Original Article

Motivators and Barriers for Using E-learning During the COVID-19 Pandemic among Students at the College of Medicine and Health Sciences, University of Rwanda

Benoite Umubyeyi[1*,2], Gerard Nyiringango[3,4], Reverien Rutayisire[5], Dieudonne Kayiranga[3], David Ryamukuru[3], Alice Nyirazigama[3], Juliet Mukankusi[3], Justine Bagirisano[3], Christine Igikundiro[3], M. Eric Niyikiza[3,6], Madeleine Mukeshimana[3], John Mugarura[7], Adejumo Oluyinka[3,8]

[1]*Department of Mental Health, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda*
[2]*Institut de Formation Interhospitalier Théodore Simon, Neuilly-sur-Marne, Île-de-France, France*
[3]*Department of Nursing, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda*
[4]*Stockholm University, Stockholm, Sweden*
[5]*Department of Medical Imaging Sciences, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda*
[6]*Open University of Tanzania, Dar es Salaam Tanzania, United Republic of Tanzania*
[7]*Learning and Teaching Enhancement Unit, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda*
[8] *New York University, New York, United States*

***Corresponding author:** Department of Mental Health, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda. Email: benoite2010@gmail.com

Abstract

Background
To continue delivering the courses despite school closure during the covid-19 pandemic, the University of Rwanda abruptly shifted its teaching from traditional physical to online teaching. This was the compulsory medium of teaching during the lockdown period. This sudden change did not allow for adequate preparation for students.

Objectives
To assess the preparation of learners to use the e-learning platform, and to explore the factors that enabled or inhibited learners' use of the e-learning platform.

Method
This was a cross-sectional quantitative research design study done between June and July 2020. An online questionnaire was sent to all students registered in the College of Medicine and Health Sciences for the academic year 2019-2020.

Results
A total of 446 students completed the questionnaire. Students reported not being adequately oriented and unprepared to effectively use e-learning. Students were motivated to use e-learning when the learning objectives were clear, interactive, with engaging materials. Inadequate e-learning infrastructure, limited access to internet connectivity and inadequate devices were identified as the strongest barriers of using e-learning.

Conclusion
The covid-19 pandemic has brought a transformational opportunity to embrace a blended learning approach. To sustain such a transformation, proper and timely planning and strategies need to be invested.

Rwanda J Med Health Sci 2022;5(1):99-112

Keywords: COVID-19, E-learning, Health-professional students, Motivators, Barriers

Introduction

Since March 2020, the COVID-19 pandemic was declared a global public health problem by the World Health Organization.[1] Ever since its discovery, the COVID-19 has caused a significant disruption in all domains of life, including education, and essentially in teaching and learning. Physical distancing measures to prevent the spread of the disease resulted in the closure of schools worldwide, affecting many learners, particularly in developing countries.[2] Such disruptions affected Rwanda as well, with its attendant effects on the education programs.

The first COVID-19 case was registered in Rwanda in March 2020, halfway through the start of the second semester of the 2019-2020 academic year. In order to continue to delivering courses despite school closures, the University of Rwanda shifted its teaching from traditional physical teaching to online teaching as the compulsory medium of teaching during the lockdown period. The urgency of the transition from physical environments to virtual learning environments happened in the context where the university infrastructure had not been previously planned for an online environment as the only teaching option. It is likely that this sudden change did not allow for adequate preparation for students.

Existing literature on teaching and learning during emergencies such as the COVID-19 coined the nature of learning being offered as an emergency remote teaching as opposed to well-planned online learning instruction.[3–5] Emergency remote teaching implies a rapidly improvised teaching strategy to maintain instruction during an emergency, with no prior adequate infrastructure planned for that purpose.[5] Recent evidence suggests that such a rapid and unplanned shift presents challenging situations to students.[3,6,7]

While the whole education sector was disrupted by the COVID-19 pandemic, health professional education is regarded as the most severely affected in all aspects, including curricula, teaching and assessment, and the whole educational outcomes. [8–10]

Most health professional education heavily relies on clinical placement and internship as the cornerstone for psychomotor skills learning through direct contact with patients. These were severely affected by lack of access to clinical areas, while the skills learnt in clinical placements or internship could not rapidly be transferred to online learning platform as it was done for other theory-focused courses.[8,11]

The College of Medicine and Health Sciences (CMHS) of the University of Rwanda caters for different health professional students. When the school closure was decided, majority of these students were nearing the end of their theoretical courses and preparing to start their clinical placements, which were abruptly canceled, while those that had started clinical placement had to suspend it forthwith. All the students were requested to continue their learning through Moodle online platform. This study aimed to assess aspects of the implementation of e-learning in the College of Medicine and Health Sciences during the COVID-19 lockdown period. Specifically, the study 1) assessed the preparation that learners had towards the use of the e-learning platform in CMHS, and 2) explored the factors that enabled or inhibited learners' use of the e-learning platform at the CMHS.

Methodology

Study design

A cross-sectional quantitative research design was adopted. Data was collected at one point in time between June and July 2020, around three months since health professional students in the College of Medicine and Health Sciences of the University of Rwanda had started learning using the online learning platform.

