Original Article

Can medicine be taught online? Cavendish University's transition from contact classes to online learning during the COVID-19 pandemic

Kaluba Longa, Malambo Mordecai, Mutati Christine, Chabinga Pauline, Simuyemba Moses, Chilengwe Welani, Kafwamfwa Muhumpu

[1]*Cavendish University Zambia, School of Medicine, Lusaka.*

ABSTRACT

Introduction: The COVID-19 pandemic imposed dramatic changes on teaching and learning worldwide. Many universities transitioned from contact classes to utilizing fully electronic online modes. This study aims to evaluate Cavendish University School of Medicine students' online learning experience during the COVID-19 pandemic.

Method: This was an exploratory cross-sectional study that used simple random sampling to select participants at Cavendish University Zambia. An online questionnaire was distributed to the selected students at the time of the conclusion of the semester. The survey was voluntary, and all data were collected and recorded via google forms with maintaining anonymity.

Results: A total of 385 participants took part in the survey. Most of the participants were female124 (50.4%) and studying MBChB 171 (44.7%). The study found that there was a significant difference in the level of understanding (p value=0.01), the ability to explain online classes (p value=0.04), and internet reliability (p value=0.04) across and within programs. Most students were affected by load-shedding but the observed difference in median scores was not significant (p value=0.07).

Conclusion: Teaching online presented an opportunity to complete the semesters' curriculum during the coronavirus pandemic. With obstacles like electricity load shedding and unstable internet reliability, students reported high rates of motivation, confidence in the materials taught, and exam preparedness.

INTRODUCTION

Schools of medicine all over the world have an enormous responsibility to equip future doctors with the knowledge, skills, and attitudes necessary for patient care. Thus, high standards are needed for the delivery of medical education. The teaching of medicine has evolved from lecturer-centred to student-centred learning. Several strategies have been incorporated by many medical schools ranging from the flipped classroom [1], team-based [2], problem-based [1,3,4,] or experimental (hands-on) learning to hybrid or blended learning which combines a didactic approach with the strategies named [5]. However, the coronavirus pandemic has caused most to think outside of the box. The face-to-face interactions that these strategies employed may not be easily replicated in online learning. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), causing coronavirus disease 2019 (COVID-19), has posed a global health threat to which Zambia has not been spared. COVID-19, characterised by high infectivity during incubation of 3-7 days, at most 14 days, when no symptoms are shown in patients, resulted in a quick spread of the disease and

Keywords: *COVID-19, Online learning, School of medicine*

overwhelmed hospital facilities. With over 100 confirmed cases by the coronavirus recorded in April 2020, the government developed guidelines to reduce disease transmission through the Ministry of Health. Social distancing was inevitably imposed, restricting public gatherings. Consequently, universities were tasked to employ other ways of teaching their students other than through contact classes. This posed a daunting task for the teaching of medicine.

Cavendish University Zambia, like most universities, was forced to conduct lessons online. The school of medicine adopts a blended learning approach and hosts about 1000 students, all of which had to be uploaded onto the online learning platform and orientated, a process that took almost three weeks. During this orientation period, a sample of students was surveyed to determine their digital competency and device preparedness. The survey provided evidence that most students had a minimum of a smartphone and were conversant of its use. Unaccustomed to formal online teaching, teaching staff were also oriented on the learning platform, and computers were distributed with the software.

The university encouraged teaching staff to engage in more discussion lectures and experiments in efforts to promote knowledge retention by students. This was to account for the various learning styles students' possess. The concept that a students' learning style must be aligned to the instructional method to yield optimum learning results has been widely accepted [5]. However, a review by Pashler, McDaniel, Rohrer, Bjork [6] reported no experimental evidence of an interaction between the two. Regardless of the information available, the university encouraged using the chat forum on the learning platform and other communication apps like Slack and WhatsApp and online laboratory experiments by lab tutors to engage with students to promote learning.

The teaching staff was also encouraged to change the delivery of instructional material to deliver simplified content through instructional videos and voice notes and expand these concepts during the discussion periods. This method, similar to the flipped classroom strategy, has been reported to increase student's retention of knowledge and stimulate deep learning [1]. Video conferencing using applications like zoom and google meet were encouraged. At the semester's end, a student satisfaction survey was conducted to determine the effectiveness of online learning.

