated that mobile apps are supportive or assistive tools for learning. While only 16 (5.7%) of the 280 students maintained they had no knowledge of educational mobile applications. This is in line with the findings of that usage of mobile apps in a classroom can act as a helpful pedagogical aid to augment learning (Diliberto-Macaluso and Hughes, 2016). The feedback showed that students are using mobile devices to access educational material, (96.1%) of students (269 of the 280) maintained they use mobile devices, such as cell phones, to access educational material, while 3.9% did not. This agrees to the findings that students use mobile devices for different academic-related activities, such as sharing tutorials and notes with peers, accessing course materials and to send and receive emails and messages (Guma et al., 2017). The results revealed that students were introduced to mobile applications through different sources as follows: 53.2% of respondents identified through self-search; 38.6% through peers; 35.4% through lecturers; and 2.1% through other sources.

6.3.2 The preferred mobile applications used by students

One of the questions sought to understand the preferred mobile applications by students. The results revealed that 87.1% of students considered educational applications as a necessity, 76.1% preferred applications for social media, 53.2% for banking, and 47.1% for news. Students (27.1%) preferred mobile applications for entertainment, lifestyle (27.1%), and gaming apps (12.9%). Students consider mobile apps as necessities for their daily lives, as indicated in Figure 1.

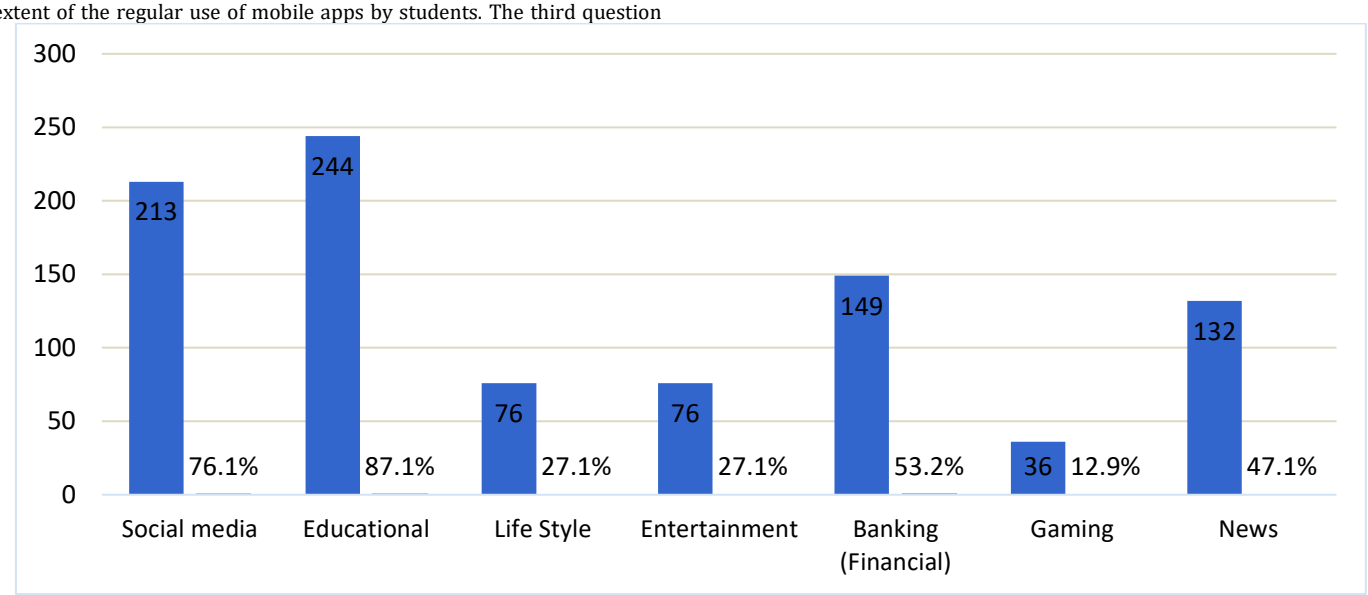

Figure 1: Preferred mobile applications used by students

The majority of students (62,9%) confirmed their lecturers encouraged them to get educational applications for learning because of their benefits. With regard to creating awareness among students on the use of mobile educational applications, 96.4% responded in the affirmative, while 36% of respondents provided negative reactions.

6.3.3 Research question 2: What is the extent of the regular use of mobile educational applications by university students?

