eLearning readiness of medical students from the University of the Witwatersrand

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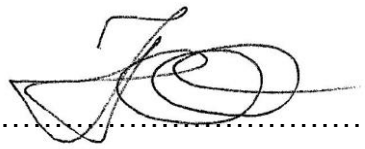
A research report submitted to the University of the Witwatersrand, Johannesburg in fulfilment for the requirements of the degree of Master of Medicine 2019.

DECLARATION

I, Argentina Maria Ingratta, declare that this research report is my own, unaided work. It is being submitted for the Degree of Master of Medicine (in the submissable format with my protocol and an extended literature review) in the branch of Internal Medicine at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university



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11th……day of ……June…….2019

DEDICATION

Dedicated to my husband, Daniel, and two sons, Joshua and Michael, without whose love and support this research report would have seemed insurmountable.

To my family and dear friends, thank you for your love, patience and support during this endeavour.

PRESENTATIONS ARISING FROM THIS PROJECT

1. **Oral presentation**

eLearning readiness of medical students from the University of the Witwatersrand.

Teaching and Learning Symposium 2018, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, 23rd May 2018

2. **Oral presentation**

eLearning readiness of medical students from the University of the Witwatersrand.

South African Association of Health Educationalists (SAAHE) conference, Durban, 27-30th June 2018

3. **Oral presentation**

eLearning readiness of medical students from the University of the Witwatersrand.

Faculty of Health Sciences Research Day, University of the Witwatersrand, Johannesburg, 6th September 2018.

Awarded: Best Oral Presentation: Education, Policy and Systems

ABSTRACT

Background

Globally the usage of eLearning in medical education is increasing. A shift towards more technology-based learning is anticipated in the medical curriculum review currently underway at the University of the Witwatersrand (Wits), Johannesburg, South Africa. This study investigated the usage of information and communication technologies (ICT) for eLearning amongst the 2017 medical student population at Wits. This information could inform the feasibility of moving towards more ICT-based learning and introducing a 'bring your own device' (BYOD) policy.

Methods

A cross-sectional survey was circulated to a convenience sample of first (n=255), third (n=350) and final year (n=319) students drawn from the six-year medical programme (MBBCh). Students were asked about what devices they had access to, how they used them for learning, and about obstacles to using their devices for learning. The survey included both closed- and open-ended questions. Quantitative data were analysed using descriptive and inferential statistics. Responses to the open-ended questions were analysed using content analysis.

Summary of results

The survey response rate was 48.5% (448/924) with a completion rate of 81% (364/448). Most students (99%) owned internet-capable devices and regarded their laptop (91.5%), smartphone (87%) and tablets (64%) as important to their academic success. The majority of students (79.1%) were willing to use their own device(s) at the university. The respondents displayed predominantly positive attitudes and

dispositions to ICT, with about half stating that they engaged more with courses that use ICT. More than 90% of respondents would prefer some degree of online teaching and learning. Perceived barriers to eLearning included poor internet connectivity; device features, especially battery life; concerns about safety and security; high data costs; and insufficient usage of eLearning by teaching staff to warrant students bringing their own devices.

Conclusions

Medical students at Wits own, value, and are willing to use their ICT devices for learning. However, the University needs to address the unreliable internet connectivity, high data costs, and safety and security concerns when using devices on campuses before eLearning can be implemented more effectively. From a student perspective, BYOD is feasible provided these barriers are addressed.

Keywords: eLearning, ICT, medical students, student readiness, barriers to eLearning

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LIST OF ABBREVIATIONS AND DEFINITIONS

Affordances	The qualities or properties of an object that define its possible uses or make clear how it can or should be used
BYOD	Bring your own device
CHERRIES	Checklist for reporting results of internet E-surveys
ECAR	EDUCAUSE Centre for Analysis and Research
GEMP	Graduate Entry Medical Programme
ICT	Information and communication technologies
LMS	Learning management system;
MBBCh	Bachelor of Medicine and Bachelor of Surgery
OS	Operating system
PDA	Personal digital assistant
QR	Quick response
REDCap	Research Electronic Data Capture
Wits	University of the Witwatersrand
WHO	World Health Organisation
YOS	Year of study

Chapter 1: PROTOCOL WITH EXTENDED LITERATURE REVIEW

1. Background

The World Health Organisation (WHO) defines eLearning as “an approach to teaching and learning … that is based on the use of electronic media and devices as tools for improving access to training, communication and interaction, and that facilitates the adoption of new ways of understanding and developing learning”.(1) eLearning refers to “the use of internet technologies to deliver a broad array of solutions that enhance knowledge and performance”(2) or stated more simply, “the use of the internet for education”.(3)

This literature review will examine the impact of eLearning in general, its role in medical education, and the use of eLearning at one South African medical school.

1.1. Affordances[1] of eLearning

eLearning is increasingly being integrated into higher learning institutions worldwide, and most discussions focus on how to incorporate it rather than whether it should be incorporated.(4) The pedagogical benefits of eLearning lie in its potential to “promote meaningful learning through constructivist pedagogical approaches.”(5–9) According to constructivist beliefs, students need to engage with the material to be learned and construct their own knowledge “in order to experience deep and meaningful learning”.(10) Jonassen et al (6) identified five requirements for eLearning to promote meaningful engagement. The learning must be “active, constructive, intentional, authentic, and cooperative”.(6) These requirements have implications for how eLearning materials are designed.

[1] Affordances: the qualities or properties of an object that define its possible uses or make clear how it can or should be used

E-learning offers a number of benefits for students and teachers that improve the efficiency of teaching and learning but that do not impact directly on learning.(11,12) For students, eLearning allows for the “flexibility in physical location and time of work”, (13) which can save on travel time and costs and for the portability of digital learning materials.(2,14) eLearning could free up teachers’ time to focus on higher order learning outcomes such as analysis and synthesis,(1) and may reduce educators’ administrative load by allowing for the automated tracking of student progress and resource usage through the learning management system (LMS).(2,4)

For institutions, eLearning could be used to generate new revenue streams (1); facilitate increased reach by accommodating both local and international students (1); facilitate cross-institutional collaboration with improved efficiency (1); and may result in significant cost savings through reduced teacher training time, and efficient programme administration and delivery.(2,15,16)

1.2. Factors affecting eLearning

For e-learning to promote meaningful learning, teachers should be using information and communication technologies (ICT) in constructivist pedagogical ways.(5,17,18) However, many factors affect teachers’ ability to design effective eLearning materials. George (11) developed a model of the external (beyond the control of the teacher) and internal (originating from within the teacher) factors “affecting teachers’ use of ICT”(11) for eLearning (see Figure 1).

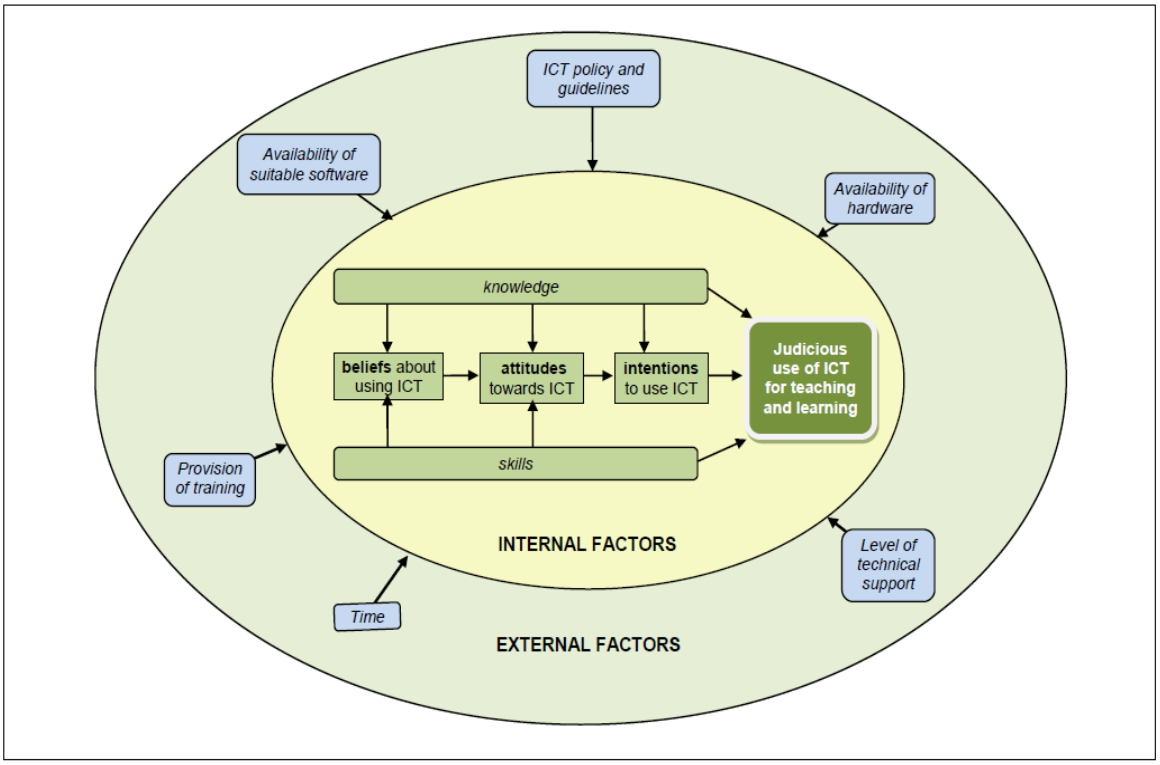


Figure 1: A model of external and internal factors affecting teachers' use of ICT (11)

The internal factors are placed in the centre of the model as they are key to successful and judicious teacher use of ICT.(11) These internal factors include teacher beliefs, attitudes and intentions towards ICT in addition to their ICT knowledge and ICT-related skills.(11)

External factors, although many of them prerequisites for effective use of ICT, are beyond the control of the teacher.(11) These include clear reasons for, and the availability of, institution ICT policies and guidelines; the provision of and access to reliable hardware; the level of timeous and effective technical support available to teachers; the provision of targeted and tailored ICT training for teachers with variable needs; the need to allocate teachers enough time to develop and test content; and the need for teachers to identify suitable software to use in their teaching.(11)

The provision of ICT training for teachers, in particular, is vital to ensure effective use of ICT for teaching.(11) Teachers need to combine "three different types of knowledge", namely "content knowledge" (knowledge of the topic matter to be

covered), “pedagogical knowledge” (knowledge of educational strategies available to them for teaching their subject),and “technological knowledge” (knowledge about different types of ICT and how to use them), to use ICT effectively for teaching.(19) George (11) showed that the “lack of technological knowledge of some teachers contributed to low levels of ICT proficiency.” Teachers’ needs with regards to technological knowledge are variable and require differentiated training to address individual teachers’ needs.(19)

Although teacher competencies are vital, there are additional well-established critical enabling success factors for eLearning, which can be divided into student and institutional factors. Student factors include their level of access to ICT devices,(1,16) students’ level of ICT awareness and skills,(1,16,20) their attitude to eLearning,(21,22) their perceived level of control,(22,23) and the perceived usefulness of eLearning.(21,22) Institutional factors include internet quality and reliability (1,21,22,24,25); instructional design of and delivery of the course(16,21,23); learning management system (LMS) functionality(3,22); faculty support of and engagement with ICT (1,21,24,26); effective eLearning policies(26); adequate infrastructure(24,25,27); and ICT technical support (1,20,22,23,25) provided to all involved.

The eLearning context determines what is done and valued, with success of eLearning often reflecting available institutional resources.(4)

The instructional design of eLearning materials, or the process by which the content is presented to the student,(28) is vital and must consider which instructional methods to use based on their ability to provide feedback to and engage the student, in order to create conditions conducive to learning.(16) Four key instructional design features include: content, or the information richness of the online content (text is low versus video which is high), the sense of realism, or extent to which the experience captures physical and psychological features of a performance, fostered by the eLearning material (immersion), the level of interactivity offered by the material (degree of interaction between students and their peers, teachers or simulated agents), and communication richness (students ability to communicate verbally and nonverbally using the net to deliver audio and video).(16) The degree to which the

students interact with the eLearning material seems to be the key to better achievement, and material should be designed and chosen accordingly.(16)

eLearning and traditional methods of instruction have been shown to be similar in effectiveness.(1,13,16,29) Many higher learning institutions choose to use eLearning in a blended fashion: combining traditional face-to-face techniques such as didactic lectures with online strategies such as pre-recorded lectures with PowerPoint slides, discussion forums, podcasts etc.(14,30) There are many options to choose from within the eLearning toolbox, and no particular intervention has shown marked efficacy over another.(1,13) One size does not fit all, and eLearning strategies need to be tailored to the context in which they are delivered.(4,25)

Some of the obstacles to eLearning described in the literature include (15,16,24): digital divides ("the economic, educational, and social inequalities between those who have computers and online access and those who do not"(31)), the risk to academic integrity (growing concern for dishonesty and cheating online), high online course drop-out rates, the costs involved (eLearning is thought to be more expensive despite long-term economic analysis suggesting cost-saving benefits), and teacher's attitudes towards eLearning (faculty may be sceptical of the value of eLearning because it differs from the way they were taught, and they fear it will distance them from their students). Digital divides are a particular challenge. Every class has students with variable ICT skills.(15,16) Digital divides are more prevalent in low income and disadvantaged settings, with students having variable access to ICT devices, variable access to broadband internet, variable intensity and nature of internet usage, and thus a lack of ICT skills and confidence.(15,16) Academically unprepared students also have less developed self-regulatory skills resulting in poorer performance than their peers in online courses.(15,16)

Within the South African setting, digital divides are a major concern. Social context and demographic divide influence how students experience or benefit from eLearning.(32) Students from advantaged versus disadvantaged schools, and with different literacy levels, interact differently with eLearning activities.(32) A review of South African universities found that student populations within and between institutions were very variable regarding baseline ICT skills sets and learning

preferences, and they suggested a blended approach might mitigate these factors.(33) There is also concern that academics neglect social context and assume that the youth are technologically literate, necessitating academic faculty support to avoid these and other traps.(32)

When considering an eLearning rollout strategy, the students wants, needs and skills must be considered in conjunction with teachers' capabilities and the institutional and social context. The instructional design and delivery of the eLearning materials chosen are vital to ensure that learning occurs, and teachers should be encouraged to use ICT in constructivist pedagogical ways.

