Africa Development, Volume XLVIII, No. 2, 2023, pp. 129-158

(ISSN: 0850 3907) (https://doi.org/10.57054/ad.v48i2.5083)

Digital Learning Response in the Midst of the Covid-19 Pandemic: The Case of Mauritius

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Abstract

This article investigates learners' perception of their ability to adapt to online learning and the challenges they encountered as well as the opportunities they found in this new e-learning environment, in the midst of the Covid-19 pandemic. A comprehensive survey was undertaken using an online questionnaire circulated among male and female students across various faculties at five universities and business schools in Mauritius. The results indicate that Covid-19 was a major disruption in higher education studies. Despite the online learning approach, students enrolled in STEM degrees were more impacted compared to those in non-STEM degrees. Around one-third of the students asserted that online learning was a major challenge, more so for those in the lowest-income group who lacked the necessary digital tools to adapt to this new learning environment. A non-conducive home environment further had a negative bearing on students' concentration and ability to cope with their studies. We noted that postgraduate students adapt to digital learning better compared to undergraduates. There is thus a need to rethink, revamp and redesign the education system to be prepared for future shocks and build resilience through the application of best practices in the digitalisation of the education system.

Keywords: digital learning; learners' perceptions; higher education; STEM degrees; Covid-19

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Résumé

L'article étudie la perception qu'ont les apprenants de leur capacité à s'adapter à l'apprentissage en ligne et les défis qu'ils ont rencontrés ainsi que les opportunités qu'ils ont trouvées dans ce nouvel environnement d'apprentissage en ligne, au milieu de la pandémie de Covid-19. Une enquête exhaustive a été menée à l'aide d'un questionnaire en ligne distribué aux étudiants et étudiantes de différentes facultés de cinq universités et écoles de commerce de l'île Maurice. Les résultats indiquent que la pandémie de Covid-19 a fortement perturbé les études supérieures. Malgré l'approche de l'apprentissage en ligne, les étudiants inscrits dans les filières STIM ont été plus touchés que ceux des filières non STIM. Environ un tiers des étudiants ont affirmé que l'apprentissage en ligne constituait un défi majeur, surtout pour les étudiants les plus modestes qui ne disposaient pas des outils numériques nécessaires pour s'adapter à ce nouvel environnement d'apprentissage. Un environnement familial peu propice a également eu un impact négatif sur la concentration des étudiants et leur capacité à suivre leurs études. Nous avons constaté que les étudiants de troisième cycle s'adaptent mieux à l'apprentissage numérique que les étudiants de premier cycle. Il est donc nécessaire de repenser, de réorganiser et de redéfinir le système éducatif afin de se préparer aux chocs futurs et de renforcer la résilience grâce à l'application des meilleures pratiques en matière de numérisation du système éducatif.

Mots-clés : apprentissage en ligne ; perceptions des apprenants ; enseignement supérieur ; filières STEM ; Covid-19

Introduction

Since the Covid-19 pandemic started, much human activity has moved online (Donthu and Gustafsson 2020; Kramer and Kramer 2020). The education system has been no exception, and has encountered profound changes (Marinoni and Van't Land 2020). Education systems across the globe reacted to the pandemic by closing schools, universities and training institutions, and rolling out remote-learning options for students as an emergency response (World Bank 2021). The traditional models of learning and teaching proved to be redundant (Lemay and Doleck 2020). Thus, most higher education institutions have precipitated their move to online teaching and learning activities and have reconsidered ways of teaching and assessment (García-Peñalvo *et al*. 2021).

School closures in fact compounded an ongoing learning crisis for many. Education was disrupted across more than 191 countries and affected around 1.5 billion students and 63 million primary and secondary teachers (UNESCO 2021). In October 2021, 32 per cent of countries across the world

had fully or partially closed their schools and universities. The lengthiest closures were in South Asia, and Latin America and the Caribbean, with an average of 429 and 387 days, respectively (World Bank 2021).

The remote-learning response of countries as a result of the Covid-19 pandemic varied and included multiple modes. According to the World Bank Report (2021), most countries delivered remote learning via online media (91 per cent) and TV (85 per cent), followed by paper-based take-home materials (82 per cent) and mobile phones (70 per cent). A multimodal remote-learning approach was adopted by 97 per cent of countries within Latin America and the Caribbean, followed by 93 per cent in Europe and Central Asia and 80 per cent in the Middle East and North Africa (World Bank 2021). However, students and teachers worldwide have been struggling with this rapid transition to online learning, even those in countries with reliable infrastructure and household connectivity. Disparities in online learning are significant across low-income countries and in particular in the global South, where nearly 90 per cent of students in sub-Saharan Africa do not have computers at home while 82 per cent are unable to connect online (World Bank 2021).

On 20 March 2020, following the confirmation of the first Covid-19 cases in Mauritius, the government took bold action and announced a sanitary lockdown[1] of the island in a bid to stop the spread of the pandemic. Initially meant to last two weeks, the curfew was extended; it ended on 31 May. Schools and universities were closed from 19 March and students did not attend classes until 1 July 2020—a period of more than two months. This critical situation forced all educational institutions to adopt online teaching and learning almost overnight. Even the law was amended with respect to this in order to maintain a continuity of teaching and learning for all through remote learning and to mitigate the immediate impact of school closures, particularly for the most vulnerable. The Covid-19 (Miscellaneous Provisions) Bill and the Quarantine Bill facilitated digital education to ensure that learning remained uninterrupted during the Covid-19 outbreak.

While primary and secondary school in Mauritius involved a blend of distance and online learning, including broadcast lessons, higher education embarked mostly on online teaching and learning (including thesis supervision and assessments). The overnight shift from traditional classroom teaching and learning to online has had a number of implications and challenges for both lecturers and students at most universities, more so in that they were not fully prepared for such an abrupt switch. Most universities in Mauritius have now engaged with a blended teaching and learning approach. This is in a bid to reduce interaction between students and avoid crowds, hence minimising the spread of the virus and infection rates. For instance, the

island's oldest university, the University of Mauritius, offered more than 50 per cent of its modules online after the removal of mobility restrictions and all education institutions were reopened in July 2020.