The obtained results show the number of time students connect to the Internet, the kind of educational activities preferred by students, the kind of social media platforms used by respondents, their perceptions on the use of educational applications, and social media platforms towards assisting students in their studies.

6.3.3.1 Time spent by students daily on mobile devices for educational activities using the Internet

Internet surfing, using mobile devices among students, varies in terms of the amount of time spent daily by students. Out of the 280 students who participated in the study, 55 (20%) spent more than five hours on the net for educational activities, 9% spent between four and five hours, 13% spent between three and four hours, 20% between two and three hours, 26% between one and two hours, while 12% spent less than one hour daily (Figure 2). Different studies have revealed that usage of smartphones among students has become part of their culture as they use them in class when studying, and while completing assignments and homework (Ng et al., 2017).

A question was asked to determine the frequency of students connecting to the Internet on mobile devices to get educational material. Students use their mobile devices to obtain educational material from the web. Sixty-seven percent (67%) (187 out of 280) of respondents connected to the Internet using a mobile device daily, 57 (20%) connected two to three times a week, while 18 (7%) connected once a week for this purpose.

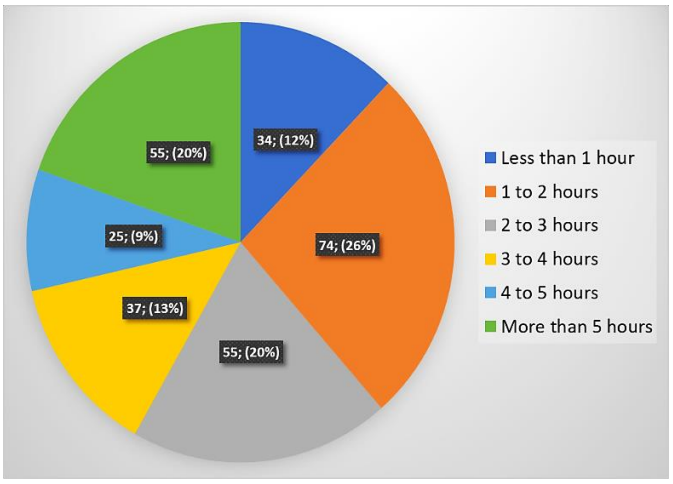

Figure 2: Time spent on mobile devices by students to surf

6.3.3.2 Kind of educational activities students engage in using mobile applications

Students engage in different educational activities using mobile applications. From a sample population of 280 students, 204 (72.9%) used mobile applications to check on university or module-related information, 52.9% used their devices to download previous question papers and search for tutorials, 50% used mobile devices and applications to listen to lectures, 42.5% used mobile platforms to check for bursary opportunities, 6.1% used mobile applications and platforms to watch educational videos, 5.4% used their devices to share educational material, while 3.9% used devices to prepare for the examination. Thus, students engage in different educational activities using mobile applications, as shown in Figure 3. The majority of the students frequently connect to the Internet to access educational material. Some researchers found that the use of applications for academic purposes was very high among university students (Wai et al., 2018). The most popular functions, as noted by these, were as follows: students used mobile apps for communication and interaction; access academic materials; organisation and sharing of information; for cloud storage; instant communication; and sharing of documents.