Study setting

The study was conducted in one of the six colleges of the University of Rwanda, the College of Medicine and Health Sciences (CMHS). The CMHS is the only public college offering health professional education in Rwanda. It offers courses in 5 different schools,

including the School of Medicine and Pharmacy, the School of Nursing and Midwifery, the School of Health Sciences, the School of Public Health, and the School of Dentistry.

Sample

All students registered in the CMHS for the academic year 2019-2020 were included in the study. We used G* power to calculate the sample size considering ANOVA as the major test. We used ANOVA: Fixed effects, omnibus, one-way with an effect size of 0.25, α=0.05, β=0.95, and the number of groups=6. Considering this ANOVA description, the G* power gave the sample size of 324. Official records indicated that 3635 students were registered in the College of Medicine and Health Sciences for the academic year 2019-2020. Among the registered students, 446 completed and returned the questionnaire.

Data collection tools

A survey questionnaire was adapted using ideas from a previous instrument used to assess students' use of e-learning in contexts similar to Rwanda.[12] The questionnaire is composed of two sections: Section A assesses participants' background including the online background, and section B assesses factors that enable or hinder the use of e-learning. Section A is composed of 11 multiple choice questions while section B is a Likert scale with two subscales: enhancing or motivating subscale with 9 items and inhibiting subscale with 13 items. All items in section B are rated on a scale from 5 (strongly agree) to 1 (strongly disagree) with the statement. The questionnaire has been found reliable with Cronbach coefficients of 0.944 on all items respectively. [12] In addition, a socio-demographic questionnaire was used to collect relevant demographic information and e-learning background information from participants. The questionnaire was formatted through the online form and a link to the questionnaire along with an invitation to participate were sent to all CMHS students through their email addresses. Two reminders were sent to all participants at a two-week interval, and after one month of data collection, completed and returned questionnaires were considered.

Data analysis

Descriptive and inferential statistics were used to analyze the findings. SPSS v.25 was used to facilitate the analysis. After cleaning data for out-of-range values, coding errors, and checking for missing data, different statistical tests were performed. Descriptive statistics were computed for frequencies and percentages of specific responses among the respondents. Inferential statistics were used for statistical tests of significance in relationships among the variables of interests. Correlation test was performed to ascertain the relationship of continuous variables: age, motivators, and barriers. Similarly, the study used the ANOVA test to find out the differences between mean scores of motivators and barriers among the variables of year of study and the type of electronic device used for online learning. The level of statistical significance was set at $P \leq 0.05$.

Ethical considerations

Ethical approval to conduct this study was granted by the Institutional Review Board (IRB) of the College of Medicine & Health Sciences at the University of Rwanda. Selected participants were informed about the study through informed consent and a letter of information that were sent along with the online questionnaire. The information letter reminded the participants that participation was voluntary, with no risks for those who did not want to participate. To ensure confidentiality, no identifying information such as names was included in the questionnaire.

Results

In this study, the demographic characteristics (such as gender, age, year of study, program, and school), as well as the e-learning characteristics (such as training on e-learning, use of e-learning before and since the pandemic, and types of electronic devices used) constituted the independent variables. On the other hand, dependent variables are motivators and barriers of using e-learning.

Characteristics of participants

A total of 446 students from the College of Medicine and Health Sciences participated in the study (Table 1). The majority, 65.8% (n=288), were male and most of them, 71.5% (n=308) were in the age range of 20 to 24 years. Year one, 28% (n= 123) and year three 28.1% (n=124) students constituted much of the sample. A larger number of participants, 79.8% (n=351) were enrolled in the bachelor's degree in their respective programs. In terms of the school of provenance, the majority 44.3% (n=195) of students, belonged to the School of Nursing and Midwifery, followed by the School of Health Sciences, 22% (n=97), and the School of Dentistry 17% (n=75).

Table 1. Demographic characteristics of participants

Item		Freq (n)	(%)
Sex	Male	288	65.8
	Female	150	34.2
	Less than 20	13	3.0
Age	20-24 years old	308	71.5
	25-29 years old	59	13.7
	30 + years old	51	11.8
Year of study	Year 1	123	28.0
	Year 2	85	19.3
	Year 3	124	28.2
	Year 4	93	21.1
	Year 5	15	3.4
Program	Diploma	47	10.7
	Bachelor	351	79.8
	Master	41	9.3
	PhD	1	.2
School	School of Health Sciences	97	22.0
	School of Dentistry	28	6.4
	School of Medicine and Pharmacy	75	17.0
	School of Nursing and Midwifery	195	44.3
	School of Public Health	45	10.2

Preparation for and use of e-learning

More than half of students who participated in the study, 58.1% (n=255) had never received any training on the use of e-learning platform by the time of data collection, and only 41.9% (n=184) acknowledged to have had e-learning training (Table 2). Before the start of Covid-19 lockdown, a relatively large number of participants 34.1% had never used the e-learning platform, and even those who used it, 27.7% would only use it on a once in a monthly basis. However, since the school closure due to Covid-19, the use of e-learning increased dramatically, with the majority of participants 45.5% using it at least once a week, and as many as 37.5% using it at least once a day.

