Perceptions of COVID-19 and the demand for integrated virtual educational system in Developing countries: Evidence from students in Senegal.

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Abstract

COVID-19 emerged in the late 2019 and has since being a global pandemic. One sector that is hardly hit is the educational sector, especially as schools must be closed and restrictions on movements of people introduced and enforced. To offset its impacts, several interventions including the virtual learning platforms in all stages of learning were introduced. This study analyzed the perceptions of tertiary students on COVID-19 and the demand for integrated virtual educational system in Senegal. This involved 297 students in second year or higher in the university. The results established mixed perception of students on COVID-19 which feed into the public perceptions on the pandemic in the country. Generally, there is a low interest of students on integrated virtual education, and this was influenced by factors such as low access to quality Wi-Fi services and access to scholarship education. It is recommended that the school authorities must ensure an improved internet services on campus while national policies designed to reduce the cost on internet services.

Keywords: COVID-19; University Cheikh Anta Diop; Virtual tertiary Education; Perception; Senegal.

1. Background

The coronavirus (COVID-19), also known as SARS-CoV-2 was first observed in Wuhan, China, and has spread across the globe. On March 2020, the global spread of the virus has led to its declaration by the World Health Organization (WHO) as a global pandemic (Jackson et al., 2020). Globally, as at 5:14pm CEST, 23rd April 2021, a total of 144,358,956 COVID-19 cases were confirmed with a total of 3,066,113 confirmed COVID-19 deaths (WHO, 2021). It is transmitted by human-to-human (AL-Rasheedi et al., 2021) and have had significant impacts on the global economy and all aspects of life. Such impacts include morbidity and mortality (Wake, 2020) and decline in economic growth (Jackson et al., 2020). This confirms

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the theory of Arrow (1963) and Grossman (1972) for whom health is an essential component of human capital and therefore participates strongly in economic growth as indicated by the theories of endogenous growth (Lucas, 1988; Romer,1990).

The World Bank (2020) and Jackson et al. (2020) descried the pandemic as one with the largest economic impact in decades. However, the impact on human health was observed to vary based on social status variables such as income and education. The notable risk factors to COVID-19 include male sex, advanced age, and presence of comorbidities such as hypertension, diabetes mellitus, cardiovascular diseases and cerebrovascular diseases (Soumya et al., 2020; Madjid et al., 2020). This link between the initial health stock, age and the current health status of an individual was shown theoretically by Grossman (1972). Indeed, according to the author, the health status of an individual deteriorates with age and also depends on the initial health stock. This is why COVID-19 may affect older people and/or those with comorbidities more. Because COVID-19 is novel, its impacts, control and prevention were unknown at its onset. However, with uncertainty, several efforts at the global level -led by WHO- and local government institutions were implemented to combat the pandemic.

Faced with a strong demand for care, a care offer should be proposed by the pharmaceutical industries (research laboratories). Thus, through research and development, vaccines have been found (Johnson & Johnson, Astrazeneca...) to mitigate the impacts of the pandemic. Unfortunately for sub-Saharan Africa, recovery is expected to be slow especially because the countries in the region have weak health systems, and already the fiscal policy space was constrained even before COVID-19. The incapability of the region to ensure its citizens adhere strictly to social distancing protocol also worsened the pandemic (World Bank, 2020).

The United Nations Educational, Scientific and Cultural Organization (UNESCO) indicated that by April 2020, about 181 countries had to shut all schools and institutions of higher learning, and this affected about 89.4% of total global enrolled leaners which dropped to 72.4% from 77 countries in May 2020 (Marinoni et al., 2020). The closure of Senegalese schools and universities between from March 2020 was one of the first measures taken by the Senegalese government to deal with the epidemic. Schools were closed for more than eight months before being reopened and learners and teachers were obliged to adhere to COVID's prevention rules. This closure results in unlearning among learners and the deterioration of human capital. Indeed, Becker (1964) shows the role of education on human capital.