With this sudden shift away from classrooms in Mauritius, the aim of this article is to investigate the learners' perception of online learning in the midst of the Covid-19 pandemic and evaluate the extent to which learning took place through digital means. It further investigates the opportunities and challenges of online learning to provide an assessment of the extent to which university students were able to adapt to this new learning and teaching method. Our focus will be on higher education given that the shift to online and now blended teaching and learning has been much more pronounced and appears to be increasingly the norm at this level.

To explore learners' perspectives, a comprehensive questionnaire was designed as per the online-learning climate scale model proposed by Kauffman *et al*. (2015). The target group was students enrolled in undergraduate or postgraduate degrees at public and private universities in Mauritius.[2] The questionnaire was circulated online to business and social sciences students across five universities; 575 usable responses were recorded. An analysis of the feedback enabled us to evaluate learners' perception of digital learning in the country and is meant to assist in the recommendation of measures that will optimise digital learning in higher education in Mauritius.

The rest of this paper is organised as follows: the next section is a brief review of the related literature, followed by the methodology, survey design and sampling; then an analysis and discussion of the results, and the conclusions and policy recommendations.

Literature Review

Theoretical review and conceptual framework of an online learning environment

The traditional classroom is no longer the only place to get access to formal education. The brick-and-mortar structure of learning has lost its importance mainly with advances in technology and the Internet. Today, the Internet has made online learning possible and students as well as educators find that it enhances the learning process (Nguyen 2015). Online learning consists of purely online and hybrid learning. The purely online programme refers to programmes delivered completely over the Internet while the hybrid or blended mode combines online and traditional in-class learning (Nguyen 2015). The online learning environment is considered to be in a unique cultural context. Cyberspace is identified by Benedikt (1991) to have 'a

geography, a physics, a nature, and a rule of human law'. Learners have predeterminations when they come to online learning. Further, Kirby and Boak (1987) argue that Internet skills alone are not enough to determine competency in Internet usage. It is important to note that learners' Internet efficacy allows them to efficiently cope with the necessities of working in this environment. Hence, teachers must make sure that learners are able to use technology and access the Internet effectively.

The technology-enhanced learning environment can be used to discuss the concept of online learning. It refers to the application of technology in the context of education in order to help the process of learning and ease the communication between students and educators. More so, it helps to diffuse multimedia teaching materials as well as motivate students to engage in research and discuss actively their personal understandings in online discussion forums (Tsai 2017). With technology, students can develop better methods of learning (Tsai 2009). The different technology-enhanced learning methods are mobile learning, Internet-assisted learning, global learning and online education.

Learning environments can be defined as a composite and dynamic system where certain strategies are applied and the available resources are used to attain certain planned learning goals. There are four core components of a technology-enhanced learning environment, illustrated in Figure 1.

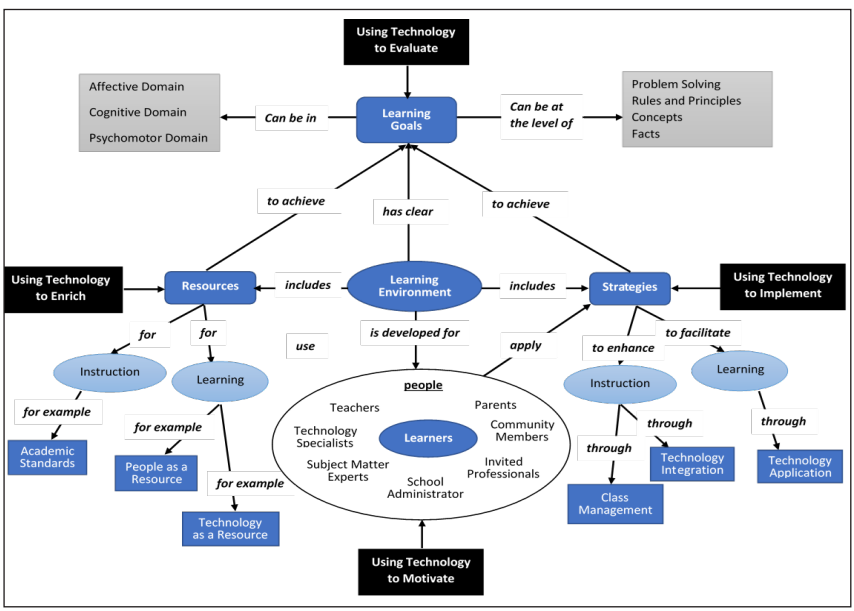

Figure 1: Core components of a technology-enhanced learning environment
Source: Wang and Kinuthia, 2004

The four core components of a technology-enhanced learning environment, as per Wang and Kinuthia (2004), comprise:

1. Technology used to evaluate learning goals.
2. Technology used to motivate learners and other stakeholders.
3. Technology used to enrich resources.
4. Technology used to implement strategies.

These four components function together to ensure a dynamic learning environment. The authors specify that any learning environment should have learning goals and these could be in any sphere of learning, such as affective, cognitive and psychomotor, and at any levels of learning, such as the learning of concepts, rules, principles, facts and so on. More so, learning goals will help to decide the resources, people and the different strategies needed in the learning environment. People are also crucial in the learning environment. In fact, they are at the centre of this environment. Initially, the people involved in the learning environment are learners and educators. However, there are other people involved in this chain. These include parents, school administrators, technology specialists, and so on. In addition, the learning environment is enhanced with resources, which are identified as the third core component. These include human resources, financial resources, information and technology resources, and learning and instructional resources. While information and technology resources include all technology equipment, learning resources include all materials needed for learning. Teaching plans and similar documents are the instructional resources. Finally, strategies imply the intellectual efforts needed to use the different skills and resources to achieve the goals effectively and efficiently. These include learning strategies, instructional strategies and management strategies. The strategies enhance and facilitate learning.

These core components are interrelated and combined in a unified system in order to result in a dynamic learning system. A technology-enhanced learning environment makes use of technology to motivate its learners. The way learning materials are presented and discussed creates a strong motivation for learners. Technology enables learners by providing well-defined guidance, instant feedback and immediate satisfaction to both learners and educators. Technology provides the learning resources needed for specific learning tasks.

Literature Review

In line with the objectives of this paper, we review the existing empirical literature that assesses the extent to which online learning and teaching were adopted and improved across countries in the wake of the pandemic,

students' adaptation to the online learning environment, their ability to cope with online learning, class interactions and collaboration, and the challenges they encountered and opportunities gained from the online learning setting.

While several scholars have discussed the benefits of using online learning platforms (video-based learning, online group learning, one-to-one online learning and so on), their effectiveness, accessibility and limitations need to be accounted for (Lorenzetti 2013). Evidence shows that higher education has received more attention when it comes to online learning (Hachey *et al*. 2022). This is explained by the greater costs of higher education and the importance of a higher degree to secure a better-paid job (Dynarski and Scott-Clayton 2013). Online learning represents an effective tool to reduce the cost of higher education and facilitates access to a greater number of students (Bartley and Golek 2004; Bowen 2013). It is a learning environment that is distinct from face-to-face learning (Bazelais, Doleck and Lemay 2018).

Studies prior to the start of the Covid-19 pandemic have analysed the relationship between students' perceptions of online learning practices, the learning climate and social belonging across age and gender (Navarro and Shoemaker 2000; Rovai and Jordan 2004; Nguyen 2015; Koohang *et al*. 2016; Gómez-Rey, Barbera and Fernández-Navarro 2017; Cole, Lennon and Weber 2019). There is evidence that students are greatly satisfied with online learning and that their learning outcomes are as good as or even better than those of traditional learning (Navarro and Shoemaker 2000; Bernard *et al*. 2004). Students tend to benefit more from online and blended learning compared to the traditional learning in classrooms as these technologies contribute towards cognitive support and improve student interaction with educators or among students themselves.

Zhang and Wang (2006) show that interactive videos are crucial as they help students to better analyse the subject, which results in an enhanced understanding of the study materials. Software like 3D technology and multidimensional representations have made online learning the same as classroom learning or even better. Feeley and Parris (2012) show that online learning results in better learning outcomes and enhanced learning perceptions as well as increased motivation to learn. Students also have a greater sense of community in an online and blended learning environment compared to the traditional classroom (Rovai and Jordan 2004). These positive learning results include higher test scores (which implies improved learning), enhanced use of class materials, better learning perception, improved sense of community among students, lower rate of failures, and fewer dropouts from the educational institutions (Nguyen 2015). Gonzàles-Gómez, Jeong and Rodríguez (2016) also highlighted the benefits of online

learning in terms of making the learning environment a more social, flexible and personal platform, which in turn promotes student-centred learning and a social-constructivist approach to learning.

However, online learning does have its limitations and existing empirical works have noted that it cannot replace all the activities that normally take place in a face-to-face learning environment. Students also have reservations about the technological proficiency and adequate course designs of online education. In some studies, they noted that students who followed the course online performed worse on assessments than those in the same course in the traditional environment (Saghafi, Franz and Crowther 2014). In effect, both learning settings complement each other and therefore a blended learning approach is the preferred option (Northey *et al*. 2015).

Cole-Lewis, Ezeanochie and Turgiss (2019) argue that a successful online learning environment must address the social dimension to counter the absence of physical interactions and overcome the distance component. Active and interactive learning strategies are vital in creating opportunities for more connection and exchange (Doleck, Bazelais and Lemay 2017; Kaufmann and Vallade, 2020). Pokhrel and Chhetri (2021) identify some broad challenges encountered with e-learning, namely: accessibility, flexibility, affordability, learning pedagogy and lifelong learning and education policy. Similarly, Arslan (2021) and Hehir *et al*. (2021) argue that hybrid courses result in less interaction with the subject materials and a feeling of isolation, and these contribute towards low achievement. Low performance was also attributed to the fact that students had issues dealing with several concepts and with insufficient teaching compared to in-class learning. Reduced in-person interaction between learners and educators may cause major challenges in the long run. Students perceived that there were advantages and disadvantages to online learning (Ebner and Gegenfurtner 2019).

The transition to remote learning has also been studied in the wake of the Covid-19 pandemic. Studies like Simamora *et al*. (2020) investigated lecturers' perspectives on e-learning during the Covid-19 pandemic in higher education in Indonesia. Their results show that online learning applications are beneficial for some lecturers to deliver lecture materials without face-to-face interactions but there are major obstacles, like inadequate Internet access. Technological developments and appropriate infrastructure facilities are vital in supporting online learning and in making it effective. Similarly, Paudel (2020) examined the forceful shift in the mode of learning and teaching from face to face to online in Nepal's higher education sector, across a sample of 280 teachers and students from five universities. Their findings indicate that the benefits derived from online education were in terms of

greater connection with practitioners and the global community as well as to a huge and authentic resource of knowledge. However, major challenges were noted in terms of Internet connectivity, limited time-management skills and computer literacy.

Akuratiya and Meddage (2020) assessed students' perception of online learning during the Covid-19 pandemic across 130 students at the ATI in Dehiwala, Sri Lanka. Their results reveal that 62.5 per cent had little or no experience with online learning prior to Covid-19, and with the rapid shift to digital means with lockdown measures, around 55 per cent showed their preference for the blended learning of traditional and online learning. Students connected to the Internet mainly via smartphone (around 44 per cent). Many challenges to learning were reported, however, in terms of reduced interaction between lecturers and friends (64.1 per cent), social isolation (55.5 per cent) and technical problems (57 per cent). These challenges notwithstanding, there was a favourable perception of online learning in terms of easy access to online materials and ability to learn at their own pace. Around 83 per cent of students stated that they would include online learning in their course in the future.

Likewise, Elshami *et al.* (2021) analysed the satisfaction of students and teachers with online learning during the Covid-19 pandemic among 358 students and 70 teachers in the United Arab Emirates. They observed that around 72 per cent of students and 82 per cent of teachers had no prior experience with the online learning and teaching environment. In addition, 69 per cent of students were less satisfied with online learning and 42 per cent would not recommend this mode. However, 63 per cent of teachers were more satisfied with online than in-person learning.

Lemay, Bazelais et Doleck (2021) analysed student perceptions of the transition to online learning in North America, reporting that two-thirds had difficulty concentrating in online learning, which led to a high level of stress and anxiety. Students preferred to get back to in-class instruction and wanted institutions to reopen after the different waves of Covid-19. Their results show the high emotional and psychological toll of fully remote learning during the pandemic when social connection was lacking after so many months of enforced social distancing and isolation. The social and affective dimension of online learning (Calderón-Garrido, León-Gómez and Gil-Fernández 2021) thus becomes important for students and educators.

Similarly, Li *et al.* (2021) assessed the perceptions of students on online learning during Covid-19, based on a large nationally representative sample across ninety medical schools in China. Their results show that around 62 per cent of students were either satisfied or extremely satisfied with the

online learning programmes during the pandemic. However, they also encountered a number of issues, the most common of which were network congestion (77 per cent), limited interaction between learners and educators (45 per cent), lack of timely feedback (10 per cent), and poorly prepared materials by instructors (6 per cent).

In line with the existing literature, this paper uses Mauritius as a case study to study the transition to online learning as a result of the Covid-19 pandemic. Compared to the extant work, this paper builds on the theoretical framework of Wang and Kinuthia (2004) to assess different components of the online learning environment via learning goals, motivation of learners, digital means used to enrich resources, and how to implement strategies for an effective technological approach to ensure adequate online learning. Our study involved a large sample of students across various universities and business schools in Mauritius. Mauritius is an important case study because, as a resource-poor country, human capital is its only resource where economic progress and development depends entirely on an educated labour force. Covid-19 highly impacted on the education system of the country, with lost school days and difficulties for certain segments of the population to connect to the digital environment. Hence, Mauritius represents a pertinent case study to assess the adoption and coping ability of students in an online learning environment.

Data and Methodology

Guided by the conceptual framework of Kauffman (2015), our methodology rests on a survey of 575 students in various areas of study enrolled across five different universities and business schools. First, the quantitative approach helped us to investigate university students' perception of online learning in the midst of the Covid-19 pandemic. Second, the survey questionnaire made it appropriate to model the broad range of factors that affect the performance and satisfaction of learners within the online learning environment. Lastly, the paper evaluates the opportunities as well as the challenges of online learning.

Data and sampling strategy

In 2019, a total of 48,568 students were enrolled in higher education in Mauritius, with 41,451 (85 per cent) studying locally and 7,117 overseas (Higher Education Commission 2020). There were fifty-four higher education institutions in December 2020, including forty-four registered private higher education institutions and ten publicly funded higher

education institutions (Higher Education Commission 2020). The study focuses on five main local institutions, whose students totalled around 30,467. This represents 75 per cent of the total number of students across higher education institutions in Mauritius.

The random sampling technique was adopted to ensure that each student had an equal chance of being selected. As such the comprehensive survey undertaken via an online questionnaire was circulated to male and female students at different schools or faculties of five universities and business schools. All the students could access the link to the online platform and each student of these selected universities carried an equal opportunity of being chosen as a part of the sampling process.

We used two important statistics—the survey's margin of error, and confidence level—to ensure that the sample represented the population. An 'acceptable' margin of error is between 4 per cent and 8 per cent at the 95 per cent confidence level (Hazra 2017). We calculated the margin of error at different sample sizes to determine the actual sample size. With a margin of error of 4 per cent and a 95 per cent confidence interval, the sample size was 589 respondents. We managed to get 575 responses with a margin of error of 4.1 per cent. This means that the statistics are within 4.1 percentage points of the real population value 95 per cent of the time.

Survey questionnaire

Prior to the finalisation of the survey instrument, we undertook a pilot of the questionnaire. After taking on board comments received, a revised questionnaire was uploaded online and the web link was shared with students at the different universities and business schools. The questionnaire includes information pertaining to sociodemographic profile as well as information linked to the different dimensions postulated in the theoretical framework. The various elements covered in the questionnaire relate to the impact of Covid-19 on the student's learning environment, their ability to adapt to the online learning environment, their views on online instructions and, lastly, on class interactions within the online teaching environment. Confidentiality of information was strictly maintained. There was no access to students' responses and the information gathered was not used to identify respondents' records. Responses were accepted at face value and there was no data extrapolation. We also took note that perceptions are subjective and that different students will have different, but equally valid views.

Data Analysis and Findings

This section depicts an analysis of the data collected from the survey of 575 students doing part-time and full-time undergraduate and postgraduate degrees in different universities and business schools.

Learner characteristics

Table 1 shows the sociodemographic profile of learners surveyed across the five main universities in Mauritius. In the sample, there is a higher percentage of young women (67 per cent) relative to young men (33 per cent). This is in line with the gender distribution of the overall population of students enrolled in higher education in Mauritius—58 per cent female and 42 per cent male (Statistics Mauritius 2020). The growth of women's participation in higher education has been stronger than that of men over the recent years with young women outnumbering men and this trend is accelerating year upon year in many other countries.

Table 1: Descriptive Statistics—Sociodemographics of Learners Surveyed

VARIABLES	%	VARIABLES	%
Gender		**Age categories**	
Female	66.84%	<20	8.29%
Male	33.16%	20–24	81.69%
Programme enrolled		25–29	6.39%
Postgraduate	5.87%	30–34	1.55%
Undergraduate	94.13%	35–39	0.86%
Full time/ Part time		40–44	0.69%
Full time	89.46%	45–49	0.17%
Part time	10.54%	55–59	0.35%
Area of study		**University attended**	
Agricultural food and science	4.49%	Middlesex University	1.90%
Agricultural production and systems	4.32%	Open University	0.35%
Applied sustainability and enterprise development	0.17%	Rushmore Business School	0.17%
Biosciences and ocean sciences	0.17%	Université des Mascareignes	24.00%
Civil engineering	2.25%	University of Mauritius	73.56%

Digital technologies	2.07%	**Household income categories**	
Economics and statistics	12.95%	Less than MUR 10 000	14.68%
Electrical and electronic engineering	3.11%	MUR 10,001–14,999	17.96%
Finance and accounting	42.14%	MUR 15 000–MUR 29 999	32.47%
Health sciences	0.17%	MUR 30 000–49,999	25.22%
Information and communication technologies	5.18%	MUR 50 000–100,000	8.46%
Law	0.17%	More than MUR 100,000	1.21%
Management	14.68%	**Performance (in terms of CPA)**	
Mathematics	0.52%	Less than 40	2.49%
Mechanical and production engineering	0.86%	40–49	3.39%
Social studies	1.21%	50–59	17.19%
Software and information systems	5.53%	60–69	41.18%
		70–80	34.16%
		More than 80	1.58%

Source: Authors' computation from survey, 2020

Most students (around 89 per cent) were enrolled in full-time programmes in various areas of specialisation, from agriculture to information and communication technologies, electrical and electronic engineering, economics and statistics, management and finance and accounting. A high percentage of respondents were enrolled at the University of Mauritius (74 per cent), which is the main publicly funded university. It usually registers the highest number of students compared to other local institutions and is an averagely selective institution with an admission rate of around 70 per cent to 80 per cent for locals. From the profiling exercise, a student in higher education in Mauritius is likely to be aged between twenty and twenty-four years, enrolled in a full-time undergraduate degree mainly in soft sciences like management, finance, accounting or business at the University of Mauritius. Respondents were also asked about their average monthly household income and the data reveals that 32.5 per cent are in the average household income category of MUR 15,000–29,999, followed by 25.2 per cent with a household income ranging between MUR 30,000 and 49,999.

Impact of Covid-19 on students in higher education institutions

Although higher education institutions have been quite fast in replacing face-to-face lectures with online learning, learning and examinations have been highly impacted by the pandemic and lockdown. Perhaps most importantly, the crisis raises questions about the value offered by a university or business school education, which includes networking and social opportunities as well as educational content.

Online platforms such as Google Meet, Zoom, Microsoft Teams, Skype, Google Classroom, Moodle and YouTube videos were the main ones used across the local universities surveyed. Online learning tools ranged from educational content (which students could probe at their own discretion), to formalised learning programmes (conducted at their own pace), to real-time lessons (led by teachers using virtual meeting platforms). There has been a pedagogical shift from the traditional method to the modern approach of teaching-learning, from classroom to Zoom, from personal to virtual and from seminars to webinars (Mishra, Gupta and Shree 2020). Lederman (2020) stated that due to the pandemic instructors and learners found themselves in a situation where they were compelled to adopt the digital academic experience in the teaching-learning process.

The survey found that there were various tools used to ensure that learning took place during the lockdown and during the post-lockdown period. In essence, remote learning became a lifeline for education, and the opportunities that digital technologies offer go well beyond a stopgap solution (Schleicher 2020). In the sample, around 52 per cent of learners spent between two and four hours daily on online lectures and tutorials, while 34 per cent spent less than two hours and 14 per cent spent more than more hours on online learning. Across gender, a higher percentage of male students (15 per cent) spent more than four hours on their online course daily compared to their female counterparts (13 per cent). Around 35 per cent of young women spent less than two hours on their studies online relative to 32 per cent of young men.

The most immediate impact of Covid-19 was the temporary suspension of classroom activity in higher education institutions, which left students—particularly undergraduates—in a completely new situation, without a clear idea of how long the impact would last and feeling its immediate effect on their daily life and on the continuation of their

studies. They had to connect with their instructors online to ensure that the materials were covered and completed. In terms of the frequency of connecting with instructors online during the lockdown, the survey shows that 27.6 per cent of learners met their teachers virtually once a week and 27.8 per cent did so a few times a week. Again, a gender differential was noted, with male learners being more frequent in their interaction with their teachers—32.3 per cent met virtually a few times a week (compared to 25.6 per cent for female learners), 8.9 per cent once a day (relative to 7.5 per cent of female students) and 6.8 per cent several times a day (compared to 4.7 per cent of female learners). Most female students met their instructors virtually once a week (30.2 per cent).

Further, students were asked about the extent to which Covid-19 had disrupted their studies. Table 2 presents the findings, where it is noted that around 43 per cent of learners found that the pandemic was somewhat disruptive to their studies and around 28 per cent stated that it was very disruptive. In contrast to Mugo, Odera and Wachira (2020), who show a disproportionate effect of the Covid-19 pandemic on women in higher education, there is not much difference across gender in our sample, while differences across areas of study are noted. Students from the fields of mechanical and production engineering, civil engineering as well as mathematics found the impact of the pandemic very disruptive to their studies. An in-depth analysis of the data shows that students enrolled in STEM degrees were more likely impacted by the pandemic compared to those in non-STEM degrees. This may be explained by the nature of the modules, being highly technical and mathematical.

It can also be observed that students with a lower average household income (less than MUR 30,000) experienced very disruptive effects of the pandemic on their studies. This could be attributed to a number of factors, namely lack of resources, IT equipment, and irregular or no Internet connection, among others. The survey participants were asked whether they used their own laptop or desktop or that of their parents/siblings for online learning. We note that 20 per cent of those in the lower income bracket of less than MUR 30,000 used the IT equipment of their parents and siblings. In terms of Internet connection, most respondents used their own Wi-Fi connection and only a small percentage used mobile data or that of their neighbours.

Table 2: The Impact of Covid-19 on University Students' Learning

How Disruptive Has The Covid-19 Outbreak Been To Studies Of University Students?	NEUTRAL	NOT DISRUPTIVE AT ALL	NOT SO DISRUPTIVE	SOMEWHAT DISRUPTIVE	VERY DISRUPTIVE
Gender					
Female	9.82%	1.29%	15.50%	45.48%	27.91%
Male	13.02%	6.77%	15.10%	38.02%	27.08%
Total	10.88%	3.11%	15.37%	43.01%	27.63%
Areas of study					
Agricultural food and science	11.54%	3.85%	3.85%	57.69%	23.08%
Agricultural production and systems	0.00%	8.00%	16.00%	52.00%	24.00%
Civil engineering	15.38%	15.38%	7.69%	23.08%	38.46%
Digital technologies	16.67%	0.00%	0.00%	58.33%	25.00%
Economics and statistics	6.67%	2.67%	16.00%	46.67%	28.00%
Electrical and electronic engineering	11.11%	0.00%	16.67%	50.00%	22.22%
Finance and accounting	10.66%	2.05%	18.03%	40.98%	28.28%
Information and communication technologies	16.67%	3.33%	13.33%	43.33%	23.33%
Management	9.41%	1.18%	15.29%	44.71%	29.41%
Mathematics	0.00%	0.00%	33.33%	33.33%	33.33%
Mechanical and production engineering	40.00%	0.00%	0.00%	20.00%	40.00%
Social studies	14.29%	0.00%	14.29%	57.14%	14.29%
Software and information systems	21.88%	9.38%	12.50%	28.13%	28.13%
Total	10.88%	3.11%	15.37%	43.01%	27.63%

Household income categories					
Less than MUR 10,000	16.47%	1.18%	15.29%	37.65%	29.41%
MUR 10,001–14,999	0.00%	28.57%	14.29%	28.57%	28.57%
MUR 15 000–29 999	15.38%	3.85%	11.54%	37.50%	31.73%
MUR 30 000–49,999	10.11%	2.66%	16.49%	43.09%	27.66%
MUR 50 000 - 100,000	7.64%	2.08%	16.67%	47.22%	26.39%
More than MUR 100,000	6.12%	6.12%	16.33%	51.02%	20.41%
Total	10.88%	3.11%	15.37%	43.01%	27.63%

Source: Authors' computation from survey, 2020

The main concerns of students during the lockdown, when universities and business schools had to move to an online environment, were the loss of contact with their instructors, followed by difficulties in keeping up with coursework and assignments, being physically isolated from classmates, and inability to keep up with extra-curricular activities. Figure 2 shows these concerns by gender. While female students were more worried about keeping up with assignments and coursework, male learners were more apprehensive of the loss of contact with professors.

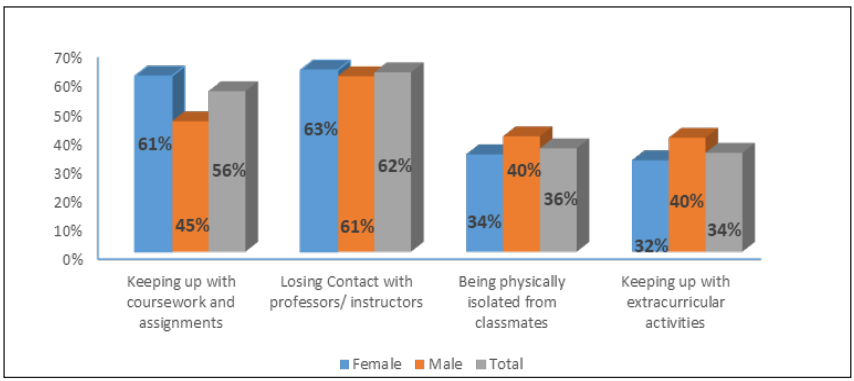

Figure 2: Learners' concerns about university shifts to an online learning environment during Covid-19, by gender

Source: Authors' computation from survey, 2020

Table 3: Online Versus Classroom Learning

Do You Prefer Online Learning More Than Face-To-Face Lectures?	NEUTRAL	NOT AT ALL	NOT SO MUCH	QUITE	VERY MUCH
Gender					
Female	12.40%	21.71%	37.47%	18.09%	10.34%
Male	20.31%	19.79%	25.52%	19.27%	15.10%
Total	15.03%	21.07%	33.51%	18.48%	11.92%
Programme of study					
Postgraduate	14.71%	11.76%	11.76%	11.76%	50.00%
Undergraduate	15.05%	21.65%	34.86%	18.90%	9.54%
Total	15.03%	21.07%	33.51%	18.48%	11.92%
Area of study					
Agricultural food and science	23.08%	15.38%	42.31%	15.38%	3.85%
Agricultural production and systems	24.00%	0.00%	36.00%	28.00%	12.00%
Civil engineering	15.38%	23.08%	46.15%	15.38%	0.00%
Digital technologies	25.00%	25.00%	33.33%	16.67%	0.00%
Economics and statistics	6.67%	30.67%	30.67%	17.33%	14.67%
Electrical and electronic engineering	16.67%	11.11%	33.33%	5.56%	33.33%
Finance and accounting	13.11%	23.36%	39.75%	14.75%	9.02%
Information and communication technologies	30.00%	16.67%	23.33%	13.33%	16.67%
Management	16.47%	20.00%	27.06%	21.18%	15.29%
Mathematics	0.00%	33.33%	33.33%	33.33%	0.00%
Social studies	0.00%	14.29%	57.14%	14.29%	14.29%
Software and information systems	18.75%	15.63%	9.38%	37.50%	18.75%

To What Extent Have You Been Able To Cope With Online Learning?	NEUTRAL	NOT AT ALL	NOT SO MUCH	QUITE	VERY MUCH
Gender					
Female	21.96%	2.58%	25.84%	37.73%	11.89%
Male	20.31%	3.13%	23.44%	34.38%	18.75%
Total	21.42%	2.76%	25.04%	36.61%	14.16%
Programme of study					
Postgraduate	2.94%	0.00%	20.59%	38.24%	38.24%
Undergraduate	22.57%	2.94%	25.32%	36.51%	12.66%
Total	21.42%	2.76%	25.04%	36.61%	14.16%
Area of study					
Agricultural food and science	30.77%	3.85%	11.54%	50.00%	3.85%
Agricultural production and systems	32.00%	0.00%	8.00%	32.00%	28.00%
Civil engineering	15.38%	0.00%	23.08%	30.77%	30.77%
Digital technologies	25.00%	0.00%	58.33%	8.33%	8.33%
Economics and statistics	20.00%	2.67%	29.33%	29.33%	18.67%
Electrical and electronic engineering	16.67%	0.00%	11.11%	50.00%	22.22%
Finance and accounting	23.77%	3.28%	26.64%	37.70%	8.61%
Information and communication technologies	23.33%	3.33%	23.33%	36.67%	13.33%
Management	16.47%	2.35%	23.53%	38.82%	18.82%
Mathematics	0.00%	33.33%	33.33%	33.33%	0.00%
Mechanical and production engineering	0.00%	0.00%	20.00%	60.00%	20.00%
Social studies	14.29%	0.00%	42.86%	28.57%	14.29%
Software and information systems	15.63%	3.13%	25.00%	37.50%	18.75%

Source: Authors' computation from survey, 2020

Adapting to online learning and meeting learning objectives

Digital technology proposes new answers to the questions of what people learn, how they learn, and where and when they learn. It has enabled teachers and students to access specialised materials well beyond textbooks, in multiple formats, and in ways that can bridge time and space. Hence, students were asked about their preference for face-to-face or online teaching. The data shows that 33.5 per cent of students did not like online learning much, with 37 per cent of female students asserting that they did not like it so much compared to 25.5 per cent of male learners. Only 18 per cent of students in the survey showed some preference for online learning, while 12 per cent had a high preference for the online mode of delivery compared with face-to-face sessions. Across degrees, postgraduate students preferred online learning, whereas undergraduate students tended to choose face-to-face instruction.