Moreover, smartphones were the most used electronic devices by students to access e-learning platform as 74.3% of students shared. Close to a quarter of participants, 21.9% used laptops for e-learning purposes.

Table 2. Preparation for and use of e-learning

Item		Freq (n)	(%)
Trainings for using e-learning platform	Yes	184	41.9
	No	255	58.1
Ever used e-learning for learning purposes	Yes	408	92.7
	No	32	7.3
Ever used e-learning for learning purposes before COVID-19	Never	149	34.1
	At least once a day	60	13.7
	At least once a week	107	24.5
	At least once a month	121	27.7
Frequency of using e-learning platform since COVID-19	Never	29	6.6
	At least once a day	165	37.5
	At least once a week	200	45.5
	At least once a month	46	10.5
Used electronic device to access e-learning platform	Computer desktop	6	1.4
	Laptop	96	21.9
	Tablet	5	1.1
	Smartphone	326	74.3
	Not smart phone	5	1.1
	Other devices	1	.2

Factors that motivate students to use e-learning platform

Enablers and barriers to using e-learning platform were explored using a Likert scale from 1 (strongly disagree) to 5 (strongly agree). Cronbach's alpha coefficient was used to obtain internal consistency between the items in the scales and was found reliable with coefficients of 0.842 and 0.868 respectively.

The most motivating factor for students to use e-learning was that e-learning made learning objectives clear, with 38% strongly agreeing, and 35.8% agreeing. Similarly, students were motivated to use e-learning because learning materials were sequenced in a logical manner, as 36.3% agreed, and 31.3% strongly agreed.

Other motivating factors to use e-learning were that e-learning was engaging where 32.3% agreed, and e-learning makes instructional strategy friendly, with 31.6% agreeing. Instructors' motivation was identified as another facilitating factor for students' use of e-learning, as 21.5% and 30% strongly agreed and agreed respectively with the statement (Table 3).

Table 3. Motivating factors for using the e-learning platform

I am motivated to use the UR e-learning platform because of	SD Freq (%)	Disagree Freq (%)	Neutral Freq (%)	Agree Freq (%)	Strongly Agree Freq (%)	Median	Mode
Interaction with peers on the forum	68(16.2)	61(14.6)	124(29.6)	95(22.7)	71(16.9)	3	3
Interaction with instructors on the forum	48(11.7)	68(16.1)	111(27)	106(25.8)	80(19.5)	3	3
Engaging	39(9.6)	48(11.8)	112(27.6)	**131(32.3**)	76(18.7)	4	4
Quick technical support	70(17.2)	50(12.3)	125(30)	86(21.1)	77(18.9)	3	3
Instructors' motivation	40(9.7)	63(15.3)	97(23.5)	**124(30)**	89(21.5)	4	4
The instructional strategy is clear and friendly	38(9.2)	67(16.3)	100(24.3)	**130(31.6)**	76(18.5)	4	4
Learning materials are sequenced in logic manner	27(6.5)	30(7.2)	78(18.8)	**151(36.3)**	**130(31.3)**	4	4
Learning objectives are clear	21(5)	14(3.4)	74(17.8)	**149(35.8)**	**158(38)**	4	5

Factors inhibiting students from using the e-learning platform

Limited internet access was highlighted as the strongest barrier that hindered CMHS students from using e-learning, as 63.8% strongly agreed with the statement. Similarly, inadequate availability of devices for e-learning was identified as a barrier to its use, by 33.1% of participants who strongly agreed with the statement. Lack of training on the use of e-learning also constituted the third factor hindering students to use e-learning, evidenced by 30% of participants who strongly agreed. Finally, 25.2% strongly agreed that concern about accessing e-learning resources hindered them from effectively using e-learning.

Table 4. Barriers to using the e-learning platform

I find it difficult to use e-learning platform due to	SD Freq (%)	Disagree Freq (%)	Neutral Freq (%)	Agree Freq (%)	Strongly Agree Freq (%)	Median	Mode
Concern about access of learning resources	58(14.3)	67(16.5)	84(20.7)	86(21.2)	**111(25.2)**	3	5
Lack of instructive support	64(15.8)	57(14)	104(25.6)	85(20.9)	96(23.6)	3	3
Inadequate availability of hardware and software	49(11.9)	35(8.5)	82(20)	109(26.5)	**136(33.1)**	4	5
Lack of time	108(26)	78(18.8)	104(25.1)	68(16.4)	57(13.7)	3	1
Concerns about the quality of e-resources	71(17.4)	79(19.3)	108(26.4)	82(20)	69(16.9)	3	3
Lack of incentives to use e-learning	51(12.6)	57(14.1)	108(26.7)	107(26.5)	81(20)	3	3
Concern about security issues on internet	101(24.5)	77(18.7)	88(21.4)	64(15.5)	82(19.9)	3	1
Lack of credit towards promotion	60(14.6)	54(13.1)	122(29.6)	80(19.4)	96(23.3)	3	3
Self-intimidated by technology	99(24.1)	71(17.3)	96(23.4)	80(19.5)	65(15.8)	3	1
No role model to follow	116(28.5)	67(16.5)	95(23.3)	63(15.5)	66(16.2)	3	1
Lack of trainings	74(18)	60(14.6)	78(19)	75(18.3)	**123(30)**	3	5
Limited access to internet	23(5.4)	21(4.9)	38(8.9)	73(17.1)	**273(63.8)**	5	5

Correlation between demographic, preparation, motivation, and barrier variables

Analysis was done to test the level of correlation between selected variables such as age, preparation for e-learning and motivational factors, and barriers to using e-learning among students. Correlation was found to be significant at 0.05 level.

