Exploring Challenges to Mobile Application Programming at a Private Higher Education Institution in Botswana

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Abstract

By 2020, smart phones will make up more than half of the connection base in Sub-Saharan Africa, presenting opportunities for locally relevant content to be accessed via mobile applications. Despite an increasing Higher Education enrollment, with significant numbers of students studying Information Technology (IT), the mobile application programming (MAP) industry in Africa is still in its infancy, resulting in mobile content which is not always locally relevant. This paper explores the challenges faced by IT students in mobile application programming at a private Higher Education institution in Botswana. The study is part of a larger study to develop a framework for enhancing mobile application programming among IT students in Higher Education Institutions. Using questionnaires, data was collected from 203 Higher Education students from a private institution studying IT in Gaborone and Maun, Botswana. The findings indicate that IT students are interested in mobile application programming but besides the known financial constraints, they also have challenges such as accessing the required mobile application programming laboratory environment, relevant, up to date literature, free tutors etc. The contribution of the study is to identify infrastructural and personal factors to be considered when designing a conducive mobile application programming environment as a way of stimulating mobile application programming in Africa.

Keywords
Mobile Application Programming, Programming Infrastructure.

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1. Introduction

Mobile applications are shaping the economic, political and social lives of people in Africa, (Murugesan, 2013). This transformation is a result of the huge adoption of mobile phones, as evidenced by Africa being the second largest mobile market worldwide, after Asia, (Phillips, Lyons, Page, Viviez, & Maria, 2011). Many users in Africa have feature phones (with a basic GPS, camera, an mp3 player, limited internet and simple apps) (Murugesan, 2013). However, smart phone adoption in Sub-Saharan Africa is forecast to see the largest growth, with over half of the connection base being smart phones by 2020, (GSMA, 2014). Mobile application development in Africa is still in its infancy (Hackathons, 2013; Coetzee, 2013) and existing systems have content that is not always locally relevant, this make users passive consumers of information and do not enable the generation of local information, (Tongia, Subrahmanian, & Arunachalam, 2005). The slow uptake of mobile application programming in Africa has been attributed to numerous IT infrastructure shortcomings in Africa such as the large user base of feature phones, limited internet connectivity in rural areas and power shortages (Murugesan, 2013). Despite the increasing number of higher education students in Africa, Pieters (2014), contend that the shortage of relevant programming skills is a contributing factor to Africa's young mobile application programming industry.

Botswana is a developing Sub-Saharan country with a population count of 2.021 million as in 2013, (The World Bank, 2015). The Botswana Communications Regulatory Authority (BOCRA) pegged the mobile telephone subscribers in December 2012 at over 3 million. This shows a high mobile penetration rate of about 150% with 18 166 ADSL versus 339 926 mobile internet subscribers, Botswana has 18 times more mobile than ADSL internet users, (B.O.C.R.A., 2013). Botswana Innovation Hub (2013) states that Botswana's mobile penetration rate is at 184%, which is one of the largest in Africa. According to Statistics Botswana (2013) there are 1.444 207 subscribers accessing internet on their mobile phone, an increase of 87.6% since 2012, the previous year. These figures indicate that Botswana has adopted mobile phones as a computing and connectivity device and the availability of locally relevant content would be conducive towards achieving Botswana's 2016 Vision since it directly supports two of the pillars as follows:

- Vision Pillar 1: The goal of having an 'Educated, informed Nation' aligns with the idea of an Informed Society.
- Vision Pillar 2: The goal of a 'Prosperous, productive and innovative nation', (Botswana Vision 2016 Council, 2010), makes innovation an expectation for the country.

Of the 46613 higher education institution students in Botswana, only 18% were studying Information Technology in the 2011/12 year, (TEC, 2012), thereby creating a relatively small pool of technically capable community members to develop mobile applications.