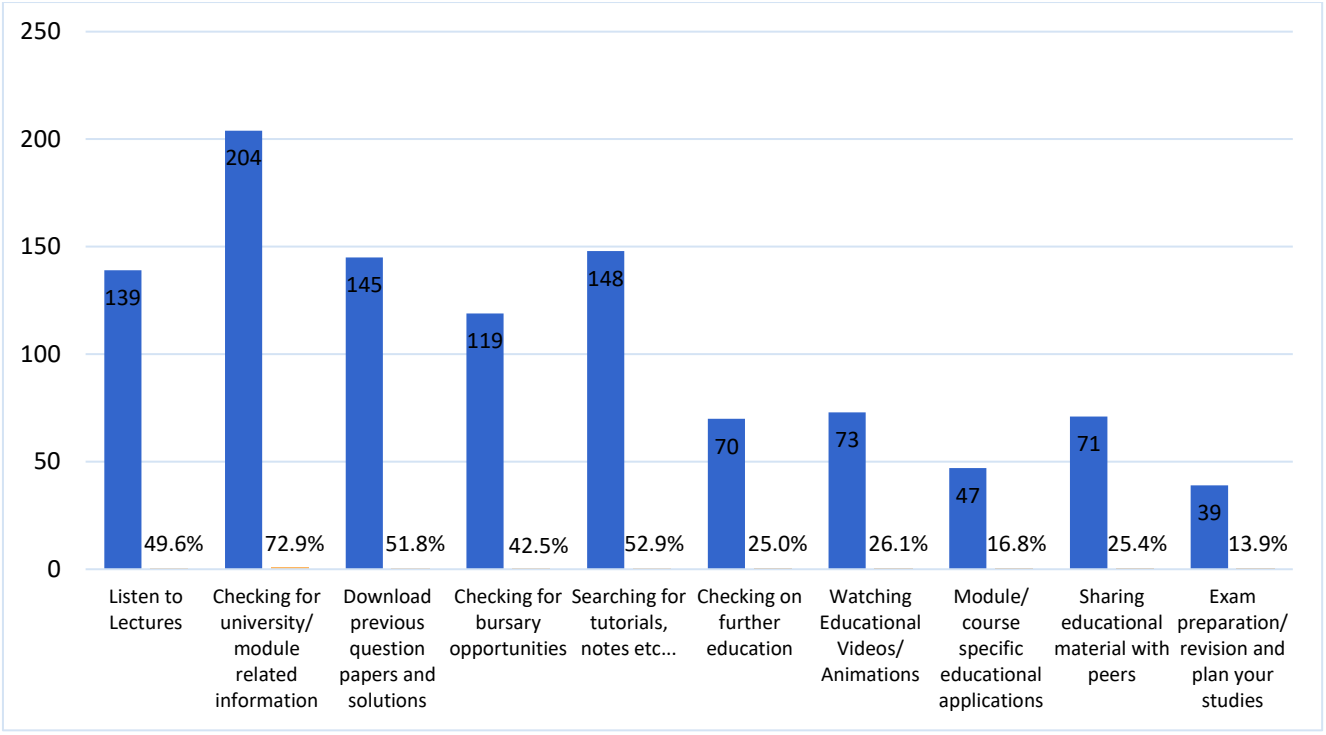

Figure 3: Activities students engage in using mobile applications

6.3.3.3 Frequency with regard to the use of mobile applications for different educational activities

Students use mobile applications for different academic-related activities at varying frequencies. Most students used their devices to check module-related information. Approximately 49% of students used mobile devices and applications to check on module-related issues daily, 30% used their devices at least two or three times a week, 30% of respondents used mobile platforms to search for tutorials daily. On an average, 35% used their devices two to three times a week as indicated in Table 1.

Table 1: Frequency of usage of mobile applications for educational activities

		Daily		2 to 3 times a week		Max: once a week		Seldom	
	Activities	**No:**	**%**	**No:**	**%**	**No:**	**%**	**No:**	**%**
1	Listen to lectures	72	27,5	89	31,8	58	20,7	61	21,8
2	Check module-related information	137	48,9	85	30,4	45	16,1	13	4,6
3	Search for tutorials	83	29,6	112	40	58	20,7	27	9,6
4	Share educational material	95	33,9	92	32,9	64	22,9	29	10,4
5	Exam: preparation and revision	64	22,9	87	31,3	78	27,9	51	18,2
6	Search for funds / bursaries	80	28,6	56	20	88	31,4	56	20

Students believe it is necessary to integrate the mobile educational application into daily lectures. Forty-four percent (44%) of respondents found it extremely necessary, 50% indicated it was necessary, while 5% indicated it was not necessary to do so and 1% see no impact at all. Thus, the majority of students saw the need to incorporate mobile educational applications into daily lectures.

6.3.3.4 Frequency of usage of social media applications for general or educational purposes

Students were asked to rate the frequency of use of different mobile social platforms. The results revealed that the most popular social media platform used by students were WhatsApp, representing 87.5%, Facebook (54.6%), Instagram (21.8%), and Twitter (14.6%). Students were asked to

indicate the frequency of usage of social media applications for different activities, which were, in essence, social interaction activities, such as instant messaging, sharing photos and videos. The results revealed that 79.6% of students used social media applications daily to chat, 61.1% of students used their devices for instant messaging, 36% to share photos, 31.8% to share videos, and 22% used social media applications for video conversations daily. It is interesting to note that everybody engages in almost all the different activities, at least occasionally.