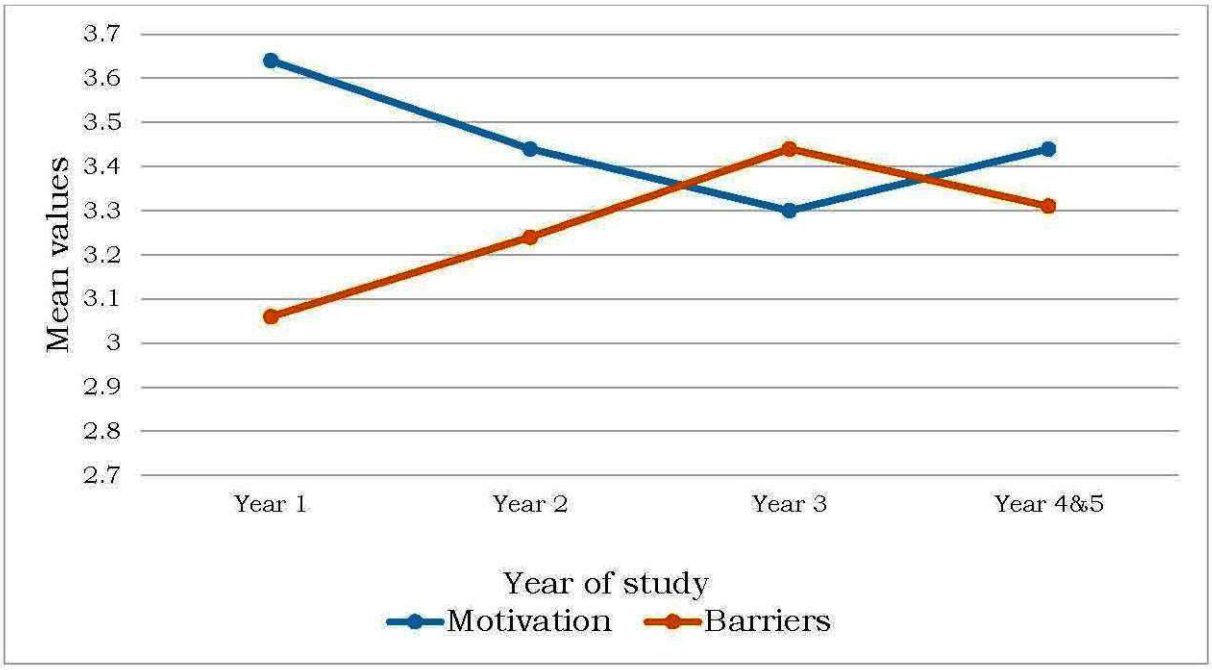

Figure 1. Mean differences of motivation and barriers using e-learning across years of study

Using the ANOVA test, the study compared the mean scores of motivation and barriers for using e-learning platform among students. Generally, motivation mean was high among first-year students and decreased as one ascends the academic years: year 1 (M=3.64), year 2 (M=3.39), year 3(M=3.30), year 4, and 5(M=3.44). Similarly, barriers to using e-learning were lower in year 1 and increased across the academic years: Year 1 (M=3.06), year 2 (M=3.24), year 3 (M=3.44), year 4, and 5 (M3.31). However, the motivation mean differences for using e-learning was statistically significant only in year 1 (M=3.64) compared with year 3 (M=3.30), p=0.021. Barriers to using e-learning were also significantly less in year 1 (M=3.06) compared with year 3 (M=3.44), p=0.007.

The ANOVA test also was used to analyze the motivation and barriers of students on basis of electronic device they use. To meet the parametric criteria for using ANOVA test, the number of those who used computer desktop, tablets, not smartphones, and others were combined into one variable known as others because the number of respondents into these categories were less than 30. Thus, three categories were compared: laptop, smartphone and others. Figure 2 shows the means differences of motivation and barriers among the students on basis of the tool they use to access e-learning platform.

