Digital economy and higher education's economic model: Benchmarking study

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Abstract:

The change in the education model requires the integration of digital technology in higher educational institutions. Great Britain is the leader by creating an Open University wich offers high quality of education at controllable costs. The Algerian university is characterized by the fragmentation of its teaching system. The COVID 19 crisis has accelerated the change in the Algerian university which, like other universities in developing countries, has made considerable efforts in the digitization of teaching and scientific research.

What is the impact of digital technology on the change of higher education's economic model? In order to give answer to this question, we have mobilized macroeconomic data called metadata that we used in a benchmarking study.

Key Words: higher education, scientific research, digital innovation, economic model of education, benchmarking, university ranking.

JEL Classification: I20, P50

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1. INTRODUCTION

The late 20th century was an era of massive social, economic, technological and political change, during which there was a shift in the perception and value of knowledge. The impact of these changes is clearly visible in higher educational institutions. Faculties are under constant pressure to deliver the quality of education to an internationally-mobile, digital-savvy cohort. Higher educational institutions compete in the international marketplace to attract funding, researchers, top students and faculty from all over the world.

Higher education in the world is experiencing unavoidable changes namely, the internationalization and democratization of training that stir up competition between institutions. This favors the development of networked university institutions in the entire of the world by associating training and innovation. However, this is a source of cost for the States as well as for the learners. (Miao F., 2016) showed that cost control for high quality of education for the greatest number of people seems impossible, except by changing the model by creating the Open University in Great Britain, which offers very high quality and recognized higher education at controllable costs. For (Peraya & Fievez, 2022) academic institutions can change the future of digital innovation, which in turn could transform the world of universities. These latter will have to show creativity and dynamism to face the future digital wave.

In an attempt to manage the ongoing changes and to prepare for an unpredictable future, higher education institutions are adapting to the evolving landscape of teaching and learning by developing new business models.

The problem of this research is illustrated in the following questions:

What is the specification of higher education's economic model in digital innovation context? Does this new model have an effect on the influence of the university on a national and international ranking by offering quality training and scientific research?

What are the efforts made by the Algerian university in the digitalization of education?

In order to give answer to those questions, we have opted for the following method: we have mobilized macroeconomic data called metadata that we used in a benchmarking study. Benchmarking has several meanings; the one that interests us in this study is the one that refers to the analysis of the processes and success factors that have allowed a superior performance. Meta-analysis is a method for carrying out such work by combining the results of several studies to produce an objective synthesis according to a precise and thus reproducible protocol.

This paper aims to study the impact of digital technology on the change of the economic model of higher education. It organized as follows. First, the need for a

business model in higher educational system is illustrated. Second, leaders in digital higher educational are presented. Third, we finish our paper by Algerian higher educational system with focus on its efforts of digitalization.

2. higher educational system: the need for a business model

"The university since Bologna in the 14th century is surprisingly the least innovative place of all society" according to S. Thrun (founder of Google X). However, demographic and economic issues and economic challenges will require an increasingly massive use of new technologies and digital technology in education and lifelong learning. The development of MOOCs in the whole word or the emergence of new training operators with massively digital models shows that this sector will undergo a real revolution. The impacts will be considerable on the entire training value chain.

2.1. Higher education: an ongoing global change

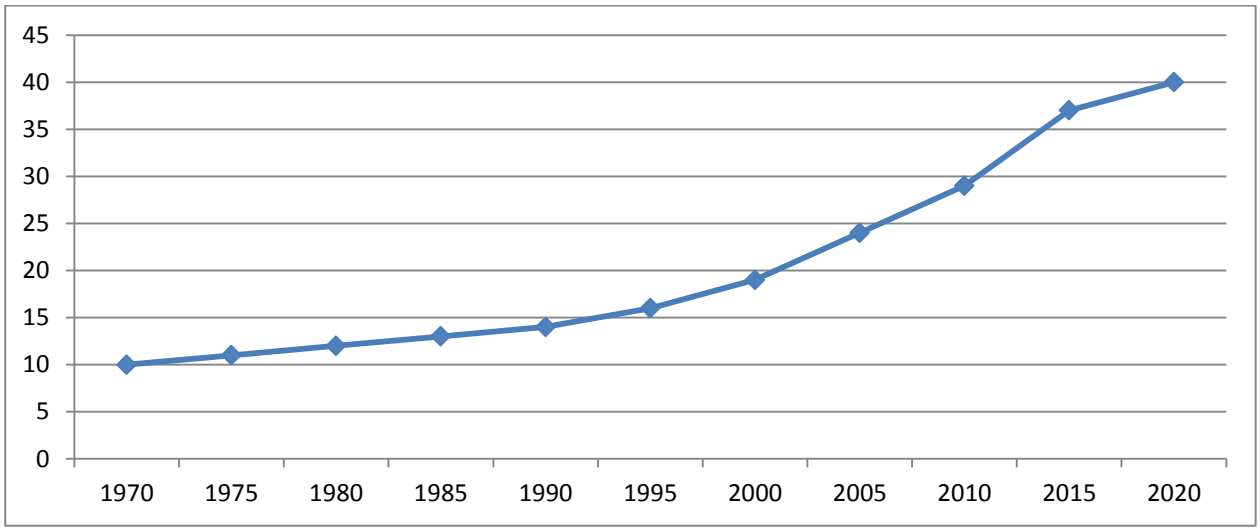
Education in the larger sense is already experiencing a real disruption effect through digital technology and, possibly, disintermediation between the actors (learners, teachers, training institutions, training operators, employers).