Correlation analyses were performed to establish the strength of the relationship between ownership of mobile devices and types of academic activities performed by students. Correlational values of 0.01 level of significance were obtained, with less than 1% error margin as indicated in Table 2. There is a moderate positive correlation between ownership of mobile communication devices and engaging in different academic activities. As noted by the use of smartphones and applications helps students to get answers quickly, allows for social learning, access to videos and audios, makes learning lively, and access to educational applications improves learning (Ng et al., 2017). Students were asked to rate the extent of usage of educational applications as assistive tools for studies, and the following results were obtained: 96 (35%) of students rated them as extremely useful; 152 (54%) found them useful, and 23 (8%) indicated they were not useful, while 9 (3%) of students maintained they had no impact at all in their studies.

Table 2: Ownership of mobile device and type of academic activities performed by students

Academic activity	Pearson's correlation value	Strength
Listen to lectures	0.288**	Weak positive
Search for tutorials and notes	0.456**	Moderate positive
Watch educational videos	0.427**	Moderate positive
Share educational materials	0.522**	Moderate positive
Exam: preparation and revision	0.487**	Moderate positive
Module-related information	0.633**	Moderate positive

A Chi-square test was performed to investigate the statistical association between ownership of mobile devices among students and their impact on academic performance. At a significance level of 0.05, the null hypothesis was rejected, and it was established that there is substantial statistical evidence for the association between the two. The statistical worth of the association between the number of times students connect to the web daily and the time spent on the web for educational purposes was calculated using a Chi-square test. A Chi-square value of 30.209, at a significance level of 0.011, was obtained, which was below the 0.05 significance level, confirming the association between the two. According to significant levels of satisfaction were reported by students when using their mobile devices to gain access to educational resources, to enhance their learning experience (Baguma and Pettersson, 2018). According to a study, mobile phones in an educational environment positively impact the academic performance of students (Gomez-Garcia et al., 2020). The authors further note that students who were poorer academic performers showed considerable improvements in their studies after the incorporation of mobile phones and applications into classroom teaching and demonstrated an enhanced level of motivation towards education.

6.3.3.5 Question two (2) summary

Students spent a considerable amount of time connected to the Internet and searching the web for academic and personal reasons. Students used mobile apps to access academic materials; for communication and interaction; sharing and coordination of information; for cloud storage; and sharing of documents. Students maintained that; the use of mobile educational applications need to integrate into daily tuition. On average, students use mobile devices daily for different educational needs and find them beneficial to their studies.

6.3.4 Research question 3: What are the challenges faced by students with regard to the use of mobile educational applications?

This research question focused on challenges faced by students with regard to the use of mobile educational applications to their full potential. Students were requested to indicate factors that can negatively impact the fruitful and effective use of mobile applications. The participants were asked whether they have access to the Internet connection daily uninterruptedly. It is rather shocking to notice that majority of students do not have an Internet connection. The results revealed that 124 (44.3%) of respondents did not have easy access to the Internet. More than half of the students 156 (55.7%) who participated in the survey did not have uninterrupted access to the Internet, while a few had to make their own arrangements to access the web.

6.3.4.1 Amount spent by students monthly to purchase data

Forty-five percent (45%) of students spent more than R210 monthly to purchase mobile data, 10.7% (30) spent between R180 and R209, 9.3% (26) spent between R150 and R179, while 11.1% (31) spent between R120 and R149; the sample size of the population being at 280. Thirteen (4.6%) students spent less than R30 per month, 6.8% (19) spent between R30 and R59, 5.4% (15) spent between R60 and R89, and 7.1% (20) spent between R90 and R119 to purchase data purchases. This number includes the ten (10) students who indicated that they only used free wi-fi to connect to the Internet. Thus, it can be concluded that the ten (10) students spent no money on mobile data since they fall under the R30 bracket. Seventy-five percent of students who participated in the survey spent R120 or more for mobile data every month. The findings shows that students spent a lot on data per month which affect their usage of educational mobile applications. Ease to connect to the Internet remain as a challenge and students were asked rate their level of easiness to connect to the Internet. The majority of students indicated that for various reasons, it was not always easy to connect to the Internet. About 162 (58%) of students indicated that it was not always easy to connect to the web, while 118 (42%) found it always easy to connect to the Internet.