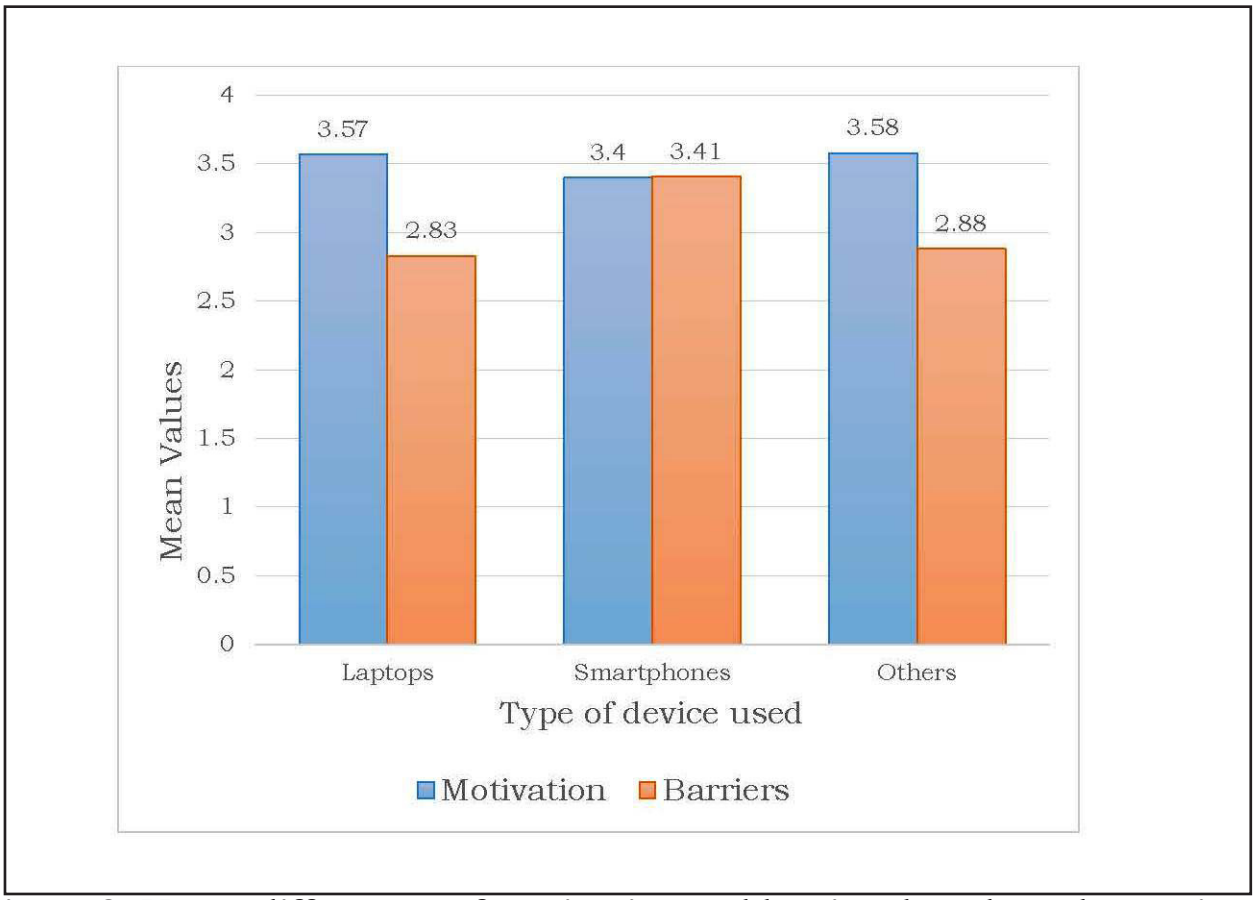

Figure 2. Means differences of motivation and barriers based on electronic device used for accessing e-learning platform.

The ANOVA results means differed according to device used: laptops (M=3.57), smartphones (M=3.40), others (M=3.58), although the difference was not statically significant p>0.05. The means for barrier scores were as follows: laptops (M=2.83), smartphones (M=3.41), others (M=2.88). However, barriers in those who used laptops were significantly less (M=2.83) compared to those who use smartphones (M=3.41), p<0.005.

Discussion

This study assessed the use of e-learning platform during the Covid-19 pandemic among health professional students in the College of Medicine and Health Sciences of the University of Rwanda. The study specifically assessed the preparedness of students to learn using e-learning, and the factors that motivate or inhibit them from adequately using e-learning.

Preparedness of learners towards the use of the e-learning platform

The study findings identified that CMHS students did not feel adequately prepared to use the e-learning platform. More than half of students who participated in the study had never received any training on the use of e-learning platform before using it, and a large number of students did not have any prior experience of using e-learning before the covid-19 lockdown. Hence, students reported not being adequately oriented on how to use e-learning, and consequently, they felt unprepared to effectively use it. This lack of preparation for e-learning has been confirmed by existing studies on online experience during the Covid-19 pandemic. Most studies identified that students were not adequately prepared for an online experience.[7,13] One of the possible reasons of this lack of students' readiness might be related to the rapid transition from the traditional learning environment to the digital environment as the only instructional approach to allow continued learning with social distancing measures.

However, even studies that have been conducted during non-pandemic periods have also identified that digital learning is likely to fail if institutions, faculty, and learners are not fully prepared and, hence, not ready for the transition.[14,15] Similarly, there is a wealth of evidence suggesting that effectively orienting students to online learning appears to be a vital factor in both their initial engagement and ultimate success in e-learning courses, since it is so important for students to become familiar with the online environment and the interactive tools they will be using to overcome anxiety, boredom and other technical issues.[16,17]

The current pandemic situation is a sign that e-learning should be more integrated into course delivery for health professionals. Since 2020, the University of Rwanda has embraced that move towards blended learning. Yet, these findings suggest that for effective and successful implementation of e-learning, adequate preparation of learners is crucial. Learners' technological competency and skills are one major factor of e-learning readiness that should be considered by institutions before its implementation.[18,19] An adequate needs assessment, considering the level of readiness of students, in terms of their technological competencies and their experiences in using e-learning platforms could allow the University of Rwanda to put in place strategies to facilitate students in making this shift.