By study discipline, students of electrical and electronic engineering, ICT and software and information systems preferred online learning. Those students who preferred face-to-face sessions and did not like the online mode of delivery at all, were mainly from mathematics and the soft sciences, with around 33 per cent of students from mathematics, followed by 31 per cent from economics and statistics, 23 per cent from finance and accounting and 20 per cent from management.

The survey also probed students' ability to cope with online learning during and after the Covid-19 lockdown. Overall, around 37 per cent were quite able to manage, 27.8 per cent were not able to cope, while 14 per cent stated that they could adapt easily with the online delivery mode of lectures and tutorials. In terms of gender, male students were able to cope better with the online learning environment than female learners. An important difference is noted between undergraduate and postgraduate students, where the latter seem to have coped successfully (38.2 per cent) compared to undergraduates (12.7 per cent). By area of study, a higher percentage of learners from civil engineering (31 per cent), agricultural production and systems (28 per cent), electrical and electronic engineering (22 per cent) and mechanical and production engineering (20 per cent) adapted to the online learning environment. Students in STEM programmes are in a better position to adapt and cope with the new technologies compared to those in non-STEM degrees.

Students were also asked whether or not the learning objectives of their modules/ courses had been met by their online lectures. Table 4 indicates that postgraduate students and male learners felt that the learning objectives were met though the online teaching environment. In contrast, most female and undergraduate students stated that the learning objectives were only partially met.

Table 4: Achieving Learning Objectives via Online Lectures

	NEUTRAL	NOT AT ALL	NOT SO MUCH	QUITE	VERY MUCH
Gender					
Female	29.46%	3.88%	24.03%	32.56%	10.08%
Male	27.60%	3.65%	19.79%	33.85%	15.10%
Total	28.84%	3.80%	22.63%	32.99%	11.74%
Programme of Study					
Postgraduate	29.41%	0.00%	8.82%	20.59%	41.18%
Undergraduate	28.81%	4.04%	23.49%	33.76%	9.91%
Total	28.84%	3.80%	22.63%	32.99%	11.74%
Area of study					
Agricultural food and science	38.46%	3.85%	11.54%	38.46%	7.69%
Agricultural production and systems	32.00%	0.00%	8.00%	48.00%	12.00%
Civil engineering	23.08%	7.69%	7.69%	53.85%	7.69%
Digital technologies	50.00%	0.00%	33.33%	8.33%	8.33%
Economics and statistics	24.00%	5.33%	32.00%	26.67%	12.00%
Electrical and electronic engineering	22.22%	0.00%	11.11%	44.44%	22.22%
Finance and accounting	28.28%	3.69%	27.05%	31.56%	9.43%
Information and communication technologies	40.00%	3.33%	10.00%	26.67%	20.00%
Management	30.59%	4.71%	18.82%	36.47%	9.41%
Mathematics	0.00%	33.33%	33.33%	33.33%	0.00%
Mechanical and production engineering	40.00%	0.00%	20.00%	40.00%	0.00%
Social studies	14.29%	0.00%	28.57%	28.57%	28.57%
Software and information systems	25.00%	3.13%	15.63%	31.25%	25.00%
Total	28.84%	3.80%	22.63%	32.99%	11.74%

Source: Authors' computation from survey, 2020

Information was also gathered on the clarity of the online courses, assignments and the instructions provided on the use of technology adopted during the course. The majority of students surveyed postulated that the online courses were appropriately organised and proper guidelines were provided on assignment and digital tools.

Class interaction and collaboration in the online learning environment

There is increasing evidence that classroom techniques designed to get students to participate in the learning process produce better educational outcomes at virtually all levels (Reuell 2019). Students learn better when they are actively engaged in the learning process, rather than just passively listening to a lecture. The survey analyses the online class interactions among students and between the instructor and the learners. The data shows that 37 per cent of students felt that student-to-student interaction in an online learning environment was important, 24 per cent stated that it was very important while for 27 per cent interaction among students was somewhat important. This interaction was extremely important for undergraduates (25 per cent) compared to postgraduates (12 per cent). This can be explained by the fact that undergraduate learners spend relatively more time on campus and this contact plays an important role in their learning environment. It is very important for learners to comfortably interact with each other, ask questions and contribute to group work. When students and teachers are physically distant, which is the case in online learning, it becomes more critical to create a social connection (Lee *et al.* 2020). Students were also asked whether they found that the instructor was respectful, understanding and supportive during this challenging period of the lockdown. The majority of learners surveyed were of the opinion that their instructor(s) were very accommodating and helpful.

Challenges and opportunities of online learning

The Covid-19 pandemic has raised significant challenges for the higher education community worldwide. Table 5 shows the challenges encountered by students in adapting to the online teaching-learning process. In the main these were lack of concentration in an online learning environment, noise and disturbances at home which prevented them from concentrating, followed by the fact that they found it difficult to ask questions during online lectures or tutorials. Song *et al.* (2004) showed that lack of communication and technical problems were most challenging for online learners. Our results show that the home environment also plays an important role in the ability of the learner to concentrate and benefit fully from online learning.

Table 5: Challenges of Online Learning

CHALLENGES	AGREE	DIS-AGREE	NO OPIN-ION	STRONG-LY AGREE	STRONG-LY DIS-AGREE
I find online learning time-consuming	20.21%	39.38%	20.21%	6.56%	13.64%
Computers are too compli-cated for me	4.84%	41.11%	9.33%	1.21%	43.52%
I get Internet problem at home and thus cannot always follow online classes	29.19%	33.16%	13.64%	6.56%	17.44%
Internet connection is costly and thus cannot always connect online for studies	16.06%	40.24%	23.66%	4.49%	15.54%
At home there is lots of noise/disturbance and I cannot concentrate	31.95%	24.87%	12.09%	20.38%	10.71%
I should share my laptop/ desktop with my siblings who are also studying online	24.35%	28.32%	12.26%	13.82%	21.24%
I feel it difficult to ask questions to my lecturer on an online platform	30.40%	21.24%	18.31%	19.00%	11.05%
I can concentrate more in a classroom environment than online	25.73%	14.51%	15.89%	35.75%	8.12%

Source: Authors' computation from survey, 2020

Next, the survey probes the opportunities from online learning as seen from the students' perspective. Table 6 shows that around 57 per cent of students found online learning interesting while around 55 per cent stated that the assignments presented to them during the course were clearly set out. However, interaction among students and between the instructor and the learner remains a hurdle in the online delivery mode across undergraduate and postgraduate degrees.