1.3. Mobile learning

Mobile devices facilitated what is known as m-Learning, a subset of eLearning.(34) m-Learning is mediated by wireless mobile devices such as laptop computers, and handhelds including smartphones, tablet computers, e-book readers, digital media players, personal digital assistants (PDAs) and mobile phones.(35–37) These devices provide multiple functions usually provided by standalone devices, and connect to both cellular telephone networks and wireless networks, making learning on the move possible.

Worldwide access to mobile devices is increasing at a rapid pace, particularly in emerging economies. The Pew Research Centre(38) reported that "In 2013, a median of 45% across 21 emerging and developing countries reported using the internet at least occasionally or owning a smartphone. In 2015, that figure rose to 54%, with much of that increase coming from large emerging economies…". (38) In addition, in both developed and developing nations, people aged 18 to 34 are much more likely to use smartphones.(38) In South Africa there were an estimated 16.1 million users in 2017. This is projected to increase to 21.9 million users by 2021.(39) This increased "spread and popularity of mobile devices"(40) has led to the question: what is the possible role of mobile devices in supporting learning in the higher education environment in the South African context?

A systematic review from the African continent (40) suggests an increasing trend in mobile learning in higher education. However, the challenges described included (40,41): poor internet access on and off campus, lack of access to mobile devices, high internet costs, the provision of training and technical support to students and teachers, as well as learning management systems which are not always compatible with devices.

Wireless and cellular phone networks have extensively expanded in most developing countries since broadband infrastructure is often poor, creating an opportunity to use m-learning in higher education institutions.(36) Most mobile devices are low-cost to maintain, require minimal power to use and can be charged using solar energy, making them ideal for learning in rural areas.(36) The relatively low cost, internet-capability and multi-functionality of these mobile devices promote their popularity and ownership amongst students,(36) and create opportunities for more personalised learning.(42)

1.4. eLearning in medical education

“Medical education’s ultimate aim is to supply society with a knowledgeable, skilled and up-to-date cadre of professionals who put patient care above self-interest, and undertake to maintain and develop their expertise over the course of a lifelong career”.(43) The training of medical students includes the challenges noted in Table 1.

Table 1: Challenges in the training of medical students

System challenges	In response to a global shortage of health care workers, there are increasing student numbers to train(1)
	Increasing student numbers require innovative ways of teaching and learning(1)
	There is a growing expectation that healthcare professionals should have instant access to up to date information(43)
	Competency based medical education trends require effective tracking of student knowledge, skills and attitudes(2,44)
Teacher challenges	Increased demands on academic faculty result in less teaching time(1,2)
	Many medical teachers, who are defining and running medical curricula, have little or no experience of eLearning(15)
	Teachers are required to function as both as students and teachers in ICT enhanced environments(1,15)
Student challenges	Medical students need to be trained in various domains including theoretical knowledge, clinical examination and procedural skills, and professional attitudes(14,43)
	Students are training to work within and adapt to a complex environment with a rapidly expanding and evolving evidence base(2,44)
	Increasing student numbers results in reduced opportunities for contact with patients(43)
	Training occurs in variable sites including community-based settings, requiring mobility in their learning(2,3)
	Expectation to provide best practice for their patients(44)

eLearning may be used “to improve the efficiency and effectiveness of educational interventions”,(2) in efforts to address the challenges in Table 1. eLearning can provide a “convenient and possibly more cost-effective alternative to traditional learning” in “supporting capacity-building and competency-development in the health-care workforce globally”.(1) eLearning in medical education is at least as effective as traditional lecture-based learning in terms of knowledge and skills gained,(1) but this depends on the course design, student attributes and an appropriate mode of delivery.(35) Blended learning in health professions education appears to be at least as effective for knowledge acquisition.(35,45) Blended learning approaches are the most common approaches in health professions training programmes.(1,25) These potential benefits, paired with worldwide trends towards eLearning in higher education, has increasingly placed eLearning in the mainstream of medical curricula.(3,30)

From a medical students’ perspective, the potential benefits included money saved on travel as eLearning allows access in remote learning sites; portability of educational materials through a device; and ease of use.(1) Medical students found

eLearning to be enjoyable and effective, with higher degrees of student satisfaction in blended learning environments than traditional lecture settings.(46) Students did, however, need guidance in selecting the most appropriate online resources.(1,15) Medical students still attribute greater value to face-to-face learning and found eLearning to be a useful adjunct to but not a replacement for face-to-face teaching.(1,15,47) Also students' reported isolation with eLearning including lack of student-teacher interaction as well as peer to peer discussion.(1)

In developing countries, there are additional challenges to eLearning in medical education such as a lack of funding, access to ICT, infrastructure, and skilled health care workers to facilitate basic health care access.(1) Even though increased internet access can transform health care quality in developing countries, access to ICT is still a major challenge for implementing eLearning in these contexts.(1) Implementation of eLearning needs careful consideration of the nature of the adopting institution, the local health system as well as cultural considerations.(1)

Much debate exists around whether students should bring their own devices or whether institutions should provide specific devices for their students.(48,49) Most higher education institutions are moving towards "bring your own device" or BYOD policies.(48,50) The BYOD concept is based on the idea that mobile devices are "portable and pervasive"(51) and offer the flexibility of learning anywhere and anytime.(52) However, student attitudes towards bringing their own devices for learning may limit a roll-out of BYOD.(48,53)

1.5. eLearning at the University of the Witwatersrand (Wits)

1.5.1. Institutional policies on eLearning

The University of the Witwatersrand (Wits) is a five-campus "South African public research university" situated in central Johannesburg.(54) "The university consists of five faculties: Commerce, Law and Management, Engineering and the Built Environment, Health Sciences, Humanities and Science".(54) The university offers 3610 courses and has an enrolment of approximately 37374 students.(55)

The “Learning and Teaching Plan 2015–2019”(56) sets out learning and teaching priorities for the University of the Witwatersrand (Wits) and has prioritised, amongst other things, that “Wits will position itself as an IT-savvy university that uses technology to enhance all its core processes, including providing new and innovative ways of engaging staff in academic activities.” There is a recognition of the urgency of promoting eLearning to “meet the needs of 21st-century” students “who increasingly demand anywhere, anytime and any device’ learning and teaching”.(56) Priorities include, amongst others (56):

> “5.1. Develop and implement a comprehensive eLearning strategy to enable the effective use of educational technologies to enhance face-to-face and blended learning, programme and course design, and engaged student learning.
>
> 5.5. Ensure that the technology is used to support learning and teaching, and constantly adapts to learning and teaching needs, as opposed to allowing technology modalities to dictate the learning and teaching philosophy of the University.”

Learning spaces are also prioritised by Wits with the recognition that “they need to flexible, student-centred and accessible to our diverse students, and to include the use of appropriate technologies to enhance learning and teaching. These spaces include well-resourced physical and virtual spaces for learning and teaching, as well as informal spaces for students to meet and study”.(56)

1.5.2. The medical programme at Wits

The Bachelor of Medicine and Bachelor of Surgery (MBBCh) programme at Wits is a six-year degree that “admits students into the programme through two routes – school entrants and graduate entrants”.(57) “Graduates join the school entrants in the third year of study into an identical track known as the Graduate Entry Medical Programme (GEMP)”.(57) Year one of the GEMP equates to year 3 of the MBBCh degree.(57)

GEMP 1-2 (MBBCh 3-4) are delivered as blocks, with GEMP 1-2 comprising “organ-system based blocks which primarily focus on basic sciences and basic pathology disciplines”, while GEMP 3-4 (MBBCh 5-6) comprises “clinical clerkships in major disciplines such as internal medicine, surgery, psychiatry, paediatrics, obstetrics, and gynaecology or combinations of smaller disciplines such as anaesthesiology, trauma, ENT, emergency medicine and public health”.(57)

Training occurs on two of the five campuses: MBBCh 1 is delivered mainly as lectures on the main Wits campus in Braamfontein, Johannesburg, while MBBCh 2, and MBBCh3-4/GEMP 1-2 is delivered as mainly lectures and small group teaching on the medical school campus 5km away in Parktown, Johannesburg, with the MBBCH5-6/GEMP 3-4 clinical clerkships taking place in the central academic hospitals (i.e. Chris Hani Baragwanath Academic Hospital, Charlotte Maxeke Academic Hospital, Helen Joseph Hospital, and Rahima Moosa Mother and Child Hospital), regional hospitals (i.e. Sebokeng, Leratong, Klerksdorp/Tshepong, Edenvale and Potchefstroom Hospitals) and peripheral clinics within the greater Gauteng region. MBBCh5-6/GEMP 3-4 is comprised of mostly bedside and small group teaching, with some lectures delivered on site and some at the medical school campus. MBBCh 1-2 students have no clinical exposure, MBBCh 3-4/GEMP 1-2 students have minimal clinical exposure, with much of the clinical and bedside teaching occurring in the MBBCh 5-6/GEMP 3-4 years. While MBBCh 1 is delivered on one campus, students are required to become more mobile for their teaching and learning from GEMP 1-2, but increasingly so for GEMP 3-4. The eLearning strategy delivered for MBBCh 1 is governed by processes in other non-medical programmes on the main campus given that the programmes share resources and use the same learning management system (LMS). From MBBCh 2-6 (GEMP) the eLearning strategy will cater for the final four years but should ideally have similarities with and links to the first year of the programme.

1.5.3. MBBCh curriculum review

The MBBCh programme at the University of the Witwatersrand is currently under curriculum review. Given the university-wide ICT-based teaching and learning

strategy, there is expected to be a major shift towards increasingly ICT-based teaching and learning in the updated curriculum. Currently, there is variable uptake of eLearning strategies. These include student-driven podcasts, individual department lecture capture, and the use of discipline-specific multimedia learning programmes. The faculty MBBCh curriculum task team has highlighted a few issues pertinent to eLearning within the medical programme in their interim report released on the 2nd February 2017 (58):

- "the strong consideration of the diminishing capacity of disciplines in basic sciences (e.g., Anatomy dissection halls) and clinical departments to cope with greater student numbers;
- the need to upgrade the current IT infrastructure to support teaching and assessments;
- direction needs to be given with respect to teaching methodology;
- the need to align the new curriculum to modern methods of education;
- faculty to provide support for developing new teaching methodologies;
- the implications of the flipped classroom teaching approach for under-privileged students need to be considered."

Given the affordances of eLearning, increasing uptake in medical curricula worldwide, the prioritising of an ICT-based teaching and learning strategy at Wits and the medical programme curriculum review underway, eLearning is the topic of numerous debates in the Faculty of Health Sciences at Wits. The sorts of questions being asked include: Do the students want eLearning? Are students ready for eLearning? Are faculty members equipped to deliver it? Does the university have the necessary IT infrastructure to allow reliable Wi-Fi access for teaching and learning? These gaps in knowledge need to be filled so that we can inform the numerous stakeholders (students, faculty, IT staff, curriculum planners, and educators) about the current state of eLearning at the University. One of the gaps that need to be addressed is what proportion of medical students own an ICT device and their capacity to use that effectively for learning.(35,59)

A better understanding of staff and students' needs will allow resources to be directed appropriately and strategically. This study thus aims to investigate the use of ICT devices for eLearning amongst the current medical student population at Wits.

2. Research question

What is the current usage of medical students of technology in order to access their learning?

3. Study Objectives

1. To describe the demographics and characteristics of medical students and their level of access to ICT devices for learning.
2. To describe the eLearning usage patterns amongst the students.
3. To identify facilitators and barriers to eLearning.
4. To determine if bring your own device (BYOD) is a possible future strategy for implementing eLearning.