6.3.4.2 Challenges faced by students with regard to connecting to a mobile network

Students indicated different challenges faced with regard to connecting to mobile networks. Respondents were requested to indicate different factors that adversely affect connection to the web for academic needs, and the following responses were received (Figure 4):

- Mobile data not affordable – 67.5%
- Poor mobile network connection – 67.1%
- No access to free wi-fi – 39.6%
- Non-availability of mobile device - 11,1%

Eleven percent (11.1%) of respondents did not have uninterrupted access (ownership) to a mobile communication device, which is an obstacle for smooth learning using a mobile device (Figure 4).

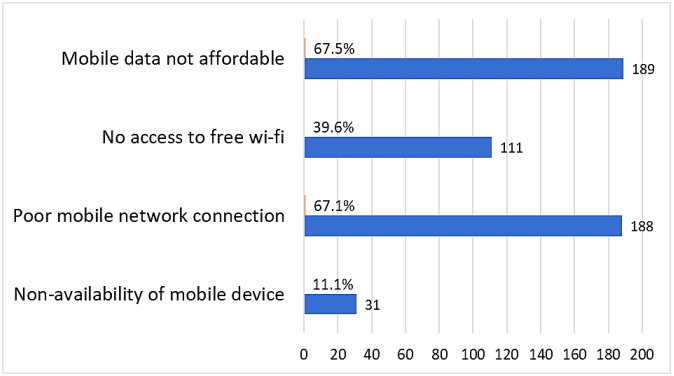

Figure 4: Challenges faced by students in to connecting to the web for academic needs

Students were asked on whether it was possible to obtain the right academic support when using a mobile device. The results revealed that 134 (52,1%) of students were not always sure about finding the right academic assistance when using a mobile device as an assistive tool, while 146 (47.9%) were sure to get the necessary academic assistance through mobile devices and platforms.

6.3.4.3 Human factors that negatively affect the proper use of mobile applications

Out of the four human factors, 49% of students identified 'the poor level of knowledge among students' as one of the human factors that negatively affect mobile educational applications' effective use. Thirty-three percent

of identified 'poor confidence level among students on their utility', followed by 11% who pointed to the 'poor level of knowledge among lecturers about educational applications' and 7% identified 'poor confidence level among lecturers' as human factors that are deterrents to the efficient implementation of mobile applications. The low level of knowledge and confidence among students with regard to the use of mobile applications were identified as the two major factors that work against students' effective use of mobile applications. The results are categorised and represented in Figure 5.

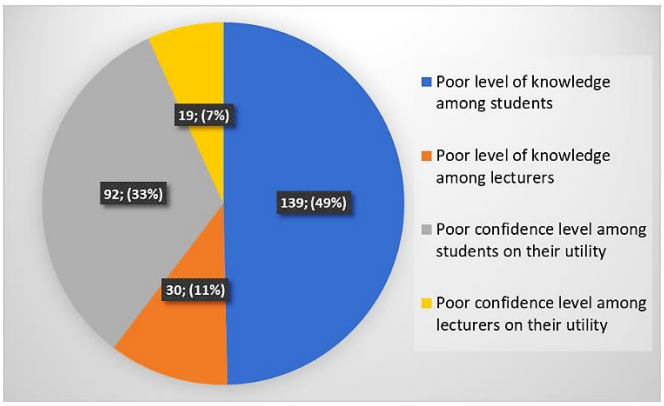

Figure 5: Human factors that impede the effective use of mobile applications

6.3.4.4 Personality traits of students that contribute undesirably to the effective use of mobile applications for learning

A majority (59.6%) of students considered poor networking skills, 59.3% identified poor technical skills, 54.6% found poor communication skills, and 32.5% identified poor social skills as personality traits that cause an undesirable impact on the use of mobile applications. Students identified different personality traits that affect the effective use of mobile applications, as indicated in Figure 6.

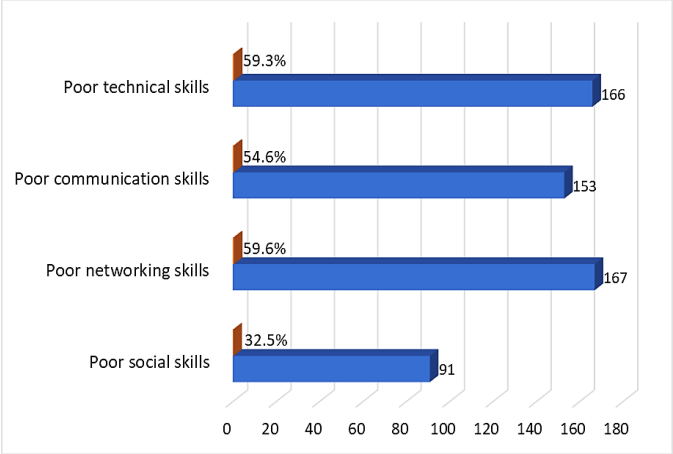

Figure 6: Personality traits of students that negatively affect the effective use of mobile applications