2.1.1. A rapidly changing demand for training

In 2020, there are around 235 million students who enrolled universities around the world up from 100 million in 2000. 6 million are studying abroad, a figure that has tripled in the last 20 years according to the data of UNESCO (UNESCO, 2022).The graph 1 shows this trend. Despite the boom in demand, the overall enrolment ratio is 40% with large differences between countries and regions.

This spectacular increase in the number of students is a response to the needs of the knowledge economy and innovation economy. This growth surpasses available resources, often resulting in higher education costs for households that many cannot afford.

Graph 1: tertiary education gross enrollment (%)



Source: UNESCO Institute for Statistics (uis.unesco.org). Data as of June 2022, accessed September 2022.

Note: Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Tertiary education, whether or not to an advanced research qualification, normally requires, as a minimum condition of admission, the successful completion of education at the secondary level.

2.1.2. A reconfigured training offer

In addition to its expansion, global higher education is undergoing profound changes.

Firstly, there is strong internationalization: According to OECD data, the number of students studying abroad tripled between 1985 and 2008, and this rate is expected to increase. The international student population is likely to reach 8 million by 2025. However, it is a volatile and asymmetric market - currently still dominated by the Anglo-Saxon countries (France is forth after the United States, the United Kingdom and Germany).

Internationalization, doubled with the overall expansion of the market, is intensifying competition between universities and encourages the concentration of institutions or their development in networked institutions (creation of almost 20 mega-universities around the world in 3 years, like Laureate with one million students in more than 80 institutions around the world). To adapt to this context, new models are being developed: pacing and programming according to short cycles, porosity between initial and continuing training, totally or partially distance learning, a logic based on certification rather than on "graduation".

Thus, new entrants will seek to impose themselves on this market according to disruptive models, highly digital models that will associate training with innovation.

The creation by Xavier Niels (CEO of FREE Company) of 42, a free, highly digitized school with a pedagogy based entirely on project work is a first illustration of this. The almost daily creation of start-ups around the world demonstrates this dynamic. More than 240 start-ups in education have been launched in the last five years in the Boston area, benefiting from the presence of GAFA (Google, Apple, FaceBook, Amazon) and Microsoft, numerous institutional investors, and an incubator dedicated to education technology, LearnLaunchX. Other examples include AltSchool, which raised $100 million in 2015 to develop a network of high-tech elementary schools, or the deployment of Google Campuses on 5 continents.

2.1.3. Digital technology: a lever for changing the economic model of higher education

Before showing the contribution of digital technologies to the creation of a new model of higher education, it seems appropriate to define the digital economy

- **Digital economy: concept definition**

The traditional economic sectors are largely impacted by digital technology. With the internet and the rise of shopping websites and applications, consumption patterns have been turned upside down and companies have no choice but to adapt to these changes. Moreover, digital technology has been integrated into all company activities, generating a new way of working (Autor, 2015) (Agrawal A., 2015) and a new organizational and managerial model (Mayère, 2016). For (Bourreau M., 2016) this new context based on digital technology rests on three pillars: technological (software, artificial intelligence, etc.), economic (new value chain, new business model, new governance, etc.) and social (coproduction, collaborative consumption, etc.).

