Journal of Learning for Development – JL4D

ISSN: 2311-1550

2023, Vol. 10, No. 1, pp. 109-121

Technology as a Key Driver in Enhancing Scientific Education during the COVID-19 Era at the University of Namibia

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Abstract: Student profiling on the use of technology for teaching, learning and assessment has the potential to enable educators to enhance their transformational teaching strategies. Therefore, this study explored the views of students on use of technology to facilitate online learning during COVID-19. The study employed a quantitative approach to collect data using a Google Form questionnaire. Nineteen conveniently sampled respondents (38%) were drawn from a population of 50 students registered for first-year BSc Microbiology and BSc Environmental Biology in 2021. The collected data was analysed through descriptive statistics using Microsoft Excel 2010. The findings revealed that during online learning some students (63%) experienced challenges related to subject knowledge acquisition. A majority of the students (84%) preferred face-to-face or blended teaching learning and assessment to ensure pedagogic access. It is concluded that students' exposure to online learning helped improve skills, such as typing (79%), internet information searching (95%) and general computer skills (89%). Thus, it is recommended that academics and students should be assisted with training, and higher education curricula should encourage the use of digital technology, which prepares students to be relevant in the digital society.

Keywords: technology, science, online pedagogies, face-to-face teaching, COVID-19, digital learning.

Introduction

The lock-down measures taken to contain the coronavirus disease of 2019 (COVID-19) led to the disruption of traditional face-to-face epistemologies. This prompted institutions of higher learning to shift teaching to online instructional methods, as an alternative to enable the continuation of academic activities. Academic institutions were, however, caught off guard in terms of technology use, thus, both lecturers and students needed to acquaint themselves with the new normal of online pedagogies.

Although the use of technology in education dates back to the 1960s, it was not until the emergence of COVID-19 that online teaching, learning and assessment became a norm for many academic institutions (Akram et al., 2021; Kaisara, & Bwalya, 2021). The measures taken by countries all over the world to contain the virus drastically challenged traditional approaches to teaching and learning (Kadhila & Nyambe, 2021). Consequently, the onset of the COVID-19 pandemic led to the collapsing of traditional face-to-face education systems from junior level to tertiary level, especially during the lockdown period which began in 2020 (Mishra et al., 2020). It was such major changes which prompted decision makers in the Namibian education setting to consider the online teaching, learning and assessment pedagogies as alternative ways of moving forward academically.

As much of a relief as it was, the shifting of academic activities to online provision was both an enabling and a constraining factor, given that academic institutions were caught off guard technologically. For example, some institutions in Sub-Saharan Africa did not have the already established platforms that can be used to facilitate online learning (Koninckx et al., 2021; Mashau, & Nyawo, 2021).

In addition, institutions were also not prepared in terms of their human capital, as lecturers had to acquaint themselves with online technological facilities to be able to carry out online teaching (Faturoti, 2022). Moreover, students also needed to familiarise themselves with online learning platforms or tools, upgrade their computer skills, ensure that they had access to the internet all the time, etc. This was a challenge, as shifting to online came with the assumption that educational institutions had all the capacity and infrastructure necessary to ensure the undisturbed progression of remote/online teaching and learning (Tshiningayamwe et al., 2020). However, this was not the case as explained above.

Among technologies that are playing a role in education is information and communication technology (ICT), which provides information through telecommunication (Ratheeswari, 2018). In the past, however, so many drawbacks limited the transformation of academic activities to online, and these included ICT barriers as well as both digital and equipment barriers (Ali et al., 2018; Mohamedbhai, 2020). This is because, harnessing ICT to improve learning requires that students and teachers have adequate access to digital technologies and the internet in their classrooms, thus, allowing the availability of high quality and culturally responsive digital content (Ratheeswari, 2018). There are currently many different computer-based learning platforms and delivery methods available, including multimedia, educational programming, simulations, games, and the usage of new media on fixed and mobile platforms, which are used as approaches to online learning and are thus applicable to all subject areas (Urdan & Weggen, 2000). However, the use of most of these platforms has only been common among distance learning students who have no access to the traditional face-face classroom (Keengwe & Kidd, 2010).