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ICT for Society through Society is an approach whereby digital inclusion is driven from within a society thereby potentially contributing to Information and Communications Technology for Development (ICT4D) efforts, (Coetzee, 2010). Coetzee (2010) notes that the depth, complexity and success of the “ICT for Society through Society" projects depend on the community member's technical prowess. Developing mobile applications that are relevant in achieving Vision 2016 would therefore require an “ICT for Society through Society” approach. Higher education students are a potential source of such technical prowess, and the small mobile application programming industry could be an indication of challenges faced by higher education students in mobile application programming. Establishing the challenges faced by Botswana’s private higher education students studying IT will therefore provide insights towards fostering mobile application programming.

2. Literature Review

Botswana’s higher education is made up of both private and public institutions. Public institutions are the responsibility of different ministries and departments of government while private institutions run under the oversight of the Tertiary Education Council (TEC) now known as the Human Resources Development Council (HRDC), (Malete & Kobedi, 2012). The HRDC had registered 37 higher education institutions (24 public and 13 private) with 46613 students in 2012, (TEC, 2012). Botswana envisages an increasing gross enrolment ratio (GER) reaching 25% by 2026, up from 17% by 2016, and private universities are key in this expansion, (Malete & Kobedi, 2012). Private institutions are considered more responsive to market needs while public institutions focus on addressing the human resource needs of the government, (Malete & Kobedi, 2012). The University of Botswana is an exception since it is a public university that focuses on market needs, (Malete & Kobedi, 2012).

Tracy (2012) defines *mobile apps* as applications that run on mobile, untethered devices. The World Bank (2012) extends this definition to include software that runs on a server and interacts with mobile phones. Programming is challenging for many students and is a key research area for computing education, (Sheard, Simon, Hamilton, & Lönnberg, 2009). Mobile application programming present unique programming challenges due to varied network speeds from wireless connections, network failures, varying platform performance and varying screen sizes (Tracy, 2012). Mahmoud and Popowicz (2010) indentify bandwidth, processor speed, screen size and resolution, memory consumption, battery life, and user input tools as characteristics that make mobile programming differ from traditional desktop programming environments. Gordon (2013) adds the mobile device’s small screens, changing orientation of the screen, several sensors and touch input as additional challenges to mobile application programmers.

Anderson and Gestwicki (2011) argue that given the proliferation of mobile devices and with many software development tools being available, undergraduates can

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explore mobile application programming as part of their curriculum. Globally, mobile application development is a hot topic that has a lot of appeal to computing students, and such popularity can be used to attract, retain and motivate students (Jackson, Ellis, & Postner, 2012). This appeal is a result of the increasing popularity of smart phones and their accompanying applications, (Alston, 2012). Computer Science departments are beginning to realize the importance of offering mobile application development courses (Gordon, 2013).

Despite the importance of mobile application programming, some African higher education institutions face financial constraints, shortages of published books, lack of basic teaching resources, lack of simple laboratory equipment and supplies to teach and do research in other countries, delays in salary payment, (Teferra & Altbach, 2004). Although the government of Botswana provides funding for public tertiary (higher) education institutions for their recurrent expenditures and capital expenditures, (Damane & Molutsi, 2013), similar funding is, not available for private higher education institutions in Botswana. This approach to funding make private higher education institutions more resource-constrained compared to their public institution counterparts.

Higher education students are affected by the challenges faced by their institutions in addition they face their own challenges. In neighboring South Africa, students face resource constraints that manifest in the form of living off campus, problems with transport leading to missing classes, the high cost of books and academic unpreparedness for higher education (Biljon & Dembskey, 2011).To keep up with the growth in student enrolments between 2009 - 2016, the Botswana government will need to spend about 5% of Gross Domestic Product on tertiary (higher) education, (Damane & Molutsi, 2013). Huge demands in other government expenditure areas and the dwindling of diamond resources has eroded the financial resources of the Botswana's government. Being the largest player in student financing, the Government had to raise the cut-off points for tertiary education admission to reduce the number of secondary school leavers eligible for government sponsorship and also limited or stopped student allowances (Damane & Molutsi, 2013). These actions could have culminated into financial resource-constraints for both institutions and students.

