

Undergraduate medical students' readiness for online learning at a South African university: Implications for decentralised training

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Background. Decentralised teaching has the potential to transform medical education but requires greater use of online learning to address some of the challenges of decentralised teaching in low- and middle-income countries. Given the digital divide that exists in South Africa (SA), it is necessary to establish the extent of student readiness for the broader implementation of online learning.

Objectives. To determine medical students' device ownership, usage and attitudes towards online learning at the University of the Witwatersrand, Johannesburg.

Methods. A cross-sectional survey of first-, third- and sixth-year students was conducted in 2017. The questionnaire included open- and closed-ended questions. Quantitative data were analysed using frequency and custom tables and Kruskal-Wallis one-way analysis of variance (ANOVA) tests. Open-ended responses were analysed using content analysis.

Results. The survey response rate was 48.5% (448/924). No significant differences in device usage and attitudes towards online learning were observed across the 3 years of study. Most respondents (99%) owned internet-capable devices, and >90% wanted some degree of online learning. The perceived barriers included poor internet connectivity on university campuses and the high cost of data in SA.

Conclusion. The majority of respondents owned internet-capable devices and requested more online learning, but the socioeconomic disparities in the country raise concerns about students' readiness. Wider online learning requires policy decisions to ensure not only access to devices and data but also the implementation of online learning in ways that avoid further disadvantaging already disadvantaged students. Institutional barriers must be addressed before an expanded online learning environment can be considered.

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The global shift towards decentralised training – that is, expanding the platforms available for the clinical training of undergraduate medical students beyond central tertiary academic complexes to community-based settings – aims to produce more health professionals who better meet the needs of the societies they serve.^[1] In addition to extending the training platform, decentralised training enhances the student experience^[2] and improves the likelihood of graduates of both urban and rural origin working in rural and remote areas.^[3] The potential for decentralised training to improve the 'quantity, quality and relevance'^[1] of South African (SA) health professionals has resulted in calls for a national commitment to adopt a comprehensive policy on decentralised clinical training.^[4] As with many other sub-Saharan African countries, SA's ability to train sufficient healthcare practitioners to meet the country's needs is constrained by limited resources.^[5] The maldistribution of healthcare practitioners has been referred to as 'a particularly critical issue'.^[6]

A model of decentralised training for the SA context developed at a workshop held in 2015 involving the country's nine medical schools identified the availability of information and communications technology (ICT) as one of five critical factors for successful decentralised training.^[7] The benefits of online learning have located ICTs in the mainstream of medical curricula,^[8] where it is at least as effective as traditional lecture-based

learning in terms of knowledge and skills gained.^[9] The benefits of online learning include reducing the costs associated with delivering educational content, facilitating the scalability of educational interventions and improving the availability of and access to educational content.^[9] The United Nations and the World Health Organization have acknowledged the value of online learning as a useful tool to address global health education needs, 'especially in developing countries'.^[9] However, 'the potential of online learning to enhance medical education assumes a certain level of institutional readiness in human and infrastructural resources that are not always present in low- and middle-income countries'.^[10]

Digital divides related to socioeconomic conditions, such as differential access to ICT and variable proficiency,^[11] present a particular challenge in low-income and resource-constrained settings. Variables such as student and staff access to ICT, access to broadband internet, and a lack of ICT skills and confidence due to variations in the intensity and nature of internet usage may impact the success of online learning.^[9,12] Lambrechts,^[13] in relation to refugee students in England, described how an accumulation of barriers to access to higher education could lead to a 'super disadvantage'. SA is the most unequal country in the world,^[14] with demography acting as a proxy for socioeconomic status. Despite efforts to diversify medical education, with preferential selection processes in place at individual universities,^[15]

persistent inequalities in primary and secondary education, even more than 25 years into the new democratic dispensation that replaced the Apartheid regime, contribute to racial inequalities in access and success at tertiary institutions.^[14,16] The digital divide that exists in SA has been referred to as 'digital apartheid'^[17] because of its demarcation along racial lines. Given this context, the expanded usage of online learning in higher education should not contribute to further inequalities in student success.

