Perceptions of Medical Laboratory Science Students on the Implementation of Information and Communications Technology in Medical Education

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Abstract. Technological environments and demands of the new teaching and learning paradigms have paved the way for educational institutions to use Information and Communications Technology (ICT) to enhance the quality of student learning. ICT has revolutionized medical education in the past two decades, as a result teaching and learning has changed profoundly. Globally, nations and universities are investing immensely on novel ICT tools and adaptation processes. To keep abreast with these advancements, low- and middle-income nations need to investigate the appropriate strategic options for adaption and incorporating ICTs in education. The cross-sectional study sought to investigate the perceptions of undergraduate Medical Laboratory Science students on the application of ICT in education at Mangosuthu University of Technology in South Africa. The data was collected through a self-administered questionnaire. The research study was underpinned by the Technology Acceptance Model (TAM), which examined the perceptions of students on the incorporation of ICT into their learning. The findings revealed that most respondents were females in the 21-to-25-year age range, living off campus and matriculated from a rural high school with no prior ICT exposure. A low mean self-perceived ICT skills was reported. Student's perceived lecturer's to be competent in delivering ICT enabled teaching. ICT was also perceived to be useful in learning. Students had access to ICT resources on campus. Students reported a positive attitude on technology adaptation. The key barriers to adaptation of ICT were external factors connectivity, time constraints and skills deficiency. This work confirmed that medical educators need to reconfigure their pedagogical approach to a blended learning strategy to accommodate the underprepared students with deficient ICT skills for gradual adaptation of ICTs in medical laboratory science. A recommendation for educational leaders and managers in low- and middle-income countries is to modify the academic calendar, improve resource access and support to ICT to effectively incorporate ICT into medical education. National leaders in higher education must play a proactive and supportive role in mitigating ICT integration constraints.

Keywords: Medical Education · Higher Education · Information and communica tion technology (ICT) · Teaching and Learning · Blended Learning

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1 Introduction and Background

The global higher education arena has transitioned from face-to-face modality based operating environment to one that responds heavily to Information and Communication Technology (ICT) driven educational options. The integration of ICT into traditional teaching and learning has proven to be a significant challenge [1]. The most recent challenge was when universities were forced integrate ICT aggressively in response to the demand of the COVID-19 pandemic [2]. ICT integration is a new global challenge, this task is worsened if you add that medical education relies heavily on people being in proximity to each other for observing simulations and demonstrations. Therefore, due to the nature of medical education it can be expected that the integration would further exacerbate the ICT integration challenge. Another additional factor that has been reported in literature is the fact that low and middle-income countries by virtue of material deprivation have even added challenges because ICT integration entails resource allocation which they often do not have. Even though the global community considers ICT as a useful tool in medical education due to the complexity of the content that is being taught. A national study involving six institutions of higher learning in South Africa reported only 54% ICT use in education within the health science discipline [1]. There are insufficient studies regarding the uptake of ICT in medical education in the African context, and the limitations of previous studies is that they have been confined to traditional universities and not Universities of Technology [2]. Despite two decades of research there's been limited interest in ICT usage by academics and students in medical education. The apathy from educators in ICT integration has been attributed to ICT being characterized by key challenging issues such as network connectivity and accessibility, lack of technical support, limited skill and competencies, insufficient time, no effective training [2]. The scholars further argue that through ICT integration the lecturer has shifted from being the primary knowledge source to a student-centered process with students learning at their preferred pace [3].