In summary, the literature overview presented here indicates an interest in mobile application programming from both students and institutions. The challenges presented in the literature focus mainly on financial challenges, and challenges resulting from MAP being different from desktop programming. The rationale of this investigation is therefore to investigate the other factors that could present challenges to students aiming to study MAP.

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3. Research Design

This section discusses the research design, sampling procedure, data collection and analysis, limitations and ethical considerations.

This survey is part of a larger study to develop a framework for enhancing mobile application programming among IT students in higher education institutions in Botswana. The research question being addressed by this survey is "*What are the challenges faced by Botswana's private HEI computing students in mobile application programming?"* The objective of this survey was to explore the challenges faced by private higher education IT students in mobile application programming. To obtain in depth information on the challenges, a descriptive survey design was used. A descriptive survey design is ideal for gathering original data describing perceptions, opinions, attitudes, orientations and relationships of large populations that would be too large to observe directly, (Tichapondwa, 2013). A limitation of this research design is that descriptive surveys do not provide any new information, but simply report on the existing situation.

3.1 Study Population and Sampling

The study population consisted of higher education students studying towards an IT qualification at a private higher education institution in Gaborone, an urban campus and Maun, a non urban campus. The research instrument was given to all students at a private higher education institution who were willing to participate. The gender and age were represented well by the sample as indicated in Table 2. The first years where however underrepresented while second years were over represented by the sample as can be observed from Figure 1.

3.2 Research Instrument

An objective and standardized questionnaire made up of structured and unstructured questions was used as the research instrument to identify the challenges faced by higher education IT students in mobile application programming. Most questions were structured to obtain focused input. The questionnaire had five sections (A – E). Section A sought the demographic details. Section B solicited the mobile application programming interests of the responded and their learning preferences while section D solicited the resource constraints faced by students. The other sections are not discussed as that is beyond the scope of this study.

3.3 Ethical Considerations

Conventional social science ethics' is guided by the four principles of informed consent, absence of deception, privacy and confidentiality and accuracy, (Christians, 2005). To ensure adherence to these principles, the researcher applied for ethical clearance to the relevant authority and was granted permission to conduct research within the concerned private higher education institution. An introductory letter and consent form were included with the questionnaire which informed participants of their right to stop participating at any moment. The researcher used a coding

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scheme to link each questionnaire to the data in the analysis software to ensure traceability and data was collectively analyzed, thus anonymizing the participants.

3.4 Data Collection

A convenient sample of students from Gaborone and Maun was used during data collection. Initially, the questionnaires were made available online via Google forms, but a low response rate and a few responses from a center not under consideration (Francistown) resulted in the researcher making printouts and handing them to students. The following table shows the number of respondents and their locations, showing that the majority of respondents were from Gaborone than Maun as there are more students in Gaborone than Maun at the private higher education institution in question.

Gaborone	Maun	Francistown	Others	Total
184	17	2	2	203

Table 1: Sample Size per Centre

Numeric, Ordinal and Nominal data was collected and the analysis is discussed in the next section.

3.5 Data Analysis

Data analysis was carried out in two phases namely coding of questionnaires followed by deriving descriptive graphs and summaries.

The coding of questionnaires resulted in the questionnaires getting a Questionnaire ID (QID) variable to enable the association of a questionnaire with a record. Each question in the questionnaire was coded based on the questionnaire section number and question number.

The derived statistics and graphs are presented in the next section.

4. Findings

The majority of the participants (144) were in the 21 – 25 year range.16 students were below 20 and 8 were above 30 years old, indicating a young majority of students studying IT as shown in Table 2 below. The same table also shows that the number of male and female students, studying IT at the private higher education institution, is well balanced.