The medical school at the University of the Witwatersrand (Wits University), established in 1919, accounts for 13% of the annual national first-year intake to the nine medical schools.^[15] Students are admitted via two routes to the 6-year undergraduate Bachelor of Medicine and Bachelor of Surgery (MB BCh) at Wits University. School leavers enter the first year of study (MBBCh 1) while graduates enter the third year of study. Students start their clinical training in MBBCh 4, progressing to clinical clerkships at distributed training platforms by the final year of study. Wits University partners with several government departments to train students at decentralised facilities. The decentralised facilities range from primary healthcare centres and community health centres in the city of Johannesburg to hospitals in the urban and peri-urban areas of Gauteng Province (a central province in SA), to more remote district and regional hospitals in the mostly rural areas of North West Province (~70 km from the university) and Mpumalanga Province (~400 km from the university). Wits University introduced rurality as a selection criterion for admission to the medical degree in 2015, as part of the government initiative to address unequal access to higher education. The present study was conducted in 2017 towards a Master of Medicine degree. It aimed to determine students' device ownership and usage of these devices, and attitudes towards online learning in the medical degree at Wits University. The study represents the most recent comprehensive survey of medical students' readiness for online learning at this institution.

Given the move towards more decentralised training at SA medical schools,^[7] the potential role for online learning to facilitate this training, and the digital divide that exists in the country, a better understanding of context-specific students' needs will allow resources to be directed appropriately and strategically. Student access to and engagement with online learning have become relevant during the recent rapid shift to online learning during the 2020 COVID-19 pandemic, both in central and distributed learning sites. The findings presented here could be of interest to medical schools in SA and other low- and middle-income countries that intend to implement or increase the usage of online learning.

Methods

A descriptive, cross-sectional, online and paper-based survey was distributed to a convenience sample of first-year ($n=255$), third-year ($n=350$) and final-year ($n=319$) medical students. These years of study were selected as they represent critical transition points in the curriculum – an entry year for school leavers (first year), a year in which the pedagogy changes from lectures to case-based learning (third year) and a year consisting of clinical clerkships (final year). The estimated sample size for the study, treating this as an online survey only, was 272/924 students, or a response rate of 29.4%. This sample size was estimated using a confidence interval of 95% with a 5% margin of error.

The questionnaire was adapted from two published surveys.^[18,19] The survey was generated using REDCap (Research Electronic Data Capture; Vanderbilt University, USA). A pilot study conducted with 19 student

volunteers from the MBBCh 5 group led to the questionnaire being edited for clarity. The final survey included both open- and closed-ended questions about respondents' demographic data, ownership of devices, device usage to support learning, including access to and reliability of internet connection, and readiness and willingness regarding online learning.

The survey was administered between September and November 2017. Links to an informational video detailing the upcoming study were circulated by class representatives to three cohorts via class Facebook and WhatsApp groups for 1 month before the roll-out of the survey. The final survey was distributed via student email addresses, the university learning management system and advertisement posters with quick response (QR) codes. Paper-based versions of the survey were circulated in lectures for each of the cohort years. A detailed information sheet provided with both the online and paper-based versions requested that students agree to participate in the survey before commencing.

Data from the paper-based surveys were manually entered into REDCap. There were no duplicate online entries. The data in REDCap were exported to Excel (Microsoft Corp., USA) for cleaning. Incomplete entries were removed. Quantitative data were analysed using SPSS version 25 (IBM Corp., USA). Frequency tables were used to analyse demographic data. Kruskal Wallis one-way analysis of variance (ANOVA) tests were used to understand the mean difference in different items by the year of study (YOS). All tests were conducted at a significance level of $p=0.05$. The open-ended responses were analysed using conventional content analysis.

The Human Research Ethics Committee of the Faculty of Health Sciences at Wits University approved the study (ref. no. M170340).

Results

The overall response rate was 48% (448/924). Of the 924 students surveyed, 56% of all first-year (142/255), 41% of all third-year (143/350) and 41% of all sixth-year (132/319) students participated in the survey. 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. The sample demographics for gender and age reflected those of the target population; however, white students were over-represented while black students were under-represented (Table 1). About one-third (33.9%) of the black students in the target population participated in the survey, compared with nearly half (45.2%) of the white students.