2 ICT Integration – A Necessary Educational Transition

Information and Communication Technology (ICT) integration into medical education impacts the effective curriculum delivery and student performance outcome significantly [2]. In fact, ICT integration has been a crucial development in health care in the past 25 years [3]. This has led to a rapid increase in the use of ICT in medical education [3]. ICT integration into medical education is not merely a tool, but a priority and a goal for developing healthcare workers who leverage technology to access better and more information [4]. ICT is recognized by the World Health Organisation (WHO) as a key competency for 21st century health care graduates and employees [5, 6]. In fact, ICT competency has become a foundational prerequisite for graduate employability [7]. Moreover, the international organizations, such as the United Nations (UN) acknowledges that ICT integration is a suitable tool for addressing medical education in developing economies. The UN's Millennium Development Goals states the significant role of ICT in addressing health and education challenges [5]. ICT has revolutionized how individuals' study, teach and practice medical science and health related professions [5]. It is expected that

ICT tools will be integral in university training and education, continuous professional development, and experiential learning for students [3]. Besides its effective impact on medical education, ICT offers many opportunities for improving the quality of interventions and care provided to patients, and for better organizing the health care system, as well. Therefore, institution that offer medical qualifications need to better prepare students for the future and ICT integration should be considered mandatory [5].

3 Global Perspectives on ICT Integration

The impact of ICT in medical education has undergone profound advancements [3]. This has led to a rapid increase in the use of Information and Communication Technology (ICT) in medical education [5]. However, the developed countries benefit the most in ICT compared to low- and middle-income countries (LMC's) [3]. There has been a reluctance in the incorporating ICT in teaching and learning of medical qualifications despite the known benefits [8]. LMC's are still struggling with the strategies for design, implementation, and delivery of the ICT in medical education [3]. The ICT integration gap that exists in LMC's should be brought to the attention of educational leaders and managers, and changes must be enacted in institutions regarding ICT.

4 Local Perspectives – A Case of South Africa

When it comes to effective implementation of ICT in education there should be policies and strategies that are aligned to economic, social, and national goals. University leaders implement ICT in education to provide ICT-enhanced learning and teaching environment. The ICT implementation must support instructional objectives to transform learning from passive to active [9]. A wide range of policies and strategies have been developed by various nations to effectively integrate ICTs into education [10]. South African institutions of higher education lack a succinct vision and comprehensive strategy for implementation of ICT in curricular activities. Universities have varied guidelines which form part of the broader institutional goals [10]. Most ICT strategies in South Africa involve gradual introduction and using the blended learning approach as previously recommended by Mhlanga [11]. A study conducted at a Central University of Technology reported that although there has been a positive uptake of ICT in higher education in South Africa the implementation practices a significantly diverse, furthermore some institutions were still in their beginning stages with the ICT integration strategies [1]. The Universities of Technologies in South Africa strive to provide effective, adaptable teaching methods to cater for undergraduate students from diverse educational backgrounds. However, student under preparedness due to a limited previous exposure to teaching and learning with ICT tools, makes ICT implementation a challenge [2, 11, 12]. In a study conducted at Mangosuthu University of Technology in using the experiences of undergraduate students with e-learning reported external factors such as inflexible timetable, insufficiency of computers and instability of internet connectivity as a barrier to ICT implementation in the institution [11]. Strategic implementation of ICTs in institutions of higher learning is primarily dependent on the institutional leadership and management support [13]. Other implementation barriers include insufficient

time allocated for training lecturer's and students [12]; limited access and support to the instruction and learning content; and ineffective ICT implementation policies were found to be ubiquitous challenges in a study conducted in Namibia [14]. A South African study conducted in Free State, reported ICT integration constraints as ambiguity in the initiation procedures, insufficient training and support of lecturers, the absence of a policy framework to guide practice, as well as a general resistance to change [2]. Despite the outlined hindrances, ICTs may improve the academic outcomes by shifting pedagogy towards a learner-centred approach.

Due to the significant role that ICT plays in medical education in both high income and LMC nations, the ICT skills of medical students have been studied immensely for the past 30 years [11]. Studies reveal that globally ICT students realize the impact of ICT in medical education and anticipate the changes implemented to facilitate this revolutionary transformation [11]. The World Bank reports that governments are investing aggressively into ICT to improve its integration into education [15]. Research assessing the medical student's ICT skills and attitudes toward ICT revealed that developed countries invest profoundly on ICT and its integration; their medical students are aware of the importance and impact of ICT on medical education and have access to the latest ICT tools required for passing the modules and to conduct research [5]. Nevertheless, due to limited budget allocation for higher education, LMC's lag in this necessary process of strategic integration of ICT into medical education even though this incorporation is pivotal due to the globalisation and dynamic and constantly changing medical knowledge [4]. The aim of integration of ICT into medical education is enhancing the acquisition of scientific knowledge, coordinating skills, facilitating better diagnostic decision making, practice for emergency situations, team learning, and honing psychomotor expertise [16].