Count		Age				
		20 and Below	21-25	26-30	Above 30	**Total**
Gender	Male	8	79	17	5	**109**
	Female	8	65	18	3	**94**
Total		**16**	**144**	**35**	**8**	**203**

Table 2: Respondents Demographics Details

Respondents were made up of 3 students in their first year, 83 in second, 53 in third and 64 in their final year as shown in Figure 1 below.

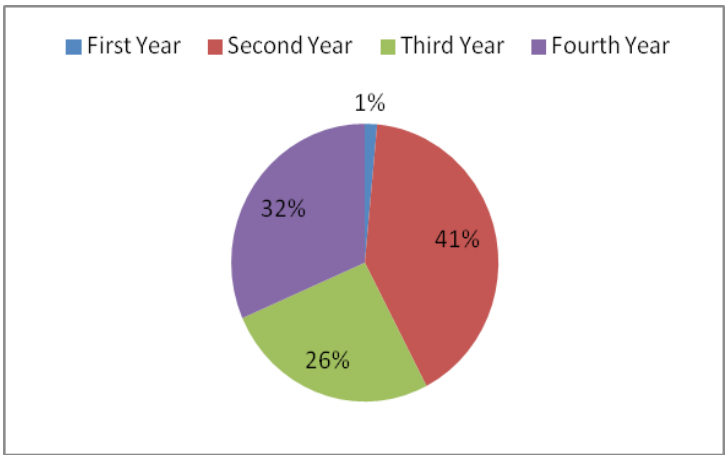

Figure 1: Respondents Level of study

The underrepresentation of first year students is a reflection of the bias brought about by convenience sampling. 96% of respondents were studying towards an IT qualification. The majority of the students in this study (96%) were government sponsored; therefore it seems that the Botswana government is the largest financial contributor in the higher education sector. The rest were sponsored by family (3%) or by themselves (1%).

Although 72.6% (146 of the 203) students know that their institution offers mobile application programming, only 11.3% had developed a mobile application before, confirming limited MAP among students. Notably 98.5% of students expressed interest in learning MAP, with 92.6% of students considering learning mobile application programming essential. The motivation for learning MAP was not to increase prospects of getting a job, but rather to start developing own apps.

4.1 Challenges related to Infrastructure and resources

Ownership of ICT resources was assessed to establish if these affect mobile application programming. As shown in Figure 2, 24% of students had a desktop computer. 81.7% owned a laptop and 81.2% possessed a mobile phone.

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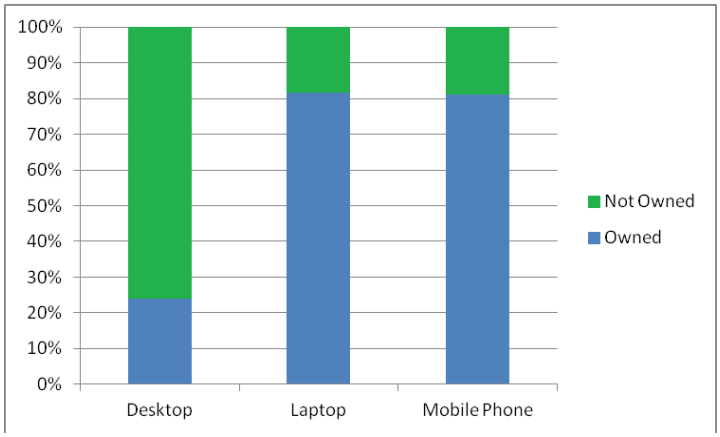

Figure 2: Computing Device Ownership by Respondents

Figure 3 below presents the mobile device platform for the respondents who possessed mobile phones. As shown, 45.7% of respondent mobile devices were running on Android, 14.9% on Blackberry, 12% on Windows Mobile, 6.2% on iOS and 20.7% not knowing their mobile phone platform.