The first thinking on the digital economy focused on the economic impact of the internet, commonly known as the internet economy (Tapscott, 1996) (Brousseau E., 2001). The development and generalization of the internet has directed studies towards the evolution of organizations under the effect of the digital. The concept of digitization has emerged to highlight this process of transformation of organizations using digital products and services (Brennen J.S., 2016) Over the past five years, the scale of digitalization has disrupted traditional sectors (transport, hospitality, banking, education, etc.).

The evolution of the digital economy is underway with the increased use of artificial intelligence, connected objects, 3D printing, robotics, cloud computing and metadata analysis (UNTAD, 2019). Technological advances are changing the tasks in organizations and the interactions between its stakeholders, which directly influence the structure of the organization and therefore its culture. It must therefore instill a culture that encourages collaboration, experimentation, continuous

learning and change.

- **Digital transformation in higher educational institutions**

Whether the models are public or private; the costs of education are considered to be very high by student: tuition fees, transport and accommodation costs, etc. The debt ratio of American students is particularly high, with 1,380 billion at the end of 2021, which is more than the total debt of credit card debt.

The economic equation in higher education remains: how to get rid of the correlation between the cost of initial training and continuing education to the increasing volume of learners (and therefore of teachers and infrastructures) and the requirement of a wide training, in context of competition at national and global level?

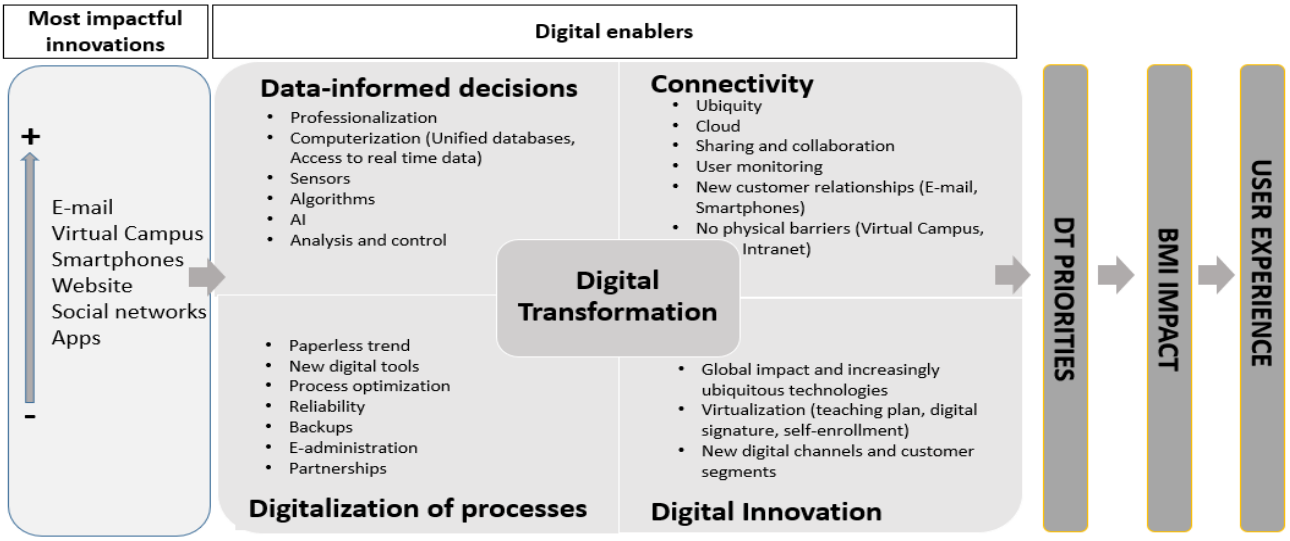
This is the famous iron triangle theorized by Sir John Daniel which tends to show that cost control for high quality of education for the greatest number of people seems impossible, unless we change the model. This thinking is at the origin of the creation of the Open University in 1969 in Great Britain, which offers today nearly 250,000 students a very high quality at a cost of two to three times lower than that of a traditional university.

To a different extent, we can also mention the emergence of free and massive open online course- MOOCs- whose value will depend on their ability to monetize their audience, or even decline their model for continuing training in companies. In how often will we see emerge of a Facebook, an Instagram or an education Uber capable of delivering knowledge and skills to 11 millions of children or students around the world, and whose valuation will exceed 10 billion dollars in a few years?

There is no doubt that new operators with pedagogical and economic models strongly focused on digital technology will emerge in direct competition from incumbents operators; this movement is underway.

