THE INFLUENCE OF REMOTE LEARNING ON STUDENTS' LEARNING HABITS DURING COVID-19

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ABSTRACT

The Covid-19 pandemic is the new buzzword in the world, which has forced the whole planet to stay home. As a result, students were obliged to change their learning habits due to school closures radically. This article aims to analyze the factors and challenges faced by students who change their learning habits to maintain remote learning. First, a correlation was calculated on the dataset to select the most influencing factors on the students' learning habits during the lockdown period. Then, the Generalized Nonlinear Model was used to predict and measure the influence of these variables on the learning hours spent to maintain students' learning. Finally, the results show that four factors most affect student learning habits and increase their learning time, which are digital technologies used awareness of self-learning progress, and knowledge needed to maintain environmental development and the format of digital resources provided.

KEYWORDS: Remote learning, Covid-19, Learning habits, Digital technologies, Generalized nonlinear model

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L'INFLUENCE DE L'APPRENTISSAGE À DISTANCE SUR LES HABITUDES D'APPRENTISSAGE DES ÉTUDIANTS PENDANT COVID-19

RÉSUMÉ

La pandémie de Covid-19 est le nouveau mot à la mode dans le monde, qui a forcé la planète entière à rester chez elle. En conséquence, les étudiants ont été obligés de changer radicalement leurs habitudes d'apprentissage en raison de la fermeture des universités. Cet article vise à analyser les facteurs et les défis auxquels sont confrontés les étudiants qui changent leurs habitudes d'apprentissage pour s'adapter à l'apprentissage à distance. Premièrement, une corrélation a été calculée sur l'ensemble des données pour sélectionner les facteurs les plus influents sur les habitudes d'apprentissage des étudiants pendant la période de verrouillage. Ensuite, un modèle non linéaire généralisé a été utilisé pour prédire et mesurer l'influence de ces variables sur les heures d'apprentissage passées pour maintenir l'apprentissage des étudiants. Enfin, les résultats montrent qu'il existe quatre facteurs qui affectent le plus les habitudes d'apprentissage des étudiants et augmentent leur temps d'apprentissage, à savoir les technologies numériques utilisées, la prise de conscience des progrès de l'auto-apprentissage, les connaissances nécessaires pour maintenir un environnement en développement et le format des ressources numériques fourni.

MOTS CLÉS: Apprentissage à distance, Covid-19, Habitudes d'apprentissage, Technologies numériques, Modèle non linéaire généralisé

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تأثير التعلم عن بعد على عادات تعلم الطلاب خلال COVID-19

ملخص

جائحة Covid-19 هي الكلمة الطنانة الجديدة في العالم، التي أجبرت الكوكب بأكمله على البقاء في المنزل. ونتيجة لذلك، اضطر الطلاب إلى تغيير عادات التعلم لديهم بشكل جذري بسبب إغلاق الجامعات. يهدف هذا المقال إلى تحليل العوامل والتحديات التي يواجهها الطلاب الذين يغيرون عاداتهم التعليمية للحفاظ على التعلم عن بعد. أولاً، تم حساب الارتباط في مجموعة البيانات لتحديد العوامل الأكثر تأثيرًا على عادات التعلم لدى الطلاب خلال فترة التأمين. بعد ذلك، تم استخدام النموذج المعمم غير الخطي للتنبؤ وقياس تأثير هذه المتغيرات على ساعات التعلم التي تم قضاؤها للحفاظ على تعلم الطلاب. أخيرًا، تُظهر النتائج أن هناك أربعة عوامل تؤثر بشكل كبير على عادات التعلم لدى الطلاب وتزيد من وقتهم في التعلم ، وهي التقنيات الرقمية المستخدمة، الوعي بتقدم التعلم الذاتي، المعرفة اللازمة للحفاظ على تنمية البيئة وتنسيق الموارد الرقمية المقدمة.

كلمات مفتاحية: التعلم عن بعد، Covid-19، عادات التعلم، التقنيات الرقمية، النموذج المعمم غير الخطي

تصنيف جال: M10

INTRODUCTION

There is no doubt that the COVID-19 pandemic has shaken the social and economic landscape. Higher education is one of the sectors that have been dramatically modified where the learning process has undergone a profound effect. To avoid the pandemic spread, all gatherings of more than ten people had to be limited or even cancelled to ensure 'social distancing' as recommended by the World Health Organization and the United States Centers (WHO, 2020; CDC, 2020). As a result, most countries have decided to close their educational institutes by implementing remote learning initiatives for students instead of the traditional learning process (World Bank, 2020).

The Algerian Government is not an exception; it has ordered all schools and universities to close on March 12 as part of disease control measures. In this regard, the higher education ministry invites teachers to continue providing online courses and contribute as well as they can to keep the academic year runs smoothly. Considering all of these sudden upsets and without a clear endpoint, this presents an extreme challenge for students. They are faced with a situation in which they have to change all their learning habits. It is not easy for them to move from the traditional learning process to remote learning where they have to be self-disciplined as they are entirely independents.

To our knowledge, there has not been an analysis of Algerian students' perceptions regarding remote learning during COVID-19. This research seeks to investigate the main challenges and factors that affect the remote learning process during COVID-19. Therefore, in that respect, we ask the following questions:

- How should Algerian universities manage their digital transformation to provide a better online learning environment for their students?
- What are the main challenges faced by Algerian students in the remote learning process during COVID-19?
- What are the main factors that can affect the success of the remote learning process during COVID-19?

The rest of this paper is structured as follows: In the first section, we discuss the relevant literature review related to remote learning and its challenges. The second section deals with a presentation of research methodology, data analysis method, discussion of the findings and finally, suggestions and conclusions.

1- LITERATURE REVIEW

1.1- Related works on remote learning

The success of any educational process depends on its acceptance by both teachers and students. Thus, in the context of the remote process imposed by the COVID-19 pandemic, student acceptance of remote learning is considered to be one of the main criteria for successful online learning (Daniel, 2020).

In this new context, schools and universities closure have several adverse impacts on students, such as interrupted learning. Therefore, the online digital learning process can address this problem with easier access (Schneider & Council, 2020). Remote learning tools such as e-learning platforms are playing a crucial role during this pandemic (Mukhopadhyay et al., 2020). These digital technologies can sustain learning providers to plan, deliver and track the teaching and learning process. Furthermore, it aims to help universities to drive their digital transformation process to provide a better learning environment for students while universities are closed. Besides, because of most of these tools are free, it will be easier to guarantee continuous learning during this COVID-19 pandemic (Chick et al., 2020). The first hypothesis of this research is formulated regarding the acceptance of remote learning by students.

H1: The perception of students on remote learning increases the learning hours of students during the COVID-19.

1.2- Managing universities' digital transformation during schools closing

The impact of this global pandemic is necessarily transformative, requiring to build digital capability throughout universities to support the remote learning process. In such a context, digital technologies (IT) had a vital role to play in the university sphere to allow the

unrolling of the academic year (Obaid, 2019). Social distancing imposed by the pandemic meant that online tools became critical in ensuring the continuity of pedagogical activities. During the lockdown period, existing digital technologies were extended, and new ones were rolled out. IT services had to react quickly to face up the crisis and come up with innovative solutions to ensure academic year continuity in better conditions (Matkovic, Tumbas, Maric, & Raković, 2018)

Universities developed specific digital strategies in response to this particular new context towards the use of their own digital platforms or by introducing new ones (Obaid, 2019). Distance learning tools are provided for free, in almost all cases, such as ZOOM, Moodle, Google classroom and so on (Mukhopadhyay et al., 2020) to allow universities to lead their digital transformation as soon as possible, as they do not have enough time to invest in a whole remote learning system.

H2: IT plateforms provided by universities during COVID-19 affect the perception of students on adapting remote learning habits positively.

H3: The delivered digital resource format has to increase during university closure to maintain positive students' perception of remote learning tools.