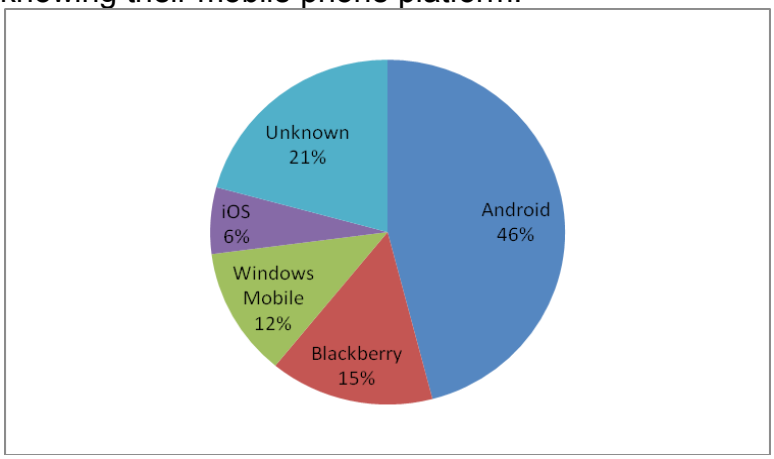

Figure 3: Mobile Device Platform of Respondents

As shown in Figure 4, most students did not have access to MAP resources as 83.7% of students indicated that they do not have access to MAP laboratories. Despite the 81.2% ownership of mobile phones among students, 68.8% said they did not have access to mobile phones for testing mobile applications, indicating the need to inform students how their mobile phones can be used as a practice device. Access to other resources as shown in Figure 4 is discussed together with Figure 5 below.

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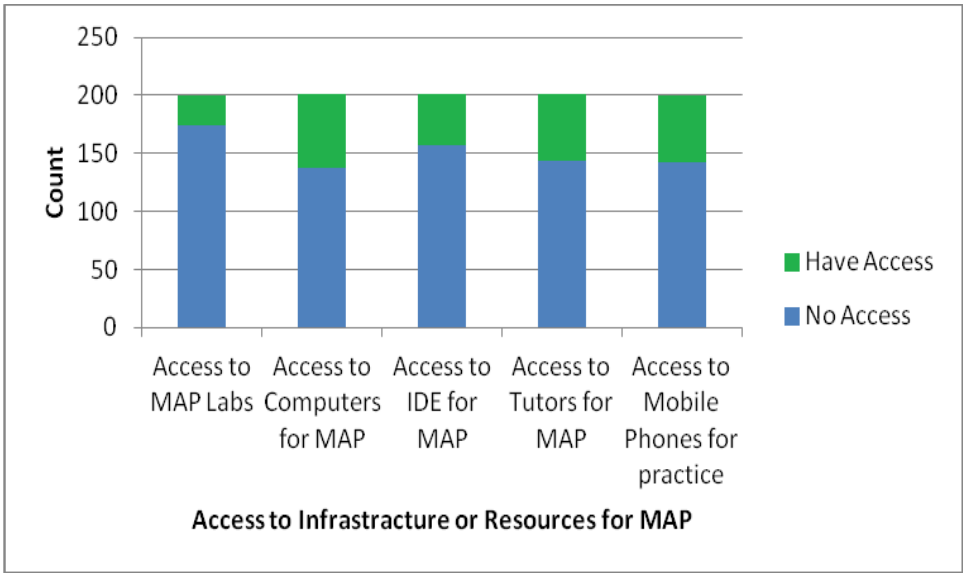