This paper presents the views from the experiences imposed by online teaching, learning and assessment, on a group of science students enrolled for the module Cell Molecular Biology and Genetics during the first semester of 2022. These students were in their second year of study at the time they filled out the questionnaire for this research, which means these are students who started their university life (the 2021 academic year) completely online and were thus considered to be in a better position to complete this survey. Therefore, this study explored the views of students on the use of technology to facilitate online learning during COVID-19.

Literature Review

Conceptualising the Sudden Use of Technology in Higher Education during COVID-19

In education, the use of technology has been associated with positive learning attributes such as improving student learning outcomes, improving access to learning, as well as enhancing learners' motivation (Lai & Bower, 2019). This has been made possible via technology-based learning platforms such as mobile learning, social media and microblogging, e-portfolios, digital games, online learning or MOOCs, as well as virtual learning environments (Lai & Bower, 2019). In today's competitive world, this is essential to ensure that graduates are technology-oriented in various aspects of life

(Fillion et al., 2007). However, the use of these platforms in higher education institutions did not become a norm until COVID-19 imposed it.

Due to restrictions that came with COVID-19, such as social distancing, educational institutions were compelled to make an immediate transition to remote methods of learning which heavily depend on technology (Abu Talib, et al., 2021). Unfortunately, these transitions to online learning came suddenly and therefore did not allow adequate preparations for the challenges ahead to be faced (Hodges, et al., 2020). Hence, although technology existed long before COVID-19, both students and lecturers in various institutions of higher learning, including the University of Namibia (UNAM), were still not prepared for the sudden shift to completely online teaching, learning and assessment (Agormedah et al., 2020; Coman et al., 2020; Haiduwa et al., 2022; Karakose, 2021; Malatji et al., 2021).

Existing Technological Challenges Faced by Students

Many students struggled to navigate through online learning due to challenges presented by the use of technology (Dube, 2020). Tshiningayamwe, et al. (2020) stated that online teaching and learning was relatively new to a number of lecturers and students in southern African countries. A number of studies revealed that the migration to online teaching and learning during COVID-19 offered some challenges (Demuyakor, 2021; Magesa & Josua, 2022; Moluayonge, 2020). In Namibia, a reflective paper by Magesa and Josua (2022) cited poor internet connectivity as a challenge. This is in line with the findings of a study by Moluayonge (2020) in Cameroon. Studies by Al-Ataby (2020) and Moluayonge (2020) found that lack of reliable internet connectivity was one of the pitfalls experienced. Demuyakor (2021) found that in Ghana the lack of digital enabling mechanisms, such as laptops and smartphones, as well as unstable electricity supply and the high cost of internet bundles, impeded learners from learning effectively during COVID-19 era. It was also reported that some students lost interest because they felt they were not engaged in lessons. Some learners and lecturers developed a digital phobia, which hinders effective instructional engagements (Magesa & Josua, 2022).

Long-Term Consequences of Online Learning

One of the major outcomes of having been exposed to online learning as a result of the COVID-19 lockdown was realising the need to be technology-oriented in teaching and learning as much as possible. This is because the shift was more of an eye-opener (Senthil Kumaran & Periakaruppan, 2022), which provided an idea of how the future is likely to be in terms of technology-based learning. For example, as mentioned above it was not until the lockdown imposed by COVID-19 that the importance of having a curriculum that can also be taught completely online was understood. This has, therefore, caused a huge transition in the education system to put in place measures that could possibly allow online teaching, learning and assessment to become a normal practice.

Some of the observed ways by which COVID-19 has impacted education include the fact that academic performance may vary with respect to the socio-economic status of students, as more environmental stress is imposed on those from less privileged backgrounds (Di Pietro et al., 2020). This means that it is crucial for institutions of higher learning to improve their measures in terms of offering inclusive education that can ensure less privileged students are not left behind in times of critical situations such as that experienced with COVID-19. Additionally, it is also worth noting that the pressure imposed on students also caused them to become academically mature as they were pushed to do whatever they could to pass their courses (Bhagat & Kim, 2020). This was also shown in

another study where 71% of students in South Africa confirmed that online education helped them to become independent (Cranfield et al., 2021).