Table 2 shows the number of devices by YOS. Only three first-year students did not own a device. Most respondents (99.2%; 361/364) owned one device, with 92.8% (335/361) owning two or more devices. Smartphones were the most common device (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). There were no statistically significant differences by YOS for ownership or access to a smartphone, laptop or desktop:

- smartphone: MBBCh1 mean rank = 181.70, MBBCh 3 mean rank = 183.16, MBBCh 6 mean rank = 182.66, H (corrected for ties)=0.156, $df=2$, $n=364$, $p=0.925$.
- laptop: MBBCh 1 mean rank = 180.19, MBBCh 3 mean rank = 184.15, MBBCh 6 mean rank = 183.24, H (corrected for ties)=0.596, $df=2$, $n=364$, $p=0.742$.
- desktop computer: MBBCh 1 mean rank = 181.26, MBBCh 3 mean rank = 188.60, MBBCh 6 mean rank = 177.04, H (corrected for ties)=1.117, $df=2$, $n=364$, $p=0.527$.

Table 1. Sample and population demographics

Characteristic	MBBCh 1, <i>n</i> (%) (<i>n</i> =126)	MBBCh 3, <i>n</i> (%) (<i>n</i> =126)	MBBCh 6, <i>n</i> (%) (<i>n</i> =112)	Total respondents, <i>n</i> (%) (<i>N</i> =364)	Total cohort, <i>n</i> (%) (MBBCh 1, 3 and 6) (<i>N</i> =924) [†]
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)	0	1 (50.0)	2 (0.5)	0
Age, years					
<21	53 (36.8)	48 (33.3)	43 (29.9)	144 (39.5)	419 (45.3)
21 - 24	59 (36.0)	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 (25.0)	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 (35.0)	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 (25.0)	9 (45.0)	6 (30.0)	20 (5.5)	48 (5.2)
Other	6 (50.0)	3 (25.0)	3 (25.0)	12 (3.3)	0

*Race as classified by Statistics South Africa.^[20]
[†]Based on admission data.

Table 2. Device ownership (N=364)

Number of devices	MBBCh 1, <i>n</i> (%)	MBBCh 3, <i>n</i> (%)	MBBCh 6, <i>n</i> (%)	Total, <i>n</i> (%)
0	3 (2.4)	0 (0)	0 (0)	3 (0.8)
1	9 (7.1)	9 (7.1)	8 (7.1)	26 (7.1)
2	56 (44.4)	55 (43.7)	36 (32.1)	147 (40.4)
3	37 (29.4)	47 (37.3)	54 (48.2)	138 (37.9)
4	12 (9.5)	6 (4.8)	10 (8.9)	28 (7.7)
≥5	9 (7.1)	9 (7.1)	4 (3.6)	22 (6.0)

Most respondents (89%) used their devices where they lived, with laptops the most frequently used device (Fig. 1). Students made infrequent usage of the university computers available in teaching hospitals, campus libraries and instructional spaces, with most students accessing them weekly (36%; 131/364) or monthly (30%; 108/364). Only 11% (40/364) accessed the university computers daily, while another 11% (40/364) used them annually.

Most respondents (82%) used their own data to connect to the internet, as opposed to the university WiFi networks (62%) and free WiFi networks (21%). Free WiFi networks include free WiFi in provided by the City of Johannesburg in areas surrounding the university, and free WiFi available in coffee shops. There was no statistically significant difference by YOS in the frequency of data usage: MBBCh 1 mean rank = 183.53, MBBCh3 mean rank = 175.04, MBBCh 6 mean rank = 189.74, H (corrected for ties)=2.551, *df*=2, *n*=364, *p*=0.279. Nor was there a significant difference in use of university WiFi: MBBCh 1 mean rank = 177.17, MBBCh 3 mean rank = 189.29, MBBCh 6 mean rank = 180.86, H (corrected for ties)=1.006, *df*=2, *n*=364, *p*=0.605.