Despite limited preparedness for online learning, students who participated in the study demonstrated motivation to adopt online learning. This was evidenced by more than 92.7% of the sample using online for learning, and 45.5% logging into the online platform at least once a week. This is in keeping with findings from previous studies done on medical, dental, and nursing students which have found that generally, students in health-related fields are more open to online learning.[6,14,15,20] Previous studies have identified that psychological readiness, focusing on an individual's state of mind and enthusiasm toward e-learning, is often high among health professional students, and facilitates their acceptance of a new way of learning despite other limitations.[14] This could also be relevant to students who needed to continue learning during the covid-19 pandemic, and online learning was offered as the only option.

Factors motivating students in using e-learning platform

Findings from this study suggest that students in CMHS are motivated to use the e-learning platform when the learning objectives are clear, the learning materials are sequenced logically, interactive and engaging, and when their instructors are motivated to engage them.

Similar to this finding, previous studies have found that the design of the e-learning materials significantly influences students' e-learning intention and attracts them to use it.[15,21]

Additionally, engaging e-learning resources containing online tests or quizzes, means of communication such as forums, emails, and instant messaging between users, interactivity, measurement of learning progress, and up to date information positively influence the use of e-learning platform.[22,23] It appears crucial that adapting the learning activities to an e-learning environment should be one prerequisite to transitioning from physical to digital classrooms.

Students' level in the program was found by this study as another motivating factor in the use of e-learning. Generally, motivation mean was high among year one students in all programs and decreased as one ascended the academic years. This finding corroborates those of other studies which found that medical students in higher levels of study were less ready to adopt e-learning than those in lower levels.[15,20] The heavy workload of health professional students in senior levels, heavy clinicals, coupled with the desire to complete the program might be the reasons why they tend to learn using their familiar traditional approach than adopting a new online approach.[15,20] Another possible explanation might be that freshman students have not yet been much exposed to traditional instructional approaches and might be more likely open to adopting any approach suggested to them, including e-learning.

Factors inhibiting students from adequately using the e-learning platform

Technological barriers related to inadequate e-learning infrastructure were identified by this study as the strongest factor inhibiting students from adequately using the e-learning platform. . Majority of students who participated in the study experienced limited access to internet connectivity and inadequate availability of devices for learning as hindering their effective use of e-learning. Although most of the full-time university students earned a government loan that includes a laptop to study through the government of Rwanda initiative, the majority of participants in the study (74.3%) used smartphones to access e-learning materials. Consequently, the ANOVA test revealed that those who used laptops encountered significantly less barriers (M=2.83) compared to those who use smartphones (M=3.41), $p<0.001$.

It is relevant to assume that navigating the e-learning platform such as the Moodle platform through a smartphone screen or downloading the learning materials on a smartphone would be more challenging than doing it through a laptop screen. Albo et al., conducted an experimental study to compare collaborative learning using smartphones versus laptops. Findings of their study confirm this current study, as they found that students who were using laptops were more engaged, demonstrated a more collaborative behavior, and were more satisfied with the overall learning experience than those who used smartphones.[24] The bigger screen offered by a laptop provided more comfort for watching the learning content than on a telephone screen [24]. Hence, this recurrent finding implies that part of the preparedness to using e-learning among students should be to assess the types of learning devices that would be used and adapt the e-learning platform to be more friendly user to such available devices.

In addition to facing equipment barriers, findings from this study also revealed that most students were often not able to afford bundles needed to cover their online learning in the required time. There are typical examples elsewhere, particularly within among developing countries. Inappropriate infrastructure and low internet bandwidth are the factors preventing the implementation of the e-learning approach in different universities across developing countries such as Ghana, Nepal, Nigeria, and Saudi Arabia.[6,13,15] Frustration and anxiety were reported during working on a very low internet connection that keeps loading and electricity that keeps cutting off.[25,26]

Although a government of Rwanda initiative was installed early following the total lockdown to increase the internet bandwidth and make e-learning platform free of charge for students, students reported having to often pay from their own bundles if the learning activities included content that required navigating outside the Moodle platform, while others experienced low internet connectivity and electricity issues. The issue of lack of access to electronic infrastructure was more relevant during the covid-19 pandemic mainly because students were meant to stay in their own homes, often located in the remote rural areas where access to electricity is even a challenge to students. This finding reiterates similar findings that identified socio-economic inequalities where students with a low socio-economic status, who live in poverty with limited availability of adequate technological infrastructure have been found to be at more risk of not accessing e-learning during the Covid-19 pandemic.[27]

Implications and Recommendations

While the Covid-19 pandemic constitutes a major disruption to education, many scholars view it also as a cutting-edge transformation toward a sustainable embracing of digital learning in higher institutions for health professionals.[8–10] For this transformation to be effective and sustainable, holistic preparation in terms of a supportive environment, technological competencies, adequate human and financial resources, adequate technological equipment and infrastructure, as well as appropriate content for courses must be the prerequisite conditions.[5,14,18]

It has been more than a year that the University of Rwanda shifted the instructional approach from predominantly physical to blended learning. However, like most other higher learning institutions worldwide, this shift took place during an emergency period, where preliminary planning and decision-making processes had not been done for that purpose. Now that the emergency period is over, it might be relevant to the University of Rwanda to re-think a shift that is better planned for the purpose.