Higher Education Institutions' Response to the COVID-19 Pandemic

As a result of the broad-based crisis created by the COVID-19 pandemic, higher education institutions globally were forced to abruptly adopt online pedagogies (while completely neglecting face-to-face pedagogies) in an attempt to cut the spread of the virus (Altbach & de Wit, 2020). This was made possible using information and communication technology (ICT) solutions, which enabled institutions to deliver their courses via remote teaching and learning (Kadhila & Nyambe, 2021; Mohamedbhai, 2020). However, barriers were highlighted in terms of some institutions being well equipped when it comes to ICT infrastructure as compared to others; similarly, some students were in a better position to afford internet connectivity, mostly those in urban areas in comparison to the ones in rural areas (Mohamedbhai, 2020).

Conceptualising of Online Pedagogies in Higher Education during COVID-19

Online pedagogies have been defined as teaching, learning and assessment that is enabled through the use of technologies such as ICT, the internet or web-based applications, as well as electronic systems which allow remote delivery of learning content (Ali et al., 2018; Arkorful & Abaidoo, 2015). Because information is not shared in a physical class, students usually have high flexibility in terms of how and when to do their work, as well as ease of access to the high volume of information available, which thus promotes critical thinking, and allows them to become independent and take control of their own learning (Kakuchi, 2021; Larbi-Apau, 2021).

However, since the lecturer does not have much control of the students, online pedagogies are also associated with a high level of academic dishonesty, as well as a lack of networking among students (Kakuchi, 2021). Furthermore, it also presents a negative impact to the scientific fields which require students to carry out hands-on experiments as part of their curricula (Kadhila & Nyambe, 2021), which cannot be accomplished online. As a result, complete online education may hinder the national goals, such as access to quality education, because some students may have challenges with internet connectivity for learning purposes.

During the COVID-19 outbreak, online pedagogies were made possible by the use of technology which allowed remote education via virtual learning, distance learning, mobile learning, cooperative learning and even machine learning (Paschal & Mkulu, 2020). The success of online learning is, however, dependent on digital skills among students and their lecturers, the availability of educational technologies, as well as good internet connectivity in the learning environment (Paschal & Mkulu, 2020). At the University of Namibia, particularly, lecturers were given approximately only one week to prepare their lessons and make them fit for online delivery (Kadhila & Nyambe, 2021), which was a challenge to many.

Objectives of the Study

The study was guided by the following objectives:

1) To identify the views of students on online teaching, learning and assessment as enabled by the existing technology.
2) To establish how students described the online learning experience at university.

3) To find out how students rated the quality of teaching of fully online compared to face-to-face or blended teaching and learning.
4) To assess whether the online learning experience improved students' general functional skills.

Research Questions

The study employed the following research questions:

1) What are the views of students on online teaching, learning and assessment as enabled by the existing technology?
2) How would students describe the online learning experience at university?
3) How do students rate the quality of teaching of fully online compared to face-to-face or blended teaching and learning?
4) How has the online learning experience improved students' general functional skills?

Methods

The study employed a quantitative approach to collect data from 19 conveniently sampled respondents (38%). The data for this study was collected during COVID-19 lockdowns and restrictions. Therefore, convenience sampling was used, which provided a chance to whomever happened to be available during the time of data collection to be included (Kumar, 2014; Mills & Gay, 2016).

Population

The target population was 50 students enrolled at the University of Namibia for second-year Bachelor of Science Microbiology, and Bachelor of Science Environmental Biology in 2022. These students started off their university life completely online in 2021 due to the restrictions imposed by the COVID-19 pandemic, hence, their selection.

Sample

The sample was drawn from a homogenous population, which, according to Brynard et al. (2014,) indicates "the more homogenous the population, the smaller the sample size" (p. 58). However, only 19 respondents filled out a Google Form questionnaire, which was shared with the whole population of 50 students. The data from these 19 respondents was then analysed through descriptive statistics using Microsoft Excel 2010.