Figure 4: Access to Infrastructure and Resources for MAP

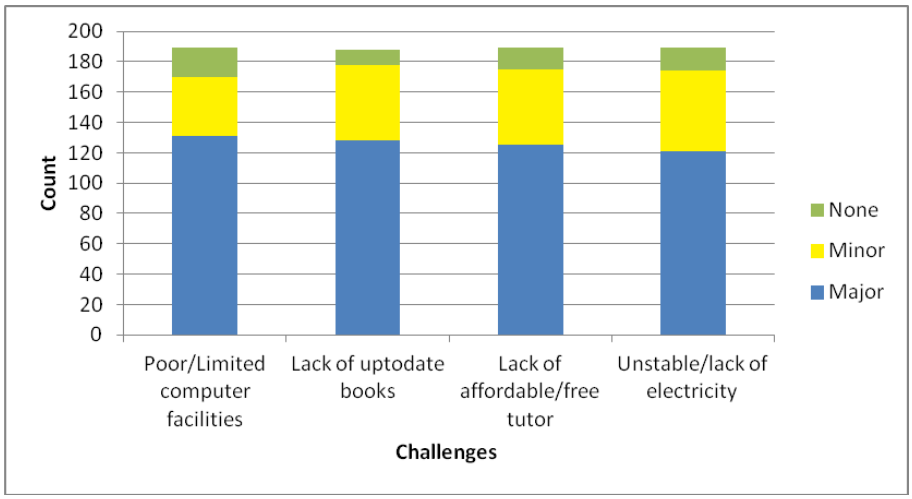

Figure 5: Infrastructure and Resource Related Challenges to MAP

Considering both Figures 4 and 5, it can be deduced that despite the large laptop ownership of 81.7% students generally perceive poor/limited computer facilities as a major challenge. More than half (63%) of the students indicated poor or limited computer facilities as a major challenge to MAP learning, possibly referring to lack of the Integrated Development Environment (IDE) as 75.5% of students said they did not have access to the required IDE for MAP. Up to date literature (books on mobile development) was another major challenge as 61.5% indicated lack of up to date literature and books on mobile application development as a major challenge to learning MAP. The lack of an affordable tutor was another major challenge in MAP as indicated by 60.1% of the students. Electricity, namely unstable access or lack of

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electricity is a major challenge in learning MAP as indicated by 58.2% of respondents. It would seem, from the above, that most students do possess the required ICT resources for MAP but lack of tutors inhibits the ability of students to use their resources to develop mobile applications.

4.2 Challenges related to Personal Factors

Although not as severe as infrastructure and resource related challenges presented earlier, Figure 6 below presents the challenges related to personal factors.

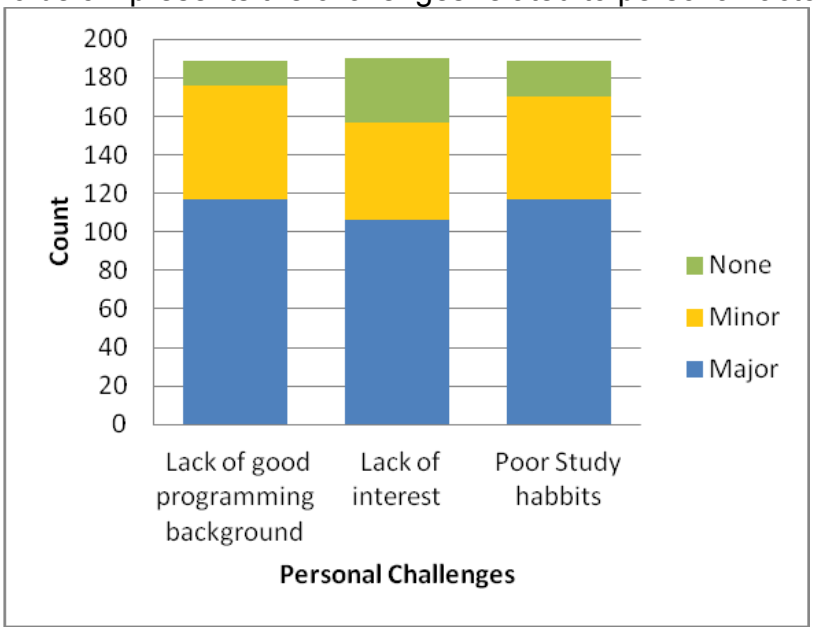

Figure 6: Personal Challenges to MAP

Poor programming background among students was found to be a major challenge in MAP as perceived by 56.2% of students. Poor study habits were another major challenge in learning MAP as perceived by 56.2% of the students. Lack of interest was less of a challenge but still perceived as a challenge by 51% of students. The following section discusses the findings.

5. Discussions

The study confirmed (Damane & Molutsi, 2013)'s assertions that the Botswana Government has been the largest financer of higher education. There is an equal balance of the number of male and female students studying IT at the private higher education institution, and this could reflect that IT appeals equally to both genders, and an intentional position taken by both the major financer of higher education and the higher education institution.

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The research also confirmed that few students are engaged in MAP, despite a huge interest and knowledge of their institution offering MAP. This could indicate some form of challenge for students to register for the MAP courses offered by their institution such as the course not being core or elective for their qualification. The interest in the MAP industry is also limited by students perceiving MAP skills as not increasing employment prospects.

Despite the challenges faced in MAP, respondents perceive personal challenges to be less severe than infrastructure and resource related challenges. The infrastructure, resource and personal challenges identified in the study revealed a need to address challenges faced by students in order to develop an environment conducive to MAP at higher education institutions. The recommendations are discussed below.

6. Recommendations

The large number of students possessing mobile phones and laptops present an opportunity for mobile application programming classes to utilize student computing resources to reduce the required MAP laboratory resources. Higher Education Institutions therefore can create a “bring your devices” environment to address the perceived lack of MAP laboratories, computers, IDEs and mobile phones for practice.

The respondent’s indication of a shortage of relevant MAP books and the lack of affordable tutorship can be addressed if Higher Education Institutions provide free MAP books available online with dedicated MAP tutors. This environment will enable students to access MAP tutorship which will, in addition to providing general and MAP programming learning support, help set-up IDEs on student laptops and share freely available electronic MAP books and videos with their students. Such a platform should admit students irrespective of whether the MAP course is core or elective to the student’s programme of study. Students can also access study improvement techniques. If resources are available, back-up generators can be installed to ensure continued electricity supply for the MAP students.

7. Conclusion

This paper explored the challenges to MAP at a private Higher Education Institution in Botswana. Using a survey questionnaire data was collected and analyzed. In response to the research question, it was found that access to a reliably powered MAP laboratory with adequate computing and mobile phone facilities, up-to-date

books, affordable or free tutors, limited programming backgrounds and poor study habits of students where the challenges faced by students at a private Higher Education Institution in MAP. An additional contribution is the finding that most respondents consider building their own mobile applications, than increasing job prospects, to be the driver of MAP interests.

The study recommends a mobile application programming environment which takes advantage of the student laptop and mobile phone ownership by setting up IDEs for students, offering free tutorials and free electronic books to students. In addition, imparting programming skills earlier and stirring interest among students to engage in MAP could address challenges to increasing the number of MAP programmers.

References

Alston, P. (2012). Teaching Mobile Web Application Development : Challenges Faced And Lessons Learned. In *Proceedings of the 13th annual conference on Information technology education* (pp. 239–244). Alberta.

Anderson, R. S., & Gestwicki, P. (2011). Hello, Worlds: An Introduction to Mobile Application Development for iOS and Android. *Journal of Computing Sciences in Colleges*, *27*(1), 32–33.

B.O.C.R.A. (2013). Retrieved from http://www.bta.org.bw/node/227

Biljon, J. Van, & Dembskey, E. (2011). Learning tools in resource constrained environments : Learning from e-learning in the time of m-learning. In *ICT for development: people, policy and practice. IDIA2011 Conference Proceedings* (pp. 26 – 28).

Botswana Innovation Hub. (2013). IDEAL TECHNOLOGIES Team wins the Mobile Innovation Hackathon. Retrieved May 22, 2015, from IDEAL TECHNOLOGIES Team wins the Mobile Innovation Hackathon

Botswana Vision 2016 Council. (2010). Status at Glance across all Pillars by Key Results Areas. Retrieved May 22, 2015, from http://www.vision2016.co.bw/vision-content.php?vid=30

Christians, C. G. (2005). Ethics And Politics In Qualitative Research. In I. . Denzin & Y. Lincolin (Eds.), *Handbook of Qualitative Research* (pp. 139–164). CA: Thousand Oaks.