Networking and social opportunities among learners were disrupted with the advent of the pandemic (OECD, 2020). In Kenya for instance, Ngwacho (2020) indicated that the main impact of COVID-19 on education is the widened distance between the learners and the instructors. To reduce the impact of the pandemic on education, countries and educational institutions have introduced measures such as provisioning of digital learning devices, financial support to schools and students as well as the provisioning of fund for safety and cleaning of COVID-19 equipment (OECD, 2020).

It is thus evident that there is a shift in teaching and learning approaches as a mitigation to the impacts of COVID-19. For many, the usual classroom (face-to-face) teaching and learning environment are being replaced by distance teaching and learning (virtual or online) approaches (Marinoni et al., 2020). This shift

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also comes with its own challenges among which are providing the needed technical infrastructure, the competences and pedagogies for the approach and the variation in the needs of different fields of study (Marinoni et al., 2020). The pandemic has therefore boosted innovations (technical services for distance learning) in several areas including education through research and development. This shows the role of innovations in economic and social development as indicated by the theory of human capital Romer (1990). Learners from advantaged homes, for instance those with financially advantaged parents, are able to continue learning even when schools are shut down (OECD, 2020) and this creates diverging impacts of COVID-19 on students. COVID-19 has thus created inequalities in virtual education between learners from rich and poor families. This is consistent with studies analyzing innovation as a source of inequality (Aghion and Howitt, 1998). The digital gap where the vulnerable students have less resource for virtual education has been acknowledged. Ngwacho (2020) estimated that about 89% of students in sub-Saharan Africa do not have access to home computers and 82% do not have internet access. This can hinder virtual learning.

The case of Senegal is not unique as the COVID-19 has disrupted the educational process and has led to the implementation of virtual learning especially in the higher educational institutions. Based on the Schumpeterian theory (Schumpeter, 1964), Senegal has thus made a process innovation in education by introducing virtual learning to circumvent the negative effect of the pandemic on education. Indeed, African universities are repeatedly faced with serious difficulties in managing the number of students in the classroom, with strong social pressure to access higher education combined with a shortage of teachers and insufficient intake capacity (Mbengue & Meinertzhagen, 2019). The emergence of new information and communication technologies (NICT) has encouraged the use of innovative distance learning materials. Strengthening the use of Information and Communication Technologies (ICT) in education (interconnection of higher education institutions); improving the quality of teaching and learning by building, equipping and rehabilitating colleges, high schools, institutes and universities, improving the learning environment and reforming the initial and in-service teacher training system and curricula are two objectives of Senegal's Strategic Plan for Education and Training (PAQUET 2013-2025). These are defined in the Plan Senegal Emergent (PSE), which constitutes the frame of reference for the Senegalese government's economic and social policy in the medium to long term (République du Sénégal, 2014). Given the government's intention to make digital education a priority, the budget for higher education, Research and Innovation has been increased by 121% from, 203 to 450 billion CFA francs between 2020 and 2021 (Diouf, 2020). With the already increasing number of enrolled students plus the now COVID-19 justifies the need for distance learning. In this pandemic context, even though distance learning seems to be more of a health security rather than a question of comfort (Ollivier, 2020), the academic year 2020-2021 is marked at UCAD by the bimodal teaching introduced by its authorities.

An important question that should be addressed is whether the introduction of virtual learning platforms into higher education can become the common practice, especially with global technological advancement? Through the collection of learners' opinions, the general objective of this paper is to provide policy makers with the needed information to enhance decision making that can benefit all stakeholders in the educational

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sector. The results present cogent views that are relevant for the consideration by the education ministry of the country and other policy makers in the education sector.

The rest of the paper is paper is organized as followed: section two covers the methodology, section three presents and discusses the results and section four concludes and provides some policy implications.

2. Methodology

University Cheikh Anta Diop was chosen for this case study because it is the prime university of the country and Dakar the hardest hit city by COVID-19 in the country. The University (known in French as Université Cheikh Anta Diop-UCAD) is located in Dakar, the capital city of Senegal. It is the oldest university among the French colonies in West Africa as it roots date back to 1918. It was created by the French to serve a particular purpose and was then named African Medical School (known in French as École Africaine de Médecine). The university has gone through several phases and currently named in honor of the Senegalese philosopher and anthropologist, Cheikh Anta Diop, in 1987 as Cheikh Anta Diop University. UCAD runs programs such as Humanities, Sciences, Engineering, Medicine, Finance, Accounting, and Law, among others and offers degrees up to post graduate level. It offers both residential and non-residential education to students. The University of Dakar welcomes nearly 90,000 students from all over West Africa.

2.1 Sampling and data

A simple random sampling was used in selecting students of UCAD at year two or higher. The non-first year students were selected because such students have had some experience on academic work at the tertiary level and would be able to provide accurate expression on the impact of COVID-19 on tertiary education in the country. The data was collected through questionnaires. A total of 320 students were selected for the study. Because the students can read and write, each selected student was given a printed copy of the questionnaire and were required to return the filled questionnaire to a collection point. The questionnaire involved the perceptions of the students on COVID-19 as well as its impacts on academic performance. The data was collected in March 2021, after a reasonable period of the emergence of the COVID-19 virus in the country. At the end of March, the returned questionnaires were collected for analysis. Overall, only 297 questionnaires were returned and out of which 249 were completely and accurately completed. This represents a response rate of 77.8%. Hence the study proceeded with analyzing the data of the 249 students.

2.2 Data analysis

The data was analyzed using descriptive statistics and a probit regression. The perceptions of the students were analyzed using percentage distribution of a five-point Likert scale. A probit regression was estimated to understand the factors that influence the choice for an integrated virtual tertiary education in Senegal. Two groups of students were identified by the study, those who agreed and those who disagreed for an integrated virtual tertiary education in Senegal. This gave a binary response, therefore, purpose of the probit

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model is to estimate the probability that a student with a given characteristic would choose an integrated virtual tertiary education or not. The probit model is defined as:

$$y_i = \beta' x_i + u_i \qquad (1)$$

Stating the underlying response variable as y^*

$$y_i^* = \beta' x_i + u_i \qquad (2)$$

where x_i is a vector of exogenous variables that influence y_i, β_i is a vector of parameters and u_i is the noise term having constant variance and zero mean. In practice, y^* is not observed, instead a dummy variable that is defined as:

$$y = \begin{cases} 1 \ if \ y_i^* > 0 \\ 0 \ if \ y_i^* \leq 0 \end{cases} \qquad (3)$$

From equations 2 and 3,

$$P(y = 1|x) = P(y_i^* > 0|x) = P(u_i > -\beta' x_i) = 1 - F(-\beta' x_i) \qquad (4)$$

Since the probit model assumes that u_i is normally distributed $[N(0, \sigma^2)]$, then:

$$F(-\beta' x_i) = \int_{-\infty}^{-\beta' x_i/\sigma} \frac{1}{(2\pi)^{1/2}} exp\left(\frac{-t^2}{2}\right) dt = \Phi(x'\beta) \qquad (5)$$

Given a likelihood function and the distribution function, the marginal effects of x_i is give as:

$$\frac{\partial}{\partial x_{ij}} \Phi(x'\beta) = \emptyset(x'\beta)\beta_j \qquad (6)$$

Empirically, the factors influencing student's decision to opt for an integrated virtual tertiary education is given as:

$$\begin{aligned} Integrated \ virtual \ education \\ = \beta_0 + \beta_1 Age + \beta_2 Sex + \beta_3 Parent's sponsorship + \beta_4 Scholarship + \beta_5 Wi \\ - fi \ quality + \beta_6 Specialization + \beta_7 COVID - 19 \ perception + \beta_8 COVID \\ - 19 \ education \ perception \qquad (7) \end{aligned}$$

Table 1: Definition of variables

Variable	Definition
Age	Total number of years of a student from birth to the time of data collection.
Sex	Dummy: 1 if a student is a male and 0 if a female.
Parents' sponsorship	Dummy: 1 if student's education is sponsored by parents and 0 if other sources.
Scholarship	Dummy: 1 if a student is under any educational scholarship and 0 if not.
Wi-Fi quality	Dummy: 1 if a student perceives the school Wi-Fi have a fast internet speed and stable network and 0 if otherwise.
Specialization	Dummy: 1 if a student is in a specialized program and 0 if not yet selected in a specialized program.
COVID-19 perception	An index of student's perceptions on what COVID-19 is.
COVID-19 education perception	An index of student's perceptions on the effect of COVID-19 on education.

Source: Prepared by authors from data analysis

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3. Results and discussions

3.1 Level of risk with COVID-19

Figure 1 shows the students perceptions on their level of risks to COVID-19, that is, how likely they are to contract COVID-19. Overall, about one in every ten students indicated very high risk and no risk to COVID-19 while about one in every four students indicated low risk to COVID-19. The perception on risk is important for the decision making of individuals on adherence to COVID-19 safety protocols. In a related study, Ding et al. (2020) and Abdelhafiz et al. (2020) respectively found that about 85% of college students in China and 86.9% of Egyptians were worried that their families could contract COVID-19. Among medical students, Soltan et al. (2020) estimated that 76.3% of the students perceived being at risk to COVID-19 during ward rotation and consistent with the present study, Soltan et al. (2020) found 33.9% of the students perceived being at risk for being a medical student. Generally, WHO (2020) indicated that although secondary and higher schools are at risk to COVID-19 more than in primary and elementary schools, transmission between student-to-student is rare. A study by Chesser et al. (2020) also indicated that one of the most notable belief students hold against COVID-19 is the fear that they and the associates could contract the disease.
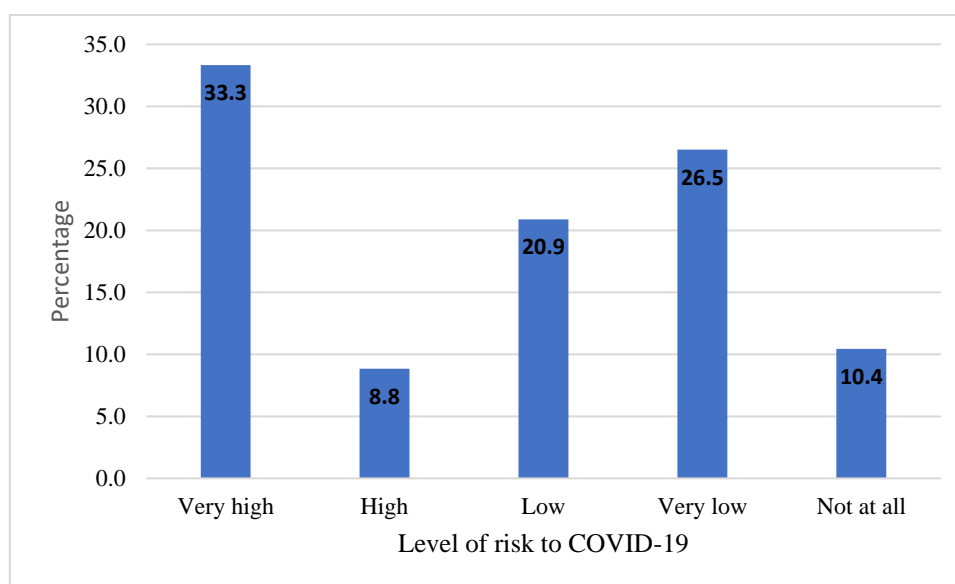

Figure 1: Students perception on their risk levels to COVID-19

Source: Calculated by authors from selected data

3.2 Perceptions of COVID-19

Table 2 revealed the level of agreement on a set of perception indicators on COVID-19. From the result, 77.6% of the students at least agreed that COVID-19 is real and not imaginary. This is against the myth especially at the beginning of its emergence that COVID-19 is not real. While 18.5% of the students are indifferent as to whether the pandemic is real or not, 4% of them clearly disagreed that it is real. About 57% of the student either agreed or strongly agreed that COVID-19 occurred as a punishment from God or Allah to mankind. Thus, about one in every two students expressed that mankind have engaged in lifestyles