6.3.4.5 To determine ease-of-use of available mobile educational applications.

Approximately 201 (72%) of respondents indicated that available mobile applications were user-friendly, while about 79 (28%) found them not user-friendly. A significant majority of students acknowledged that available mobile apps were user-friendly.

6.3.4.6 Confused or frustrated while using educational applications.

The results showed that 167 (59.6%) of respondents were confused or frustrated while using mobile applications, while 112 (40%) did not experience such a challenge.

6.3.4.7 Mental effort required by students with regard to the use of mobile applications.

Out of the 280 respondents who participated in the study, 212 (75.7%) maintained the use of mobile apps requires a lot of mental effort, while 68 (24.3%) indicated that there was no need for an unreasonable level of mental effort in using mobile applications. The majority of students indicated that using mobile applications requires a lot of mental effort.

6.3.4.8 The need for an expert when using an application for the first time.

Students were almost evenly divided on whether they need expert assistance to navigate a mobile application when first introduced. About 151 (54%) of students indicated that they prefer to have expert assistance when navigating an app for the first time, while 129 (46.1%) maintained they were comfortable using a mobile app for the first time. Thus, many students require expert assistance when using mobile educational applications. This shows that students struggle to use educational mobile applications without expert's guide.

6.3.4.9 Question three (3) summary

Young people and university students, in particular, use mobile devices and applications for different activities that span multiple facets of their daily lives. These facilities have become essential amenities for students' survival in today's university environment. Anything that curtails their seamless availability and usage is disadvantageous to students' survival in a robust academic environment. The purpose of this section is to examine challenges faced by students with regard to the effective use of mobile educational applications. It is worthy of indicating that a moderate positive correlation value of 0.415 and a significance level of 0.01 was observed between ownership of mobile devices and their frequent use. In a study conducted by perceived social usefulness and perceived enjoyment were identified as significant factors that influence the regular use of mobile devices by students (Normalini et al., 2018). The most palpable human factors identified by students that contribute negatively towards the proper use of mobile applications were (Figure 6):

- Poor level of knowledge among students with regard to their use (49%);
- Poor confidence level of students to use them (33%);
- Poor level of knowledge among lecturers (11%); and
- Poor confidence level among the lecturers (7%).

These results are in line with the findings of as summarised below (Fadzil, 2018):

- Students' (consumers) adoption and usage of mobile applications depend on the usefulness they find for them in their daily lives.
- Effort expectancy significantly impacts the behavioural intention of students towards the adoption of a mobile application. In simple terms, applications that are not easy to use due to spec complexity are not readily adopted by students.

Students maintained the following factors have an adverse influence on the proper use of mobile apps: poor technical skill (59.3%); poor networking skill (59.6%); poor communication skill (54.6%); and poor social skills (32.5%), as indicated in Figure 6. The majority of students (71.8%) confirmed mobile applications were user-friendly, while 28.2% indicated they were not user-friendly (*ease-of-use of available mobile educational applications*). In addition, 59.6% of respondents were at times confused or frustrated when using mobile applications, while 40.4% did experience such challenges (*confused or frustrated while using educational applications*). It is significant to note that 75.5% of respondents found the use of mobile applications demanding a lot of mental effort (*mental effort required by students with regard to the use of mobile applications*).

Based on the data, a Chi-square test was performed to establish the level of association between how easy it was for students to connect to the Internet using mobile devices and their user-friendliness. The 0.01% significance value obtained for Pearson and continuity correlation, together with Fisher's exact test, confirmed there was a statistical correlation between the two. Students identified many challenges they experienced while using mobile educational applications, such as ownership of mobile devices, uninterrupted Internet connectivity, affordability of data, and different human and technical factors, among others.

6.3.5 Research question 4: What are the effects of the use of educational applications on students' education, performance and advancement?