4. Methods

4.1. Sample population

The study will be conducted amongst the medical student population in the MBBCh programme. The sample will be drawn from first year (entry year with about 200 students), third year (transition year and entry point for GEMP students with about 350 students) and sixth year (final year of the programme with about 250 students) medical students in the Faculty of Health Sciences at the University of the Witwatersrand. All 800 students in the selected years will be invited to complete the questionnaire.

Response rates for surveys differ according to the method of administration.(35) For the purposes of estimating a sample size, this study will be treated as an online questionnaire. The impact of paper-based surveys might need to be taken into account after the pilot study has been conducted, see Section 4.3. Response rates for online questionnaires) are typically low (21-30%).(35) Treating this as an online survey only, an estimated sample size of 260 students was calculated using a

confidence interval of 95% with a 5% margin of error. This will require a response rate of 32% from the 800 students.

4.2. Study design and data collection

This is a cross-sectional study using a voluntary online survey with open-ended questions and close-ended questions. The study will use an electronic based questionnaire using the REDCap platform hosted at the University of the Witwatersrand.(36)

Understanding the inherent bias of using an electronic survey tool to survey ICT access, this will be supported by paper-based questionnaires that will be made available for students who are not able to access the survey online. Course coordinators will be asked to make the questionnaires available during lectures. We will ensure that this process is done with sensitivity in order not to inhibit or isolate those students unable to access the electronic version. This data will be entered manually into the survey program. Data will be collected from the sample of medical students listed above. The data collection period will last for three months to allow for adequate time to achieve the estimated sample size of 260 (response rate of 32%). Pre-emails will be sent to inform students about the upcoming survey as this has shown to increase subsequent response rates for online surveys. Reminder emails will be sent approximately two, four and six weeks after the initial invitation email. Similarly, the paper-based surveys will be re-circulated at these three time points by lecturers. Every effort will be made to ensure that response rate percentages are equitable across the three different study years.

The questionnaire (see Appendix A) is divided into the sections shown in Table 1, and linked to the study objectives.

Table 1. The questionnaire sections mapped to the study objectives

Section		Study objective
1.	Information and consent	*ethics*
2.	Student demographics	1
3.	Year of study	1
4.	Device ownership and usage to support learning	1,2,3,4
5.	Access to and reliability of the internet connection	2,3
6.	Use of the LMS (Wits-e)	2,3
7.	Bring your own device (BYOD)	4

The questionnaire was adapted from two published surveys to suit the similar circumstances of the medical students in the current MBBCh programme.(48,60) The survey will be generated using REDCap (Research Electronic Data Capture) software. Links to the survey will be circulated via the student email addresses, the university LMS (Wits-e), in lectures and via bulk sms sendings. Student names will not be recorded to ensure anonymity. Students will be given the opportunity to opt out directly on the survey.

4.3. Pilot study

The questionnaire will be piloted using a small group of student volunteers (n=20) from the MBBCh 5 class, which is not included in the study, to obtain feedback on the clarity of the questions and modify the questions where necessary. Fifty percent will be asked to answer the paper-based questionnaire and fifty percent will be asked to answer the online survey to compare the responses from the two versions. This could have implications for the sample size calculation.

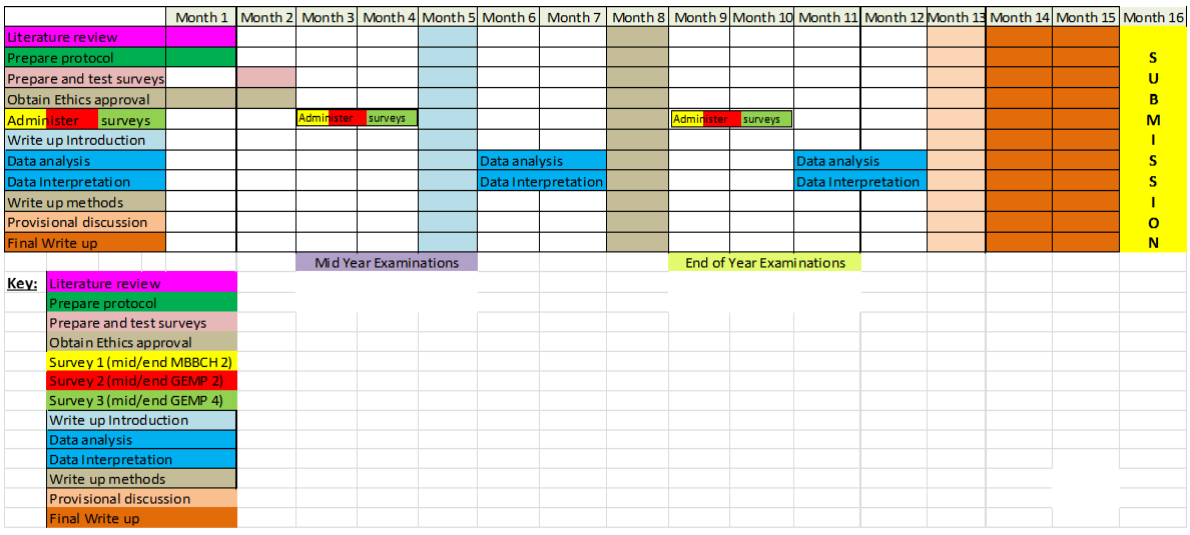
5. Data Analysis

The quantitative data will be analysed using descriptive statistics and where possible, appropriate tests of significance, e.g. chi-square test or t-tests will be applied. STATA software will be used. The types of data analysis permissible will be influenced by the final response rate.

6. Ethics

An application has been submitted to the University of the Witwatersrand Human Research Ethics Committee (HREC-Medical). Students are regarded as a vulnerable group hence a number of ethical considerations will be taken into account. Firstly, students will be assured that their participation in the study is voluntary and that there is no direct advantage or disadvantage to their participation or lack thereof. They will also be provided with a participation sheet (see Appendix A) informing them about the purpose of the study and that they may opt out of the study at any stage. Permission to conduct this study has already been obtained from the Department of Internal Medicine, the office of student support, UUME (Undergraduate Unit for Medical Education), the University registrar and the Medical Students Council at the University of the Witwatersrand.

7. Proposed Timeline



8. Funding

Costs include printing costs, which will be absorbed by the Department of Internal Medicine at the Helen Joseph Hospital, and purchasing of statistical software: Dr Ann George, Thuthuka grant holder, will cover these costs from her grant.

9. References

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Chapter 2: SUBMISSABLE ARTICLE

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Title: Factors affecting students' eLearning at one South African medical school: A cross-sectional survey

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Abstract

Background

Globally the usage of eLearning in medical education is increasing. A shift towards more technology-based learning is anticipated in the medical curriculum review currently underway at the University of the Witwatersrand (Wits), Johannesburg, South Africa. This study investigated the usage of information and communication technologies (ICT) for eLearning amongst the 2017 medical student population at Wits. This information could inform the feasibility of moving towards more ICT-based learning and introducing a 'bring your own device' (BYOD) policy.

Methods

A cross-sectional survey was circulated to a convenience sample of first (n=255), third (n=350) and final year (n=319) students drawn from the six-year medical programme (MBBCh). Students were asked about what devices they had access to, how they used them for learning, and about obstacles to using their devices for learning. The survey included both closed- and open-ended questions. Quantitative data were analysed using descriptive and inferential statistics. Responses to the open-ended questions were analysed using content analysis.

Summary of results

The survey response rate was 48.5% (448/924) with a completion rate of 81% (364/448). Most students (99%) owned internet-capable devices and regarded their laptop (91.5%), smartphone (87%) and tablets (64%) as important to their academic success. The majority of students (79.1%) were willing to use their own device(s) at the university. The respondents displayed predominantly positive attitudes and dispositions to ICT, with about half stating that they engaged more with courses that

use ICT. More than 90% of respondents would prefer some degree of online teaching and learning. Perceived barriers to eLearning included poor internet connectivity; device features, especially battery life; concerns about safety and security; high data costs; and insufficient usage of eLearning by teaching staff to warrant students bringing their own devices.

Conclusions

Medical students at Wits own, value, and are willing to use their ICT devices for learning. However, the University needs to address the unreliable internet connectivity, high data costs, and safety and security concerns when using devices on campuses before eLearning can be implemented more effectively. From a student perspective, BYOD is feasible provided these barriers are addressed.

Keywords: eLearning, ICT, medical students, student readiness, barriers to eLearning

1. Background

The global demand for an expanded and appropriately trained health care workforce(1) has resulted in a rapid increase in the numbers of students in South African medical schools. The training of medical students includes a number of challenges (Table 1).

Table 1: Challenges in the training of medical students

System challenges	In response to a global shortage of health care workers, there are increasing student numbers to train(1)
	Increasing student numbers require innovative ways of teaching and learning(1)
	There is a growing expectation that healthcare professionals should have instant access to up to date information(2)
	Competency-based medical education trends require effective tracking of student knowledge, skills, and attitudes(3,4)
Teacher challenges	Increased demands on academic faculty result in less teaching time(1,3,5)
	Many medical teachers, who are defining and running medical curricula, have little or no experience of eLearning(6)
	Teachers are required to function as both as students and teachers in ICT enhanced environments(1,6)
Student challenges	Medical students need to be trained in various domains including theoretical knowledge, clinical examination and procedural skills, and professional attitudes(2,7)
	Students are training to work within and adapt to a complex environment with a rapidly expanding and evolving evidence base(3,4)
	Increasing student numbers results in reduced opportunities for contact with patients(2)
	Training occurs in variable sites including community-based settings, requiring mobility in their learning(3,8)
	Expectation to provide best practice for their patients(4)

eLearning offers an avenue for addressing the challenges in Table 1 through facilitating “the adoption of new ways of understanding and developing learning”(1) and improving “the efficiency and effectiveness of educational interventions”.(3) This paper reports on students’ readiness and willingness to adopt eLearning at one South African Medical school.

E-learning offers a number of benefits for students and teachers that improve the efficiency of teaching and learning but that do not impact directly on learning.(9,10) For students, eLearning allows for the “flexibility in physical location and time of work”,(11) which can save on travel time and costs and for the portability of digital learning materials.(3,7) eLearning could free up teachers’ time to focus on higher order learning outcomes such as analysis and synthesis,(1) and may reduce educators’ administrative load by allowing for the automated tracking of student progress and resource usage through the learning management system (LMS).(3,12)

eLearning in medical education is at least as effective as traditional lecture-based learning in terms of knowledge and skills gained,(1) but this depends on the course design, student attributes, and an appropriate mode of delivery.(13) Blended learning combines traditional face-to-face techniques, such as lectures, with online strategies like pre-recorded lectures with PowerPoint ® slides, discussion forums, podcasts etc.(7,14) Blended learning is the most common approach employed in health professions training programmes(1,5) and appears to be at least as effective for knowledge acquisition as compared with traditional face-to-face techniques.(13,15) Medical students show higher degrees of satisfaction in blended learning environments than traditional lecture settings.(16) The potential benefits of eLearning have located it in the mainstream of medical curricula.(8,14)

The critical enabling success factors for eLearning are well established and occur at three levels: student, teacher, and institutional level. Student factors include their level of access to ICT devices,(1,17) students’ level of ICT awareness and

skills,(1,17,18) their attitude to eLearning,(19,20) their perceived level of control,(20,21) and the perceived usefulness of eLearning.(19,20) Teacher factors include attitude to(9,19) and acceptance of eLearning,(9,22) ICT competence,(9,22) ability to design interactive and relevant digital content,(17,19,20) and sufficient time to develop online learning tools.(1,9,19,22) Institutional factors include internet quality and reliability(1,5,19,20,22); instructional design of and delivery of the course(17,19,21); learning management system (LMS) functionality(8,20); faculty support of and engagement with ICT(1,19,22,23); effective eLearning policies(23); adequate infrastructure(5,22,24); and ICT technical support(5,18,20,21) provided to all involved.