Results and Discussions

What are the Views of Students on Online Teaching, Learning and Assessment as Enabled by the Existing Technology?

The findings from this study demonstrated that the shift to online teaching, learning and assessment presented major challenges to science students at the University of Namibia. Internet connectivity, inability to interact with peers and lecturers, as well as technological barriers to facilitate online learning, are some of the major challenges faced by students enrolled for the first-year BSc Microbiology and BSc Environmental Biology programmes, during the 2021 academic year. A similar study revealed similar results which indicated that in shifting to online learning, students faced

challenges such as technological barriers, lack of proper training, low motivation, resource constraints and low computer literacy (Anwar et al., 2020).

Challenges with Internet Connectivity

Although the university has made provisions of internet devices to students, these devices were reported to have slow internet connections in some parts of the country. This presented challenges to many students in accessing their learning platforms, and they thus ended up missing out on lectures and submission deadlines. The missing of submission deadlines was not only a challenge to students but also put pressure on the lecturers, since this forced them to set up different make-up activities and exams for students who missed their first opportunity due to internet connectivity issues. In order to overcome this challenge, students residing in areas with a poor connection had to find solutions such as buying mobile data regularly, moving in with relatives who had the internet at home, or finding a place with internet to rent, all of which are costly. The study found that most students (13/19, 68%) had the internet at home, as compared to 3/19 (16%) who needed to buy data regularly and the other 3/19 (16%) who actively made use of the UNAM internet device. However, of the 68% who had the internet at home, 4/13 (31%) were either renting or hosting in relatives' houses. The above findings were no surprise, as the issue with internet connectivity has been a major drawback to students' learning in many universities, during online teaching and learning, as a result of the COVID-19 pandemic (Gurung, 2021; Khanna & Prasad, 2020; Mathew & Iloanya, 2016; Sartika et al., 2021).

Some students were also employed as frontline workers who were tasked with combatting the COVID-19 pandemic. Curbing the spread of the disease was a priority over teaching and learning. Consequently, these students could not attend most of the online lectures and were left behind. Sometimes arrangements had to be made to accommodate such affected students. However, this also meant an increased workload for the lecturers.

Preference between Virtual and Physical Lab Sessions

The other criterion assessed on the views of students towards online pedagogies was the preference of students for practical learning, between online virtual lab simulations and physical lab practice. Interestingly, none of the respondents indicated they preferred virtual lab simulations. This is not surprising, given that science experiments are robust, require critical thinking, and thus are better done in a physical lab where one can troubleshoot as much as possible. Students also mentioned that physical experiments allowed them to see where one went wrong, how they could correct the mistake, and also to experiment using the things around them and the available lab consumables. This could be the reason why other studies described lab simulations as better when used only as pre-lab assignments or active learning exercises in lectures, instead of serving as viable substitutes for in-person labs (Alvarez, 2021).

How would Students Describe the Online Learning Experience at University?

Many students described their first year at university to have been the worst learning experience ever, both in terms of technology upgrades (53%) and subject knowledge acquisition (63%) (Fig. 1). The students believed that with everything being online, it was a bit unfair to them since this was their first year and thus, they did not have any prior university experience of how things were done. This is because the students were never exposed to online learning in high school, and it was thus a challenge to use the presented technologies, such as the learning platforms, to complete their academic tasks.

This higher expectation placed on their shoulders therefore forced students to work extra hard in order to be able to pass their courses.

However, some students also showed concern as they ended up being tempted to get involved in illegal activities, such as using their friends, relatives or even paying someone to do their schoolwork for them, since there was no physical control from the lecturers. Consequently, students who took this route are now suffering terribly in their second year, which is face-to-face, which shows that they did not acquire any knowledge from 2021 onto which they could build in 2022. The knowledge to solve problems related to technology has been reported in other studies as one of the major challenges faced by students ever since the transition from face-to-face to online pedagogies (Khanna & Prasad, 2020).