The main purpose of this research question is to evaluate the impacts of the use of educational applications on the academic performance of

students. Ninety percent (252 of the 280) students maintained mobile educational applications have an impact on their studies, while 10% (27) of respondents indicated they had no such impact. It was found that forty-five percent (126) of respondents believe mobile educational applications have a strong positive impact on the academic performance of students, 40% (113) maintained they impact moderately, while 15% (41) indicated that they do not have any real impact on their academic performance. Together, at least 85% of students maintained mobile educational applications had a positive impact on their academic performance. According to the question results, 84.3% (236) of students maintained it was easy to access electronic resources through mobile applications, while 15.7% (44) had a different view. The easy access to resources provides benefits to students.

6.3.5.1 Impact of educational applications in assisting students with different learning activities

Students rated the impact of mobile educational applications on a list of academic activities under three broad categories: no real impact, strongly positive, and moderate positive impact. Less than 10% of students reported that mobile applications and platforms had a real impact on their activities. Apart from the above, more than 90% of students found the contribution made by mobile applications as strong positive or moderate positive, as shown in Table 3. Thus, there need to establish the correlation between access to mobile facilities and the perceived impact.

Table 3: Impact of mobile educational applications on academic activities and performance

		No Real Impact		Strong Positive		Moderate Positive	
	Activities	**No:**	**%**	**No:**	**%**	**No:**	**%**
1	Listening to Lectures	35	13	144	51	101	36,1
2	Searching for Tutorials	26	9,3	174	62	80	28,6
3	Watching Educational Videos	24	8,6	176	63	80	28,6
4	Sharing Educational Material	25	8,9	174	62	81	28,9
5	Exam: Preparation and Revision	25	8,9	175	63	80	28,6
6	Checking Module-Related Information	24	8,6	177	63	79	28,2
7	Other Academic Activities	25	8,9	152	54	103	36,8

6.3.5.2 Impact of Mobile Educational Applications With Regard To Completion of Academic Activities

Students were asked to rate the impact of mobile educational applications with regard to the completion of different academic activities. According to the results, 60% of students indicated they had a strong positive impact, 30% indicated they had, at least, a moderately positive impact, while less than 9% reported they had no real impact on the completion of various academic activities. There is, therefore, the need to investigate the correlations between the frequency with regard to the use of mobile devices by students and their perceived impact on the completion of various academic activities.

Table 4: Impact of Mobile Educational Applications on The Completion of Academic Activities

		No Real Impact		Strong Positive		Moderate Positive	
	Activities	**No:**	**%**	**No:**	**%**	**No:**	**%**
1	Assignments	20	7,1	183	65,4	77	27,5
2	Projects	20	7,1	169	60,4	91	32,5
3	Investigations	20	7,1	171	61,1	89	31,8
4	Research	16	5,7	185	66,1	79	28,2
5	Tests and Quizzes	22	7,9	183	65,4	75	26,8
6	Presentations	27	9,6	150	53,6	103	36,8
7	Other Academic Activities	21	7,5	153	54,6	106	37,9

6.3.5.3 Mobile Educational Applications as A Substitute for Lectures

Majority of students stated that mobile educational applications could substitute lectures in class. From the 280 respondents who participated in the study, 186 (66,4%) believed mobile educational applications could replace classroom teaching and learning, while 94 (33,6%) had a negative opinion. The majority of students indicated that mobile applications could substitute actual lectures. This can be explained by the fact that recorded lectures can be accessed from mobile educational platforms.

6.3.5.4 Question Four (4) Summary

University students get to know about novel technologies and their conveniences earlier and faster. Student's test, experiment, and share their experiences using high-tech opportunities that make their university life simpler, effortless and effective. Mobile educational applications are the latest of such additions to the list of efficacies that students use daily to organise their lives in and out of campus. This section focuses on the discussion on the findings with regard to the effects of educational applications on the academic performance of students. Results of the correlational statistics on the impact of educational applications to complete different activities towards improved academic performance are indicated in Table 5. A significance value of 0.01 was obtained, indicating an error margin of less than 1%.

Table 5: Correlation Between Completion of Activities Towards Improved Academic Performance

Academic Activity to Be Completed	Pearson Correlation Value	Strength
Assignments	0.427**	Moderately Positive
Projects	0.438**	Moderately Positive
Investigations	0.560**	Moderately Positive
Research	0.551**	Moderate Positive
Teats and Quizzes	0.372**	Moderate Positive
Presentations	0.674**	Moderate Positive

There was a moderate correlation between different academic activities and the impact of mobile applications to complete them. Singh and Samah state that the use of smartphones by students in the higher education environment influences their performance positively through assumed activities, such as accessing course content, retrieving information regarding students' performance, sharing academic information, and inspiring discussions between students and lecturers (Singh and Samah, 2018). The statistical worth of the association between the use of mobile educational applications to receive the right academic support and

students' academic performance was examined using the Chi-square test.

The results were found to be irrelevant as the Chi-square value was 3.556 and a significance level of 0.169, which was outside the admissible alpha value set at 0.05. In short, obtaining the right academic support when using mobile applications had no significant correlation to students' academic performance. The association between the impact of mobile educational applications on students' learning and their impact on improving the academic performance of students was assessed using Chi-square test analysis. The result revealed a Pearson Chi-square value of 17.801 and a significance level of 0.000, representing an almost 0% error margin. Thus, it was established that there was a significantly strong correlation between the two factors under consideration.

6.3 Implications of the Study

The aim of the study was to investigate the degree of use and value of mobile educational applications in learning. The results and findings are valuable additions to the existing body of knowledge. Very few studies have focused on the topic under investigation. The findings directly and indirectly impact on the effective incorporation of mobile educational applications into students' daily academic lives and higher education institutions in South Africa. This study has revealed some interesting findings, which point to the existence of a subtle but robust mode of learning supported by social platforms and mobile technology prevalent at the university campus where the research was conducted. The study was conducted at a time when the University had adopted a blended approach to teaching and learning, which is a combination of distance learning, using digital and mobile platforms, and alternating contact sessions, due to the COVID-19 pandemic. A summary of the findings is provided below.

Mobile technology and social platforms are widely used by students for academic and non-academic purposes. Students spend most of their time on mobile devices engaging in activities and use different social platforms and mobile applications that are appropriate for different needs. Students use their mobile devices to communicate on social media, text, chat, call and for online learning. The majority of students maintained that mobile applications are assistive tools for learning and use them to access educational material. Students are familiar with popular educational applications, use them regularly, and believe mobile educational applications improve learning. Students frequently connect to the Internet to access educational material and share academic knowledge with peers through social media platforms.

Students maintained mobile educational applications facilitate access to electronic resources. Students also use mobile applications for educational activities, such as listening to lectures, viewing educational videos, and searching for tutorials, among others. Furthermore, students use mobile applications as enabling tools to complete different educational activities, such as assignments, projects, research, tests, quizzes and presentations. The type of learning described above is ubiquitous among students at the Campus where the research was conducted. Students also use these devices to access social platforms, educational and utility apps, supported by mobile Internet and various smart-mobile devices. The three key identifiers that are key to this model are students, social platforms for communication and interaction, and mobile (smart) devices. These findings are in line with the theoretical framework considered in this study.

6.4 Direction for Future Research

The study can be extended to investigate how well the integration of mobile educational app-based learning fit in with the modern learning theories namely the behaviourism, cognitivism and the most modern socio-cognitive learning to mention a few. The need to incorporate the knowledge on learning theories into the development of educational apps and their impact is also worth investigating. Also to determine the measures that mitigate the identified challenges facing students in utilising mobile learning apps optimally is worth studying. Also, to develop framework for mobile application-based learning is an area for further study.

7. Conclusion

Prior research conducted in South Africa on the use of mobile devices and communication were focused mainly on the general pattern of use of mobile phones by university students, assessment of smartphone addiction risks among students, and the financial and academic implications of their usage among students. However, few studies have been conducted on the effective use of mobile educational applications by students to enhance their learning processes in South Africa. Therefore, the aim of this study established the extent to which university students use educational applications for learning. Determining measures to mitigate challenges faced by students with regard to the use of mobile learning applications to their advantage can form the focus of a future study. To develop a framework to ensure students' regular and continued use of mobile educational applications as a norm can be researched further. Educating students about the availability of mobile educational applications, how to access and use them, and informing them on how best these applications and platforms can be utilised optimally for their benefit could also be considered for future study.

Rebuttal

In the experimental part explain the experimental environment, experimental index, experimental scheme and so on (Reviewers' comment).

This study entails a quantitative study based on the inputs received against an online questionnaire administered to students at a South African university. The experimental context and demographics are clearly explained in this paper. Furthermore, the study is different from any natural or physical sciences investigation where experimental index and experimental scheme have greater importance.

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