5 ICT Integration - A Critical Assessment of Benefits

There is sufficient empirical evidence citing that the undisputed benefits of ICT use in education, far outweigh the drawbacks; however, there are still significant challenges with its implementation. ICT implementation has altered the educational environmental dynamics towards supporting the global demands for life-long learning and 21st century graduate attributes. Majority of the studies reviewed in this paper utilized the pencil and paper surveys to assess student's ICT skills. This may be an inaccurate method due to student's incorrect perceptions of the term ICT or the lecturer's and institution's inaccurate perception, imprecise definition, social desirability, and potential bias in responses [16, 17]. Thus, paper-based surveys may only be used to assess student's perceptions rather than actual skills, therefore, research that uses paper-based survey's for assessing student's ICT skills should be viewed with caution. Although, other studies reveal that students do not use ICT in their learning effectively [17]. Successful strategies for ICT implementation into learning considers the views and attitudes of students who are the primary beneficiaries of this strategy [18–21].

6 From Literature Review to Empirical Research

The discussion above sets a background scene and gave an impetus for an empirical study whose aim was to evaluate the student's perceptions on ICT implementation in education, will inform; (1) operational and curricular decisions of administrators, departments, students, lecturers, academic support staff; (2) enhance the educational service delivery; (2) ultimately prevent wastage of resource, and fast-track efforts aimed at improvement in the quality and learning process. It is therefore important to investigate this topic in higher education. This study was aimed at assessing medical laboratory science undergraduate student's perceptions of their skill, the skills proficiency of staff members involved in teaching, perceptions regarding resource availability and access and attitudes towards the implementation of ICT in medical education at Mangosuthu University of Technology.

The specific objectives were as follows:

(1) Assessing the student's self-reported ICT skills and computer literacy.
(2) Establish what are the student's perceptions of ICT proficiency levels of staff involved in their routine teaching.
(3) Evaluate student's perception of the utility of ICT in their learning
(4) Ascertain the perceptions of student's regarding ICT Resource availability and access in the university.
(5) To gauge the attitude of students in welcoming the use of ICT technologies for academic purposes.
(6) To offer the recommendations regarding student support and improvement for ICT implementation and implications for educational leaders at the institution under study.

7 Theoretical Framework

There exists a myriad of technology acceptance theoretical frameworks that are utilized to explore and explains the perceptions of students. The study is undergirded by the Technology Acceptance Model (TAM) [22]. TAM was first described by Davis in 1986 to accurately predict the probability of technology adoption within a group of people [22]. The TAM theory was developed on a foundational basis that asserts that beliefs may influence the attitude of individuals towards the utilization of technology. Added to this, the TAM associates an individual's intention to be influenced by perceived usefulness and ease of use. The TAM model is applicable in varied technologies, software, and online learning platforms [23]. The researcher utilized the TAM theoretical framework to gauge the adoption of ICT amongst medical laboratory science students at Mangosuthu University of Technology.

The TAM theoretical framework asserts that presenting new technology to individual triggers numerous factors which impacts the decision of when and how they will use it. The Perceived usefulness (PU) refers to "the degree to which a person believes that using a particular system would enhance his or her job performance". And the Perceived ease-of-use (PEOU) is demarcated as "the degree to which a person believes that using a particular system would be free from effort". These two factors influence the attitude

towards the intent to use the new technology and the actual usage of the new technology [22, 23]. In sum, the TAM model explains why individuals use technology and explains factors that influence the acceptability of the technology.

8 Methodology

In this descriptive survey the perceptions of students were assessed through a quantitative inquiry in which they participated in a survey. The researcher opted to utilize the descriptive design. The descriptive design remains the simplest of the observational studies available for research. The current research is a case study that uses a survey to collect data. The selection of this study design was purposeful for it provided an opportunity to combine quantitative and qualitative data collection methods for comprehensive and generalizable findings. Added to this these data collection methods remain popular owing to their ability to allow a scope for further research. For instance, the current study sought to establish what are views of the student's pertaining ICT, further research that could be undertaken in future would be to establish why do the students have the perceptions that emerge from the findings of this study.

9 Context of the Study

Mangosuthu University of Technology is an institution in South Africa. The university offers a medical qualification named, Bachelor of Health Science in Medical Laboratory Science (BHSC: MLS) under the support of the Department of higher education (DHET). The (BHSC: MLS) program spans over four years. The ICT skills for students in medical laboratory science are taught in their first-year module of computer skills. During this course students learn the necessary ICT technology required for the medical field such as basic web searches for medical literature which they utilize throughout the duration of their study. Medical students ICT skills remain asymmetric. Studies have found that students use the internet for non-medical purposes [16].

9.1 Research Strategy/Design

The current study aimed to establish the students' experience-based perspectives through the utilization of ICT technology in their academic institution. The study was conducted in a quantitative approach. The data was collected through a self-administered, semi-structured questionnaire.

9.2 Target Population and Sample

The target population comprised of all students enrolled within the Department of Biomedical Sciences (n = 161). Other departments did not form part of the study. The investigation was conducted at a University of Technology, Durban, in Kwa-Zulu Natal only.

9.3 Sampling Strategy

The questionnaire was distributed electronically through Google forms, the data collection spanned over a period of a months starting from 22 June 2022, after which 79 usable instrument data were appropriately processed for statistical analysis.

9.4 Ethical Considerations

The researcher was guided by ethical considerations which are the following: Consent was sought from all participants of the study prior to the survey being conducted. Confidentiality, the researcher guaranteed that any form of communication was protected and that all responses were coded should participants feel uncomfortable to be identified. All participants were informed about the study. Recruitment for participation, participation was voluntary. The researcher endeavored to maintain objectivity in relation to the presentation and analysis of the research findings using appropriate statistical tool and educational theories and subsequent recommendations. The data was interpreted based on statistical and theoretical facts and not the researcher's subjective biases. Lastly, authorization, prior to commencement the study, the proposal was reviewed and approved by an Institutional Research Committee of Mangosuthu University of Technology (Reference number: RDI/08/2022).

9.5 Limitations of the Research

The research findings were limited to factors and conditions existing at the university, as at the time of the study. Moreover, the conclusion of this research study was limited and constrained to unique factors associated with this university. Consequently, the conclusion may not be the same as other universities.

9.6 Data Analysis

The data were collected electronically and converted into an Excel spread sheet and analyzed. The variables were presented according to their categories as percentages and frequencies. The continuous data was presented in percentage means and standard deviations.

10 Results

Theme 1: Student skills and computer literacy
The student's self-reported ICT competencies were rated from no capacity to excellent. Responses to the skills level questions are detailed on percentage mean values and SD on Table 2, (n = 79) unless otherwise stated (Fig. 1).

Theme 2: Student perceptions of staff proficiency
The students were asked, what are your perceptions of teaching staff's proficiency in using technology to facilitate ICT enabled teaching and learning? The results are presented on Table 3.

Theme 3: Student's perception of ICT usefulness in their learning
The participating students were requested indicate their level of agreement or disagreement with the following Information Communication Technologies (ICT). The findings are presented on Table 4 (n = 79):

Theme 4: Resource availability and access in the university

Table 1. The demographic characteristics of the participants (n = 79)

	Description	%
Gender	Female	78, 5
	Male	21, 5
Level of study	First Year	27, 8
	Second Year	57
	Third Year	1, 3
	Fourth Year	13, 9
Age distribution	< 20 years	45, 6
	21 – 25 years	49, 4
	26 – 30 years	4
	>30 years	1
Residence	On main campus residency	13,9
	University external residency	75,9
	At home	8,9
	Private residency	1,3
Type of high school attended	Rural school	57
	Township school	29,1
	Private school	7,6
	Former model C	6.3

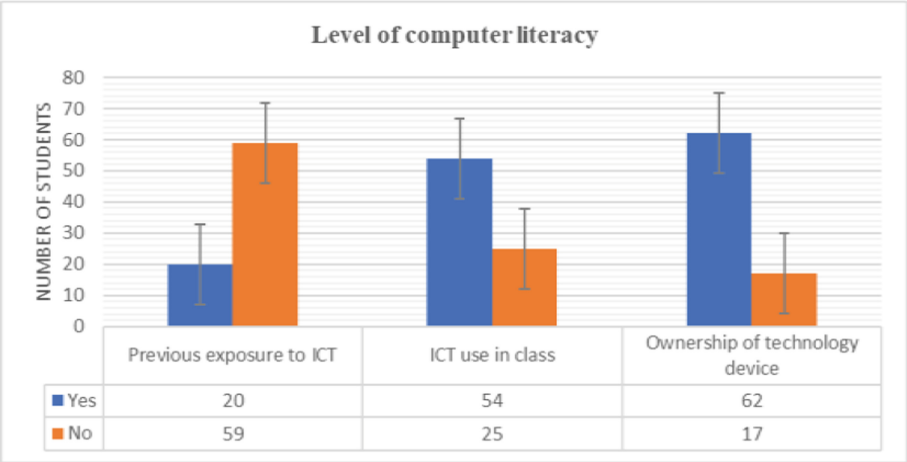

Fig. 1. The level of computer literacy (n = 79). The participants were requested to indicate their level of computer literacy by indicating whether they had (1) Previous exposure to computer skills prior to enrollment to the university (2) They use of computer applications and related ICT facilities in classrooms and (3) if they owned a personal technology enabled device such as a cellphone.

To assess the student's perception on infrastructure, the participating students were asked "How do you agree or disagree on the availability of the following ICT resources in your university?". The findings are depicted in the Table 5.

Additionally, to establish access to ICT at the university. The study asked" At the university, how often do you access ICT resources in the following locations? The responses are indicated in percentage means and standard deviations on Table 6, (n = 79).

Theme 5: Student's attitude on the uptake of ICT

The students were asked an open-ended question, "would you welcome the use of ICT technologies for academic purposes? Why?". The total number of respondents for this item was 66. A total 61 (92%) of the students responded positively, whilst 5 (8%) had a negative response to the question.

The reasons as provided by the respondents are summarized in Table 7.

Most preferred ICT related activities

When students were asked about their favorite ICT related activities, there were 62 (78%) participants that responded. The common responses were internet surfing; completing assignments; social media; gaming; research and studying through educational videos.

Theme 6: Student suggestions for support and improvement

To conclude the study, students were asked for suggestions on how the institution could support students and staff in their implementation of ICT in learning. There was a total of 60 responses (75%). The student's suggested the following areas of improvements. Allocation of computers for students and lecturers; Training and practice for students;

Table 2. Student's skills on the use of various computer applications

Items	Excellent	Good	Poor	No capability	Mean	SD
I can use word processor to create, edit and format documents for specific purposes.	17,72	62,03	16,46	3,8	25	22,06
I can use spreadsheet to record data, compute simple calculations and represent data in the form of tables and graphs. (n=76)	8,87	25,32	51,90	11,40	24,38	17,09
I can email documents.	43,038	49,37	6,33	1,27	25	21,40
I can browse the internet. (n=76)	50,64	44,30	1,27	1,27	24,37	23,21
I can use presentation tools (PowerPoint) (n=63)	29,11	31,65	22,78	3,80	21,84	10,90
I can use chatting platforms.	37,97	39,24	21,52	1,27	25	15,38
I can use applications (word processing, spreadsheet, PowerPoint) for learning.	18,99	55,70	22,78	2,53	25	19,29
I can use various applications to do assignments, research, and projects	24,06	56,96	18,99	0	25	20,52
I can use email to collaborate on group assignments and projects with other students, exchange information and ideas and contribute to discussions.	26,58	54,43	17,72	1,27	25	19,27
I can use internet resources to prepare my assignments, projects, and research.	39,24	56,96	3,80	0	25	23,97

Table 3. Student Perceptions of Teaching Staff Proficiency

Item	Excellent	Good	Poor	No capability	Mean	SD
Lecturers (n=76)	34,18	63,29	6,33	0	24,45	22,46
Tutors (n=68)	7,59	55,70	22,78	5,06	23,95	18,05
Laboratory assistants (n=78)	26,58	59,49	10,13	2,53	24,53	19,59
Laboratory Technologists (n=67)	29,11	55,70	10,13	2,53	24,37	18,35

Table 4. Student's perception of ICT usefulness in their learning

Items	Definitely Agree	Agree	Disagree	Definitely Disagree	Mean	SD
Learning with ICT requires highly developed study skills and strategies.	34,18	62,03	3,80	0	25	25,15
I think audio materials can improve my learning.	34,18	58,23	5,063	2,53	25	22,87
I think video materials can improve my learning.	53,16	43,04	2,53	1,266	25	23,38
I prefer to study with a traditional method than ICT	21,52	40,51	35,44	2,53	25	14,72
Learning via the internet alone is acceptable to me	17,72	36,71	39,240	6,33	25	13,61
I like to learn with ICT because it brings reality into the room	31,65	58,23	8,86	1,27	25	22,20
ICT allows for effective sharing of information	22,78	50,63	22,78	3,80	25	16,71
In general learning with ICT is time consuming	35,44	58,22	5,06	1,266	25	23,00
Information that I find on the internet is irrelevant	15,19	36,71	40,51	7,59	25	13,93
I prefer to learn alone if I use an educational software	8,86	32,91	48,10	10,13	25	16,42

(*continued*)

Table 4. (*continued*)

Items	Definitely Agree	Agree	Disagree	Definitely Disagree	Mean	SD
In general availability and access to ICT provides me more opportunity to enhance my learning.	13,92	29,11	54,43	2,53	25	19,43
I can do science with ICT without handling toxic chemicals	36,71	55,70	5,06	2,53	25	22,26
In general, I find learning with ICT interesting	10,13	39,24	39,24	11,39	25	14,25

Table 5. Resource availability and access in the university.

Items	Definitely Agree	Agree	Disagree	Definitely Disagree	Mean	SD
Computers/PC in classroom (n=74)	18,99	41,77	26,58	8,86	24,05	12,01
Internet and email (n=71)	17,72	62,03	11,39	2,53	23,42	22,93
Television set (n=73)	11,39	27,85	46,84	8,86	23,73	15,20
Projector (n=66)	29,11	54,43	11,39	0	23,73	20,54
Software (n=74)	16,46	48,10	22,78	2,53	22,47	16,51
Computer laboratory (n=74)	25,32	60,76	7,59	2,53	24,05	22,82
Video conferencing equipment (n=59)	22,78	40,51	26,58	6,33	24,05	12,17

Table 6. How often students access ICT resources

Items	Always	Sometimes	Not sure	Never at all	Mean	SD
Library	7,59	55,70	20,25	16,46	25	18,31
Computer lab	17,72	49,37	17,72	15,19	25	14,11
Lecture rooms	36,71	30,38	18,99	13,92	25	9,01
Resource center	7,59	39,24	34,18	18,99	25	12,51
Halls of residence	15,19	24,05	36,71	24,05	25	7,67
Internet kiosk	7,59	34,18	31,65	26,58	25	10,41
Other	3,80	32,91	40,51	22,78	25	13,76

Table 7. Student's attitude on the uptake of ICT

Reasons provided for YES	Reasons provided for NO
• ICT is becoming increasingly important in daily lives; it is important to understand the basics of ICT. • Enhances the learning experience, makes studying easier, effective, easy, efficient. • Biomedical scientists work with computer applications, sorting, and recording laboratory results, these skills are required in the future field work. • As the country develops, the use of technology is much needed to keep abreast with 21st century and 4th industrial revolution. • For virtual learning and studying with group members. • Boost confidence of the student. • It ensures that students are the ones doing the assignments because online can be tracked.	• Time consuming, • Students don't have knowledge of how to use ICT • Network connectivity issues, • A blended learning approach is preferred.

Improved internet connectivity before implementing online learning; Projectors in classrooms; Installation of smart boards; Access to computer labs, each department to have a designated computer laboratory; Technical assistance in computer laboratories.

11 Discussion

This work sought to establish the views of students regarding their competencies, the teaching team's skillsets, resource allocation, attitude towards the implementation of ICT in medical education at a University of Technology. The questionnaire was distributed proportionately to all students both male and female had an opportunity to participate in the research. With regards to the demographic characteristics of participants; out of a total population of 161 eligible students, 79 were consented to participate in the study. The actual study response rate was 49% (n = 79) of the total population. The was high response rate of (27,8%) from the second-year students' compared to the third and fourth years because the students were in work integrated learning (practical training) and pathology laboratory rounds (internship) in the local hospitals affiliated with the university. The qualification of Medical Laboratory Sciences has a heavy workload particularly with third- and fourth-year levels. Moreover, the students have varied rotational schedules hence access to the senior students was a challenge. Table 1 depicts the demographic details of all the participants. Most of the participants were females (78, 5%). Our findings are comparable with those found in an Iranian descriptive study that sought to establish the skills and attitude of medical students towards ICT. The study had 68% females and 32% males [6]. The high female survey turnover is attributed to the MLS program enrolment that has higher proportion of females than males. The participants were within the age range of 21 to 25 years (49,4%) and 45, 6% were below age 20. Additionally, a majority resided on the external university accommodation (75,9%) only a few lived on campus, at home or private accommodations. Lastly, a bulk of participants had previously attended rural schools (57%) and township schools (29,1%).

In the Southern African context, there are public schools which belong to the state and are dependent on the government subsidiary for resources and funding. The facilities and standards vary, and government schools are differentiated according to geographical zoning. The rural schools are those located in areas that are underdeveloped, with low populations and further away from the urban cities and towns [1, 24]. The township schools are those located in low-cost housing at the outskirts of urban cities and towns due to historical racial segregation. The habitants of townships originally came for employment. Whereas private schools are schools that are independent from the state, belonging to a trust, community, entities, and churches [12]. A model C school refers defunct semi-private school that was originally reserved for white learners only by the past apartheid state. A previous South African study revealed that rural schools were digitally disadvantaged to limited access to the internet and computers [24]. In fact, 73% of the students reported that they had no prior exposure to computers before university entry [25]. Correspondingly, our study revealed that 75% (n = 59) students had no previous exposure to computer skills prior to enrollment to the university, 68% (n = 54) indicated that computer applications and related ICT facilities are available and used in their current university classrooms and 79% (n = 62%) owned a personal technology enabled device.

The first theme was to establish the student's self-perceived skills in ICT, the mean percentage skills competency item was computed as 24,55 with a standard deviation of 19,31. The prominent skills were using email, chatting, surfing the internet, and use of word processor to create documents. A study amongst South African university students reported that students underutilized the technological resources for their learning due to a deficiency in ICT proficiency and experiences [25].

The second theme of the study assess the student's perception of the staff competencies in ICT skills. The statistics computed revealed a mean average of 24,32 and the standard deviation 19,61. The lecturers were perceived to have higher ICT skills (97, 47%) competencies in comparison to the academic support personnel (laboratory assistant - 86,07%; Laboratory technologists - 84,81%; and tutors - 63,29%). ICT competence of lecturers enhances their interaction with students, promotes effective teaching and learning process and ease of feedback to and from students.

The third theme of the student's perceptions was the usefulness of ICT in learning, the mean percentage value of 21, 67 and standard deviation of 16,55 were computed. The consensus among the majority was that learning with ICT; requires sophisticated skills, videos and audio materials improves learning, science experiments can be conducted safely with ICT. ICT improves effective communication. However, 62,03% of the students still preferred to study using the traditional method, 49% indicated that learning with ICT is interesting. Suggesting that studying with the internet alone may not be an effective option for this cohort. A blended learning approach may be beneficial.

The fourth theme item with regards to the availability of resources yielded a percentage mean of 23,30 and standard deviation of 17,33. The resources that were indicated to be available at the University of Technology under study were the internet and email, projectors, software, computer laboratory, computers, and video conferencing equipment. The items on access to the resources to students yielded a mean of 25 and standard deviation of 12,25. The findings reveal that students access the ICT resources through the computer laboratory, lecture rooms and the library.

Theme five was student's views on ICT implementation were solicited and A total 61 (92%) were for ICT whilst 5 (8%) were against. The results reveal a general positive attitude towards the uptake of ICT tools in learning. Nevertheless, the reasons for apprehensive attitudes to ICT implementation correlate with those previously reported on a study conducted in the same University of Technology where connectivity issues were external factors that were barriers [12]. According to the Spence model, connectivity is the basis for school leadership support for effective ICT integration in education [26]. Connectivity encompasses the infrastructure of telecommunications, the charges and access to hardware and software [25].

Secondly, low competency and time factor were other reasons cited. The issue of inflexible lecture schedules was also reported in 2018 as a barrier to ICT implementation in learning at the institution under study [12]. Another challenge highlighted with ICT implementation in health education was related to access and pedagogical practice [27]. Nevertheless, the same study on the perceptions of students about their competencies in ICT it was discovered that when students trust their competency in ICTs, they were confident to engage in ICT mediated learning environments [28]. Furthermore, the ICT activities that the students engaged in were social media, internet, research, assignments,

and video enabled studying. Self-directed learning in the digital age is dependent on familiarity and comfort with the usage of ICT tools which begins with awareness and functional abilities [27, 28]. Lastly, theme six was for suggestions aimed at improving implementation and support to students were also captured. The access to hardware and software, skills development, reliable connectivity, access to computer laboratories, availability of mentoring and technical support, smartboards and overhead projectors for students were found to be fundamental factors to effective ICT integration in medical education.

12 Conclusion

Students are enrolled from high school to the University of Technology underprepared for ICT integration into their education due to deficient ICT skills. There was a positive attitude among medical laboratory science students towards ICT integration into their education. For the medical educators within this department, a blended learning technology is recommended to improve the digital literacy and critical thinking skills. Through this pedagogical method, students will be guided on evaluating information for authenticity to find the relevant information for their qualification. Technology enabled learning endow students with life skills which are information and technology adaption skills which improves the learning experiences. The ICT resources are available on campus however majority of the students reside on the external student accommodation. As such, the study recommends strengthening the connectivity bandwidth off campus, training for students, reconfiguration of the academic calendar to be on the ICT integration strategy for the educational leaders and managers of the university of technology understudy. This work is important for enhancing the incorporation of ICTs teaching and learning experiences. Even if there is general acceptability that ICT Integration is necessary there are much more challenges in populations with limited resource, which becomes yet another source of discrimination which further widens the gap between the haves and the have nots in the digital space. Although the study suggests that we need to be cautious about ICT integration, there is also the imperative that institutions should be concerned about, that if South Africa aims to be global players there is a need to integrate ICT. Given the findings of this work, ICT integration is a necessity but should be supported at national level so that there is no vast variation in the integration strategies in all the institutions of higher education in South Africa.

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