Forty-five percent of respondents were willing to use data that they had purchased to access the internet for learning. When respondents were not willing to use data that they had purchased, it was because data is expensive (*n*=121) and because they viewed it as the university's responsibility to provide them with internet access (*n*=42). Of those who used data they had

bought to access the internet for university work, 63 respondents stated that they did so willingly. In contrast, other respondents stated that they had no choice because they needed it to complete university work (*n*=55), found the university WiFi unreliable (*n*=27) or found their own network more reliable (*n*=17). Students' suggestions to improve their experience of university-provided wireless networks included the provision of faster and more reliable WiFi (*n*=188), improved WiFi coverage (*n*=123) and better ICT support (*n*=4).

Most respondents (68%) felt adequately prepared to use the technologies needed in their courses when they entered the university. Thirty-six percent wished they had been better prepared to use institution-specific software such as the university's learning management system, with 20% wishing they had been better prepared to use basic software such as Office and Windows Explorer (Microsoft Corp., USA).

Fig. 2 shows the respondents' attitudes and dispositions to using technology when asked to place themselves on a 100-point scale bound by opposite terms. The numbers reflected in Fig. 2 indicate positive dispositions (enthusiast, supporter, early adopter or technophile) and attitudes (useful, beneficial or enhancement) towards online learning. The overall score for attitude towards online learning was 75 points, and for disposition towards online learning was 70 points.

Table 3 shows respondents' preferred teaching approach. Most (86%) preferred courses that have some online (62.4%) and mostly online components (23.6%). Only 6.3% preferred courses that are purely face-to-face, while 4.1% preferred fully online courses. No statistically significant results were observed across the 3 years: MBBCh 1 mean rank = 178.54, MBBCh 3 mean rank = 182.79, MBBCh 6 mean rank = 186.63, H (corrected for ties)=0.473, *df*=2, *n*=364, *p*=0.789.

Feeling that 'online learning benefits learning' was respondents' primary reason for wanting online learning (Fig. 3), while connectivity issues were the major reason they were not in favour of online learning. The major reason for preferring face-to-face learning was the opportunity for interpersonal interaction, while the major reason against face-to-face

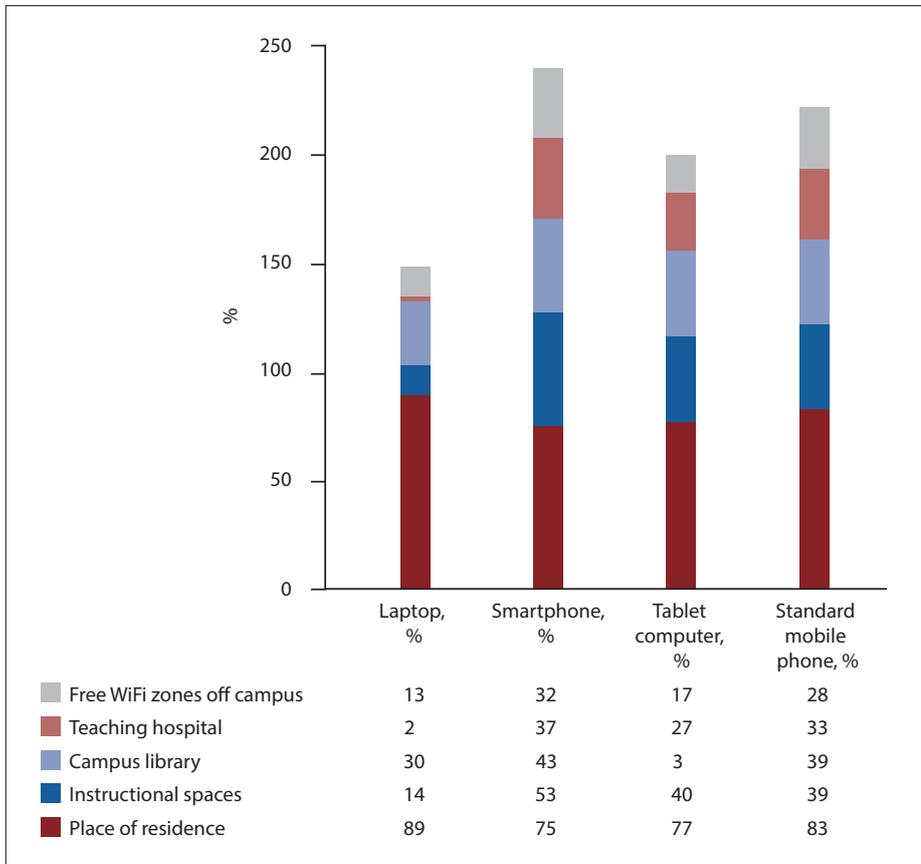


Fig. 1. Most common locations where students used devices to support their studies. (Percentages exceed 100% because respondents were asked to indicate all areas in which they used their devices.)

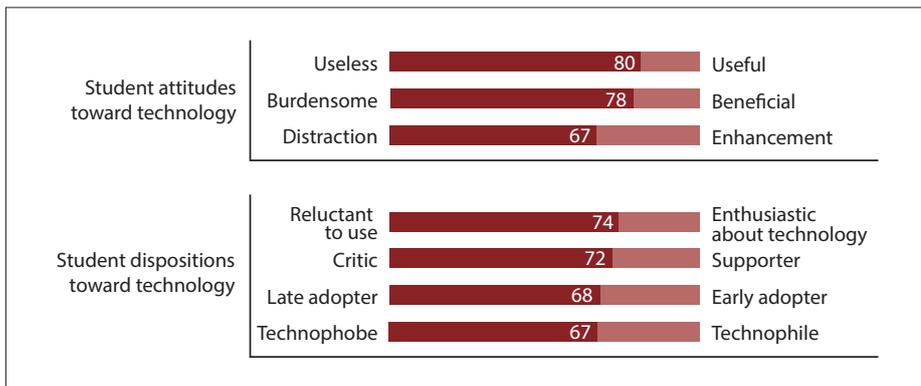


Fig. 2. Student attitudes and dispositions towards technology. (Students were asked to place themselves on a 100-point scale bound by opposite terms. The numbers indicate positive attitudes (useful, beneficial or enhancement) and dispositions (enthusiast, supporter, early adopter or technophile) toward online learning.)

learning was the difficulties experienced with travelling to the university for these sessions.

Fig. 4 shows the types of technologies that students would like their teachers to use more, and less, for teaching and learning. Videos or multimedia resources (96%) were the technologies that respondents wanted their teachers to use more. Social media was the least preferred teaching tool.

Discussion

Respondents' patterns of device ownership and usage showed no significant differences across the 3 years of study. Most of the respondents owned devices, were positively disposed towards technology usage, requested that their teachers use more online learning and were willing to use their own devices in teaching and learning spaces. Poor and unreliable connectivity in university spaces meant that students used their devices on campuses infrequently and relied on data they had purchased, mainly where they lived. Given that smartphones were ubiquitous, the potential for more online learning, especially mobile learning, makes this a feasible option for teaching across both centralised and remote training platforms. The findings, however, raise vital questions about student, staff and institutional readiness for the broader implementation of online learning.

Respondents' patterns of device ownership and usage are similar to those reported in other studies. Nearly all respondents had access to a device, with smartphones being the most common device, followed by laptops. These findings are similar to the 2017 EDUCAUSE Centre for Analysis and Research (ECAR) survey,^[21] which found that laptops are critical to the academic success of undergraduate students in the USA. The prevalence of smartphones is unsurprising, given that people in the age group 18 - 34 years are more likely to own a smartphone than older people, in both developed and developing countries.^[22] The value placed on mobile devices for learning by the respondents is in keeping with studies on medical students

Table 3. Preferred teaching approach (N=364)

Approach, n (%)	MBBCh 1, n (%) (n=126)	MBBCh 3, n (%) (n=126)	MBBCh 6, n (%) (n=112)	Total, n (%)
No online components	5 (3.96)	10 (7.9)	8 (7.1)	23 (6.3)
Some online components	86 (68.3)	75 (59.5)	66 (58.9)	227 (62.4)
Mostly but not completely online	28 (22.2)	31 (24.6)	27 (24.1)	86 (23.6)
Completely online	5 (4.0)	3 (2.4)	7 (6.3)	15 (4.1)
No preference	2 (1.6)	7 (5.6)	4 (3.6)	13 (3.6)

globally.^[23,24] Kaliisa and Picard^[25] suggest an increasing trend in mobile learning in higher education in Africa. The increased growth in access to mobile devices projected in SA^[26] has implications for the mobile learning required for decentralised training platforms. The relatively low cost, internet capability and multifunctionality of these mobile devices promote their popularity and ownership among students,^[27] and create opportunities for more personalised learning.