METHODOLOGY

Study Design and Population

This was an exploratory cross-sectional study on the viability of teaching medicine online during the COVID-19 pandemic at Cavendish University Zambia, School of Medicine. The study participants included only the medical students of this medical institution for whom regular online classes were started as soon as the university had to shut down. The survey was conducted in the preclinical year intakes (1 and 2) in the pursuit of a medical degree, the first two years in the nursing and clinical science degree, and the bridging course to these programs called foundation years (years 1 and 2). Participants were sent individualized emails that included a link to the self-administered questionnaireand a statement informing them that participation is important but voluntary. Detailed information about the purpose of the study, risks, and benefits was included in the informed consent form that was attached on the first page of the survey.

Sampling and Sample Size

A simple random sampling method was adopted to determine the required sample size. The number of respondents (n) to be surveyed with 95% confidence was calculated using the following formula and assumptions:

$$\frac{Z^2 1 - \alpha P(1-P)}{d^2}$$

Where:

Z= level of confidence measure and it represents the number of standard errors away from the mean. This describes the uncertainty in the sample mean or prevalence as an estimate of the population mean (normal deviation if alpha equals 0.05, Z = 1.96, for 95% confidence level).

P= Baseline level of indicators. Since this estimate was not available, it was recommended that the value of p= 0.5, at maximum variability, is used. Since variability was also not known, a conservative value of p=0.5 was used.

d = Margin of error. The expected half-width of the confidence interval and taken 0.05 for this study. Substituting these values into the equation

$$n = (1.96^2 * 0.5^2)/0.05^2$$
$$=384.16$$
$$\approx 385$$

Data Collection

A self-administered online questionnaire was prepared and sent to the selected students through emails after three months of online classes. The survey contained an introductory paragraph that informed participants of the study's aims, the confidentiality of their responses, and the freedom to decline to answer any question or to withdraw from the study altogether. The questionnaire comprised a combination of closed and open-ended questions. The questionnaire consisted of 21 questions divided into two sections: section one included questions on the demographic characteristics of participants (gender, residence place, and program)and the second section evaluated the effect of the COVID-19 pandemic on online learning during the closure. This section consisted of eighteen questions, that is, three single-choice questions, three multiple-choice questions, nine Likert-scale questions (which used the seven-point Likertscale) and three questions with a free text answer. An ethical waiver was obtained from ERES converge IRB (reference number 2021-July-001).

Inclusion and Exclusion criteria

The study only included students from the faculty of medicine at Cavendish University Zambia and non-medical students from the school were excluded from the study.

Statistical analysis

All results are expressed as medians with the interquartile ranges. A normality test using the Shapiro Wilk was done. Comparisons among the four programs were made by the Kruska-Wallis test (nonparametric ANOVA) and the post hoc multiple comparisons tests were made by Dunn's test. To measure the effect of COVID-19 lockdown on the academic performance of students, a seven-point Likert scale was used. Answers were converted into numeric values as follow (exceptional=7 points ;excellent=6 point; very good= 5 points; good= 4 points; fair= 3 points; poor=2 points; very poor= 1 point). To evaluate online education during the pandemic lockdown, a seven-point Likert scale was used. Participants were asked to evaluate the online education in general, and the online education in practical lessons during the lockdown (moderately dissatisfied=7 points; very dissatisfied =6 points; slightly dissatisfied=5 points; neutral= 4 points; slightly satisfied= 3 points; moderately satisfied= 2 points; very satisfied= 1 point. A level of $P < .05$ was considered statistically significant.

RESULTS

A total of 385 students were enrolled in the study: 124 were female and 122 were male. Most of the students who were enrolled for the resided in urban areas 207 (54.1%) whilst 107(27.9%) and 69 (18%) resided in peri-urban and rural areas respectively. A majority of students owned the devices that they used to access online classes 332 (86.7%). A summary of the demographics characteristics is shown in table 1 below.

Table 1: Description of background social demographic factors

Characteristics	Frequency(%)
Gender	
Female	124 (50.4)
Male	122 (49.6)
Program	
Foundation	77 (20.1)
Nursing	60 (15.7)
Clinical Science	75 (19.6)
MBChB	171 (44.7)
Residence	
Rural	69 (18)
Peri-Urban	107 (27.9)
Urban	207 (54.1)
Internet Service Provider	
Airtel Zambia	191 (50)
MTN Zambia	106 (27.8)
Zamtel	16 (4.2)
Other networks (Mifi, Telecom, MTC)	65 (17)
None ofthe Above	4 (1.1)
Device	
Smartphone	260 (67.9)
Tablet	6 (1.6)
Laptop	41 (10.7)
Desktop	4 (1)
Two or More Devices (Desktop, laptop, tablets/smartphone)	72 (18.8)
Device Ownership	
No	51 (13.3)
Yes	332 (86.7)
Shared Device	
No	305 (79.8)
Yes	77 (20.2)