Table 6: Opportunities of Online Learning

OPPORTUNITIES	AGREE	DIS-AGREE	NO OPIN-ION	STRONG-LY AGREE	STRONG-LY DIS-AGREE
I find online learning interesting	43.01%	15.72%	21.24%	13.82%	6.22%
The assignments presented to me during the course were clear	42.66%	19.69%	20.21%	12.26%	5.18%
Interacting with my classmates online allows me to build a strong relationship with them	17.62%	25.73%	26.25%	8.81%	21.59%
E-learning allows a more effective interaction between the student and teacher than face-to-face classes	15.20%	31.78%	22.28%	8.46%	22.28%
E-learning gives the lecturer the chance to guide, discuss and answer students' questions more than the traditional teaching	21.76%	27.98%	21.76%	8.29%	20.21%
All the skills I have learned via e-learning are useful and effective	37.82%	10.02%	31.26%	13.82%	7.08%

Source: Authors' computation, Survey 2020

Conclusion and Policy Implications

The paper adopts the technology-enhanced learning environment model as per Wang and Kinuthia (2004) to assess perceptions of students on online learning in Mauritius and their ability to adapt to this new digital environment. Based on our findings, it can be noted that the pandemic disrupted undergraduate and postgraduate studies across five universities and business schools in Mauritius. Around 43 per cent of learners in the survey found that the pandemic was somewhat of a disruption to their studies and around 28 per cent stated that it was very disruptive. One implication of the results can be found at the theoretical level, where the technology-enhanced learning environment framework can be extended to incorporate external factors, such as shocks like the Covid-19 pandemic, and thus could be tested in the context of exclusive online teaching and learning.

Further, our study shows that though there is no gender divergence in terms of the impact of the pandemic on female and male learners, students from various fields were affected differently. Those in the fields of mechanical and production engineering, civil engineering as well as mathematics found the impact of the pandemic very disruptive to their studies. It can be postulated that students enrolled in STEM degrees were more impacted by the pandemic compared to those in non-STEM degrees. Hence, there is a need to adapt the online learning environment and tools to the specificities of different areas of study. Universities must consider moving non-STEM online in times of shocks like the Covid-19 pandemic, but for classes that require a hands-on lab component, institutions may wish to keep those courses in-person while ensuring physical distancing and other safety measures to prevent the spread of the virus.

In terms of their ability to adapt to online learning, our results reveal that around 37 per cent were quite able to manage, 27.8 per cent were not able to cope, while 14 per cent stated that they could adapt easily to the online delivery mode. Students encountered difficulties in coping with this new learning tool, as important elements—like social connection and exchange between learners and educators and among learners themselves, conflict resolution and creative problem-solving—were missing. Social connections remain a fundamental issue to be dealt with but this was especially so in the midst of the Covid-19 pandemic.

Social media can be used by higher education institutions to promote teaching and learning and motivate students to be active participants as well as establish connections in the university community. Social media platforms like Facebook, Instagram Information and Twitter, among others, offer the chance for students to develop self-confidence to participate within teams, build trust between peers and allow for in-depth discussions. Social media networking enables communication in real time and across different regions and countries.

The results further reveal that students enrolled in STEM programmes were in a better position to adapt and cope with the new online tools compared to non-STEM students. STEM students tend to have more extensive exposure to technology, time-management and self-directed learning so they adapt more readily to online learning than others. Thus, it may serve as a best-practice approach to train non-STEM and STEM students and faculties on using educational technology in online-learning courses before starting the semester or at the onset.

There is also evidence that the home environment may not be supportive of or conducive to online learning, as the main challenge reported by learners was the lack of concentration in an online learning environment with noise and disturbances at home. Parents should be clearly guided as to their needs of their children in terms of an adequate learning setting at home that will enable them to concentrate better on their studies. The findings further indicate that students from low-income groups have greater difficulty adapting to the new online-learning environment. Hence, increased access to hardware and Internet connectivity for all students is fundamental to access courses and resources remotely. Some students may need more help than others in accessing these digital devices, so these specificities should be considered by higher education institutions.

Lastly, it is high time for countries like Mauritius to rethink, revamp and redesign their education system to remain relevant to the present Covid-19 situation. Universities will need to reinvent their learning environments so that digitalisation expands and complements student–teacher relationships. Effective modes of instructions using the latest digital tools must be a priority for heads of institutions. Interaction remains the main element in making an effective online-learning environment. At the same time, offering varied modes of instructions can adapt to the different needs of students. For universities to adjust to these changing conditions, there should be greater investment in digital technology and online programmes. There is a need to pool resources and develop high-quality online courses together. Plans for adopting digital technology to uphold student learning outcomes via refined assessment and designed courses in a student-centred manner remain a must.

Notes

1. On 24 March 2020, the Prime Minister of Mauritius announced that the country would be under complete lockdown until 31 March 2020, with only essential services such as police, hospitals, dispensaries, private clinics, fire stations and banks being open. All other activities would be banned during the curfew period including supermarkets.
2. In December 2018, there were 10 publicly funded institutions operating in Mauritius (with the main ones being the University of Mauritius, University of Technology Mauritius, Mauritius Institute of Education, Mahatma Gandhi Institute, Université des Mascareignes and Open University of Mauritius). In addition, 55 private institutions (the main ones being Charles Telfair Institute, Middlesex University (branch) and Rushmore Business School) were registered locally, providing higher education in diverse fields, from certificate to doctorate

level, with the awarding bodies mostly based overseas. Out of the total number of tertiary students who study in Mauritius, over 23,000 were registered in the publicly funded universities and over 1,700 were in local private universities, with a predominantly female composition of around 60%.

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