Some of the obstacles to successful eLearning described in the literature include(6,9,17,22): digital divides ("the economic, educational, and social inequalities between those who have computers and online access and those who do not"(25)), the risk to academic integrity (growing concern for dishonesty and cheating online), high online course drop-out rates, teacher factors (a lack of ICT proficiency, a lack of time, and a negative attitude towards eLearning) and cost factors (eLearning is thought to be more expensive despite long-term economic analysis suggesting cost-saving benefits). Digital divides are a particular challenge, especially in low income and disadvantaged settings, with students having variable access to ICT devices, variable access to broadband internet, variable intensity and nature of internet usage, and thus a lack of ICT skills and confidence.(6,17) Within the South African setting, digital divides are a major concern. South African student populations within and between institutions were very variable in terms of baseline IT skills sets and learning preferences, and a blended approach might mitigate these factors.(26) High

data costs in South Africa, as much as 134% more expensive compared with other BRICS nations, exacerbate the digital divide.(27)

Worldwide, access to mobile devices is increasing at a rapid pace, particularly in emerging economies, with increased growth projected in South Africa.(28) Increased access to mobile devices creates opportunities for mobile learning mediated by wireless mobile devices (laptop computers, and handhelds including smartphones, tablet computers, and mobile phones).(13,29,30) The relatively low cost, internet-capability, and multi-functionality of these mobile devices promote their popularity and ownership amongst students,(29) and create opportunities for more personalised learning.(31) Kaliisa(32), in an African review, suggests an increasing trend in mobile learning in higher education. The review echoed the challenges reported by other authors(9,17,33) but also raised the problem of learning management systems that are not always compatible with devices.(32,34)

Much debate exists around whether students should bring their own devices or whether institutions should provide specific devices for their students.(35,36) Most higher education institutions are moving towards “bring your own device” or BYOD policies.(35,37) The BYOD concept is based on the idea that mobile devices are “portable and pervasive”(38) and offer the flexibility of learning anywhere and anytime.(39) However, student attitudes towards bringing their own devices for learning may limit a roll-out of BYOD.(35,40)

1.1. Context of the study

The University of the Witwatersrand (Wits) is a five-campus “South African public university situated” in central Johannesburg.(41) The Bachelor of Medicine and Bachelor of Surgery program (MBBCh) at Wits is a six-year degree that “admits students into the programme through two routes – school entrants and graduate entrants”.(42) “Graduates join the school entrants in the third year of study into an identical track known as the Graduate Entry Medical Programme (GEMP)”.(43) Training of medical students is done across a decentralised clinical platform. Teaching methodologies evolve from more didactic early in the programme, progressing to clinical clerkships by the final year.

The MBBCh programme at the University of the Witwatersrand is currently under curriculum review with a task team suggesting a renewed drive towards an ICT-enhanced environment.(44) This idea is further enhanced by the university-wide “*Learning and Teaching Plan 2015–2019”,*(43) which recognises the urgency of responding to 21st-century students’ desire for "‘anywhere, anytime and any device learning and teaching."

In response to the global dialogues, eLearning is the topic of numerous debates in this study school. Questions are being asked about students’ desires and readiness, staff willingness to engage eLearning, and the university’s infrastructure capacity. This study addresses some of these questions.

This study aimed to investigate the usage of ICT for eLearning amongst the 2017 medical student population at Wits: what types of ICT devices do students have

access to, how are they using them, how frequently are they using them, and where are they using them to support their learning? (13,45)

2. Methods

A descriptive, cross-sectional, online and paper-based survey was distributed to a convenience sample of medical students at Wits. The target population was first year (entry year; n=255), third year (when graduate entrants join the school leavers in the GEMP; n=350) and sixth year (final year; n=319) medical students. These years of study were selected representing a point in the curriculum in which there is a change due to the teaching and learning methodology being used or the insertion of new students into the class (MBBCh 3).

2.1. Ethics approval and informed consent

The Human Research Ethics Committee of the Faculty of Health Sciences at Wits approved the study in April 2017 (Clearance certificate number M170340). A detailed information sheet and briefing were provided, and consent was implied by completion of the survey.

This study is reported according to the Checklist for Reporting Results of Internet E-surveys (CHERRIES(46)).

2.2. Survey development and pre-testing

The questionnaire was adapted from two published surveys(35,47) with some modifications for the medical student population in this study.

The survey was generated using REDCap (Research Electronic Data Capture(48)) software. A pilot study with 19 student volunteers was conducted in May 2017. Volunteers were recruited by students from the fifth year of study. Following the pilot study, the questionnaire was edited to reduce the length, enhance clarity and ensuring readability across a range of devices.

The final survey consisted of seven sections: information and consent (1 question), demographic data (4 questions), year of study (2 questions), device ownership and usage to support learning (12 questions), access to and reliability of the internet connection (5 questions), usage of the learning management system (2 questions), and specific questions around BYOD (6 questions).

2.3. Recruitment process and survey administration

Links to an information video, detailing the upcoming study, were circulated by class representatives to the three cohorts (MBBCh 1, 3 and 6 students) via class Facebook and WhatsApp groups for one month prior to roll out. The final survey was distributed via the student email addresses, the university learning management system (Wits-e), advertisement posters (with quick response (QR) codes that can be scanned using a smartphone) placed in student areas, in lectures, and by student representatives via class Facebook and WhatsApp groups. Paper-based versions of

the survey were circulated by the principal investigator in two back-to-back lectures per each cohort year. Anonymous collection was assured.

The collection period for the survey was from 10 September 2017 to 7 November 2017. The survey used adaptive questioning, conditionally displaying some items based on responses to other items. The paper-based survey was twelve pages long with an average of five questions per page. The online version was between 24 and 32 pages long depending on adaptive responses, with two questions per page. Students were able to review answers, go back if needed, and complete the online questionnaire at a later stage if desired (via a unique link). All questions were mandatory except for open-ended questions. The average completion time was 21 minutes (range: 7-54 minutes).

2.4. Data analysis

Data from the paper-based surveys were manually entered into REDCap. There were no duplicate online entries. For the purposes of estimating a sample size, this study was treated as an online questionnaire.(49) The estimated sample size of 272 was calculated in STATA version 14 using a finite population of 924 and adjusting for population correction.

Data collected in REDCap was exported into Microsoft Excel® for cleaning. Incomplete questionnaires were removed. Quantitative data were analysed using IBM SPSS version 25. The statistical analysis included frequency tables, custom

tables, Pearson's chi-squared, Fisher's exact and the Kruskal Wallis One-Way ANOVA test. All tests were conducted at a significance level of 5%.

The open-ended responses were analysed using conventional content analysis, where text was interpreted and coded into individual factors.(50,51) The factors were clustered into categories and subcategories. Frequency counts of factors were added.(51) The coding was iterative(52) and intercoder–reliability(53) was used to improve the rigour of the study: an experienced researcher checked all steps from initial coding through grouping the factors into subcategories and categories, and naming the final categories.

3. Results

3.1. Response rates

The study had an overall response rate of 48% (448/924). Of the 924 students surveyed, 56% of the MBBCh 1 (142/255), 41% of the MBBCh 3 (143/350), and 41% of the MBBCh 6 (132/319) class responded to the survey, with 3% not indicating their year of study (YOS) (31/924). The overall completion rate for the survey was 81% (364/448): MBBCh 1 (88.7%; 126/142), MBBCh 3 (88.1%;126/143), and MBBCh 6 (84.8%; 112/132).

3.2. Sample demographics

Respondent demographics by YOS are listed in Table 2. Most respondents resided off campus (67.6%; 246/364), while the remainder lived in university residences,

some of which are on main campus, but others are dispersed throughout the surrounding areas.

Table 2: Respondent demographics for completed surveys by YOS

	MBBCh 1 (n; % of respondents)	MBBCh3/GEMP1 (n; % of respondents)	MBBCh6/GEMP4 (n; % of respondents)	Respondents (n; % of total respondents)	MBBCh1,3 & 6 (N; %)
Gender					
Male	54 (38.3)	47 (33.3)	40 (28.4)	141 (38.7)	378 (40.9)
Female	71 (32.1)	79 (35.8)	71 (32.1)	221 (60.7)	546 (59.1)
Other	1 (50)	0	1 (50)	2 (0.5)	0
Age					
<21	53 (36.8)	48 (33.3)	43 (29.9)	144 (39.5)	419 (45.3)
21-24	59 (36)	57 (34.8)	48 (29.3)	164 (45.1)	399 (43.2)
25-29	13 (27.1)	19 (39.6)	16 (33.3)	48 (13.2)	84 (9.1)
>29	1 (12.5)	2 (25)	5 (62.5)	8 (2.2)	22 (2.4)
Race					
Black	62 (47.6)	34 (26.2)	34 (26.2)	130 (35.7)	383 (41.5)
White	31 (22.6)	58 (42.4)	48 (35)	137 (37.6)	303 (32.8)
Asian/Indian	22 (33.8)	22 (33.8)	21 (32.4)	65 (17.9)	190 (20.5)
Coloured	5 (25)	9 (45)	6 (30)	20 (5.5)	48 (5.2)
Other	6 (50)	3 (25)	3 (25)	12 (3.3)	0

3.3. Student engagement with ICT

3.3.1. Access to devices

Fewer than 1% of students, all in the first year of study, did not currently own or have access to a device. Of the 99.2% (361/364) of respondents who owned a device, 92% (335/361) owned two or more devices. There was no significant difference in the number of devices owned by YOS (p=0.075).

Handheld devices were the primary instrument while a laptop was added where there was more than one device. Smartphones were the most common device students owned or had access to (97.3%; 354/364), followed by laptops (94.2%; 343/364), tablet computers (51.6%; 188/364), desktop computers (31%; 113/364), and standard mobile phones (15.1%; 55/364). Most respondents owned or had access to both a smartphone and a laptop (94%; 343/364), then a smartphone and a tablet (50%; 183/364), and a smartphone and a desktop computer (30%; 111/364). Fifty-two percent (191/364) of respondents owned or had access to both a laptop and a tablet.

The most common smartphone was Android-based (64.1%; 227/354), then iPhone (33.3%; 118/354) and other (2.6%; 9/354). There was no significant difference in student preference for Android vs iPhone OS by YOS (p=0.58). The most common operating system (OS) on laptops was Windows (83.4%; 286/343) followed by MAC or OSx (Apple) (15.7 %; 54/343), while on tablet computers it was Apple iOS/iPad (55.8%; 106/190) then Android OS (38.9%; 74/190) followed by Windows OS (3.7%; 7/190).

3.3.2. Device usage to support learning

The majority of the students used ICT to support some or all their subjects (see Fig.1)

Fig. 1: Frequency of device usage to support studies

Students' usage of computers available on the university campuses was infrequent, with 11% (40/364) accessing them daily, 36% (131/364) weekly, 30% (108/364) monthly, 11% (40/364) yearly and 12% (45/364) never. There was no significant difference (p=0.634) in this usage between the three years of study.

Fig. 2 shows the locations in which students used their devices to support their studies.

Fig. 2: Most common locations where students used devices to support their studies *Percentages exceed 100 % because students were asked to indicate all areas where they used a device.

Laptops were rated by the majority of students (91%) as being moderately to extremely important to academic success, followed by smartphones (88%), tablets (64%) and desktop computers (62%). The owners of standard mobile phones (72%) rated them as moderately to extremely important to their academic success.

3.3.3. Student preparedness to use ICT on entry to university

Respondents (68%) were adequately prepared to use the ICT needed in their courses on entry, with 49% stating that they became more actively involved with courses that use ICT. Thirty-six percent of respondents wished they had been better prepared to use institution-specific ICT such as the learning management system (LMS), with 20% wishing they had been better prepared to use basic software such as Microsoft Office© and Windows Explorer©. There was no significant difference by YOS in student wish to be better prepared on entry to university to use the LMS

(p=0.134) and basic office/browsers (p=0.404), and preparedness to use technology (p=0.700).

3.4. Student willingness to use eLearning

3.4.1. Preferred teaching approach

The majority (90.1%) of the students preferred courses that have some online components or that are mostly online. Specifically, 23.6% of students said they learn best in a course that is mostly but not wholly, online. Another 62.4% said that they learned best when there are at least some online course components. At the extremes of the continuum, 6.3% of students prefer entirely face-to-face courses, while 4.1% of students say that fully online courses work best for them. Only 3.6% of students expressed no preference. There were no significant differences (p=0.716) between the students of different YOS. The reasons students gave for their preferred teaching approach are given in Table 3. Students' cited the affordances offered as the major reason for wanting online learning and connectivity issues as the major factor against online learning.

Table 3: Reasons for and against online vs. face-to-face learning

Category	Sub-category	Count of factor
For online learning	Affordances offered by online learning	319
	Type of resources students want online	107
	ICT-related reasons	7
	Other	1
Against online learning	Connectivity issues	43
	Difficulties/ problems with online learning	8
	Difficulties relating to accessing devices	8
	Time issues related to online learning	8
	Problems with LMS	8
	Quality/ structure of online resources	4
For face-to-face learning	Prefers inter-personal interaction in lectures and tutorials for initial understanding	74
	Finds lectures and tutorials useful for explaining concepts and interaction	42
	Want hands-on learning	38
	Prefers conventional learning (face-to-face)	23
	Lecture/tutorial used to take their own notes	14
	Prefers assessment in person or paper-based rather than online	4
	University DP (duly performed) requirement to attend teaching sessions	1
Against face-to-face learning	Experiences difficulties with travelling to the university	9
	Feels that lectures are boring or not needed	7
Prefer a combination	Would prefer a combination of online and face-to-face teaching	126
No preference	No preference so long as they are taught what is needed	2

The result for students' preference for simulation or educational games was statistically significant ($p = 0.027$). The majority of the cohort requested simulation or educational games occasionally rather than all the time: MBBCh1 (79%), MBBCh3 (78%), MBBCh 6 (75%). The result for students' preference for pre-recorded lectures (to allow viewing before the lecture session with lecture time used for discussion /other activities) was statistically significant across the three years ($p = 0.038$). Nearly half the respondents, 49% in MBBCh1, 43% in MBBCh3 and 47% in MBBCh6, requested that **all** lectures be pre-recorded, with lecture sessions focusing on discussions rather than delivering content.