Figure 1 shows the distribution of the student's perceived ability to learn online in all the programs. The median index of the student's perceived ability to learn online was five across programs. The graph shows that males, on average, found it easier to learn online compared to females across programs except for clinical science and MBChB. Concerningthe foundation group, it was observed that males had a median score of approximately six, whereas females had a median below the score of six. The graph shows that there was no significant difference (p-value0.07) in the median scores of the students' perceived ability to learn across programs. The multiple comparisons Dunn's test showed that there was no difference in their perceived ability to learn among the programs (Appendix table 1).

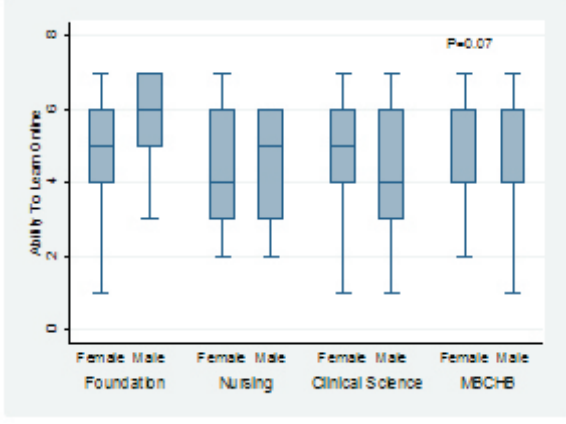

Figure 1: Students Ability to learn online using the Kruskal Wallis equality of populations rank test

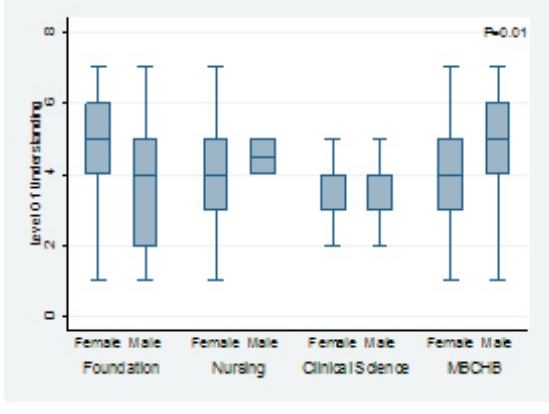

Figure 2: Level of understanding of students using the Kruskal Wallis equality of populations rank test

Generally, students fairly understood the online content delivered by their lecturers as the overall median level of understanding score was four (Figure 2). On average male students studying MBChB and females in the foundation, classes had a higher level of understanding when compared with the other programs as their median score was approximatelyfive. This was higher than most students in the study and the observed difference in the medians was statistically significant. The multiple comparisons Dunn's test showed that there was a statistical difference in the level of understanding amongthe programs (Appendix table 2). Generally, it was observed that there was a significant difference in the level of understanding of the online content between the foundation, nursing and MBChB programs with the clinical science group.

Concerning interaction with lecturers, the median score of the interaction of students with lecturers was four. Generally, all the students across programs interacted with lecturers around and above the overall median score. Furthermore, it was observed that female and male students in foundation and nursing groups respectively had a higher median score above four showing better interaction with lecturers when compared with others doing the same or different programs (p-value-0.55). The Dunn test shows that there was no significant difference among the programs concerning interactions with the lecturers (Appendix table 3).

Concerning internet reliability, the overall median score across programs was four. Generally, a difference in the median score across and within programs was reported.For instance, male students in the nursing program had a median score above the overall score while female students in the nursing program had a median score of approximately around three. Furthermore, it was observed that male students in the foundation group also had a median internet reliability score of less than four (p-value0.01). In addition, the width of the boxplots shows that most students had poor internet reliability. The post hoc Dunn test shows that there was a statistical difference in internet reliability among the clinical science program with the MBChB, nursing and foundation program respectively (Appendix table 4).