Chapnick recommends to institutions envisioning an online learning approach to conduct their online readiness assessment before starting it. Elements to be assessed include aspects of psychological, sociological, environmental, human resources, financial, technological, equipment, and content readiness.[18] This readiness assessment would help the University of Rwanda College of Medicine and Health Sciences to identify their strengths and opportunities that could make their online approach a success and will help identify the existing needs that must be fulfilled before starting the online teaching approach.

Assessment should go beyond infrastructure readiness but also look at the competence of students in learning using e-learning. A well-planned orientation session for new students and ongoing refresher trainings for students should be included in the academic plan to equip students with skills to understand different features of the Moodle platform and their use. Students in this study felt motivated to learn online when the content is engaging. It is recommended to the CMHS to invest time, resources, and trainings in developing course contents that are tailored to online learning and are engaging enough to attract students.

A significant difference was identified that junior students were more motivated to use e-learning than their senior colleagues across all programs in the College of Medicine and Health Sciences. Further investigation is needed to comprehend this difference thoroughly. If the nature of the content for senior students is less adequate to be covered online, CMHS may put more effort into strategies to cover clinical and laboratory components of the programs virtually. These strategies may likely increase the motivation of senior health professional students in adopting e-learning.

Strategies must be put in place by the University of Rwanda and partners to improve accessibility to technological equipment for students, including reliable and less expensive internet connectivity, access to laptops, and improved access to electricity.

Ensuring that a good number of students get a loan for computers can increase the number of those accessing e-learning using smartphones with identified associated challenges found in this study. Long-lasting negotiations with local internet service providers to offer free or low-cost internet parks to students could improve accessibility to the online learning platform.

The College should also be mindful of the different emotional and mental wellbeing needs of students during a pandemic period like this. It might be that students are struggling to meet their day-to-day needs in their families. It might be also that health professional students who have not been engaged in online learning have been working as frontline helpers and are not in the state of learning. The economic and mental toll associated with the pandemic and the lockdown measures have been found to profoundly impact students' desire and motivation to learn, be it physically or virtually.[28] Hence, as recommended by the authors, during periods of pandemic uncertainty, students "must Maslow before they can Bloom" ,[28] and faculty should ensure that their students' well-being, experiences, and emotional needs become an important focus for learning during the pandemic.

Limitations

This study used an online questionnaire and only considered the responses of participants who returned the completed questionnaire. This constitutes a limitation since those students who were able to access the questionnaire could also be the ones that had access to the necessary equipment to use the e-learning platform. Thus, the experiences of students with limited internet access were not considered. Future studies should diversify the methods of data collection.

Conclusion

Lack of adequate e-learning infrastructure and students' unpreparedness were identified by this study as the strongest obstacles to proper e-learning uptake in Rwanda.

While the covid pandemic had caused significant distribution to health professional education in Rwanda, it has also brought a transformational opportunity to embrace a blended learning approach at the college of Medicine and Health Sciences of the University of Rwanda, which had never been possible before. To sustain such a transformation, proper and timely planning and strategies need to be invested, to provide a supportive e-learning infrastructure, minimize identified barriers and enhance the factors influencing its effective use. These may include increasing the technological competence of students, their access to technological equipment and the internet, and tailoring the course content to online learning.

Authors' contribution

All authors have contributed to this manuscript.

Conflict of interest

There is no conflict of interest.

This article is published open access under the Creative Commons Attribution-NonCommercial NoDerivatives (CC BYNC-ND4.0). People can copy and redistribute the article only for noncommercial purposes and as long as they give appropriate credit to the authors. They cannot distribute any modified material obtained by remixing, transforming or building upon this article. See https://creativecommons.org/licenses/by-nc-nd/4.0/

References

1. World Health Organization WHO. Coronavirus disease (COVID-19) pandemic [Internet]. 2020. Available from: *https://www.who.int/emergencies/diseases/novel-coronavirus-2019*
2. UNESCO. A Global Crisis for Teaching and Learning [Internet]. 2020. Available from: *https://teachertaskforce.org/knowledge-hub/covid-19-global-crisis-teaching-and-learning*
3. Hussein E, Daoud S, Alrabaiah H, Badawi R. Exploring undergraduate students' attitudes towards emergency online learning during COVID-19: A case from the UAE. *Child Youth Serv Rev [Internet]. Elsevier Ltd;* 2020;119:105699. Available from: https://doi.org/10.1016/j.childyouth.2020.105699

4. Ferri F, Grifoni P, Guzzo T. Online Learning and Emergency Remote Teaching: Opportunities and Challenges in Emergency Situations. *Societies*. 2020;10:86
5. Hodges C, Moore S, Lockee B, Trust T, Bond A. Remote Teaching and Online Learning. *Educ Rev* [Internet]. 2020;1–15. Available from: https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-
6. Neupane HC, Sharma K, Joshi A. Readiness for the Online Classes during COVID-19 Pandemic among Students of Chitwan Medical College. *J Nepal Health Res Counc*. 2020;18:316–9.
7. Amir LR, Tanti I, Maharani DA, Wimardhani YS, Julia V, Sulijaya B, et al. Student perspective of classroom and distance learning during COVID-19 pandemic in the undergraduate dental study program Universitas Indonesia. *BMC Medical Education*; 2020;20:1–8.
8. Rabe A, Sy M, Cheung WYW, Lucero-Prisno DE. COVID-19 and Health Professions Education: A 360° View of the Impact of a Global Health Emergency. *MedEdPublish.* 2020;9:1–17.
9. Lucey CR, Johnston CS. The transformational effects of COVID-19 on Medical Education. *JAMA - J Am Med Assoc.* 2020;324:1033–4.
10. Rose S. Medical Student Education in the Time of COVID-19. *JAMA - J Am Med Assoc.* 2020;323:2131–2.
11. Arandjelovic A, Arandjelovic K, Dwyer K, Shaw C. COVID-19: Considerations for Medical Education during a Pandemic. *MedEdPublish*. 2020;9:1–7.
12. Mtebe JS, Raphael C. Key factors in learners' satisfaction with the e-learning system at the University of Dar es Salaam, Tanzania. *Australas J Educ Technol*. 2018;34:107–22.
13. Aboagye E, Yawson JA, Appiah KN. COVID-19 and E-Learning: the Challenges of Students in Tertiary Institutions. *Soc Educ Res.* 2020;109–15.
14. Coopasami M, Knight S, Pete M. e-Learning readiness amongst nursing students at the Durban University of Technology. *Heal SA Gesondheid.* 2017;22:300–6.
15. Obi IE, Charles-Okoli AN, Agunwa CC, Omotowo BI, Ndu AC, Agwu-Umahi OR. E-learning readiness from perspectives of medical students: A survey in Nigeria. *Niger J Clin Pract.* 2018;21:293–300.
16. Carruth AK, Broussard PC, Waldmeier VP, Gauthier DM, Mixon G. Graduate nursing online orientation course: Transitioning for success. *J Nurs Educ.* 2010;49:687–90.
17. Jones KR. Developing and implementing a mandatory online student orientation. *J Asynchronous Learn Netw.* 2013;17:43–5.
18. Chapnick S. Are you ready for E-learning [Internet]. 2000. Available from: *http://marefateadyan.nashriyat.ir/node/150*
19. Khalid S, Jahan A, Sobhan MA. E-Preparedness of Students of Private Universities in Bangladesh for Blended E-Learning : A Case Study. 2014; Available from: *http://www.researchgate.net/publication/230585064_E-Preparedness_of_Students_of_Private_Universities_in_Bangladesh_for_Blended_E-Learning_A_Case_Study/file/79e*
20. Alsoufi A, Alsuyihili A, Msherghi A, Elhadi A, Atiyah H, Ashini A, et al. Impact of the COVID-19 pandemic on medical education: Medical students' knowledge, attitudes, and practices regarding electronic learning. *PLoS One* [Internet]. 2020;15:1–20. Available from: http://dx.doi.org/10.1371/journal.pone.0242905
21. Jovi M, Stankovic KM, Neskovic E. Factors Affecting Students Attitudes towards E-Learning. *Manag Solut Emerg Econ*. 2017;22:73.
22. FitzPatrick T. Key Success Factors of eLearning in Education: A Professional Development Model to Evaluate and Support eLearning. *Online Submiss*. 2012;9:789–95.
23. Alhabeeb A, Rowley J. E-learning critical success factors: Comparing perspectives from academic staff and students. *Comput Educ*. 2018;127:1–12.

24. Albó L, Hernández-Leo D, Moreno Oliver V. Smartphones or laptops in the collaborative classroom? A study of video-based learning in higher education. *Behav Inf Technol. Taylor & Francis;* 2019;38:637–49.
25. Becker K, Newton C, Sawang S. A learner perspective on barriers to e-learning. *Aust J Adult Learn.* 2013;53:211–33.
26. Naresh B, Reddy B. Challenges and Opportunity of E-Learning in Developed and Developing Countries-A Review. *Int J Emerg Res Manag &Technology.* 2015;2278–9359.
27. Adedoyin OB, Soykan E. Covid-19 pandemic and online learning: the challenges and opportunities. Interact Learn Environ [Internet]. *Taylor & Francis;* 2020;0:1–13. Available from: https://doi.org/10.1080/10494820.2020.1813180
28. Schlesselman LS, Cain J, Divall M. Improving and restoring the well-being and resilience of pharmacy students during a pandemic. *Am J Pharm Educ.* 2020;84:677–82.