Fig. 3 shows the technologies that students would like their teachers to use more (and less).

Fig. 3: Technologies that students would like their teachers to use more (and less) *Percentages that total less than 100 are accounted for by the "I don't know" category not included in the figure. The negative percentages account for the "never" category.

3.4.2. Disposition towards ICT usage

Students were asked to place themselves on a 100-point scale bound by opposite terms designed to measure their attitude and disposition and attitude to technology as developed and validated in the EDUCAUSE Centre for Analysis and Research (ECAR) study.(54) Lower numbers indicate certain characteristics about disposition to use technology (reluctant user, late adopter, critic, technophobe) and attitudes towards technology usage (useless, burdensome, distraction), while higher numbers indicate more positive dispositions (enthusiast, supporter, early adopter, technophile) and attitudes (useful, beneficial, enhancement) towards ICT.(54)

Students' displayed positive attitudes and dispositions to using technology in every item in the series (see Fig. 4).

Fig. 4: Student attitudes and dispositions toward technology

The overall score for attitude toward technology was 75 points while the overall score for disposition toward technology was 70 points.

Forty-three percent of respondents agreed-to-strongly-agreed that they were more likely to skip classes that were streamed or when recorded lectures were available online, and when materials presented in class were available online (40%).

3.5. Time spent engaged online

The majority of students (81%) spent at least one hour a day online engaged in various educational activities including online research and video streaming, with 25% of respondents spending more than two hours a day on online research/homework. Thirty-one percent of respondents spent more than two hours a day online engaged in other activities, mainly for entertainment (n=135), online learning (n=69) and social networking (n=69). The online learning category consisted of practice tests, online tutorials, e-textbooks, the LMS and the online library. The results for time spent online for research purposes by YOS were statistically significant (p = 0.04). MBBCh 6 spent more time online for research, which is possibly because final year students needed to submit a research report. There were no significant differences between the students in different years for time spent online for social media usage by YOS *($p = 0.638$*). It was interesting to note that 81% of respondents used social media daily for academic purposes given they requested it infrequently from their teachers as a teaching tool.

3.6. Barriers to effective eLearning

3.6.1. Data costs/availability

Most students connect to the internet daily (see Fig. 5), using their own data provider (82%), followed by university Wi-Fi networks (62%) and free Wi-Fi networks (21%). The results for how students connect to their own data provider by YOS were not statistically significant (p = 0.279).

Fig. 5: How students connect to the internet

Majority of students (99%) purchase mobile data monthly to connect to the internet for any reason, with 71% of respondents purchasing 500MB of data or more.

3.6.2. Connectivity issues

Most students rated their experience with wireless networks on campus unfavourably. Only 38% reported good-to-excellent experiences with the Wi-Fi in campus libraries, 16% with Wi-Fi in student housing, 12% in classroom/instructional spaces, and 2% in teaching hospitals. The Kruskal Wallis results for students' experiences with Wi-Fi connectivity by YOS were not significant for student housing (p = 0.544). Students found it difficult to log in to the university network more than half the time with ease of login reported as poor to fair by 56% of respondents; while only 18% of students found the network performance good to excellent.

Fig. 6 shows students' suggestions to improve their experience of university-provided wireless networks. These included: provide faster and more reliable Wi-Fi (n=171), improve Wi-Fi coverage (n=141), and provide IT support (n=3).

Fig. 6: Student suggestions to improve their experience of university-provided wireless networks

3.6.3. Use of the University learning management system (LMS)

Students accessed the LMS daily to weekly for course materials (65%), timetables (30%), to track academic progress (22%) and to view recorded lectures (19%). More than 70% of respondents never accessed the LMS for discussion forums or to view recorded lectures. Students also accessed the LMS for other reasons such as accessing other content (n=45), administrative tasks (n=38), assessment events (n=18) and to track academic progress (n=9).

Student suggestions to improve the university LMS included improved LMS consistency and efficiency (n=111); improved functionality (n=77) and improved teacher usage of the multi-functionality of the LMS (n=99) and, students preferred using their own repository created in Google Drive™(n=22) over the university LMS.

3.6.4. Teacher use of ICT

The teachers used ICT some (45%) to all (26%) the time in teaching sessions to enhance learning. Teachers infrequently supported students' usage of their own devices, only encouraging students to use their own devices to take notes during teaching sessions some (16%) to all (5%) of the time. Students were encouraged to use their own devices in teaching sessions to deepen their learning some (27%) to all of the time (7%). There were no significant differences between students' perceptions of their teachers' use of ICT by YOS: encourage note taking (p=0.746),

encourage device usage to deepen learning (p=0.957) and teacher use of technology to enhance learning (p=0.879).

Respondent suggestions to the university to promote student usage of ICT included: provision of more online courses/resources (n=234), improve internet connectivity (n=107), facilitate better teacher use of ICT (n=86), and facilitate student access to devices (n=29). Online resources requested included more recording of (n=91) and usage of videos in lectures (n=22); online lectures, online assessments and practice examples (n=81); improvement of the LMS (n=25); and mobile applications (n=15).

3.7. Feasibility of BYOD

Seventy-nine percent (288/364) of respondents are willing to bring their own computing device for learning at university: smartphone (83%; 239/288), then laptop (58%; 167/288), and then tablet computer (50 %; 145/288). Fig. 7 shows perceived barriers to students using their own device for learning.

Fig. 7: Perceived barriers to students using their own device for learning

The students cited concerns about safety and security (personal and device(n=62)) and device issues such as the size of the device, specifically laptops, (n=17) as reasons why they might not want to bring their own devices. Reasons for agreeing to bring smartphones for learning included device portability (n=43), device readily available (n=34), size (n=14) and convenience (n=9), with laptops, in contrast, seen as heavy (n=11) and unsafe to carry (n=27). Tablets were selected for their small size (n=5), portability (n=5) and own internet access (n=3).

Forty-five percent of respondents were willing to use their own data to access any device for university work. The main reasons students said no to using their own data was because data is expensive (n=121) and it is seen as the responsibility of the university to provide them with internet access (n=42). Of those who said 'yes' to using their own data, sixty-three respondents did so willingly, while other respondents stated that they had no choice as they need it to complete university work (n=55), university Wi-Fi was unreliable (n=27) and their own data was more reliable (n=17).

4. Discussion

Successful eLearning depends on critical factors at three levels: student, teacher, and institutional-level. This study found that nearly all the medical students surveyed had access to a device that they were ready and willing to use for their learning, but barriers to students' use of ICT for learning were identified at all three levels of critical factors required for successful eLearning.

4.1. Student-level factors

Nearly all Wits medical students from the three years surveyed had access to a device, with no significant difference in number of devices owned across the three years. Those without a device intended to purchase one in the future. The most common device the students had access to was a handheld device, predominantly a smartphone, with no difference in student preference for Android vs iPhone

operating systems. The prevalence of smartphones is unsurprising given that people in a similar age group (18-34 years) to the students are more likely to own a smartphone than older people, in both developed and developing countries.(55) Most students had access to two or more devices, usually a combination of a handheld device and a laptop computer. Handheld devices had predominantly Android and Apple operating systems, and laptops had predominantly Windows and Apple operating systems. Any e-learning material must thus be designed to be functional across different operating systems.(35)

While the usage of university-provided computers was low across the study years, respondents were using their own devices for learning (mainly mobile devices – laptops and smartphones) and regarded them as vital to academic success. These findings are similar to those of the 2017 ECAR survey(56) which showed that laptops are critical to academic success for undergraduate students in the US. The value placed on mobile devices for learning by Wits medical students is in keeping with studies on medical students globally.(33,35,57–64)

The most common location students used their devices to support their studies was at their place of residence. Laptops were used more frequently at home, while handheld devices, especially smartphones, were favoured in university teaching and learning spaces. Most students, however, preferred smartphones over laptops when asked which device they were willing to bring to university for their learning. This preference may reflect the greater ease of use and functionality of a smaller more portable device and possibly reflect social context such as risk to personal and device safety. These findings are echoed in studies showing that large size of the

device, battery life, and poor connectivity are known student barriers to BYOD.(36) Mobile devices provide multiple functions usually provided by standalone devices,(29) and connect to both cellular telephone networks and wireless networks, making learning on the move possible,(30) so the popularity of these devices in this cohort that needs to access their learning in multiple spaces is unsurprising. The low frequency of usage of university computers compared to the high frequency of own device usage to support their studies may suggest that the location and capacities of the university computer facilities do not match the needs of these students for whom much of their learning may be off campus.

The respondents displayed predominantly positive attitudes and dispositions to technology, with about half stating that they engage more with courses that use ICT. Students appear to want increased ICT but prefer the provision of resources that offer them “immediate and clear benefits”(56) such as lecture capture, early alert systems, and practice tests, a similar finding to the ECAR survey from 2017.(56) Students requested recordings of the entire lecture rather than just the audio provided by a podcast, which is the current practice at Wits medical school. Social media was regarded as an avenue for entertainment rather than for learning. Although there was an overall positive disposition to ICT, at least 20% of the class felt underprepared, on entry to university, to use the university LMS and common office and internet browsing programs. There might be a benefit in offering additional training in these areas for first-year students.

Medical students value online learning, with most respondents requesting some degree of online teaching and learning. Online learning offered a convenient way to

review lectures, clarify concepts, and practice quizzes, all at a time, place and pace suited to the student. This flexibility in physical location and time of work is a well-described benefit of eLearning.(11) Possible feelings of isolation with eLearning were not reported as a barrier in this study, as they have been elsewhere.(1) Wits medical students valued face-to-face learning for explaining concepts, interacting with the lecturer and facilitating hands-on learning. Medical students at Wits prefer a combination of online and face-to-face teaching. These findings are similar to those in the literature which show that medical students still attribute greater value to face-to-face learning, and found eLearning rather to be a useful supplement to but not a replacement for face-to-face teaching.(1,6,65)

4.2. Teacher-level factors

Students at Wits felt that their teachers used ICT in their teaching less than they would like the teachers to do, and infrequently supported students' usage of their own devices in teaching spaces. Teacher beliefs, attitudes, and intentions towards ICT are factors that influence teachers' use of ICT,(9) a critical success factor for eLearning.(1)

4.3. Institutional-level factors

The major barrier to accessing their devices for learning was poor internet connectivity, particularly in university residences and teaching and learning spaces. Students requested better Wi-Fi coverage, improved network performance, and simplified login access. However, this study was run before the completion of the

Wits university network upgrade[2]. Students connect to the internet using their own mobile data more often than the university Wi-Fi networks. However, this was often done reluctantly given that less than half the class is willing to use their own mobile data to access any device for university work. Students found data costs too high and felt it the responsibility of the university to provide them with internet access. Those who agreed to use their own data stated that they had no choice as they need it to complete university work and mobile data was more reliable than university Wi-Fi.

The university LMS was used infrequently and not to full capacity, being used mostly as a content repository and for administrative tasks. The infrequent usage may reflect the suboptimal design of eLearning materials and teacher usage of the LMS. Students requested better teacher use of and regular maintenance of the LMS, and the provision of a more simplified, personalised and standardized experience for students. Students showed a preference for the student-generated Google drive and asked for the development of a mobile application.

Recommendations:

- The university LMS must be functional on different devices running different operating systems.(32,35)
- Computer facilities should be placed close to student residences to ensure more efficient and broader access to ICT.

[2] The study was conducted from September to November of 2017. Project Quantum, which involves the university-wide replacement of old cabling and upgrading of the network infrastructure across all Wits campuses, is only due for completion in July 2018.(67)

- Provide reliable internet connectivity in the student residences and in all teaching and learning spaces. Facilitate access to mobile data as a backup for times when Wi-Fi access may be sub-optimal.
- Promote a blended learning approach, where feasible. Not all courses or all topics within a course lend themselves to having online components.
- Develop additional adaptive learning spaces such as the Wits eZone.(66)
- Provide ICT training for teachers to ensure the effective use of ICT for teaching,(9) including how to maximise usage of the LMS.
- Provide adequate security in teaching and learning spaces so students can safely bring and use the device they most value for learning.

The limitations of this study are that students' level of ICT skill and digital literacy were not explored. The study also did not evaluate the student usage of the current eLearning material available at the university. A further limitation is a possible non-response bias as only 48% of the cohort responded to the survey.