Nevertheless, a total of 47% of the respondents also demonstrated that in terms of technology upgrades, online learning was the best experience. This could be attributed to the fact that the students navigated through the different learning platforms by themselves and this must have upgraded their technological learning experience. This was a good sign, as it is crucial for students and academics to develop the habit of accepting change over time, as well as practising the art of being positive about technology upgrades (Khanna & Prasad, 2020). Moreover, in today's competitive world, as stated earlier, the expectation for graduates to be technology-oriented is essential (Fillion et al., 2007), and because of this, both institutions of higher learning and even elementary schools are increasingly transforming from traditional classrooms to digital technology rooms (Weyant & Gardner, 2010).

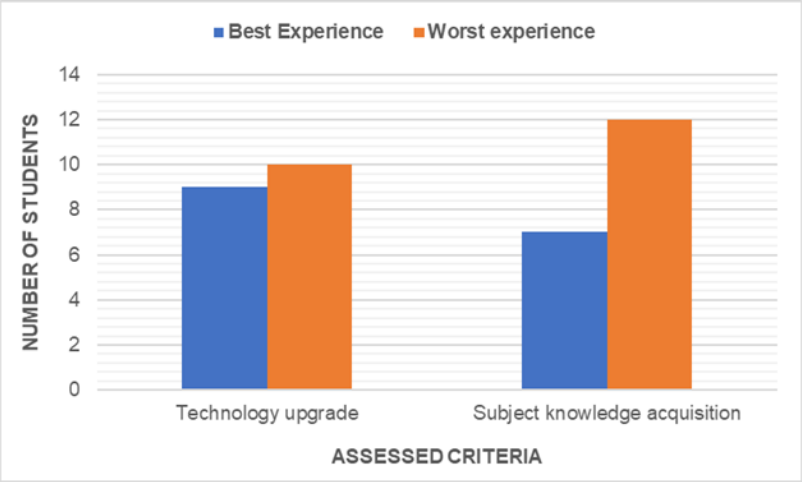

Figure 1: The online learning experience of students

How do Students Rate the Quality of Teaching of Fully Online Compared to Face-to-Face or Blended Teaching and Learning?

In response to the mode of teaching that students preferred between online (2021) and face-to-face or blended mode (2022) in terms of quality, a majority of the students (84%) indicated they preferred the face-to-face mode. One main reason for this preference was the fact that students usually feel closer to their lecturer and could easily interact and ask questions. Students also reported they were more confident in a face-to-face class as compared to an online class.

In other institutions of higher learning, students highlighted that the whole absence of socialisation that would normally take place in a traditional classroom, as well as issues like lecturers taking time to respond to students' emails, adversely affect the whole learning environment (Adnan & Anwar, 2020). All these issues are likely to discourage students from liking online learning. Hence, institutions of higher learning need to do something that will ensure that implementation of online learning in universities encourages rather than discourages students, perhaps through technology upgrades of the online learning system.

Furthermore, although this was not assessed in the current study, it is possible that the experience and total enthusiasm of lecturers about becoming digitalised may have contributed to lowering the quality of online teaching. As a result, with faculty members being continuously expected to remain competitive in this digitalised era, professional development in the use of technology is thus crucial, so is the infusion of technology-focused courses into the curricula (Alsaady, 2007). Interestingly, it has even been shown that higher education institutions are falling behind as students are already more experienced in content sharing, as well as web technologies, than their professors at the university (Barnatt, 2009), which could thus reduce their interest in attending online lessons from inexperienced lecturers.

How has the Online Learning Experience Improved Students' General Functional Skills?

The study lastly investigated how online pedagogy improved the reading, typing and internet information searching as well as general computer skills of students during the academic year 2021. Most students reported a high improvement in their internet searching (95%), general computer skills (89%), and also typing skills (79%) due to online learning (Fig. 2). In support of these results, another study showed that the online education during the pandemic also helped to improve the digital literacy of students in South Africa (68%), Wales (50%) and Hungary (37%) (Cranfield et al., 2021). This could be attributed to the fact students had no choice but to make use of various digital platforms, in order to ensure success in their schoolwork. As a result, this must have helped them to become more digitalised, which is thus an advantage.