Higher education providers and students are increasingly aware of the several challenges associated with adopting remote learning process (Almaiah, Al-Khasawneh, & Althunibat, 2020). However, it remains a reality due to the digital divide encountered by both the university and the students (Berge, Muilenburg, & Haneghan, 2002). Although remote learning is an innovative way of teaching at any time and anywhere, it still presents other problematic. Students don't have sufficient time to study and research. They also have difficulties in access and use of digital technologies, where not all of them have computers, smartphones or Internet at home. Besides, ineffective feedback is noticeable because almost all remote learning tools are asynchronous (Almaiah, Al-Khasawneh, & Althunibat, 2020). Moreover, such struggles could be observed in the technical problems encountered and in the lack of students' motivation and in the fact that they haven't independent work skills (Gillett-Swan, 2017).

1.3- Digital tools for remote learning in African universities

African universities have become aware of the importance of digital technologies as a pillar of successful remote learning during the COVID-19 pandemic while all universities are closed (Henderson, Selwyn, & Aston, 2015; Global Window on Higher Education, 2020). In this section, we present some African universities that resorted remote learning tools to ensure the well ongoing of the academic year and illustrate the formulation of our research hypotheses. We took Egyptian, Moroccan, South African, and Rwandan universities as an example to illustrate this new learning context.

The Egyptian Ministry of Communication and IT collaborate with mobile carriers to make available SIM cards for free to students if they possess a device. A digital platform is made available to offer a communication channel between students and teachers using interactive learning process as if they were present in the school (World Bank, 2020). The same source declared that the Moroccan Ministry of Education provided students free access to TelmidTICE remote learning platform without necessarily having an internet subscription to download all digital resources on the platform. This initiative aims to promote equal opportunities among Moroccan students and facilitate easy access to educational content during this pandemic.

As a strategy to mitigate the Covid-19, Rwanda Education Board has resorted to ensure continuous learning while students being homes. Rwandan education system confirms that digital technologies have the potential to improve the quality of remote learning. Remote learning tools include technology applications and processes such as audio or videotape, and computer-based learning, as well as local intranet/extranet and web-based learning. Digital technologies also serve as a communication channel between teachers and students (World Bank, 2020). In the same stream, The Basic Education Department of South Africa provides a host of distance educational material organized and accessible through its website. Students can find multimedia resources (such as videos, audios, or interactive workbooks). The website also has a section with information about

support related to educational broadcast content, including television and radio (World Bank, 2020).

2- REMOTE LEARNING IN ALGERIAN UNIVERSITIES

The Higher Education Minister in Algeria had invited the university community to get massively involved by giving the best of them so that the academic year runs smoothly. The main challenge is technological due to the non-mastery of the IT tools, whether by students or teachers, as well as the low Internet speeds, which prevents students from downloading their online courses. Also, it is not all students have the necessary device such as computers and smartphones to pursue remote learning (Derradj, 2020).

In this study, we focus on the remote learning process of Algerian students during the COVID-19 pandemic, where social distancing was imposed by the Ministry of Health to limit the spread of this pandemic. The dataset focused on learning habits of 420 students (Grade from L2 to M2) in Algerian universities during the month of May of university closures due to COVID-19. The dataset includes four major groups of variables: (A) Individual demographics, including family socioeconomic status (SES), university/school type, and occupational aspirations; (B) Students' learning habits, including hours of learning before and during the period of university suspension, with and without other people's support; (C) Students' perceptions of their self-learning during the school closures; and D) Students' perception of digital resources access to measure the integration of online lessons during this time with sustainability topics.

2.1- **Research Materials and Methods**

The survey was conducted between May 29 and June 3, 2020, the first week of midterm evaluations in e-learning platforms of universities nationwide school closures due to COVID-19. Initially, online questionnaires were delivered. A total of 460 responses were received, but only 420 valid observations were accepted for further analysis due to the elimination of obviously invalid answers (e.g., more than 20 hours of learning per day).

Overall, the influence of SES and students' occupational aspirations on their learning habits during COVID-19 was examined using generalized nonlinear least square in R.

Theoretically, the survey was designed based on prior literature on transformative learning, with the focus on socioeconomic differences. Variables in group A related to students' demographics, including SES factors and students' self-evaluated competencies. Scholars have pointed out that SES factors such as monthly family income, parents' occupations, number of siblings, school type, and grade level have significant influences on students' learning habits (Urh & Jereb, 2014). This study complements the conventional notion of SES with additional variables about students' competencies. Specifically, in the case of Algeria, we added subjects for university entrance, which demonstrate students' occupational aspirations, and English, which is a crucial competency in today's world.

Variables in group B measured students' learning habits by their learning hours per day (Urh & Jereb, 2014). In particular, students were asked their total hours of self-learning before and during COVID-19. With regard to the total number of learning hours during COVID-19, there were sub-questions about the total hours of off-line and online study modes, as well as the total hours of learning with instruction or without instruction from other people.

Variables in group C were mainly designed for this specific data collection. All items in this section were measured using a five-point Likert scale (1: Totally Disagree, 5: Totally Agree). First, we examined students' perceptions of the necessity for self-learning during COVID-19. According to the literature on transformative learning, students' learning practices are influenced by their beliefs about learning and influences from teachers, parents, and peers (Salieva, 2020). Thus, we constructed the variable of "students' necessity for self-learning" using the following items: (i) to ensure my learning progress; (ii) to maintain my learning habits; (iii) influenced by teachers; (iv) influenced by parents; (v) influenced by siblings; (vi) influenced by friends. Second, we measured students' self-reports on factors that influence self-learning effectiveness. This variable consisted of different physical

factors (the availability of learning resources, learning space (Urh & Jereb, 2014)) psychological factors (self-motivation, family support (Almaiah, Al-Khasawneh, & Althunibat, 2020)), and behavioural factors (concentration, goal-setting (Gillett-Swan, 2017), communication and peer collaboration (Chandrasekaran, Badwal, Thirunavukkarasu, & Littlefair, 2016; Usluel & Mazman, 2009).

In addition, concerning the unique context of school closures due to COVID-19, we measured the integration of students' online lessons with their perception regarding digital resources access and learning quality. Students were asked whether they were taught any of those topics or not: (i) General preventive health care; (ii) Sustainable environment development; (iii)Sustainable society development; (iv) E-learning tools and technique.

As shown in Table 1, students' demographic impacts learning hours during the lockdown period. Students' concern about exams leads them to increase their hours (mean=4.05). It also demonstrates family income, especially working mothers, has a significant impact on their learning hours (mean=2.33). During the quarantine, students spend almost their learning time studying without instructions (mean=4.32), which contributes to the increase in learning time going from 1.29 hours before COVID-19 to 1.57 hours during the remote learning period. Although, students coming by a gateway from the classic higher educational background to the LMD system show a relevant place in the sample (mean=1.40) compared with LMD background students (mean=1.46).

On the other hand, regarding the Higher Institutional Education type (HIE), the research considered public schools/universities, gifted public schools (i.e., selected students with superior intellectual skills and academic aptitudes), private and international schools. Results show that students coming from gifted (mean=1.65) and private (mean=1.63) schools are more flexible to accommodate their learning habits during the closures period due to COVID-19. Also, if we look at the family income (expressed in thousands of local currency), we could conclude the non-significant deriver among students explaining their learning habits (mean approximatively the same). And, as well as is the

field of the students. Indeed, the variable entitled "university entrance exam" observed six major fields of study: A=Medicine, Pharmacy, etc. ; B=Computer science, Mathematics, ¨Physics, etc. ; C=Economics, Management, Law, Sociology, etc. ; D=Biology, Ecology, Chemistry; E= Literature, Language, etc. ; F= Others. These fields did not determine a closure explanation for the learning habits of students.

Table n° 1. Descriptive statistics of demographics and students' learning habits

Learning hours		N	Mean	Std. Deviation	Std Error	Max	95% Confidence Interval for Mean		Min
							Lower Bound	Upper Bound	
A. Students' demographic									
Gender	Male	166	1.63	0.94	0.05	3.00	-0.01	0.19	1.00
	Female	239	1.65	0.96	0.04	3.00	-0.01	0.19	1.00
	Not Public	15	1.54	0.73	0.16	3.00	-0.03	0.34	1.00
	Total	420	1.64	0.91	0.04	3.00	-0.02	0.15	1.00
Grade level	LMD	234	1.46	0.49	0.03	2.00	-0.21	-0.09	1.00
	Not LMD	168	1.40	0.51	0.05	2.00	-0.33	-0.05	1.00
	Total	420	1.44	0.50	0.02	2.00	-0.22	-0.05	1.00
HIE Type	Public school (normal)	186	1.50	0.67	0.05	4.00	1.40	1.60	1.00
	Gifted school (normal)	132	1.65	0.74	0.06	4.00	1.52	1.78	1.00
	Private school	94	1.63	0.67	0.07	4.00	1.49	1.77	1.00
	International school	8	1.50	0.93	0.32	4.00	0.73	2.27	1.00
	Total	420	1.58	0.70	0.03	4.00	1.51	1.64	1.00
Siblings	One	38	2.38	0.99	0.11	4.00	0.45	1.20	1.00
	Two	247	2.44	0.88	0.05	4.00	0.74	1.00	1.00
	Three	57	2.34	0.88	0.09	4.00	0.52	1.00	1.00
	Four or more	78	2.39	0.91	0.08	4.00	0.62	0.98	1.00
	Total	420	2.41	0.89	0.04	4.00	0.73	0.95	1.00

Father's job	Technical related	141	2.10	0.89	0.05	4.00	0.33	0.66	1.00
	Social related	172	2.08	0.94	0.05	4.00	0.35	0.68	1.00
	Free	73	1.59	0.95	0.08	4.00	0.20	0.58	1.00
	Others	34	1.49	0.87	0.09	4.00	0.52	0.64	1.00
	Total	420	2.00	0.91	0.04	4.00	0.31	0.53	1.00
Mother's job	Technical related	32	2.35	0.83	0.12	4.00	0.52	0.96	1.00
	Social related	270	2.48	0.83	0.04	4.00	0.82	0.92	1.00
	Free	63	2.20	0.72	0.07	4.00	0.46	0.73	1.00
	Others	55	2.42	0.74	0.08	4.00	0.50	0.79	1.00
	Total	420	2.33	0.80	0.04	4.00	0.66	0.86	1.00
Family income	Under 10	62	2.88	1.42	0.89	6.00	1.04	1.49	1.00
	From 10 to 20	141	2.79	1.38	0.53	6.00	1.06	1.38	1.00
	From 20 to 30	97	2.93	1.53	0.76	6.00	1.10	1.55	1.00
	From 30 to 40	50	3.12	1.49	0.96	6.00	1.22	1.80	1.00
	From 40 to 50	30	3.05	1.57	1.02	6.00	1.12	1.80	1.00
	Up to 50	40	2.93	1.53	0.99	6.00	1.09	1.64	1.00
	Total	420	2.92	1.48	0.99	6.00	1.18	1.50	1.00
University Entrance Exam	A	52	3.85	1.64	0.05	6.00	2.07	2.70	1.00
	B	64	4.38	1.67	0.05	6.00	2.47	3.01	1.00
	C	23	4.25	1.59	0.11	6.00	2.24	2.94	1.00
	D	22	3.78	1.73	0.16	6.00	1.81	2.73	1.00
	E	187	3.96	1.74	0.15	6.00	2.23	2.67	1.00
	F	72	3.88	1.67	0.12	6.00	2.13	2.69	1.00

	Total	420	4.05	1.71	0.08	6.00	2.30	2.66	1.00
Self-evaluation of Academic performance	Below average	7	2.71	0.32	0.14	4.00	1.15	1.35	1.00
	Average	109	2.44	0.702	0.05	4.00	0.99	1.38	1.00
	Good	251	2.92	0.82	0.04	4.00	0.98	1.50	1.00
	Excellent	53	3.05	0.69	0.11	4.00	020	1.70	1.00
	Total	420	2.83	0.65	0.03	4.00	1.17	1.35	1.00
English language proficiency	Below average	35	2.54	0.78	0.11	4.00	0.75	1.19	1.00
	Average	135	2.59	0.75	0.05	4.00	0.83	1.06	1.00
	Good	191	2.69	0.85	0.05	4.00	1.12	1.27	1.00
	Excellent	59	2.84	0.91	0.10	4.00	1.09	1.29	1.00
	Total	420	2.65	0.82	0.04	4.00	0.97	1.18	1.00
B. Students' learning habits									
Learning time before COVID-19	Under 4h	312	1.08	0.49	0.03	3.00	0.99	1.34	1.00
	From 4h to 7h	93	1.83	0.57	0.07	3.00	1.90	2.14	1.00
	Over 7h	15	2.24	0.58	0.19	3.00	2.01	2.61	1.00
	Total	420	1.29	0.53	0.03	3.00	1.31	1.44	1.00
							1.29	1.58	
Learning time during COVID-19	Under 4h	229	1.52	0.50	0.03	3.00	1.45	1.44	1.00
	From 4h to 7h	140	1.56	0.69	0.06	3.00	1.47	2.24	1.00
	Over 7h	51	1.83	0.54	0.09	3.00	1.60	2.94	1.00
	Total	420	1.57	0.70	0.03	3.00	1.51	1.64	1.00
Online learning time during COVID-19	Under 4h	304	4.10	4.41	0.22	3.00	2.10	2.97	1.00
	From 4h to 7h	88	4.71	4.22	0.45	3.00	2.66	3.62	1.00
	Over 7h	28	4.46	4.47	0.62	3.00	3.17	4.47	1.00
	Total	420	4.32	4.42	0.22	3.00	2.32	3.18	1.00
Learning time with instruction	Under 4h	373	1.29	1.98	0.10	3.00	-0.40	-0.03	1.00
	From 4h to 7h	38	1.62	2.23	0.83	3.00	-0.51	-1.03	1.00
	Over 7h	9	2.10	2.17	0.91	3.00	-0.83	-1.64	1.00
	Total	420	1.34	2.12	0.10	3.00	-0.45	-0.03	1.00

Source: illustrated by authors using R

The value p <2.2 e-16 rejects the null hypothesis at the critical value α = 0.05, which describes a significant distribution between actual and forecast observations. This means that students' learning habits have changed during the COVID-19 pandemic. They went from face-to-face learning to online courses and therefore had to modify their habits and routines to adapt to this new specific context. Moreover, Table 2 shows that students' perception of their self-learning during COVID-19 (or school/university closures) is maintained with all variables (with p-value<0.05). It appears clearly that parents' occupation, support of siblings and students' competencies have a significant influence on students' learning habits with increasing hours spent on learning during this remote learning period.

Table n° 2. Descriptive statistics of students' perceptions

C. Students' perception of self-learning during COVID-19	**N**	**Mean**	**Std. Deviation**	**Std Error**	**Max**	**95% Confidence Interval for Mean**		**Min**
						Lower Bound	Upper Bound	
Self-learning during school closure due to COVID-19 is necessary because ...								
I Can ensure my learning progress (nec_prog)	420	3.9	0.96	0.04	5	-2.43	-2.20	1
I can maintain my learning habits (nec_habit)	420	3.88	0.92	0.04	5	-2.41	-2.19	1
My teachers show me it is necessary (nec_teacher)	420	3.66	1.03	0.05	5	-2.20	-1.96	1
My parents show me it is necessary (nec_parent)	420	3.72	1.01	0.05	5	-2.27	-2.03	1
My siblings show me it is necessary (nec_sib)	420	3.26	1.12	0.05	5	-1.81	-1.56	1
My friends show me it is necessary (nec_friend)	420	3.25	1.11	0.05	5	-1.80	-1.55	1
I consider my self-learning activities are effective because I have ...								
good concentration skills	420	3.35	0.97	0.04	5	-1.89	-1.66	1

(eff_con)								
Effective learning environment (eff_env)	420	3.54	1.03	0.05	5	-2.09	-1.85	1
Effective friends to collaborate with (eff_friend)	420	3.21	1.12	0.05	5	-1.76	-1.51	1
Motivation for self-learning (eff_mot)	420	3.44	0.99	0.04	5	-1.98	-1.75	1
Capacity to define daily learning objectives (eff_obj)	420	3.44	1.01	0.05	5	-1.98	-1.75	1
Various learning resources (eff_resource)	420	3.65	0.98	0.05	5	-2.19	-1.96	1
Support from my family (eff_supp)	420	3.35	1.08	0.05	5	-1.89	-1.65	1

Source: illustrated by authors using R

Regarding students' perception of digital resources access to online learning, results revealed in Table 3 that tasks given by teachers to ensure better learning during remote learning would be beneficial for maintaining students' motivation and engagement. Moreover, from the integration of students' online sessions with sustainability topics, results show that there is a strong influence to increase learning spent time.

Table n° 3. Descriptive statistics of online sessions during Covid-19

D. Students' perception of digital resources access to integrate online sessions with sustainability topics	**N**	**Mean**	**Std. Deviation**	**Std Error**	**Max**	**95% Confidence Interval for Mean**		**Min**
						Lower Bound	Upper Bound	
Tasks to ensure better learning (better learning)	420	3.398	2.10	0.10	7	-2.03	-1.61	1

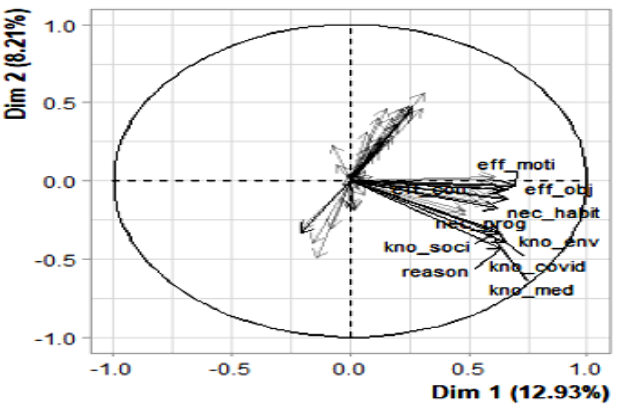
Digital technology used during emote learning (Dig_tech)	420	2.967	0.91	0.44	4	-0.53	-0.31	1
Capability of learning (learn_percent)	420	2.92	1.33	0.06	4	-1.49	-1.20	1
Importance of voice/video recording against reading (importance)	420	2	0.91	0.04	4	-0.53	-0.31	1
IT Difficulties during learning (Reason)	420	3.84	0.98	0.04	5	-0.38	-2.15	1
Online courses or reopening schools preferences (preferences)	420	1.44	0.67	0.03	11	0.37	0.22	1
Digital resources format	420	2.967	1.31	0.04	4	-1.53	-1.24	1
Internet accessibility (Internet)	420	4.26	0.93	0.04	5	-2.79	-2.57	1
Remote learning taking into account knowledge about Covid-19 (Kno_covid)	420	3.92	0.96	0.04	5	-2.46	-2.23	1
Knowledge of used e-learning tools and techniques (kno-e-learning)	420	3.34	1.08	0.04	5	-1.89	-1.64	1
Knowledge to prevent environmental health care (Kno_env)	420	3.54	0.99	0.05	5	-2.11	-1.88	1
Knowledge to maintain environment development (Kno_med)	420	3.84	0.98	0.4	5	-2.38	-2.15	1
Knowledge to maintain sustainable society development (kno_soci)	420	3.48	1.03	0.05	5	-2.03	-1.79	1

Source: illustrated by authors using R

To reflect the most important variables influencing student habits by increasing the learning hours spent, the principal component analysis (PCA). Indeed, it attempts to identify relevant factors and challenges explaining students' learning habits during this period. An estimation of the right number of axes to interpret suggests restricting the analysis to the description of the first 15 axes. Figure 1 illustrates the axis where the labelled variables are the best shown on the plane.