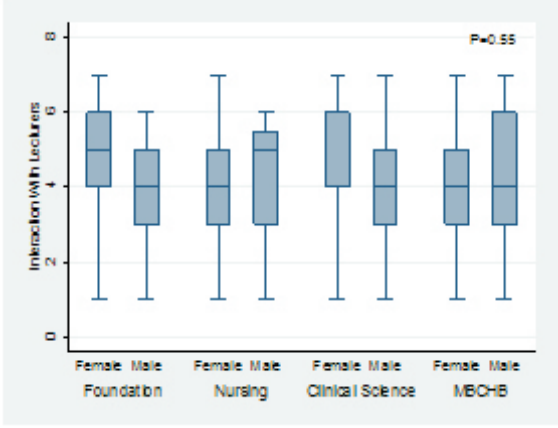

Figure 3: Level of student interaction with lecturers using the Kruskal Wallis equality of populations rank test

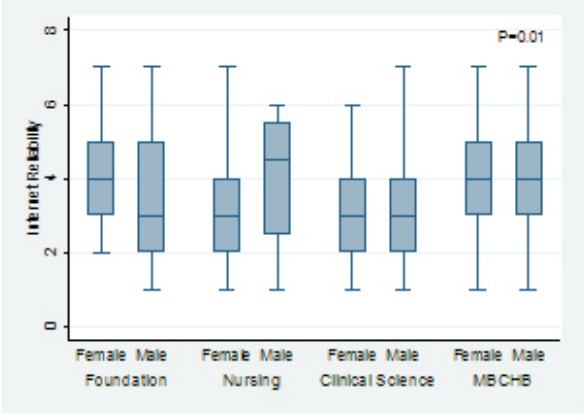

Figure 4: Internet reliability where students stay using the Kruskal Wallis equality of populations rank test

Figure 5 belowshows the students' perception of their preparednessfor having examinations after having online classes. The overall median score across programs was four and on average all the students had a median score around and above four across programs (p-value0.04). It was observed that

students in the nursing and MBChB programs had a difference in median scores with the students in the clinical science program respectively (p-value0.02 and 0.003) when the post hoc Dunn test was done(Appendix table 5). Figure 6 below shows the perceived impact of electricity loading shedding on the students' ability to learn online. The overall median score was five showing that most students were heavily affected by loading shedding. On average most students across programs had a median score of around five except for female students studying MBChB who reported a median score of four. In addition, the boxplot shows that male students on average had a higher median score across programs except for male students in the clinical science group. A closer analysis of the boxplots shows the observed difference in median score was borderline significant.

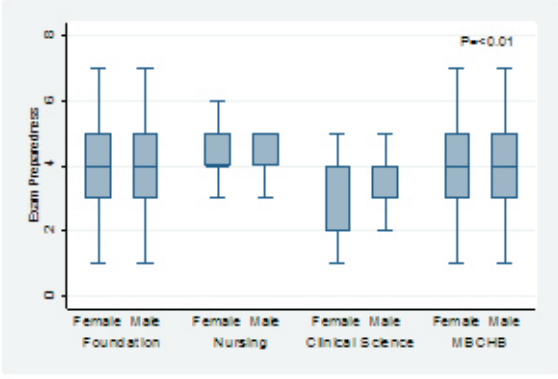

Figure 5: Examination preparedness of students using the Kruskal Wallis

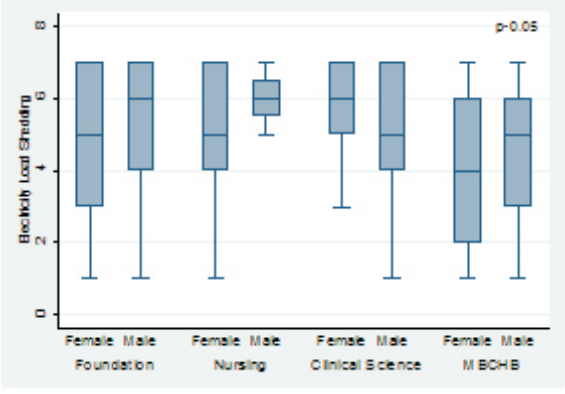

Figure 6: effects of load-shedding on students online classes using the Kruskal Wallis equality of populations

The multiple comparisons Dunn's test showed that there was a difference in the severity of electricity loading shedding between the clinical science and MBChB program (p-value0.03, Appendix table 6).

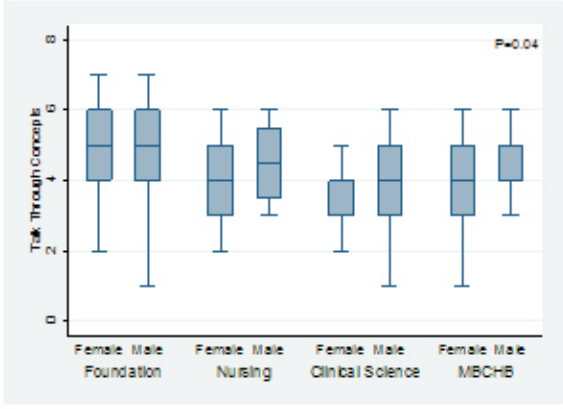

Figure 7: Students ability to explain online classes Kruskal Wallis equality of populations rank test

Concerning students' perception of their ability to explain concepts taught, Figure 7 above shows that all students regardless of gender had a median score around or above the overall median score of four. Generally, students in the foundation group had the highest median score of five as compared to the other programs (p-value=0.04). The multiple comparison post hoc Dunn test shows there was a difference in median scores between the foundation and MBChB with the clinical science program respectively (p-value0.03 and 0.04, Appendix table 7). Concerning students' motivation to learn in figure 8 above, the overall median score was five. Male students in the nursing program had a higher motivation to learn with the highest median score slightly below six. Furthermore, the boxplot shows that females in the nursing and MBChB program had a lower motivation to learn as their median score was four respectively and statistically there was no difference in the motivation to learn among programs (p-value=0.12). The Dunn test shows that there was no difference in the motivation to learn among programs(Appendix table 8).

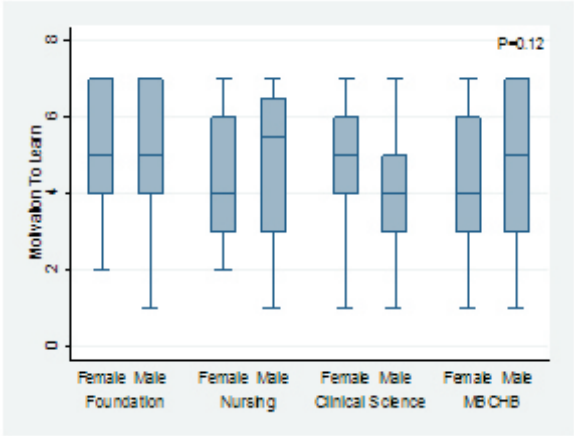

Figure 8: Students motivation to learn using the Kruskal Wallis equality of populations rank test

DISCUSSION

Contrarily to what would be predicted using the containment theory and similar to others[1] most of our students responded favourably to online platforms with others keen on engaging in this form of self-directed learning[2]. According to the students, a total of 75.5% were able to fully appreciate the concepts being delivered with 80.2% of the students felt confident to talk through those concepts. The majority of students were highly motivated to learn (78.9%) with 72.7% of the students felt prepared to attempt the final year exam. Whether these positive satisfaction rates were associated with the time this study was conducted or the circumstances surrounding the transition to online are yet to be determined. A positive association has been reported between the past online learning experience and student satisfaction evaluation[3,4]. Further, satisfaction rates varied between rural and urban students[5]. Most of our students presided in urban and peri-urban areas. This could have been attributed to the high satisfaction rates; however, this was not statistically determined.

Electricity load shedding and unstable internet connectivity were the significant challenges experienced by both students and teaching staff. A total of 76.7% of the students felt significantly affected by electricity load shedding and 61.5% reported unstable internet connectivity. This, similar to others that have predicted a high success rate of online medical education with the improvement of the networks (both electricity and internet), media resources and hardware[2,3]. Fast internet speed and efficient bandwidth are essential for effective content delivery[6].

Teaching delivery methods quickly changed from lecture-based to incorporating techniques from the flipped classroom model and adopting a more humanistic approach to learning. This prompted our students to be highly participative, innovative and liberal, inquiry-centred, transactive, self-reliant with a high level of responsibility for their learning. Managing discussion forums became a challenge, especially in large classes with extensions like breakout rooms on google meet not available at the time. However, 76.6% of the students felt lecturers were making efforts to interact with them when challenges were raised. Indeed, Rhim, Ham[7] reported that effective online teaching requires cognitive, social and teaching presence and an independent learner mindset. That is, facilitating an environment in which the learner can construct meaning and express emotion from the subject matter through an exchange of views and opinions. Indeed, effective communication strategies must be implemented for effective content delivery and increased student satisfaction[8].