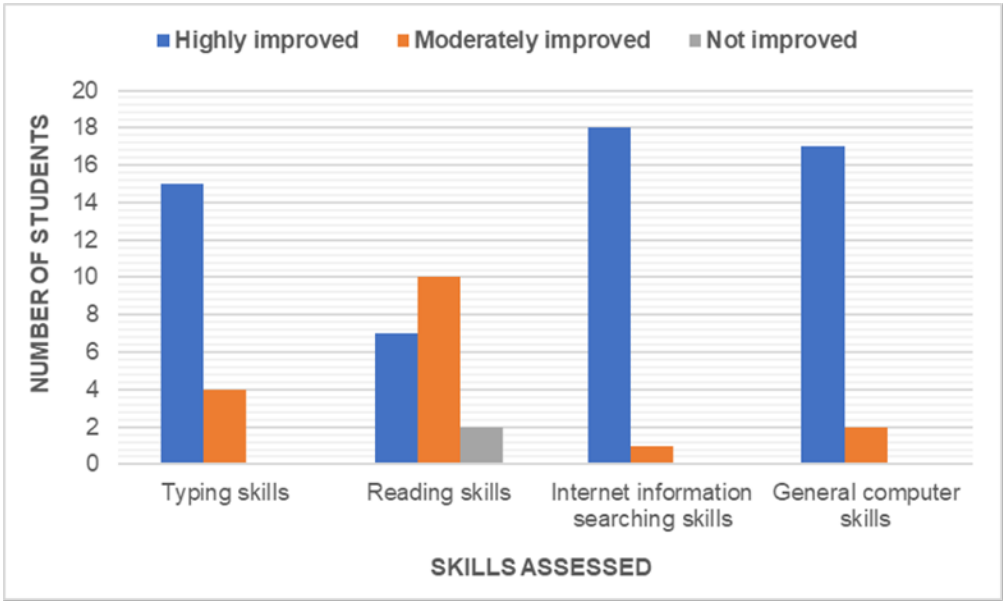

Figure 2: Some students' skills that were improved as a result of the complete online learning that was imposed by the COVID-19 pandemic in 2021

Conclusion and Recommendations

Conclusion

Despite the small sample size, this study further showed that the shift to online pedagogies due to COVID-19 has presented major challenges to both students and academics in institutions of higher learning. With the significant challenges associated with technology, which was experienced by students in this study, the importance of technology advancement in schools that will allow the embracing of online teaching, learning and assessment as a norm was demonstrated. It was further shown that although lab simulations were used on behalf of physical lab exercises, they may not serve as the best tool for practical exposure to students, given that the knowledge being passed on is restricted only to what is available online, which may not necessarily be reflective of the targeted context. Nevertheless, students still demonstrated an appreciation of the online learning experience as it allowed them to upgrade in terms of technology advancement, as well as gaining digitalised skills. Lastly, it is worth noting that the research instrument (questionnaire) used in this study was not statistically checked for validity or reliability, hence, strongly suggesting that similar studies in future should consider this in order to ensure reliability of the obtained results.

Recommendations

The study presents several recommendations. It is recommended that:

- when training students, the content should be more appropriate to the local context, to make it responsive to local demands and what they have at their disposal
- internet connectivity and accessibility should be widened across the country
- the institutions should consider designing their own lab simulations to reduce the overreliance on online experiments designed by other institutions

- professional development on the use of technology is crucial, therefore, the technology focused courses should be infused into the curricula
- the university should upgrade the technological infrastructures as well as ensuring that staff members remain updated in terms of technology
- policies should be introduced to curb irregularities such as students using their friends, relatives or even paying someone to do their schoolwork for them since there is no physical control from the lecturers
- the online curricular activities should be designed with the inclusion of socialisation that would normally take place in a traditional classroom.

Conflict of Interest: Authors have no conflict of interest in publishing this paper.

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Cite this paper as: Kanyemba, S., & Josua, L.M. (2023). Learning with digital media: A systematic review of students' use in African higher education. *Journal of Learning for Development, 10*(1), 109-121.