Coetzee. (2010). ICT for Society through Society : Application of code-sprints as entrepreneurial enabler. *CSIR 3rd Beinnual Conference 2010, Science Real and Relevant*. CSIR International Convention Center, Pretoria, South Africa.

Coetzee, J. (2013). OnePixel says we need more “apps for Africa”. Retrieved from http://ventureburn.com/2013/07/onepixel-says-we-need-more-apps-for-africa/

Damane, V., & Molutsi, P. (2013). Crisis of a Rich State:Botswana’s Dilemma in Financing Tertiary Education. In D. Teferra (Ed.), *Funding Higher Education in Sub-Saharan Africa* (pp. 13 – 37). Palgrave Macmillan.

Gordon, A. J. (2013). Concepts for mobile programming. In *ITiCSE ’13: Proceedings of the 18th ACM conference on Innovation and technology in computer science education* (p. 58). New York, New York, USA: ACM Press. http://doi.org/10.1145/2462476.2462483

GSMA. (2014). *The Mobile Economy. Sub-Saharan Africa 2014*. *GSMA*.

Hackathons. (2013). Retrieved from http://www.saisprogramme.com/?p=532

Jackson, S., Ellis, H., & Postner, L. (2012). Mobile application development in computing curricula *. *Journal of Computing Sciences in Colleges*, *27*(6), 110–112.

Mahmoud, Q. H., & Popowicz, P. (2010). A mobile application development approach to teaching introductory programming. *2010 IEEE Frontiers in Education Conference (FIE)*, T4F–1–T4F–6. http://doi.org/10.1109/FIE.2010.5673608

Malete, L., & Kobedi, K. (2012). Botswana. *A Profile of Higher Education in Southern Africa, Volume 2*, *2*(2011), 13–22.

Murugesan, S. (2013). Mobile Apps in Africa. *IEEE Computer Societ Y*, (October), 1–5.

Phillips, T., Lyons, P., Page, M., Viviez, L., & Maria, M. (2011). *African Mobile Observatory 2011*.

Pieters, J. (2014). Mobile app development faces skills crunch in 2014. Retrieved from http://www.itweb.co.za/index.php?id=70060

Sheard, J., Simon, S., Hamilton, M., & Lönnberg, J. (2009). Analysis of research into the teaching and learning of programming. *Proceedings of the Fifth International*

Workshop on Computing Education Research Workshop - ICER '09, 93. http://doi.org/10.1145/1584322.1584334

Statistics Botswana. (2013). *INFORMATION & COMMUNICATION TECHNOLOGY 2013: Statistics Report*. Retrieved from http://www.cso.gov.bw/images/ict_report.pdf

TEC. (2012). *Tertiary Education Council Annual Report 2011/2012*.

Teferra, D., & Altbach, P. G. (2004). African higher education : Challenges for the 21st century. *Higher Education*, *47*(1), 21–50.

The World Bank. (2012). *Mobile Usage at the Base of the Pyramid in South Africa*.

The World Bank. (2015). Botswana Data. Retrieved May 22, 2015, from http://data.worldbank.org/country/botswana

Tichapondwa, S. M. (2013). *Preparing your Dissertation at a Distance : A Research Guide*. Virtual!University!For!Small!States!of!the! Collonwealth!– Vancouver. Retrieved from http://www.sadc.int/files/3713/7821/2867/Dissertation_PDF.pdf

Tongia, R., Subrahmanian, E., & Arunachalam, V. S. (2005). Information and Communications Technology (ICT). In *Information and Communications Technology for Sustainable Development Defining a Global Research Agenda* (pp. 19–41).

Tracy, K. (2012). Mobile Application Development Experiences on Apple's iOS and Android OS. *IEEE Potentials*, *31*(4), 30–34. http://doi.org/10.1109/MPOT.2011.2182571