5. Conclusions

Most of the medical students in this study have their own ICT devices which they value and are willing to use for learning. They are positively disposed towards the use of technology, request that their teachers use more ICT in their teaching approaches and expect permission to use their own devices in teaching and learning spaces. However, the internet connectivity available at the university teaching and learning spaces as well as student residences, data costs, and security concerns may limit student's use of their privately-owned devices. Many of these limitations

are institutional-level issues that will have to be addressed before considering a bring your own device policy. This study has shown that this medical student community is ready for an expanded ICT-enhanced learning environment.

List of Abbreviations

BYOD: Bring your own device; CHERRIES: Checklist for reporting results of internet E-surveys; ECAR: EDUCAUSE Centre for Analysis and Research; GEMP: Graduate entry medical programme; ICT: Information and communication technologies; LMS: Learning management system; MBBCh: Bachelor of Medicine & Bachelor of Surgery; OS: operating system; QR: quick response; REDCap: Research Electronic Data Capture; Wits: University of the Witwatersrand; YOS: Year of study.

Figures

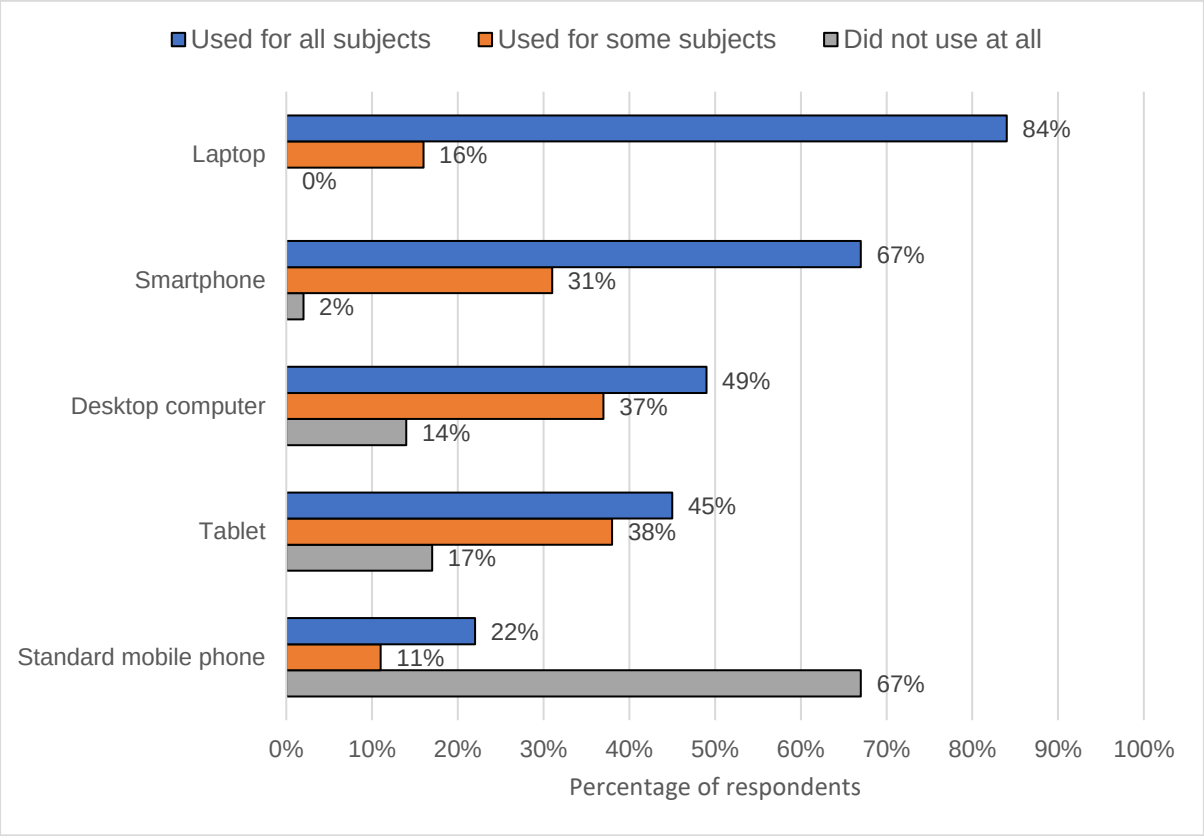
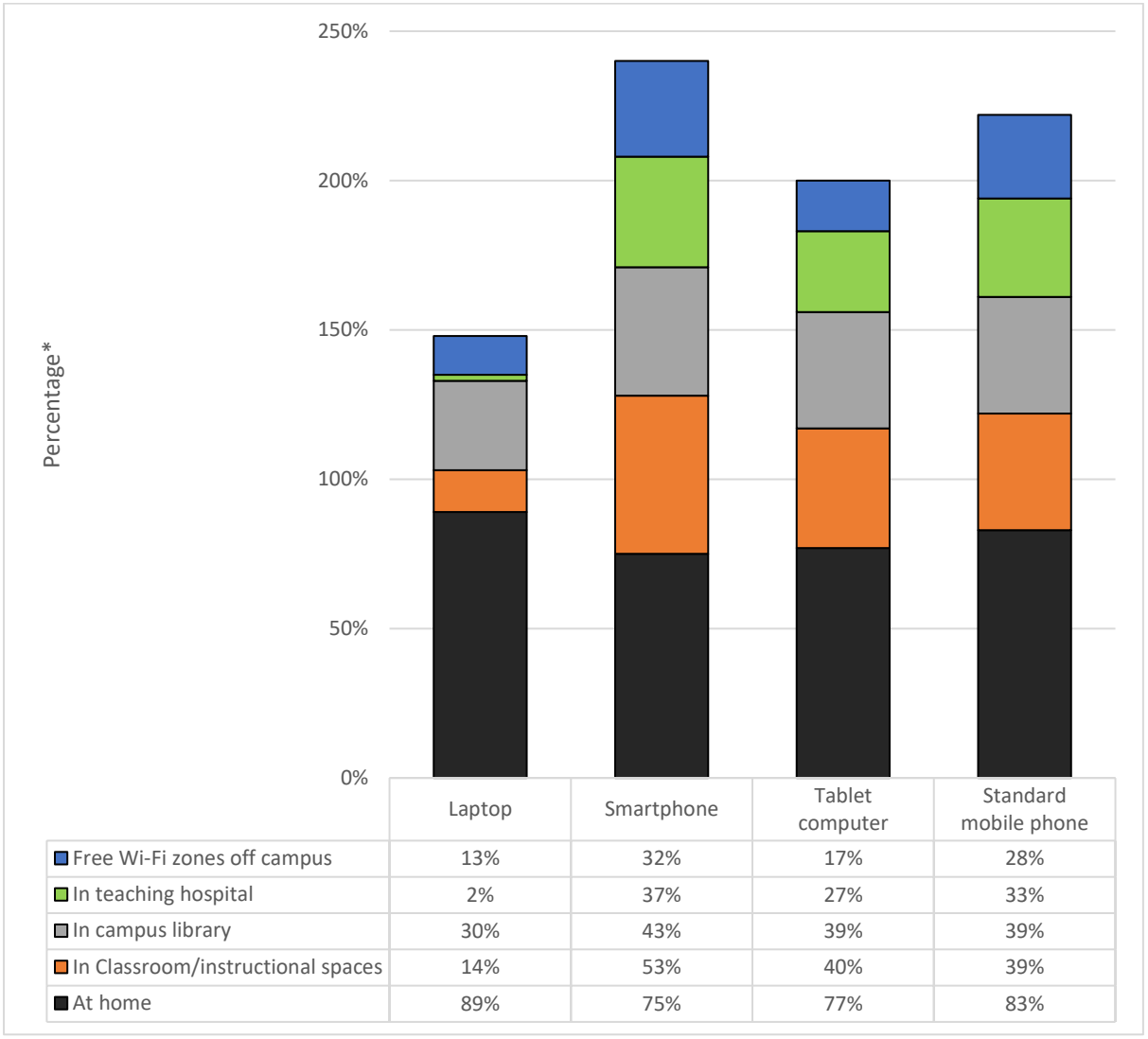


Fig. 1: Frequency of device usage to support studies



	Laptop	Smartphone	Tablet computer	Standard mobile phone
Free Wi-Fi zones off campus	13%	32%	17%	28%
In teaching hospital	2%	37%	27%	33%
In campus library	30%	43%	39%	39%
In Classroom/instructional spaces	14%	53%	40%	39%
At home	89%	75%	77%	83%

Fig. 2: Most common locations where students used devices to support their studies

***Percentages exceed 100 % because students were asked to indicate all areas where they used a device.

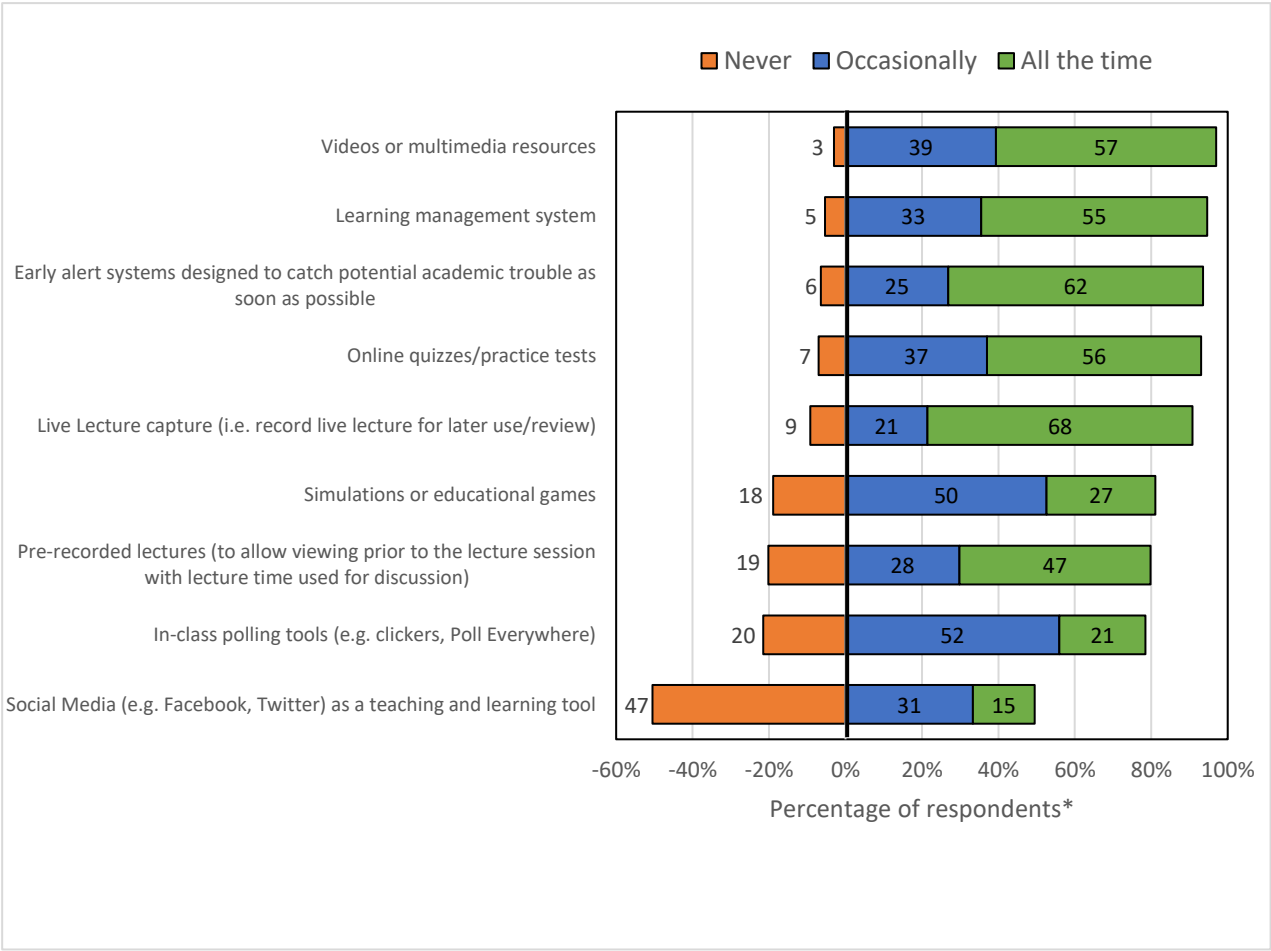


Fig. 3: Technologies that students would like their teachers to use more (and less)

*Percentages that total less than 100 are accounted for by the "I don't know" category not included in the figure. The negative percentages account for the "never" category.