Digital transformation in higher educational institutions is commonly understood as an evolutionary process, something that affects and transforms all the main areas of activity (teaching, research and transfer of research, administration). Digital transformation is not only about the adoption of new digital tools and equipment, but it is also about the transformation and automation of all the processes, thus increasing their effectiveness and eliminating any physical processes and barriers through the increased connectivity and digitalization of everything. Figure 1 shows a structured summary of the digital transformation concept in higher educational institutions.

Figure 1: Higher Educational Institutions (HEI) Digital Transformation Concept



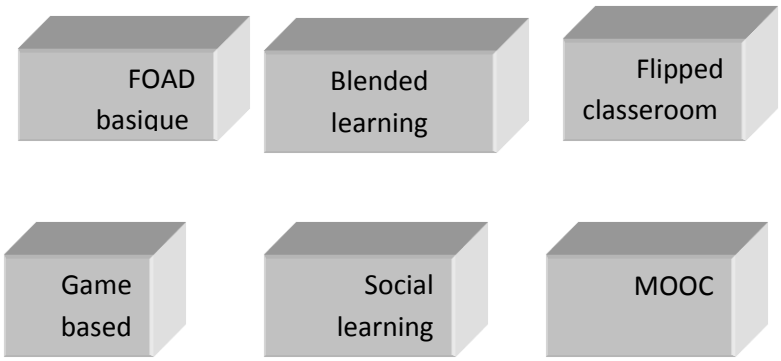
Source: (Rof A., 2020)

- **Different forms of digitalization of education**

The digitalization of education is leading to new ways of teaching, learning and working (Gaebel, 2021) According to (Albero B., 2009), innovating pedagogy in higher education consists essentially in developing or adapting new devices based on digital technologies. Generally speaking, the so-called innovative teaching methods are distinguished by the fact that the teaching is not lectured. Thus the digitalization of education is a set of technologies used to modify the programs and teaching offered within higher education organizations. The use of these new technologies influences the training offer (content), the way of teaching (transmitted teaching versus co-constructed teaching) and the means (techno-pedagogical tools).

Various forms of digitalization have been identified: blended learning, flipped classes, serious games, gaming, social learning and MOOCs.

Figure 2: forms of digitalization of education



Source: (Ghozlane S., 2016)

Blended learning is a teaching system based on face-to-face teaching combined with online or distance learning activities (Graham, 2006).

The flipped classroom is based on work done by the students themselves, prior to the course. Class time is then devoted to student interaction and participation.

Game based learning is the use of technologies from the world of video games for training or learning purposes.

Social learning is online educational system that use simple tools such as forums, blogs, wikis or peer review. The principle of peer assessment is that students assess the work of their peers.

MOOCs are "massive open online courses". Free and open access, these courses do not require any prerequisites from the participants.

2.1.4. Ranking universities: from ranking web to global ranking

The Ranking Web or Webometric is the largest academic ranking of Higher Educational Institutions. It uses both webometric (all missions) and bibliometric (research mission) indicators. The first indicator is Visibility of web contents: number of external networks linking to the institution's webpages. The second indicator is Transparency or Openness: number of citations from top 210 authors. The last one is Excellence or Scholar: number of papers amongst the top 10% most cited in each one of the all 27 disciplines of the full database.

The table below illustrates top 5 ranking web of university around the world. The top 3 universities in this ranking are American. The USA is the most-represented country overall with 56 institutions in the top 100, 8 of 100 universities are from United Kingdom. The movement of digitalization is already well established in Anglo-Saxons countries.

Table 1: top 5 world university web ranking

Ranking	University	Country
1	Harvard university	USA
2	Stanford university	USA
3	Massachusetts institute of technology MIT	USA
4	University of Oxford	UK
5	University of California Berkeley	USA

Source: www.webometrics.info accessed 10/09/2022.

According to the THE (Times Higher Education) ranking, universities of North America are well ranked (Chart 2). The Times Higher Education World University Rankings include more than 1,600 universities across 99 countries and territories, making them the largest and most diverse university rankings to date. The table is based on 13

carefully calibrated performance indicators that measure an institution's performance across four areas: teaching, research, knowledge transfer and international outlook.

Table 2: World University Rankings 2022 (THE)

Ranking	Name\country	Score
1	University of Oxford\ UK	95,7
2	California Institute of Technology \ USA	95,0
2	Harvard University\USA	95,0
4	Stanford University\USA	94,9
5	Massachusetts Institute of Tchnology\ USA	94,6

Source:https://www.timeshighereducation.com/world-univ%C3%A9rsity-rankings/2022, accessed 10/09/2022

Harvard University tops the teaching pillar, while the University of Oxford tops the research pillar and Macau University of Science and Technology (China) leads the international pillar. By linking the two rankings (table 1 and table 2), the digitalization of higher education is one of the elements that contribute to improving the higher education's performance and quality.

2.2. A comparison of the higher education model

In this point, we compare two higher education systems: United Kingdom system and USA system. Table 3 illustrates the human and financial resources allocated to information technology. MIT (USA) spends the most on IT.

Table 3: the human and financial resources allocated to information technology (IT)

	IT budget %	IT expenditure per IT team $	IT expenditure per teacher $	teachers per IT team
Cambridge	0,83	20 000	2445	8
MIT	7,65	n.k	91 984	n.k

Source: OECD data www.data.oecd.org accessed 15/09/2022

2.2.1. Open University in United Kingdom: initiator of digital higher education

The Open University was introduced in United Kingdom in 1969 by Labour Prime Minister Wilson to increase access to higher education, particularly for adults, by reducing the cost of entry and giving priority to digital higher learning.

With over 250,000 students (50,000 of whom are outside the UK), it has become one of the world's leading higher education institutions.

The UK has become one of the world's leading distance learning higher education institutions.

It offers 450 courses covering all major subject areas at both undergraduate (Bachelor) and graduate (Master and Doctorate) levels. It relies on extensive digital learning resources and a network of 13 regional centers in the UK and Ireland and 350 study

centers in the rest of the world.

Students take courses on learning platform (communication services, social learning networks, portability of services, online evaluation ...) and benefit from tutorials provided in person by nearly 7,000 tutors. Open University's business model is based on a strong industrialization of the conception process of digital resources and educational systems, combining reference professors for each subject and a dedicated central digital editorial centre (e-learning centre); on the other hand a method of distributing courses online and face-to-face via local tutors.

The e-learning pole brings together all support activities for the design and publication of digital teaching devices (IT specialists, educational engineers, technicians, graphic designers, video makers, etc.), i.e. around 500 people... Open University has widely diversified its content distribution methods by investing in new media (i-Tunes U, YouTube, etc.), in a partnership with the BBC (more than 25 programs produced per year) and with the setting up of Open Learn (650 programs per year).

I-Tunes U page of Open Learn has 28 million visitors and 450,000 download per week, and accounts for about 10% of i-Tunes U traffic. Open University has also launched a dedicated MOOC platform, Future Learn, which has been bringing together nearly 60 European universities for the past two years.

Open University UK has become the world leader in online MBA training, is the most popular university in the UK, and trains nearly 10,000 students abroad. Its digital learning resources are used by 70% of the top 100 UK universities.

2.2.2. Digitalization of American high educational system

The majority of American universities are now actively using ICT in their teaching, in particular through the principle of flipped classrooms and the famous MOOCs which mean the instruction is delivered online, outside of class. More precisely, 55% of universities have already taken the plunge recently or often for many years, according to a study by the very serious Campus Technology's 2016.

However, this digitization of higher education is not without significance. Only 14% of American teachers use the flipped classroom for all their teaching. The majority (41%) are content to use this blended learning method for part of their teaching. A quarter of the remaining teachers are considering flipped classrooms in the near future, and only 20% are still using a traditional face-to-face teaching system.

If American universities are turning to the virtues of ICTE, it is because student demand is strong. According to the education media Educause, 78% of American students recognize the concrete usefulness of MOOCs and other digital tools in their final exam success. Moreover, 46% of these same students say they are more motivated and more

involved in their courses by working with ICT.

Here again, while the demand is real, with more than half of learners wanting their teacher to become more involved in the digitalization of teaching, in general it is not a question of students wanting to make their entire training virtual at all costs. Seemingly crucially, the human relations factor with teachers and other students remains very strong. Thus, the overwhelming majority of students want a measured use of ICT, with 82% declaring themselves in favour of blended learning.

Over the past two years, 73% of universities surveyed have improved their IT infrastructure. This is one of the results of a survey conducted by Unit4 (Dutch Software Publisher) among 150 decision-makers in American higher education. The Dutch software company, which has been involved in the education sector for several years, found that 81% of respondents said they had invested in new technologies. The aim is to "help their students to succeed in their studies", the survey notes, but also and above all to keep them within the institution throughout their training, according to a majority of respondents.

Among the technological services developed, 60% of the universities surveyed have set up **an automatic alert system** to identify students who are failing academically and help them overcome their difficulties. To make life easier for their students, 62% have recently updated their online welcome portal or developed mobile applications. At University Davis in California, an app makes it easy to apply for financial aid. On the other hand, new technologies such as chatbots or artificial intelligence are far from being universally supported: only 6% of respondents say they use these resources.

University of the People, based in the United States, is one of the digital universities that allow students from 194 different countries to learn and train at their own pace.

Founded in 2009 and accredited in 2014, it also offers scholarships for foster children to pursue higher education. The degrees are internationally recognized as UOP is accredited by the US Distance Learning Commission (DEAC). As a result of this government accreditation, the UOP is entitled to award recognized degrees. 7000 professors and academics from Harvard, Colombia and everywhere reached out to volunteer for this university. Thousands of students reached out to attend the university.

3. Algerian higher education system: the effort in digitalization

The digitization of higher education in Algeria has resulted in the use of the following platforms. Before developing this point, we will rank the web performance of Algerian universities on the North Africa scale. Table 4 shows that Algerian University is not well represented in North Africa ranking (28 institutions in top 100). Egypt is the most-represented country overall with 41 institutions in the top 100. The top 5 of universities

are Egyptian.

Table 4: ranking web of Algerian universities in the North Africa ranking

Ranking	University	Ranking	University
27	U. des sciences et de la technologie Houari Boumediene	**53**	08 Mai 1945 Guelma
28	U. des frères Mentouri Constantine 1	**55**	U. M'hamed Bougara Boumerdes
31	U. de M'sila	**56**	U. Amar Telidji Laghouat
34	U. Abou Bekr Belkaid Tlemcen	**60**	U. de Tébessa
38	U. Oran 1 Ahmed Ben Bella	**61**	U. des sciences et de la technologie d'Oran Mohamed Boudiaf
41	U. Ferhat Abbas Sétif	**68**	U. Abdelhamid Ibn Badis Mostaganem
42	U. Djillali Liabes Sidi Bel Abbes	**69**	U. Saad Dahlab Blida
45	U. de Bejaia	**73**	U. Hassiba Benbouali Chlef
46	U. Mohamed Khider Biskra	**79**	U. de Jijel
48	U. Kasdi Merbah Ouergla	**81**	U. de Skikda
51	U. Badji Mokhtar Annaba	**84**	U. Ibn Khaldoun Tiaret

Source: www.webometrics.info accessed 18/09/2022

3.1. Digital database

Dspace (Digital Space) is a digital service that collects, preserves, and distributes digital material. Repositories are important tools for preserving an organization's legacy; they facilitate digital preservation and scholarly communication.

This database includes: international scientific papers, doctoral thesis in medical sciences, magisterial thesis, master's thesis, engineering thesis, scientific events and doctoral thesis. This database contains more than 16,000 references per university. Searches can be made by author, publication date, title, subject, communities and collections.

SNDL (système national de documentation en ligne). It provides access to a very rich and varied national and international electronic documentation, covering all fields of scientific education and research.

- International documentation (acquired via subscriptions)

In terms of access, this documentation is divided into two categories: The first category is accessible without restriction to all students, lecturers and permanent researchers on university campuses and research centers. The other category, on the other hand, concerns the research aspect. It is dedicated to teacher-researchers, permanent researchers, post-graduation students (PhDs), engineering students at the end of their studies and Masters. Access to this second category of documentation is unrestricted by location but requires an individual account. The procedure for obtaining an account is simple. It is handled by: The laboratory director (director for research centers and units) for teacher-researchers affiliated to a research laboratory (respectively research centers and units) and postgraduate students (PhDs). The head of the central library, for teacher-researchers not yet affiliated to a research laboratory, Master 2s and final-year engineering students.

- Documentation produced at national level

CERIST (Centre de Recherche sur l'Information Scientifique et Technique) is leading a project to identify, process and report on national scientific production and to put it online. Resources are therefore already available to users through this site. The national scientific production is available through: the Algerian journals portal (WebReviews), the Algerian Collective Catalogue (CCDZ), the National Thesis Reporting Portal (PNST), the bibliographic databases (ALGERIANA and ASA).