These axes present an amount of inertia more significant than those obtained by the 0.95-quantile of random distributions (64.81% against 35.28%). This observation suggests that only these axes are carrying real information. As a consequence, there is not one more determining factor than others, which could explain the number of studies spent on online learning during the COVID-19 pandemic (i.e., during the universities' closure period). This situation conducted this research to use the correlation matrix to declare the most correlated factors with *increasing learning hours of students during the COVID-19.regarding their perception of remote learning.*

Figure n°1. Variables factor map (PCA)



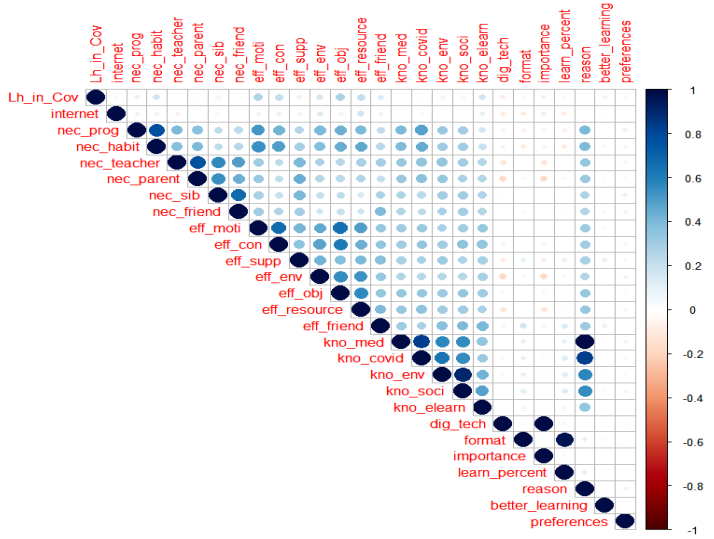
Source: illustrated by authors using R

Figure 2 shows four factors which can be identified as follows: digital technologies used (*dig-tech*), the format of digital resources provided

by teachers (*format*), student's perception of self-learning during school closures to ensure learning progress (*NEC-prog*), and necessary integration of online courses regarding knowledge to maintain environment development for better learning (*kno-med*).

At this stage, research findings could respond to the three hypotheses formulated in this research. To check the accuracy of the model regression predictions, cross-validation needs to reflect the nature of the relationship between the four factors taken into account from the correlation matrix. Because the respondents were from different universities/schools in Algeria, we need to reflect the elasticities of the chosen variables with the spent hours for learning during school closures.

Figure n°2. Correlation matrix



Source: illustrated by authors using R

We use the generalized nonlinear least square. Because the investigation of disparities among universities is not the scope of our research, the research tends to generalize the results and discussion.

Results in Table 4 shows that all of them have a p-value<0.05, and the model is acceptable (F-statistics <0.05).

Table n° 4. Generalized nonlinear least square for students' learning habits

Coefficients of interest:				
(Intercept)	dig_tech	nec_prog	kno_med	format
0.44724	-0.03748	0.04700	-0.02654	-0.01039
(<2e-16)*	(<2e-16)*	(<2e-16)*	(<2e-16)*	(<2e-16)*
Deviance:		119.7344		
Pearson chi-squared:		126.9344		
Residual df:		415		
(p-value) *0.05				

Source: illustrated by authors using R

Recommendations from these results tend to provide students with a more accurate format of digital resources while they are aware of the necessity to progress during the closures period. Digital technologies appear to be the best tool to provide learning and increase students' motivation. At this observation, the Government needs to collaborate with mobile operators and telecommunication ministries to increase digital resources access and ensure large internet diffusion. Teachers need to be aware of SES students regarding the issue of Covid-19 to maintain sustainable knowledge environment development.

CONCLUSION

The COVID-19 pandemic presents an immense challenge to learning systems. All students around the world have to switch their learning habits. They are moving from the traditional method to remote learning, where teachers give courses through digital technologies without any direct support. This paper afforded a new reflection for measuring factors and challenges encountered by students regarding their learning habits during the university closure. First, we reviewed the relevant literature on remote learning, remote learning strategies adopted in Africa in general and in Algeria in particular. Then, sixty-three (63) evaluating indicators are applied to propose the initial evaluation model, and we used Generalized Nonlinear model to measure factors that contribute to the change in students' learning habits on a dataset of 420 Algerian students.

Results show that the digital technologies used when taking their courses determine students' learning habits, their willingness to ensure their learning progress, the format in which the courses are published, and also by the readiness to maintain the knowledge environment development.

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