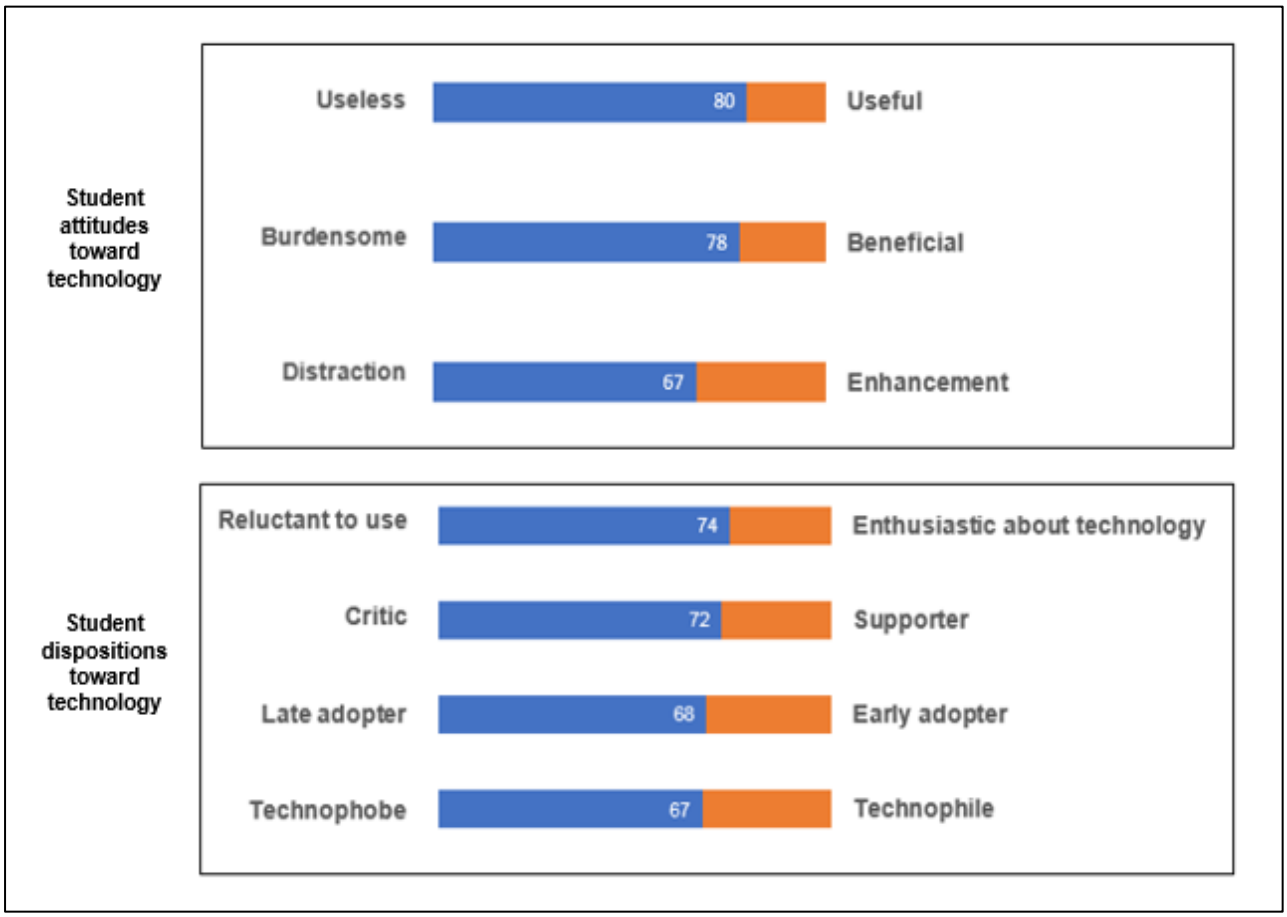


Fig. 4: Student attitudes and dispositions toward technology

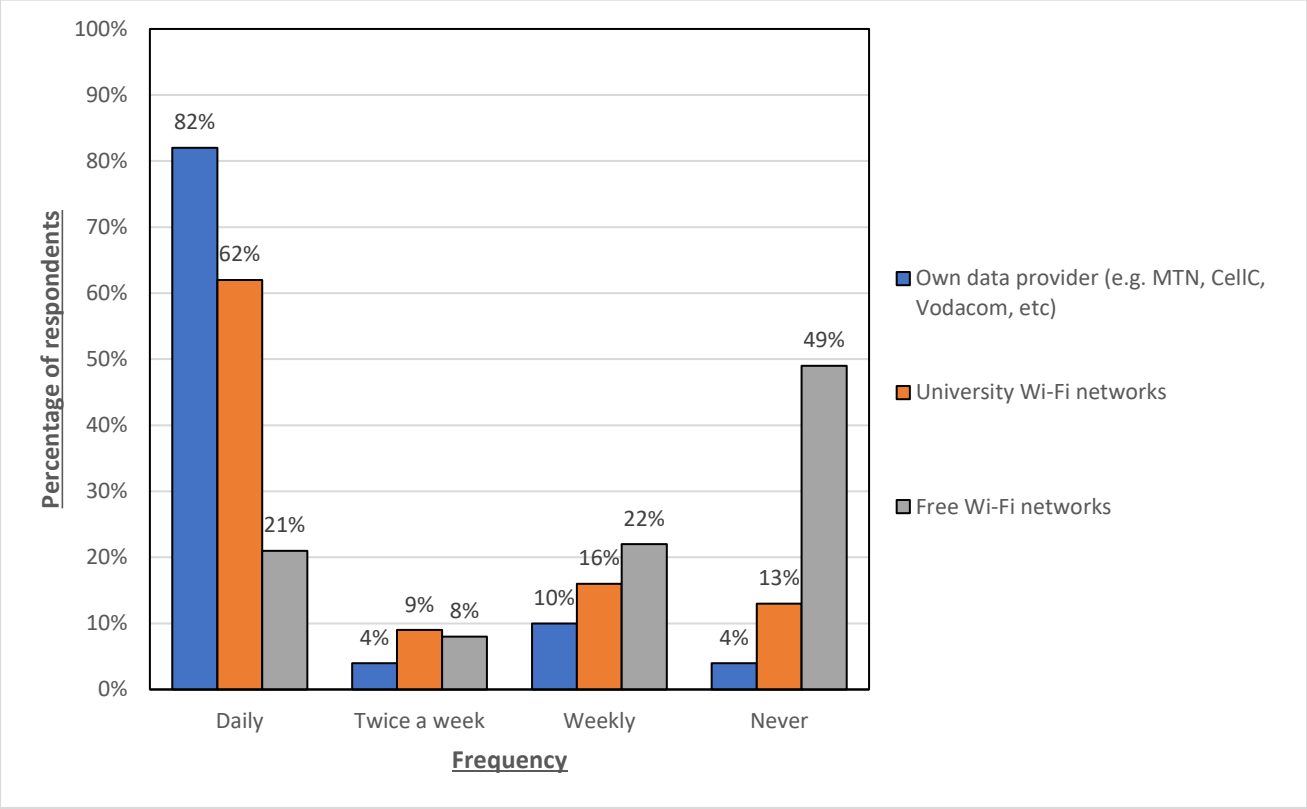


Fig. 5: How students connect to the internet

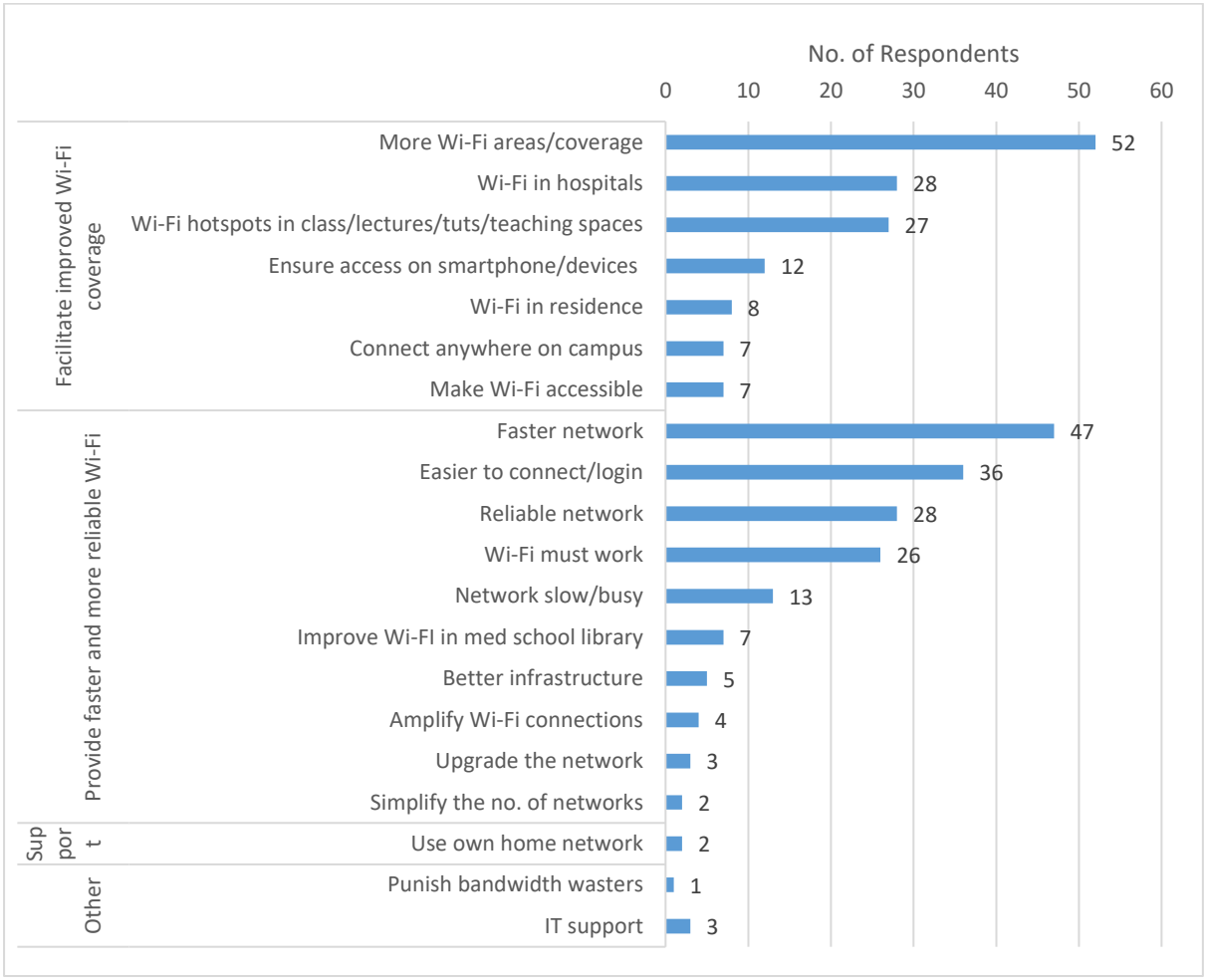


Fig. 6: Student suggestions to improve their experience of university-provided wireless networks

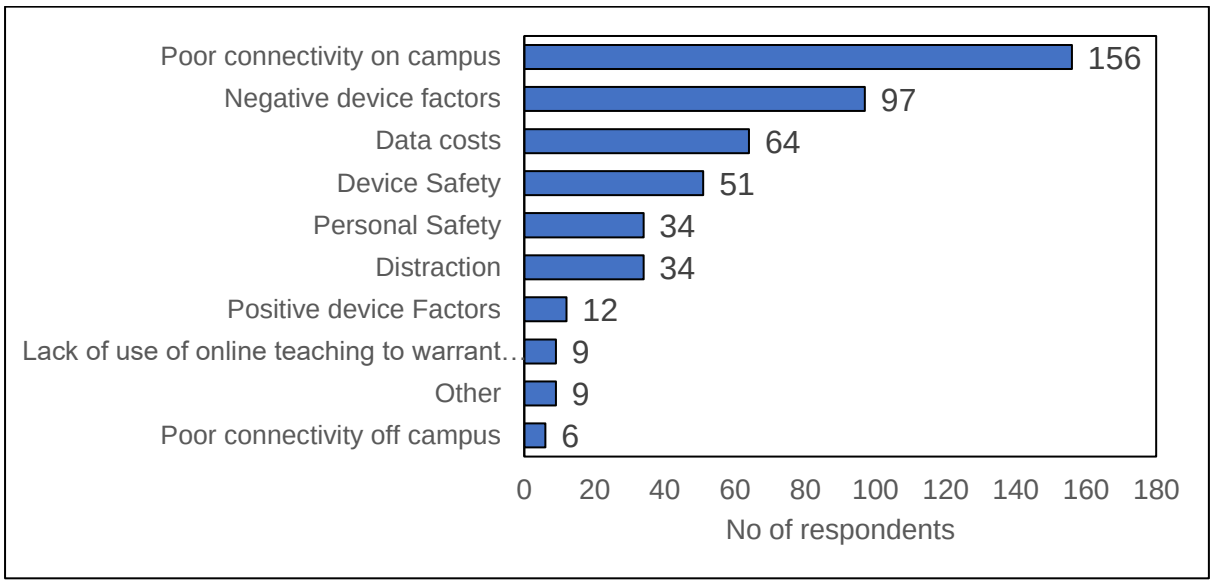


Fig. 7: Perceived barriers to students using their own device for learning

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Declarations

Ethics approval and consent to participate

This study was reviewed by the Human Research Ethics Committee (Medical), Faculty of Health Sciences, University of the Witwatersrand on the 31/03/2017 and approval was obtained on the 21/04/2017 (Clearance certificate number M170340)

Consent for publication

Not applicable

Availability of data and materials

The datasets generated/ analysed during this study are available in the University of Witwatersrand repository, Wiredspace at http://dx.doi.org/10.17605/OSF.IO/8N3YS. Any request for de-identified sample data will be considered by the data access committee on a case-by-case basis.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

All authors made substantial contributions to the design, data collection, analysis, drafting, and final approval of the manuscript. All authors were involved with revising the manuscript for critically important intellectual content. All authors gave final approval of the version to be published. Dr. Ingratta has agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Chapter 3: APPENDICES

1.1. Questionnaire

Questionnaire

Section 1: Information and Consent

Study title: eLearning readiness of medical students from the University of the Witwatersrand

Good day student. My name is Dr Argentina Ingratta and I am enrolled as a Masters student at the University of the Witwatersrand. I am a lecturer and clinician who teaches internal medicine to students in GEMP 2-4 (MBBCh 4-6).