PDOC: Algerian documentary platform. It includes

- DOCUMENTARY RESOURCES: The various scientific and technical databases, search engines, search tools, dictionaries, encyclopedias and bibliographies.....etc. available free of charge on the Internet.

- OPEN ARCHIVE

It includes the various digital repositories of higher education institutions and others that mainly include its scientific output and its free availability.

Thesis include: PhD thesis, Bachelor's and Master's thesis, Articles and Scientific papers, Printed books, etc.

- BOOKS

E-books of different specialties that meet the needs of research and teaching are freely available on the Internet. Those E-books are collected, classified and arranged in a scientific manner to facilitate access, to enhance the efforts of authors for more visibility and also to popularize the various books written by teachers and publish them to constitute a database for Algerian authors.

- LIBRARY CATALOGUES

Library catalogues for remote bibliographic research: locating the site of resources, interlibrary loans, orientation of book acquisition policies.

- DOCUMENT SHARING

The participation of the different actors in the field of scientific research in research products: Doctoral thesis, Bachelor's and Master's thesis, Articles and Scientific Communications, printed books, instructional videos .....etc via the deposit in the space designed for this purpose.

SAGACITE: Among the leaders in digital publishing, relying on a know-how in the distribution of books and in the university bookstore, Sagacitelink aims to offer to students, teachers and researchers, as well as professionals, the best scientific and technical publications from eminent Algerian academics. To download in a simple click, these educational documents, covering all the university disciplines:
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- Languages
- Preparatory classes
- Mathematics
- Physics, Chemistry and related sciences
- Technology-Engineering Sciences
- Medical Sciences
- Earth and Life Sciences
- Economic and Social Sciences
- Architecture-Urbanism-Arts
- Continuing Education

3.2. Online teaching and evaluation database

Moodle e-learning platform

A platform for open and distance learning is software that supports the conduct of open and distance learning. This type of software brings together the tools needed by the three main users - trainer, learner and administrator - of a system whose primary purpose is the remote consultation of educational content, the individualization of learning and remote tutoring.

3.3. Management base for administrative and pedagogical tasks

Progress: The PROGRES platform allows the management of the orientation of new baccalaureate students, the transfer, the timetable, the teachers' timetable, the deliberations, the management of the rooms, the maintenance and the tracing of the history and the course of the students, but also offers the possibility of publication of the

various states (PV, transcript of marks, official report ...)

The PROGRES Platform is a computer system providing a reliable database on all students and teachers of the Algerian university.

3.4. Research-related databases

ASJP: Algerian scientific journal platform is a platform dedicated to the creation of journals in all fields. Researchers and teacher-researchers can find articles to be used in their research, and they can also submit their work for publication. There are 761 journals and 191,946 articles.

PRFU Platform: Platform for the Management of University Training Research Projects. This platform is dedicated to the submission of research projects by including doctoral students in order to introduce them to research and contribute to their training. The evaluation of research projects is also done online.

National Research Projects (NRP) submission platform

Like the PRFU platform, this one is dedicated to submit research projects that require more human and financial means.

Research.dz: Algerian researcher platform. It aims to improve the visibility of Algerian researchers by integrating all their work and achievements in the field of scientific research.

Ibtikar: this digital platform, Ibtikar, facilitates access to technological platforms and analysis laboratories as common services accessible to all. These include physical-chemical analyses, materials characterization and scientific computing. E-infrastructures for intensive calculation, storage, management and mass processing of data complete the park developed to meet the needs of students, researchers and industrial communities.

4. Conclusion

This paper aims to study the impact of digital technology on the change of the economic model of higher education. Demographic and economic issues and economic challenges will require an increasingly massive use of new technologies and digital technology in education. Indeed, we see the emergence of new training operators with massively digital models. This sector will undergo a real revolution. United Kingdom is the initiator of digital higher education in 1969 by creating of Open University. Several countries have now followed the trend in order to get rid of the correlation between the cost of initial training and continuing education to the increasing volume of learners (and therefore of teachers and infrastructures) and the requirement of a wide training, in context of competition at national and global level.

The movement of digitalization is already well established in Angloaxons countries especially in the United States of America. American universities are well ranked in web infrastructure.

In Algeria, the pandemic of COVID 19, is the accelerator of digitalization on higher education system which concerns relation with students, teaching, administrative and pedagogic tasks. But efforts are still needed because of the delay accumulated by Algerian universities. The relevant authorities should invest more in digital technology by making the internet and digital communication tools very accessible to teachers, students and administrators.

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