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that contradicts God or Allah's purpose and as such, COVID-19 is a reward for such sinful acts. Relatedly, Habib et al. (2021) found that 60% of urban and peri-urban dwellers in northern Nigeria perceived COVID-19 as a punishment from God. Such findings raise concern over the importance of religion in disaster risk management. As high as one-third of the students were indifferent in attributing the emergence of COVID-19 to God or Allah but could not rule-out its possibility. Over half the interviewed students agreed that the government does not provide accurate information on the number of reported cases and recoveries. Meanwhile, people who have confidence in the political leadership in their management of the COVID-19 pandemic perceives lower risk to the virus (Shao & Hao, 2020).

Most of the students disagreed that COVID-19 is an elite and 'rich' people's disease. This is tested against the backdrop by some citizens that COVID-19 is contracted mostly by people who are rich especially on the account that they often travel to other parts of the world where the pandemic is high. Although this maybe a myth, it is also true that the first reported cases were imported, hence, juxtaposing that most people feel that it is the rich who travel to the western countries, it justifies the expression of the respondents. However, this can be described as myth because of the community spread of the disease, without a respect of person as poor or rich. Relatedly, most of the students were indifferent on whether the pandemic is a western world disease or not. They are indifferent because they although they are aware that COVID-19 emerged from China, they agreed it is certainly a global pandemic. For one in every two students respectively indicated that COVID-19 is deadly but also, there is an exaggeration on the impact of the COVID-19.

Table 2: Perceptions on COVID-19 pandemic

Perception	Level of agreement (%)				
	Strongly agreed	Agreed	Neutral	Disagreed	Strongly disagreed
It is real and do exist	38.6	39.0	18.5	2.0	2.0
It occurred as a punishment from God/Allah to mankind	27.3	29.7	30.5	7.6	4.8
The government is not truthful with information on the number of COVID-19 cases in the country	34.5	23.7	28.1	7.2	6.4
COVID-19 is an elite and rich people's disease	12.1	10.0	35.3	22.9	19.3
It is too exaggerated	22.9	28.1	28.5	10.0	10.4
It is a creation of the Western world	15.3	16.9	43.0	14.9	10.0
It is too deadly	23.7	29.3	28.9	14.5	3.6

Source: Calculated by authors from selected data

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2.3 Perceptions on the effect of COVID-19 on education

COVID-19 has had effects on all aspects of life including education. Therefore, the students were asked specific effects of COVID-19 on tertiary education and the results presented in Table 3. About one in every two students agreed or strongly agreed that there is a decline in socialization among students. This is because of the general restriction on movement and social activities in the school. This is consistent with the high percentage of the students who indicated a decline in interaction among students and the relationship between students and lecturers. The result of Browning et al. (2021) also indicated that there is a change in behavior among students due to COVID-19 is a decline in socialization. The majority of the students also at least agreed that COVID-19 has created panic among the students, and this has affected learning among students. For many students, the emergence of the pandemic has affected them psychologically and for their minds are also with fear of contracting the disease, hence inability to learn. About seven in every ten students expressed that there is an increase in education expenditure due to the COVID-19 pandemic. This was attributed to the adherence to the safety protocols such as buying of sanitizers and nose masks and virtual learning costs such as buying of internet. However, Browning et al. (2021) found that only 4.2% of students raised concerns over the potential or actual financial challenges due to COVID-19.

COVID-19 has been recognized as one the greatest pandemic over centuries. In fact, the most perceived risk factor for the next decade is infectious diseases (World Economic Forum, 2021). Consistently so, 67.5% of the students perceived that COVID-19 poses the greatest threat to them in life, and considering the effect of risks on students, it is expected that these perceptions have negative implications on the school attitude and academic performance of the students. Related to this study, Soltan et al. (2020) found that 83% of students have the feeling that COVID-19 is a life threatening disease while students in the study of Chesser et al. (2020) generally agreed that it is a major global health threat. Also, about 59% of the students did agreed that COVID-19 has led to a delay in academic calendar. Eight in every ten students and seven in every ten students noted a decline in happiness in school and a decline in overall academic performance, respectively.

Table 3: Perceptions on the effects of COVID-19 on education

Perception	Level of agreement (%)				
	Strongly agreed	Agreed	Neutral	Disagreed	Strongly disagreed
It reduces socialization among students	26.9	24.5	25.3	16.1	7.2
It creates panic among students thereby affects the learning abilities	30.5	37.0	20.1	6.8	5.6
It leads to increase in expenditure on education	30.9	39.0	20.1	6.4	3.6
Over my entire school life, COVID-19 pose the greatest threat to me	39.0	28.5	21.7	7.2	3.6
It reduces group studies among studies	31.3	37.0	23.3	6.0	2.4
It reduces student-lecturer relationship	32.1	37.4	21.3	6.8	2.4

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It causes academic delay	29.7	28.9	24.5	8.0	8.8
The level of happiness on campus is reduced due to COVID-19	49.4	31.3	13.7	2.4	3.2
My overall academic performance would reduce due to COVID-19	44.8	27.4	16.9	6.1	4.8

Source: Calculated by authors from selected data

3.4 Relationship between perceptions of COVID-19 pandemic and perceptions on the effect of COVID-19 on academic work

Figure 2 shows the relationship between the indices of the perceptions on the COVID-19 and the perceptions on the effect of COVID-19 on education. This shows that there is a positive correlation between these two perception variables. Thus, students who strongly agreed on the outline indicators on COVID-19 (Table 2) also strongly agreed on the outlined indicators on the effect of COVID-19 on education, vice versa. A correlation analysis shows a coefficient of 0.36 and this was statistically significant. This generally revealed that students who are knowledgeable about the pandemic are also knowledgeable on its impacts. Dryhurst et al. (2020) indicated that risk perception correlated with the adoption of preventive health behaviors.
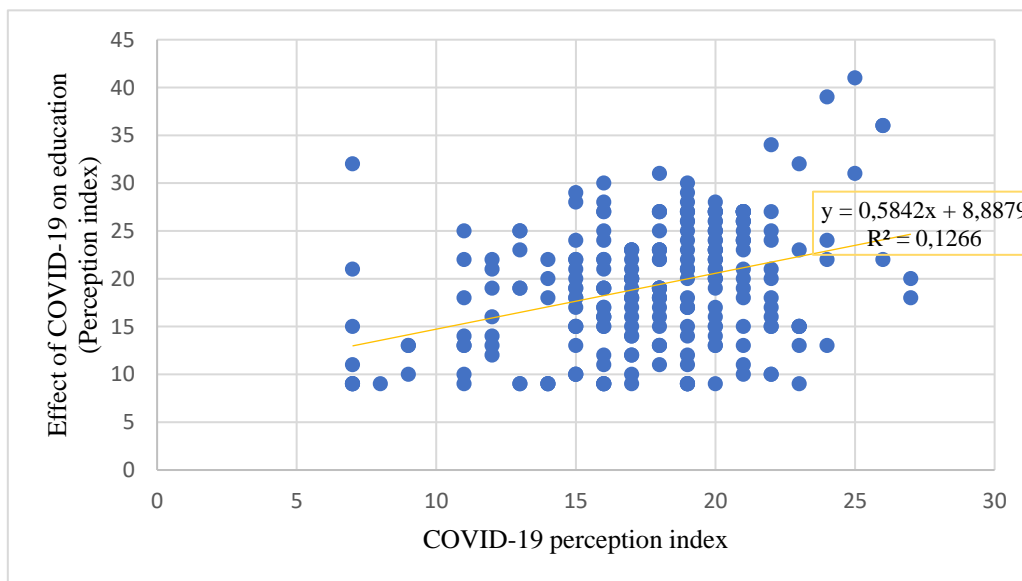

Figure 2: Relationship between perceptions of COVID-19 pandemic and perceptions on the effect of COVID-19 on academic work

Source: Calculated by authors from selected data

3.5 Adherence to COVID-19 safety protocols

Table 4 shows the various COVID-19 safety protocols that were adopted by the students. On wearing of nose masks, 95.4% of the students indicated wearing a nose mask anytime they step out of their rooms and about 3% of them indicated not always wearing nose masks. The high use of nose masks by the students is appropriate for curbing the spread of the virus among the students. The majority of the students indicated

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the use of hand sanitizers whenever they touch an item or shake hands while 38% of use anytime they remember to use. There are others (9.3%) who use sanitizers when it is mandatory, for instance, before entering banks. As high as 38% and 37.6% of the students respectively wash their hands only when they touch an item or shake hands and when they get to a place where there is a running water for hand washing. As high as 16.8% only do wash their hands when they remember to do so. These results indicate relatively high compliance to COVID-19 safety protocols by the students. Nonetheless, the few students who either do not adhere to the safety protocols or comply only when it is mandatory or remembered could compromise the effort by the other students who comply effectively. This result also suggest that the safety protocols should be made mandatory and strictly implemented by the school's COVID-19 team.

Table 4: Adherence to COVID-19 safety protocols by students

Response	Frequency	Percentage
Wearing of nose masks		
I don't use face mask at all	7	2.9
Anytime I step out	229	95.4
Every time	1	0.4
When mandatory	3	1.3
Use of hand sanitizers		
Anytime I remember	90	38.0
Anytime I touch something or shake someone	112	47.3
When I enter the campus	4	1.6
When I enter the restaurant	6	2.5
Every time I go out	3	1.3
When mandatory	22	9.3
Washing of hands		
After classes	2	0.9
Anytime I remember	39	16.8
When I shake hand with others or touch something	88	38.0
When I see a convenient place of washing	87	37.6
When mandatory	5	2.2
Every time I go out or when I want	11	4.7

Source: Calculated by authors from selected data

3.6 Virtual education

The emergence of COVID-19 has led to a wider use of virtual education practices. This has brought some lessons on the practically and relevance of virtual education in delivery quality education across the globe. The result (Table 5) shows that 59% of the students have had a virtual class due to the pandemic. These classes were organized as a strategy of covering outstanding topics. Nonetheless, as high as about 62% of

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these students indicated that the virtual classes were not helpful to their academic progress. Again, about 56% of students who had virtual education indicated that the virtual education should not be integrated into tertiary education system of the country. When specifically asked for their preference, about 89% indicated preference for physical classes while about 7% of the students indicated that it does not matter to them whether classes are organized virtual or physical. The World Economic Forum (2021) indicated that COVID-19 has accelerated and broadened the Fourth Industrial Revolution with increased use of online education and this has changed interactions among humans and how livelihoods would operate post-COVID-19.

Table 5: Virtual education and its preference

Response	Frequency	Percentage
Had virtual classes		
No	102	41.0
Yes	147	59.0
Usefulness of virtual education		
No	91	61.9
Yes	56	38.1
Integrate virtual education into education system		
No	82	55.8
Yes	65	44.2
Preference for virtual classes		
Not preferred	101	68.7
Preferred	46	31.3

Source: Calculated by authors from selected data

3.7 Factors influencing the preference for integrating virtual education into tertiary education of Senegal.

In estimating the preference for integrated virtual education, students who preferred integrated virtual education were defined as 1 while those who were indifferent or do not prefer were defined as 0 as the indifferent group of students are few. Table 6 shows the estimate on the factors that influence student's preference for integrating virtual education into tertiary education of Senegal. This shows that age, having scholarship, quality of internet Wi-Fi, area of specialization and the index on the perception of COVID-19 effects on education had significant effects on the preference of the students. More specifically, an increase in age of students leads to an increase in the student's choice for integrating virtual education into tertiary education of the country. This is because with an increase in the age among the students, the tendency to be more familiar with online processes is high. For instance, the slightly older students might have used smart phones for longer time than the relatively younger students and this might have influenced their choice.

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Students who are on scholarship preferred that virtual education should be integrated into tertiary education of the country. This is because these students may have access to stable funds that they can expend on virtual technology. For instance, students under scholarship can often afford laptops. Therefore, access to virtual equipment including the ability to buy internet data is high. OECD (2020) indicated while students of financially capable parents can continue to learn even when schools shut down, those from disadvantaged homes cannot. This highlighted the relevance of financial support under virtual learning. The result also established that students who are offering specialized programs such as medicine had higher probabilities of preferring an integrated virtual education. This is because such programs are more tailored and the students are focused on specific subjects, unlike general courses such as agriculture. The report of IAU (Marinoni et al., 2020) indicated that one of the challenge to the shift from face-to-face teaching and learning to virtual system is the difference in the needs among different fields of study. The estimated marginal effect is highest for access to scholarship. The result also suggests that students who perceived high impact of COVID-19 on education had higher probability of preferring an integrated virtual tertiary education in Senegal. This is because such students may not want any future pandemic or shock to interrupt tertiary education of the country. Dryhurst et al. (2020) estimated that risk perception correlates significantly with the adoption of preventive health behaviors.

Table 6: Factors influencing the preference for integrating virtual education into tertiary education of Senegal.

Variable	Coef.	Std. Err.	Z-value	P-value	Marginal effect
Age	0.080*	0.044	1.81	0.071	0.031
Sex	-0.071	0.208	-0.34	0.735	-0.028
Parents' sponsorship	0.016	0.193	0.08	0.935	0.006
Scholarship	0.352**	0.178	1.97	0.048	0.137
Wi-Fi quality	0.222**	0.104	2.13	0.034	0.087
Specialization	0.307*	0.177	1.73	0.083	0.120
COVID-19 perception	0.004	0.024	0.17	0.863	0.002
COVID-19 education perception	0.046***	0.014	3.21	0.001	0.018
Constant	-3.879	1.153	-3.36	0.001	

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Prepared by authors from output of regression.

4. Conclusions and policy implications

COVID-19 has become a major global threat since the later part of 2019. Its impact on education has been very significant, especially considering that the future of the next generation has been affected by the pandemic. The emergence has also brought about innovation, especially virtual technology, in all aspects

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of life. The questions that this study included were what the perceptions of tertiary students are on COVID-19 and its impacts on education, and whether virtual education should become an integral part of tertiary education in the country. The empirical evidence led to the following conclusions. First, there is a generally mixed perception of students on COVID-19 and these feed into the public perceptions on the pandemic in the country. For instance, although most of the students agreed that the pandemic is real, they also expressed misgivings on government communications on the pandemic. Divine expressions were also asserted by the students. This suggest that addressing pandemics and other shocks require that traditional and religious authorities should be involved in their management. This is crucial considering the mistrust for government information.

Secondly, the students clearly expressed several impacts of COVID-19 on education including academic performance, reduced socialization and happiness among students. This provide an understanding on the specific components of education that are affected the most by the pandemic. Nonetheless, actual data is required to examine the academic performance of students graduating from the school prior to the pandemic and those who graduated post 2019. There is an established correlation between the perceptions of the students on the pandemic and the perception of the pandemic on education. The implication is that students who have clear understanding of COVID-19 perceived that it has high impact on education. Third, there is a low interest of students on virtual education as most do not prefer an integrated virtual tertiary education. This low interest was influenced by a number of factors including access to quality Wi-Fi services and access to scholarship education. The perception of the students on the impact of COVID-19 on education also fed into their interest for an integrated virtual education in the country. However, considering the innovative importance of virtual education, these influencing factors must be addressed. For instance, there must be an improved internet services on campus while national policies designed to reduce the cost on internet services and improve the internet service of the telecoms. Overall, this study provided a basic information to trigger discussion on integrated virtual tertiary education in the country.

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