Although there was an overall positive disposition to online learning, at least 20% of the respondents felt underprepared, on entry to university, to use the university's learning management system, standard Microsoft Office applications and internet browsing. Given the survey response rate of 48%, this finding suggests a strong need for additional training to promote equitable access for all students, especially with the preferential selection for students from rural areas. Respondents' preference for a combination of online and face-to-face teaching is similar to other studies' findings that medical students still attribute greater value to face-to-face learning, and regard online learning instead as a useful supplement to, but not a replacement for, face-to-face teaching.^[9,28] A blended learning approach could be more appropriate in the SA context; Bagarukayo and Kalema^[29] found that SA student populations within and between institutions had variable baseline ICT skill sets and learning preferences, which a blended approach could mitigate.

The primary barrier to online learning identified by the respondents was the poor quality of the university WiFi network and its variability across different teaching and learning spaces. An unreliable network forces students to purchase mobile data, potentially compromising those from lower socioeconomic backgrounds. Data costs in SA are as much as 134% more expensive compared with other BRICS nations, making it more difficult for students to purchase data.^[30]

The recent COVID-19 pandemic focused attention on several of the issues highlighted by our findings, as higher education institutions globally had to consider student access to devices and WiFi, and technological proficiency, in the move to emergency remote teaching.^[31,32] Like universities globally, Wits University was forced to move its teaching and learning programme online. While the findings from our 2017 study suggest that students were ready and willing to undertake extended online learning across the 3 transition years sampled, many students at

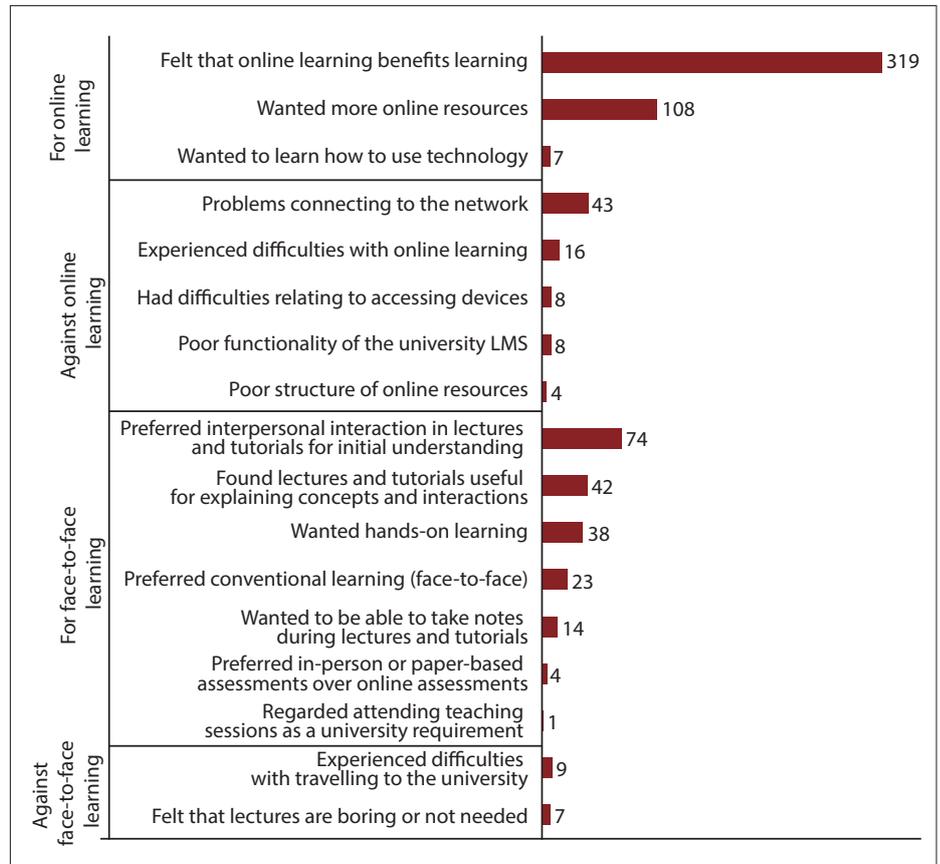


Fig. 3. Reasons for respondents' preference for online and face-to-face learning modalities. (LMS = learning management system.)