I am asking you to participate in this study by completing the attached questionnaire.

What the study is about

I am looking at your eLearning experience at the University of the Witwatersrand. eLearning is more simply stated as “the use of the internet for education”. I will be asking you about which information and communication technology (ICT) devices you currently have access to, how you use them for learning, and how often and where you are using these devices. I will also ask you questions about your internet access, both on and off campus, as well as your use of the learning management system (Wits-e/SAKAI).

Why you are being invited to participate in the study

I would like to explore how students from first year (as the entry level year), third year (as the transition year), and sixth year (as the final year) are using devices for learning. This will help me identify patterns of usage as students progress through the MBBCh programme.

What it will mean if you participate in the study

With this information, I hope to better inform educators, faculty and information technology (IT) staff about how best to facilitate your learning in the future.

Risks if you participate in the study

There are no risks to you from participating in the study.

Potential benefits if you participate in the study

There will be no remuneration provided to you for participating in the study

Additional information about your potential participation in the study

- Your participation in the study is voluntary, and you will not be penalized if you choose not to participate.
- Your name will not be recorded, so you cannot be identified.
- You are free to withdraw from the study at any stage and you will not be penalized for this.
- There are no right or wrong answers; I would just like you to answer as honestly as you can.
- The survey will take between 10-15 minutes to complete. Please mark your choice by colouring in the () next to the chosen option or making a X. Boxes allow for free text to be written.
- Additional questions may need to be completed based on certain answers. Please follow the << >> to direct you accordingly.
- Should you want feedback on the results of the study, please let me know.

If you have any questions about the study, please contact me:

Dr. Argentina Ingratta

Email: Argentina.Ingratta@wits.ac.za

Tel: (011) 489 0315

If you prefer the online version go to: https://is.gd/e_learning **or go to**

If you need to report any problems with or complaints about the study, please contact the ethics department of the University of the Witwatersrand. The HREC (Medical) contact details are as follows:

Chairperson: peter.cleaton-jones1@wits.ac.za

Administrators - Ms. Zanele Ndlovu/ Mr. Rhulani Mkansi/ Mr. Lebo Moeng

Tel 011 717 2700/2656/1234/1252

Email: HREC-Medical.ResearchOffice@wits.ac.za

Thank you!

---

1. I agree to participate in this survey () Yes
   () No <<exit survey close at 1.1>>

Date: ----------/----------/----------

Section 2: Student demographics

2.1. Age in years (please specify): ☐

2.2. Gender:
() Male
() Female
() Other (please specify) _____
() Prefer not to say

2.3. Race:
() Black
() White

() Asian/Indian
() Coloured
() Other (please specify) _____
() Prefer not to say

2.4. Accommodation:

() Campus residence
() With family/parents
() With partner and/or children
() With housemates/friends
() In single accommodation off campus
() Other (please specify) _____

Section 3: Year of study

3.1 Year of study

() MBBCh I
() GEMP 1 / MBBCh 3<<proceed to 3.2>>
() GEMP 4 / MBBCh 6<<proceed to 3.2>>

3.2 Graduate entrant

() Yes
() No

***Section 4: Device ownership and usage* to support learning**

4.1 How many internet-capable devices do you own?

() None
() One
() Two
() Three
() Four
() Five or more

4.2. Do you currently own or have access to any of the following devices?

	No, and I don't plan to purchase one within the next 12 months	No, but I plan to purchase one within the next 12 months	Yes, I currently own or have access to one (or more)
Smartphone			<<show 4.2a>>
Laptop			<<show 4.2b >>
Desktop computer			<<show 4.2c>>
Tablet computer			<<show 4.2d>>
MP3 Player			
Standard mobile phone			

4.2a What type of smartphone do you have?

(If you have more than one smartphone, please select the one you use most often for university-related work.)

() iPhone
() Android phone
() Windows phone
() Blackberry phone
() Nokia phone
() Other smartphone (please specify) _____
() Don’t know

4.2b What type of operating system (OS) does your laptop have? (If you have more than one laptop, please select the one you use most often for university-related work.)

() Microsoft Windows
() Mac or OS X
() Linux
() Other OS (please specify)_____
() Don’t know

4.2c What type of operating system (OS) does your desktop computer have? (If you have more than one desktop, please select the one you use most often for university-related work.)

() Windows
() Mac or OS X
() Linux
() Other OS (please specify)_____
() Don’t know

4.2d What type of operating system (OS) does your tablet have? (If you have more than one tablet, please select the one you use most often for university-related work.)

() Apple iOS (iPad)
() Windows OS
() Android OS
() Fire OS
() Blackberry OS
() Other OS (please specify)_____
() Don’t know

How frequently are you using current university provided computers (e.g. in the library and computer labs) to support your learning?

() Daily
() Weekly
() Monthly
() Yearly
() Never

4.3 You said that you own or use the following technologies. Which of these have you ever used to support your studies? <<only reply for devices you currently own>>

	Have not used at all	Used for some subjects/blocks	Used for all my subjects/blocks
Smartphone			
Laptop			
Desktop computer			
Tablet computer			
MP3 Player			
Standard mobile phone			

4.4 Where are the most common locations that you use these devices to support your studies? Please mark all that apply<<only reply for devices you currently own>>

	At home	In classroom/ Instructional spaces	In campus Library	In teaching hospital	Free Wi-Fi zones off campus
Smartphone					
Laptop					
Tablet computer					
MP3 Player					
Standard mobile phone					

4.5 How important is each device to your academic success? <<only reply for devices you currently own>>

	Not at all important	Only slightly important	Moderately important	Extremely Important
Smartphone				
Laptop				
Desktop computer				
Tablet computer				
MP3 Player				
Standard mobile phone				

4.6 Thinking about your university experiences within the past six months, how many of your instructors…

	None	Very few	Some	All
…used technology during teaching sessions to enhance learning with additional material (e.g. by providing audio or video examples/ demonstrations/ simulation of learning concepts)?				
…encouraged you to use your own technology devices to take notes during teaching sessions?				
…encouraged you to use your own technology devices in teaching sessions to deepen learning (e.g., by searching online for examples or related concepts)?				

4.7 To what extent would you like your instructors to use, or make more use of, the following resources/tools:

	Never	Occasionally	All the time	Don't Know
Learning management system (e.g. Wits-e/SAKAI)				
Simulations or educational games				
Online quizzes / practice tests				
In-class polling tools (e.g. clickers, Poll Everywhere)				
Live lecture capture (i.e. record live lecture for later use/review)				
Pre-recorded lectures (to allow viewing prior to lecture session with lecture time used for discussion/other activities)				
Videos or multimedia resources				
Social media (e.g. Facebook, Twitter) as a teaching and learning tool				
Early alert systems designed to catch potential academic trouble as soon as possible				

4.8 What type of teaching approach is best to facilitate YOUR learning?

() One with no online course components
() One with some online course components
() One that is mostly but not completely online
() One that is completely online
() No preference

4.8 a Kindly explain your answer in the text box below

4.9. Kindly comment on which factors make you more/less likely to attend a scheduled teaching session?

4.10 To what extent do you agree with the following statements?

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I get more actively involved in courses that use technology					
I am more likely to skip classes when streamed or recorded lectures are available online					
I am more likely to skip classes when materials presented in class are available online					
When I entered university, I was adequately prepared to use technology needed in my courses					
I wish I had been better prepared to use institution-specific technology when I started university (e.g. the course registration system; the learning management system, Sakai; the library search system)					
I wish I had been better prepared to use basic software programs and applications when I started university (e.g. MS Office, Windows Explorer, etc.)					

4.11a Please rate yourself in terms of your DISPOSITION toward information technology on the following scales (write in a number please):

Reluctant to use technology	0				100	Enthusiastic about technology
Late adopter	0				100	Early adopter
Technophobe (dislikes technology)	0				100	Technophile (loves technology)
Critic	0				100	Supporter

4.11b Please rate your ATTITUDE toward information technology on the following scales (write in a number please):

Burdensome	0				100	Beneficial
Useless	0				100	Useful
Distraction	0				100	Enhancement

4.12 Explain one way you feel that your *UNIVERSITY* can promote the use of technology to enhance your academic success.

Section 5: Access to and reliability of the internet connection

5.1 Thinking about the past six months, please rate your experience with wireless networks in the following areas:

	Poor	Fair	Neutral	Good	Excellent	N/A
WI-FI in student housing						
WI-FI in campus libraries						
WI-FI in classroom/instructional spaces						
WI-FI in teaching hospitals						
Ease of login to WI-FI network(s) provided by the university						
Network performance (e.g. high internet speed, no interruptions)						

5.2 Do you have any suggestions to improve your experience of university-provided wireless networks?

5.3 In a typical day, approximately how much time do you spend actively engaged in each of the following online activities?

	None	Less than 1 hour	1-2 hours	More than 2 hours
Online research/homework				
Social media (e.g. Facebook, Twitter) for academic purposes				
Streaming video for academic purposes				
Other online activity <<proceed to 5.3a>>				

5.3a Please indicate what these other online activities include?

5.4 In a typical week, how often do you connect to the internet using the following means?

	Daily	Twice a week	Weekly	Never
University Wi-Fi networks				
Own data provider (e.g. MTN, CellC, Vodacom, etc)				
Free Wi-Fi networks				

5.5. In a typical month, approximately how much mobile data do you purchase to connect to the internet for any reason? << only if Q5.4 = own data provider>>

() nil
() 1-250 MB (megabytes)
() 250-500 MB
() 500-1 GB (gigabytes)
() 1-5 GB
() >5 GB
() Uncapped (unlimited)
() I don't know

Section 6: Use of the LMS (Wits-e)

6.1 How frequently do you access the university learning management system (Wits-e/SAKAI) for the following?

	Daily	Weekly	Monthly	Yearly	Never
Timetables					
Course materials					
Discussion forums					
View recorded lectures					
Track your academic progress					
Other << proceed to 6.1a >>					

6.1a Please indicate what these other resources, on the university learning management system, include?

6.2 Do you have any suggestions to improve your experience of the current learning management system (Wits-e/SAKAI)?

Section 7: Bring your own device (BYOD)

7.1 I am willing to bring my own computing device for learning at university:

() Yes <<proceed to 7.1a>>

() No << proceed to 7.1b>>

7.1a Please indicate which device/s you would be prepared to bring to university to help you learn (mark all that apply):

() Smartphone

() Laptop

() Tablet computer

() MP3 Player

() Standard mobile phone

7.1b Kindly explain your answer in the text box below:

7.1c What is the biggest obstacle to using your own device for learning?

7.2 Would you be willing to use your own data to access any device for university work?

() Yes

() No

7.3 Please explain your answer?

1.1 Thank you for your participation!

Kindly leave any comments in the text box

If you have any questions about the study, please contact me:

Dr. Argentina Ingratta

Email: Argentina.Ingratta@wits.ac.za

Tel: (011) 489 0315

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UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

CHSE CENTRE FOR HEALTH SCIENCE EDUCATION

1.2. Ethics clearance

R14/49 Dr Argentina Maria Ingratta

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M170340

NAME: (Principal Investigator)	Dr Argentina Maria Ingratta
DEPARTMENT:	Internal Medicine UUME
PROJECT TITLE:	E-Learning readiness of medical students from the University of the Witwatersrand
DATE CONSIDERED:	31/03/2017
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr Ann George and Prof Lionel Green-Thompson
APPROVED BY:	Prof P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	21/04/2017

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in March and will therefore be due in the month of March each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

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12 June 2017
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Dr AM Ingratta
Postnet Suite 48
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Johannesburg
2034
South Africa

Dear Dr Ingratta

Master of Medicine: Approval of Title

We have pleasure in advising that your proposal entitled *E-Learning readiness of medical students from the University of the Witwatersrand* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences