ONLINE TEACHING IN A UNIVERSITY ENVIRONMENT WITH LIMITED INTERNET ACCESS: CASE OF CONGOLESE UNIVERSITIES

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ABSTRACT

For the past couple of decades, online learning and working remotely has become a daily reality in western countries. Governments, companies and universities continuously invest in equipment and software that will help promote and better facilitate working and learning remotely. With COVID-19 pandemic, working and learning remotely became indispensable as traveling was restricted to stop the spread of the virus. In developing countries such as Democratic Republic of the Congo, (DRC), realities are unfortunately different. There is a strong mistrust of online learning. In addition, authorities tarry to invest in educational infrastructures regardless of the fast-increasing number of students. However, the global health crisis of 2019 as well as other factors has shifted the mindsets of many Congolese authority figures in regards to online learning. The purpose of this reflection is to examine these developments before proposing some avenues for, on one hand, safeguarding the achievements and, on the other hand, working to improve these avenues. Ultimately, the main idea would be to examine the experiment conducted in four DRC's universities in order to build a solution, the cheapest possible, that could be applied to sub-Saharan Africa nations' universities where the education's condition is similar to DRC's. Internationally, in a context where the Internet is almost everywhere continuously, such a study might seem of little use. However, in a poorly connected environment, it is a challenge to implement a web campus.

KEYWORDS

Online Teaching, Educational Scenario, COVID-19, Virtual Classroom, Strategies, Web Campus, Limited Internet

1. INTRODUCTION

Distance learning, also known as distance training, online education, or e-learning, is a paradigm of learning delivered electronically (Anderson, 2001). There are also many different elements that can constitute an e-learning program, such as live or pre-recorded lecture, video, quizzes, simulations, games, activities and other interactive elements. Indeed, online learning encompasses a range of technologies such as the worldwide web, email, chat, new groups and texts, audio and video conferencing delivered through computer networks to impact education. It helps the learner to learn at their own pace, according to their own convenience. Online Education requires a great deal of resources and careful planning. Therefore, teachers act as facilitators rather than transmitters of content, knowledge, and Information and Communications Technology (ICT) is regarded as resource that enhances the learning experience of students (Katsaris, 2021). In this context, students learn through e-learning tools which are available to all (Lavidas, 2022). e-Learning has brought back the joy in the learning process through its innovative and interactive contents delivery and has been proved to be more appealing among students (Indira, 2016). Nevertheless, one relevent advantage of public schooling is that most schools are local, and all children can therefore attend. Thus, for online learning to be acceptable as an alternative to in-class instruction, it should be available to all children. This was clearly not the case during Covid-19, in even the most economically advanced countries (Tony, 2021). Therefore, facing the challenges of the underdevelopment of education in Africa, particularly in the Democratic Republic of Congo (DRC), this article seeks to analyze how and why e-learning could be one of the answers. The ultimate goal is to put forward proposals that would allow the introduction of e-Learning without an explosion of installation and operating costs for the country's higher education and academic institutions.

1.1 Problematic

Despite the valuable efforts of both academic and political authorities, the real observation is that the buildings of the public universities of the Democratic Republic of Congo continue to deteriorate. At the same time, the student population continues to increase each year with a relatively lenient policy of hiring personnel. As if this was not enough, the authorities granted authorizations for the creation of new academic orientations without having the classrooms to receive these new students. Thus, in order to accommodate the exponential growth of students per classroom space, some faculties were forced to hold lectures in disorganized segments. For example, in the Mathematics, Statistics and Computer Science Department of the Faculty of Science and Technology of the University of Kinshasa twelve classes shared six auditoriums. The Table 1 below illustrates the growth between 2015-2016 and 2020-2021 regardless of the category of the five estimated populations.