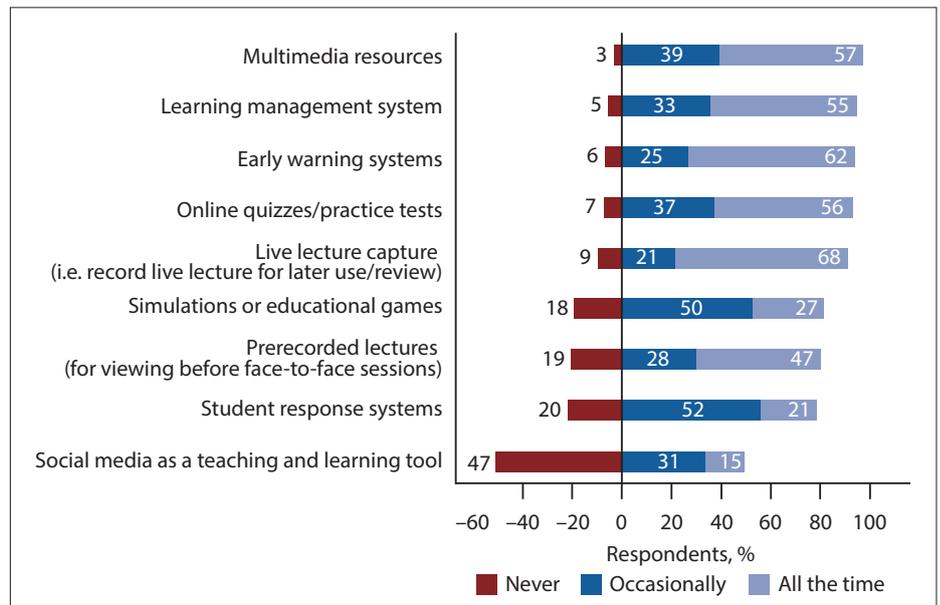


Fig. 4. Preferences for types of online learning. (Percentages <100 are accounted for by the 'I don't know' category not included in the figure. The negative percentages account for the 'never' category.)

our institution were not ready to learn remotely during the pandemic. The university had to urgently procure laptops and negotiate data

packages for students, resulting in delays in the academic programme. Barteit *et al.*^[5] attribute the failure of online

learning to substantially improve medical education and, ultimately, healthcare provision, in low- and middle-income countries to the lack of a comprehensive system-wide approach that goes beyond providing online learning as a technology. Online learning should be integrated into local educational contexts and aligned with national strategies. The need to avoid further disadvantaging already disadvantaged students by the indiscriminate and undiscerning use of online learning in medical education requires policy decisions that will ensure access to ICT devices and data and the successful implementation of online learning to promote student engagement.

The survey response rate of 48% is higher than the typical low rate of 21 - 30% for online surveys.^[19] The higher rate could be attributed to using a combination of online and paper-based surveys. The under-representation of black students and the over-representation of white students raises the possibility of non-response bias. Given that demography is often a proxy for economic status in SA,^[14,17] the overall results and the results within each cohort year might be different if the respondents' racial demographics were more reflective of the population. A further limitation of this study is that it relied on self-reported data.

Ongoing studies such as this one are essential for determining student readiness for online learning, especially when the student demographics at medical schools are likely to change, with preferential selection for students from rural areas. In addition to issues around access to technology and connectivity, students from rural areas are more likely to have low entry-level skills when entering higher education,^[33-35] which, based on the vast socioeconomic discrepancies that persist in the country,^[14] may extend to the ICT skills and proficiency required for online learning. A more systematic and inclusive framework of implementation and evaluation is required for successful online learning.

Conclusion

The majority of respondents owned internet-capable devices and requested more online learning, but the socioeconomic differences in the country raise concerns about students' access to devices and readiness to use them. The institutional barriers must be addressed before an expanded online learning environment can be considered.

The datasets generated and analysed during this study are available in the University of the Witwatersrand repository, Wirespace, at <http://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.

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