However, some students, similar to other studies[9,10], did not adapt accordingly to this mode of delivery. Approximately 400 students received counselling psychotherapy during this period with a majority being international students. A variety of psychological and other mental health problems were presented to the counselling department. These seem to have arisen as a result of the difficulties experienced by students in making payments, missing modules, difficulties in joining certain online links, fear of failing exams, Covid-19 concerns and fears and communication challenges with the university help centre. Indeed, student

confidence and support in information technology is key in their self-esteem and motivation[8]. Conditions specifically noted were; panic attacks, exam-related anxiety, phobia, depression, stress arising from difficulties with online study and exam formats, anxiety due to fear of infection and difficulties in accessing testing, phobia during the waiting period of the coronavirus test results, despair, low self-esteem, substance abuse and suicide. However, it is not clear if these conditions reported in other studies[1], would be attributable to online teaching and learning or were prevalent at the time of counselling. There is a strong possibility that the pressure from online teaching and learning could have activated stress and underlying psychosis in the students. Further, even though online learning allowed students to learn at a time and place that may be convenient to them, the lack of structure[11] may have contributed to the increased stress and anxiety[8]. A combination of psychotherapy modalities, skills, and techniques including breathing techniques, cognitive behaviour therapy (CBT), person-centred psychotherapy, systemic family psychotherapy amongst others was used to assist students during the lockdown period.

While others reported the resistance in online teaching by faculty members[12,13], the university created an online support group that strengthened the sense of unity and commitment to craft for both full and part-time teaching staff. In the same line, the university management introduced a book club in which two types of mindsets; fixed and growth, were discussed in the context of teaching and learning[14].

CONCLUSION

The concept of teaching medicine online has received a lot of opposition during the past decade. However, with the coronavirus pandemic, this method had to be implemented. Our study showed that though our basic sciencestudents had difficulties in learning online, most reported high motivation, satisfaction and exam preparedness rates. Thus, with the right infrastructure in place, online teaching has the potential to be an added resource in medical education. More research needs to be done on the technologies that may be useful to strengthen skills learning in these unprecedented times.

STUDY LIMITATIONS

The findings of this study cannot be generalized because they were collected from one medical school. Although the themes used to assess these students have been documented in other literature, the authors are aware that these may not be generalized to other undergraduate medical students.

DECLARATION OF CONFLICTING INTERESTS

The author(s) declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

FUNDING

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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Appendix

Table 1: Post Hoc Dunn Test results on Students ability to learn online

	Foundation	Nursing	Clinical
Nursing	1.98		
P-value	0.14		
Clinical	1.97	-0.12	
P-value	0.15	1.00	
MBChB	2.53	0.05	0.21
P-value	0.03	1.00	1.00

Table 2: Post Hoc Dunn test results on the level of understanding of the online content among programs

	Foundation	Nursing	Clinical
Nursing	-0.75		
P-value	1.00		
Clinical	2.41	3.00	
P-value	0.05	0.01	
MBChB	0.09	0.94	-2.73
P-value	1.00	1.00	0.019

Table 3: Dunn Test Post Hoc Test on students Interaction with the lecturers

	Foundation	Nursing	Clinical
Nursing	-0.16		
P-value	1.00		
Clinical	1.12	1.21	
P-value	0.79	0.68	
MBChB	0.66	0.79	-0.66
P-value	1.00	1.00	1.00

Table 4: Post Hoc analysis of Internet reliability among programs

	Foundation	Nursing	Clinical
Nursing	0.48		
P-value	1.00		
Clinical	3.05	2.37	
P-value	0.01	0.05	
MBChB	0.49	-0.10	-3.08
P-value	1.00	1.00	0.01

Table 5: Dunn Test results on Examination Preparedness among the programs

	Foundation	Nursing	Clinical
Nursing	-2.03		
P-value	0.13		
Clinical	0.84	2.80	
P-value	1.00	0.02	
MBChB	-2.35	0.18	-3.31
P-value	0.06	1.00	0.003

Table 6: Post Hoc results using the Dunn test on electricity loading shedding across programs

	Foundation	Nursing	Clinical
Nursing	0.83		
P-value	1.00		
Clinical	-0.72	-1.50	
P-value	1.00	0.40	
MBChB	1.80	0.69	2.63
P-value	0.21	1.00	0.03

Table 7: Post Hoc analysis of the differences in students motivation to learn among programs

	Foundation	Nursing	Clinical
Nursing	1.24		
P-value	0.64		
Clinical	2.34	0.96	
P-value	0.06	1.00	
MBChB	1.07	-0.45	-1.68
P-value	0.86	1.00	0.280

Table 8Post Hoc analysis of students ability to talk through the concepts

	Foundation	Nursing	Clinical
Nursing	0.18		
P-value	1.00		
Clinical	2.62	2.27	
P-value	0.03	0.07	
MBChB	0.57	0.31	-2.50
P-value	1.00	1.00	0.04