Table 1. Recorded variation in the intervals 2015-2016 and 2019-2020(*)

N°	Variables	Academic Year		Growth rate %
		2015-2016	2019-2020	
1	Establissements	843	971	15
2	Students	462604	564421	22
3	Academic personnel	3137	3692	18
4	Scientific personnel	36589	47866	31
5	Administrative, technical and labor staff	37575	50092	33

(*) Source = Statistical directory of higher and university education for the 2019-2020 academic year, produced by the technical unit for education statistics with the technical and financial support of Unesco, Kinshasa, February

Table 2. Sharing of classrooms between classes of the Faculty of Science and Technology of the University of Kinshasa, Mention Mathematics, Statistics and Computer Science (**)

ROOM	CLASSES	
B1	2nd Year of Computer Science	3rd Year of Computer Science (LMD)
B16	1st Year of Computer Science (Focus on software engineering)	1st Year of Computer Science (Focus on Management)
B27	2nd Year of Computer Science (Focus on software engineering)	2nd Year of Computer Science (Focus on Management)
D5	1st year of Mathematics (LMD) and 1st Year of Computer Science (LMD). Both classes take all courses together.	
D12	3rd Year of Mathematics (LMD)	2nd Year of Mathematics (LMD)
D20	1st year of Mathematics	1st year of Biology

(**) Source = Office of the Department of Mathematics and Computer Science

This being the case, the purpose of this article is to make a plea for Congolese universities to resort to online teaching not only to guarantee the continuity of teaching, despite insufficiency of classrooms, but also to improve the quality of university pedagogy with the exploitation of new information and communication technologies via online teaching. Ideally, this should be done properly without exploding the operating costs of universities. Therefore, the main challenge of this article is to answer the following question: *What is the least expensive strategy for optimizing education in DR Congo?*

1.2 Methodological Approach

With the size of the DR Congo being 2, 345, 408 square kilometers and a population of 89.56 million, the answer to the above question is not obvious. To achieve this, we opt for an experimental approach by implementing a web campus ourselves and making it available to students who follow our courses in four Congolese universities, three being private and one public. Before expanding on the different classes' schedule, we must mention that we have examined the possibility of exploiting, based on the context of this work, the four scenarios of online teaching: (1) *In person - Synchronous*: the teacher and the student are in relatively the same place and work live (at the same time); (2) *In person - Asynchronous*: the student and the teacher are in relatively the same place but work off-line; (3) *Distanced - Synchronous*: the teacher and the student are physically distant from each other but work live (at the same time). Students attend real-time videoconferences according to a defined schedule and; (4) *Distanced - Asynchronous*: the student and the teacher are physically distant from each other and work offline. Students have access to their courses in different formats at any time.

Generally, a fifth scenario called *mixed*, or *hybrid* learning refers to the joint use of e-learning and the traditional learning method, often called face-to-face. The learner will alternate between remote online sessions and face-to-face sessions with the trainer.

1.3 State of Play

First of all, it is worth recalling before moving forward, that e-Learning is the acquisition of knowledge through electronic technologies and media. In simple terms, e-Learning is defined as learning where knowledge transmission and activities are done electronically (Brandon Hall, 2008). It has been shown that online learning gives students greater flexibility in what courses they can take, when they can take them, and where they need to be to take them. Today, the world is witnessing a rapid increase of online courses known as Massive Open Online Courses (MOOCs) that are accessible to a wide audience. Most MOOCs found on the Internet are free (Gerardus, 2022). Some, however, charge a fee in order to award a certificate of completion. In terms of material, the learner will only need a computer and a good internet connection to ensure their studies (Pablo, 2017). Additionally, the year 2020 has served as a laboratory for large-scale online education. Some universities have even taken the steps towards committing completely to distance learning. Indeed, with the COVID-19 pandemic and health restrictions, many schools and universities have closed their doors and distance learning has become a necessity (Benigno, 2020). The effects of the COVID-19 pandemic are present in nearly every aspect of our lives, and the resulting disruption is expected for months and even years to come. With the closing of schools and social distancing measures comes a unique set of challenges for the education sector. (Ambigapathy, 2021). In a very short period of time, teachers have been forced to move from textbooks to online platforms and social networks in order to ensure pedagogical continuity for their learners. They have been forced to find, adapt and develop educational resources for use in these online and offline environments (Alessia, 2021).

However, the Democratic Republic of Congo (DRC) lacks infrastructure in almost all areas. Unfortunately, education is not immune to this reality. Both private and public universities face serious development challenges due to the limited availability of funding. Ideally, CLOMs, the new trend in training and education, will be one of the answers to integrating e-learning into the DRC's education system. Few years ago, education looked like a classroom filled with students and a teacher at the front leading the process. Physical presence was a given, and any other type of learning was questionable at best. Then the Internet came along, radically changing pedagogical paradigms through the exploitation of digital online teaching platforms (Bates, 1996). Without seeking to cast stones at anyone, we notice that some professors are succeeding brilliantly in this transition by transforming their "paper-based" courses into effective teaching materials that can be used online. In the same way, while we are witnessing many dropouts of students disgusted and disoriented by distance learning, there are some who are very studious and very concerned with their course of study despite the difficulties, such a poor quality of the Internet connection and/or the financial overhead (Bernard Michel, 1999). Also, after the lockdown, some universities have evolved their mode of operation by changing their internal regulations and integrated distance learning (Roy, 2021). To achieve this, they have doubled or tripled classroom sizes to accommodate the large number of students. Similarly, they have set up rooms with good network connections to allow students to take courses online. The objective of this paper is to ideally move the future of the DRC education system in three directions: (1) Identify and highlight best practices in online

education; (2) Make some proposals to enhance the knowledge and skills of teachers and learners concerning the use of online platforms and educational technologies and (3) Encourage political authorities to implement mechanisms to encourage potential investors to provide capital for hardware and software infrastructure for online education. We hope that this reflection will serve as a basis to initiate constructive exchanges that will allow everyone to progress thanks to the experiences of others in this time of health crisis.

2. TODAY'S ONLINE EDUCATION

Moore et al. (2021) argue that there can now be no return to 'normal', in the sense of what existed before Covid-19: *"for those institutions that have already invested in online and hybrid learning, "normal" is not an idealized past but is a continuation, a process of leaning into multimodal learning ecosystems to further expand access and opportunities*."

Prior to moving on, it is important to remember that the term "Online Education" refers to the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services as well as exchanges and collaboration remotely. In other words, online education is a type of educational instruction that is delivered through internet to students using their home computers. During the last decade, online degrees and courses have become popular alternative for a wide range of nontraditional students, include those who want to continue working full-time or raising families. Most of the time, online degree programs and courses are offered via the host school's online learning platform, although some are delivered using alternative technologies (Online Education, 2020). Accordingly, an online campus, a virtual campus or a virtual university would be a multimedia computer environment dedicated to online teaching and generally accessible via a website. In continuity, a virtual classroom is an online course space that can complement ex-cathedra sessions. Today, almost every major university in the world is involved in e-learning and each has at least one virtual campus. In other words, almost every institution of higher education and university runs one or more multimedia environments dedicated to virtual classrooms. Now that affordable e-learning solutions exist for both computers and the Internet, all it takes is a good e-learning tool to make education easier and virtual from anywhere. Technology has advanced so much that the geographic gap is bridged by using tools that make one feels like being in the classroom (Morrison, 2003). In other words, e-learning is an affordable solution (often free when internet connection is available) that offers learners the opportunity to fit learning into their lifestyle, allowing even the busiest person to pursue a career and gain new skills. However, in Africa the bell is timidly ringing for universities to follow the same trend by accompanying traditional teaching with online training. Certainly, we note here and there a few e-Learning projects, most of which are animated and financed by international organizations, but to date the African university community has shown little interest in these rare e-learning investments.

3. COVID-19 AND EDUCATION

In 2020, the world faced an unprecedented crisis. The International Monetary Fund (IMF) and its members from various countries took action. At the same time, national authorities took bold steps to save lives and prevent the global economy from collapsing. Even reluctant businesses have switched to remote working. And, to prevent the spread of the virus through pupils and students, policymakers in many countries have taken the difficult step of temporarily closing schools and universities. In other words, because of the dangers of a fast-spreading pendemic, most schools, colleges and universities across the world were forced to close to protect students and staff from infection (Oecd, 2021). But education did not stop (Tzavara, 2023). Certainly, in North America, all post-secondary instructors, and many k-12 teachers, pivoted within two weeks to emergency remote learning, using mainly Internet-based video-conferencing technology such as Zoom, Microsoft Teams or Google Meet. This enabled teaching to continue and students to complete their courses and programs (Bccampus, 2021). However, in this section, we will first briefly review the crisis of 2020 and then analyze its impact on education.

3.1 Covid-19, An Unprecedented Crisis

By the fall of 2021, France had acknowledged that it had officially entered the fifth wave with an accelerating Covid-19 epidemic with nearly 20,000 new cases daily, or 7,000 more cases than seven days earlier (Ministere, 2021). At this rate, the country could quickly reach the levels of the United Kingdom and Germany, which recorded nearly 40,000 new infections each day, while the French average over a week remained above the 10,000 new cases mark, which was more than in Italy and Spain. After "Delta", the new variant was now called "Omicron". In Geneva that same year, experts mandated by the World Health Organization (WHO) decided that it should be taken as "a concern". Experts called for increased surveillance and sequencing (Figaro, 2021). With nearly 100 million more people pushed into extreme poverty by 2020, 1.4 billion children affected by school closures, and record unemployment, COVID-19 represents a monumental obstacle to human progress. Before moving on, it is worth recalling that coronavirus (COVID-19) is a disease caused by a new coronavirus now called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; formerly known as 2019-nCoV), which was first identified amid an outbreak of respiratory disease cases in Wuhan City, Hubei Province, China. It was initially reported to WHO on December 31, 2019. On January 30, 2020, WHO declared the COVID-19 outbreak a global health emergency. On March 11, 2020, WHO declared COVID-19 a global pandemic, its first designation since the 2009 H1N1 influenza pandemic declaration (Philip, 2021).

3.2 Education During The COVID-19 Crisis

Global data suggests that the risk of transmission of COVID-19 between children in a school setting is minimal when protective measures (social distancing) are adequate (mask, distance, hygiene). However, many governments around the world have instituted temporary school closures. In fact, as early as March 2020, as part of their efforts to contain the COVID-19 pandemic, several governments including the DRC's decided to shut down schools nationwide, denying more than 27 million children access to education. DRC schools first reopened in October 2020, only to close again after two months in response to a second wave of the COVID-19 epidemic. Following advocacy efforts by national and international organizations operating in DRC, the government reopened schools and universities on February 22, 2021 (Unicef, 2021). Overall, more than one billion children are at risk of falling behind due to school closures aimed at containing the spread of COVID-19. To keep the children around the world learning, countries have implemented distance learning programs. Yet many children in the world, especially those in the poorest households, do not have Internet access, personal computers, televisions, or even radios at home. This amplifies the effects of existing learning inequalities. Students without access to the technologies needed for home-based learning have limited means to pursue their education. As a result, many run the risk of never returning to school, undoing years of progress in education around the world. In countries or regions where community transmission of COVID-19 was high, and in settings where social distancing was not feasible, the World Health Organization (WHO) recommended that certain criteria be applied to avoid prolonged closure of schools and/or universities. For example, the WHO encouraged children aged 5 years or younger not to wear masks. For children aged 6-11 years, it advised them to take a risk-based approach to deciding whether or not to wear a mask. Children and teenagers aged 12 years or older should follow national guidelines for adults regarding mask use.

Lockdown in response to COVID-19 have interrupted conventional schooling with nationwide school closures in most OECD and partner countries, the majority lasting at least ten (10) weeks. While the educational community have made concerted efforts to maintain learning continuity during this period, children and students have had to rely more on their own resources to continue learning remotely through the Internet, television or radio. Teachers also had to adapt to new pedagogical concepts and modes of delivery of teaching, for which they may not have been trained. especially students in the most marginalized groups, who don’t have access to digital learning resources or lack the resilience and comittement to learn on their own, are at risk of falling behind (Andreas Schleicher 2020). Indeed, Children and adolescents tend to have more mild disease compared to adults if they catch the coronavirus that causes Covid-19, but they are still struggling to cope with the pandemic. Curfews, closures, and lockdowns are taking their toll on their emotional wellbeing (Elizabeth 2021, Fernando 2020, Wayne 2022). In other terms, the outcome of school closures and declining school attendance not only have serious consequences for education, but also carry significant health and safety risks for children and teenagers.

4. EXPERIMENT AND RESULTS

The purpose of this section is to present both the environment in which I have worked and the results I have achieved. Then we introduce a discussion about this experience.

4.1 Research Context

We have opted for a simple solution by taking advantage of our teaching to directly test our hypotheses. Indeed, we currently have an hourly load in four institutions in the DRC as indicated in the Table 3 below where the first column gives the name of the institution. The second gives the nature or type of the university. The third indicates the cities and the number of universities in those areas. The last three columns give the number of faculties, courses and students concerned by our teachings in each of these four universities.

Table 3. Institutions concerned by the experience

Institution	Type	City and #Implantations	#Faculties	#Courses	#Students
Institut Supérieur d'Informatique Programmation et d'Analyse (ISIPA)	Private	Three location in Kinshasa and 1 in Matadi	1 in 2 orientations	2	300
Catholic University of Congo (CUC)	Private	Two locations in Kinshasa	4	8	2000
University of Kinshasa (UNIKIN)	Public	One location in Kinshasa	2 in 5 departments	8	1500
New Horizons University (NHU)	Private	One location in Lubumbashi	4	3	22

4.2 Teaching Tools

For the past twenty years, we have been constantly learning and following the pedagogical and technological evolutions concerning online teaching in order to disseminate them through our courses. Therefore, each new academic year, we spare no effort to make available to our students a web campus developed with Moodle software and presented in figure 1 below to support the various courses in our charge (https://efremmbaki.com/Moodle2022/). by exploiting the list of students, the access parameters to the web campus for each of them were dynamically generated. In this way, each student receives a username and a password to connect to the web campus. We counted 3,355 users as shown in Figure 2 below. Students can find a variety of multimedia learning resources such as simple or commented *.docx, *.pptx, *.PDF or images.

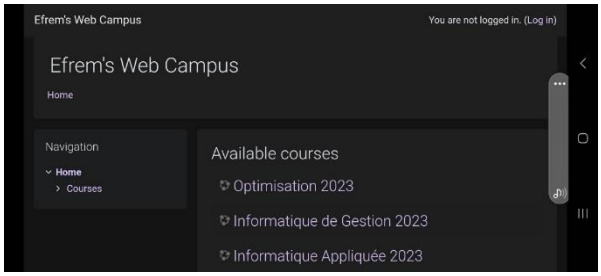

Figure 1. Efrem's Web Campus

Figure 2. Efrem's YouTube Chanel

Where possible and appropriate, we have also posted explanatory videos on our YouTube channel, see Figure 2 above, before sharing the links in the Web Campus. We opt for "Unlisted" visibility to prevent the videos from being exploited in a context not compatible with our teachings. In addition, we also used activity-type resources to provoke student interactivity and thus follow their respective progress. In fact, after each classroom or distance learning session (with the Zoom Meeting application), we propose interactive tests (Scorm Quizzes) to the learners. Generally, we impose a delay of three days before the exercises expire. It is possible to use Moodle to design and implement quizzes but we have exploited the iSpring Suite to carry out our exercises (Bornouane, 2011). In the same order of idea, we opted for the Wooclap platform to design digital quizzes and/or exercises that can be used in synchronized mode. Moreover, regardless of the telecommunication operators in the DRC, Internet connections are unstable and relatively very expensive. Often it is a miracle to download a video and/or a small document of about ten pages. Under these conditions, to minimize the overall cost of student connections, we have designed and published a nine (9) Gigabyte multimedia DVD (Figure 4) with our course notes, a recent computer dictionary, software setups to be installed as well as explanatory and illustrative videos of the concepts covered in the different courses.

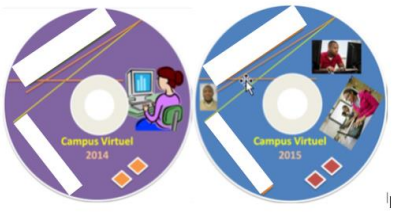

Figure 3. Class notes and videos' DVD

4.3 Discussion

In this section, we will examine the way we have applied the pedagogical scenarios of online teaching in the four universities mentioned above. Indeed, at ISIPA, we teach two courses in the first year of a computer science degree in Software Engineering and Database. On one hand, the Computer Marketplace course was entirely taught online except for the first two sessions which were held in person. As soon as ISIPA does not have the infrastructure to help the students to follow the course in videoconference, we had to find a way around. Therefore, we share three files weekly via WhatsApp: an explanatory video published via YouTube, lecture notes in PDF or PPTx format with comments, and a WooClap link of the formative test. In contrast, the second course on advanced Java programming language was organized as a face-to-face session with substantial support from online tools. Indeed, at the beginning of each session, we offered the students a live WooClap quiz. And at the end of the session, students were invited to solve the Moodle quiz that we posted on our web campus. In the end, we used two of four online pedagogical scenarios: in person-Synchronous and Distanced-Asynchronous.

At the Catholic University of Congo, we taught ten courses during the 2021-2022 academic year as mentioned in the Table 3 in section 4.1 relative to research context. Generally, the lecture sessions always started with an online quiz with the WooClap platform. And after each session, we would give the students a week to go into the web campus to solve the test associated with the material seen. In this way, we were leveraging two of the four online teaching scenarios mentioned above, namely In person-Synchronous and Distanced-Asynchronous. I applied this pedagogy at the University of Kinshasa. However, at New Horizons University, things went differently. In the first semester, we taught the System Administration course totally online with the Zoom application on the university's account. We must emphasize that the university's IT department provides students with well-equipped facilities to connect and follow the course remotely. Since the students were in Lubumbashi and the teacher in Belgium, the only two possible scenarios were: (1) Distanced-Synchronous for the presentations and the Wooclap questions and, (2) Distanced-Asynchronous for the web campus tests. In the second semester, we had the privilege of joining the students on site in Lubumbashi where some sessions were online with Zoom for the Master 2 Project Management course.

5. WINNING STRATEGY

The health restrictions imposed by COVID-19 justify the increased use of online education. As a kind of training, schools and universities are preparing themselves pedagogically and materially in the use of NICTs in order to overcome any closure. Also, in case that computer equipment is no longer a barrier, the establishment of virtual campuses is undoubtedly a positive response to the shortage of documentation so decried in the DRC. This being the case, we will propose to any university that does not yet have a virtual campus to start the process. To begin with, it will reserve a pedagogical space on its web server, which space will be accessible at first by professors who will upload electronic notes, even if it'd be draft only. In a second phase, this space will be opened to students to consult the courses and/or the notes uploaded by the teachers. Furthermore, we will emphasize that ICT and e-learning skills are a key indicator of the ability to engage in e-learning. Certain skills in the use of information and learning technologies, such as Internet-related tools, but also the ability for self-directed learning processes, can be described as necessary preconditions for a successful approach to e-learning. Ideally, therefore, computer courses should give all teachers and learners the opportunity to experience good practice in the use of the Internet and communication technologies. Of course, there is a clear difference between a paper-based course and an electronic course, but in order to move things forward, we sincerely believe that it is unnecessary to set the bar very high in terms of computer quality for the first notes to be produced. Little by little, and according to a strategy to be set up, teachers will learn to exploit existing techniques and/or tools to enrich their courses in order to make them more interactive, and then, more attractive for the learners. For example, it is now very easy to transform an MS Word document into a pedagogical HTML document thanks to one of the tools produced in the e-Learning platforms.

"Win-Win" collaborations can be considered at different levels (governmental, academic or even personal) in order to allow exchanges of pedagogical data from one university campus to another. For example, we could negotiate the possibility of moving all or part of the courses of the virtual campus of the "*Facultés Notre-Dame de la Paix*" in Namur to one or more African universities. Similarly, students from a European university could benefit from video sequences of an erupting volcano, with pedagogical comments by a professor from the South. Only, to avoid any ambiguity, each university will set the rules and manage registrations to their virtual campus(es). The success of the virtual campus will also depend on the active participation of the learners. It would therefore be recommended that students take part in the improvement of course content (Clark 2007).

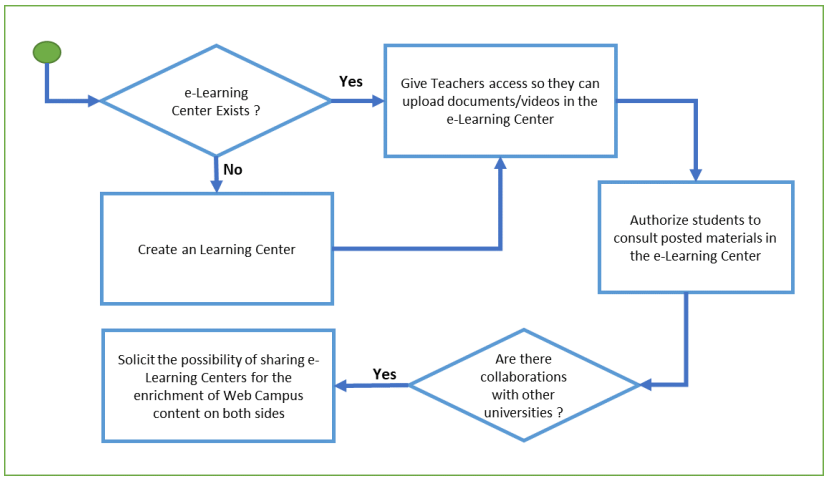

Figure 4. Initialization phase

For example, taking advantage of seminars or programming assignments, they can create PowerPoint documents, video sequences, flash objects or java applets for a given course. In this sense, the competent authorities would be asked to promote and disseminate information about projects or courses to be implemented which are essential factors for the future. This also means raising awareness of the potential of e-learning methods and techniques. In terms of the sustainability of the course and of e-learning in general, promotion, information dissemination and awareness raising will produce a cascading effect that will reach a wider audience than that of a single course, also helping to increase public interest in e-learning (Leplatre, 1998). To summarize, the ideal would be to organize the implementation of e-Learning in two phases: a first phase of initialization (figure 4 above) before moving on to a second phase of consolidation (Figure 5 below). Indeed, the first phase would concern institutions that do not have a digital environment shared by their academic community. In these conditions, it would be best to start slowly by encouraging each teacher to upload files and/or videos without worrying about their quality. Then, proceed to a second stage of consolidation by insisting on the continuous training of teachers, on free Internet connection and on a pedagogical and technical evaluation of contents.

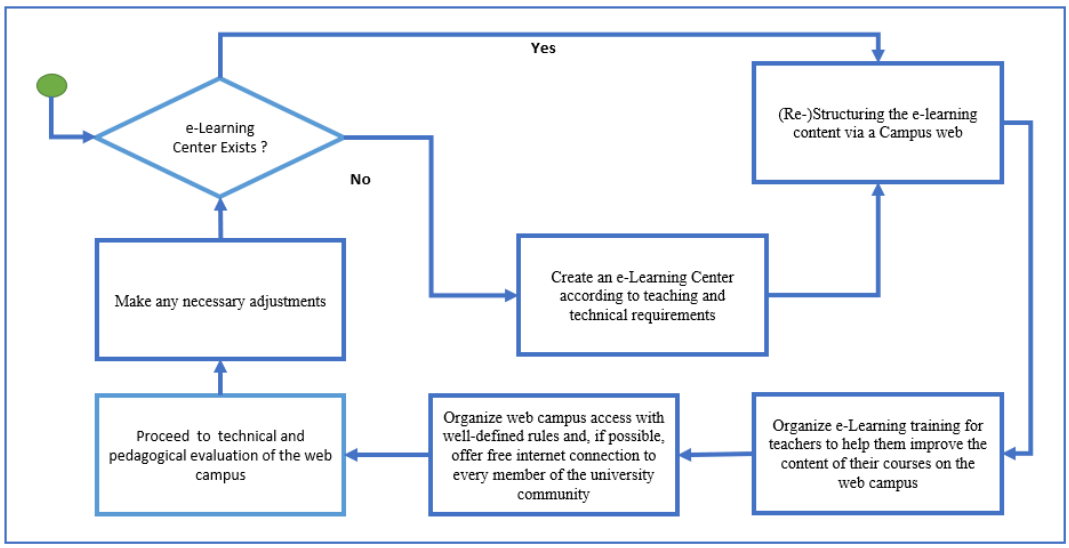

Figure 5. Consolidation phase

Specifically, we propose the implementation of web campuses with the characteristics described in table 4 below:

Table 4. Online learning platform's characteristics

Property	Details
Map	Implementation of a digital platform in order to amplify the online teaching in all the sites of the university by defining, on one hand, the components of the platform and on the other hand, the Business Process (Protocols) of access and/or Publication of contents
Goals	•To strengthen the capacity of our institution, which has been using e-Learning to support teaching for several years (Ex-Cathedra) •To cope with repeated interruptions due to the COVID-19 pandemic by ensuring continuity of teaching
Components	•The Digital Portal (www.isipa.eu or www.isipa.com) •The Web Campus (Moodle and/or Claroline) •A YouTube Channel (of the University dedicated to the cause) •Two Laptops (1 Server and 1 Client) with a good internet connection •A Zoom license •A Quiz Maker license •The rules of internal order of the platform
Enrollment process	•Plan a Zoom meeting in collaboration with the teacher and possibly with the students involved in the course
	•The teacher gives a synchronous lesson with Zoom installed in the Laptop Client
	•If necessary, he/she shares his/her course notes (PPT, PDF, Quiz or Other) with the Administrator
	•At the same time, the Administrator records the course with Zoom installed in the Laptop called Server
Publication process	•Administrator posts recording to YouTube channel (Unlisted and not for children)
	•Administrator shares the YouTube link on the Web Campus
	•Eventually, the Administrator publishes the course notes in the Web Campus
	•Automatically, the rights holders view the new item in their Web Campus accounts
Access protocol	•Each Teacher receives an individual Login and Password with the Courses Creator' profile (Read/Write for his courses)
	•Each student receives an individual Login and Password with the Student profile (ReadOnly)
	•Each member of the community signs the internal rules of the digital platform
Global Approach	•Analyze the Acceptability and the Technical and Financial Feasibility
	•Analyze the conditions to obtain the Adhesion of the teachers
	•Analyze the financial modalities by the students
	•Analyze the possibilities of exploitation of the products archives (Quizzes, notes, videos...)
	•Write the internal order rules

Finally, the table 5 below provides a rough idea of the cost of the essential components of the solution described above. PCs are a one-time cost that generally pay for themselves in four years. On the other hand, it is extremely difficult to estimate the cost of producing DVDs and/or purchasing USB drives. Indeed, it all depends on the quantity of items that you wish to put in place.

Table 5. Components prices

N°	Objects	Source	Cost/Month	Cost/Year
1	Zoom subscription	https://www.zoom.us/	12 x 20€	240 €
2	License IsPring Suite	https://www.ispring.fr/		800 $
3	Website .eu GoGeek	https://www.siteground.com	12X40$	480 $
4	PC Administration Server	https://www.dell.com/		1200 $
5	Multimedia PC Client	https://www.dell.com/		1200 $
5	YouTube	https://www.youtube.com/		Free
6	Moodle	https://moodle.com/		Free
7	Web Campus administration	Price compilation based on congolese market	200 $	2400$
8	Two 360° cameras	https://www.amazon.fr/		2200$
8	DVDs or USB drives	https://www.amazon.fr/	5€ /item	

Clearly, the solution built is the cheapest in the sense that it minimizes costs in the four axes that make up the implementation of a web campus: (1) For the hardware Infrastructure a desktop or laptop computer is enough to serve as a web and application server. The best option would be the subcontracting of the hosting of the web server by paying for a space. And thus, minimize and relieve administrative and / or security tasks related to the website. Since it is a web solution, students use their smartphones, tablets or computers to connect. Under these conditions, we do not think of investing for a large laboratory with connected computers; (2) For the software, we chose Moodle which is free, and we buy a relatively cheaper application to create interactive exercises. In addition, we also subscribe to Zoom with the cheapest formula that can allow us to organize synchronous sessions in small groups; (3) For the administration, one person is enough for the begining. Indeed, the Administrator must ensure access to the web campus by managing the creation of user accounts (students and teachers), the creation of courses and other equivalent tasks and; (4) For the content, we worked alone. Ideally, we would hire a person whose role would be to accompany the professors in the design of their online course.

6. CONCLUSION

Although COVID-19 has caused many human losses around the world, this study has shown that it is a great opportunity for the establishment of online education. Under these conditions, it would be a real shame if the DRC, or any other sub-Saharan country, were to lag behind. Convinced of the usefulness of the web, this article encourages actors in higher education and university to work hand in hand so that each institution can have at least one virtual campus. Of course, it would be naïve to believe that virtual campuses, by themselves, would overcome the digital divide and the cruel shortage of documentation that Africa suffers. Nevertheless, it is certain that electronic data, electronic pedagogy and online learning will mitigate some of the damage. At least students, researchers and professors will enjoy the benefits of online education as they will be optimally browsing for well-formatted and good quality literature. The ideal would be that the cheaper solution proposed in this study be implemented to allow sub-Saharan universities to enjoy the benefits of online education. An idea to continue this study would be to analyze and compare the real cost of implementing e-Learning in a university in a developed country.

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