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HIGHER EDUCATION CONTRIBUTION TO ESTABLISHING THE KNOWLEDGE ECONOMY ALGERIAN CASE 2011-2018 WITH REFERENCE TO ARAB COUNTRIES

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ABSTRACT

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Algeria initiated reforms in various fields, including higher education in order to facilitate the transition to knowledge economy. This study showed the reality of higher education in Algeria and investigated its role in the production of knowledge by assessing the number of patents, scientific researches, university rankings; and it compared the Algerian higher education performance through Global Innovation Index and global competitiveness index. Using the collected data, the study clarified the relationship between expenditure on higher education and the number of patents issued, the result showed a strong positive relationship, and on the other hand it tried to explain the regression between Algeria's ranking on the global innovation index and the sub-indicator tertiary education. This study concluded by proposing the most important possible solutions to upgrade the Algerian performance.

KEY WORDS: ***higher education, knowledge economy, government expenditure, university rankings, Innovation, patents, scientific research, human capital, GII, global competitiveness index, Algeria, Arab countries.***

1. INTRODUCTION

Higher education institutions are the main element in any educational system as they put the final touches on the learner, define his directions and interests. These institutions are also considered to be one of the most important sources of creativity, innovation, human resource development; according to Ruxandra (2018) universities must be able to prepare students for jobs in a very different way from the traditional ones and also prepare them for jobs that are yet unknown but shall pop-up into the labor market at any moment; on the other hand These institutions are the most responsible for the way society is built. All of this has led to the necessity of investing in higher education institutions and managing them in such a way that educational services meet the needs of the market, economy and society; Developing countries face the particular challenge of not only providing broader access to higher education, but also of interlinking their universities with the knowledge economy, by producing competitive graduates and generating innovative research (Teferra, 2016).On this basis, new work mechanisms should be introduced to develop higher education institutions, and to continuously improve them so as they help establishing knowledge economy instead of the traditional rentier economy that characterizes Algeria. The importance of our study comes from the close relationship between Innovation activities and development in economic systems and life; as Borisas (2018) insisted, they must be a priority in academic studies and in the scientific research on knowledge economies. The crucial problem that we tackled in this study is that the existing literature in The contemporary science neglect the challenges facing the higher education sector in underdeveloped countries, The core of the problem also focus on providing these countries mainly Algeria by some recommendations that can facilitate the transition to a knowledge economy through the crucial role that higher education can play; The essence of the study also lies in answering some questions, what is the reality of higher education in Algeria? to answer this question, we relied on a set of quantitative indicators, including: the number of university institutions and centers affiliated to the Algerian Ministry of Higher Education and Scientific Research, as well as the number of students enrolled in the graduate and post-graduate phase, then the number of permanent, associate and foreign professors, Finally, we pointed to the expenditure on this sector, all this was during the years 2011-2018; depending on the most important indicators which are patents, international scientific publications and universities global rankings we tried to analyze how Algeria and the higher education sector perform in the same period of time specified above, second main question: what are the implications for achieving creativity and innovation in higher education institutions? And to answer it we used the indicators aforementioned, we tried to analyze the relationship between

expenditure on higher education and the number of patents produced at the level of the same ministry, and on the other hand we tried to investigate the correlation between Algeria's ranking on the global innovation index and the sub-indicator tertiary education.

2.LITERATURE REVIEW

2.1 What is knowledge Economy?

New methods are emerging to produce goods and services 'knowledge economy' this economy is based on the production, distribution and use of knowledge information, Also known as the ability to generate, collect, use and disseminate knowledge and technology (Ávalos, 1999; Bell, 1973), it consists of two main groups of assets one concerning human resources such as knowledge, skills and experience, introduced under the collective term know-how and the other concerns the intangible assets such as patents, licenses, trademarks, designs etc (Oxford and Cambridge dictionaries, 2020), in the same context Walter and Kaisa (2004) define the knowledge economy as products and services based on knowledge-intensive activities that contribute to an accelerated pace of technological and scientific advance as well as equally rapid obsolescence; in addition to its focus on employing information technology, Associating with innovation and creativity (Hashem and Nadia, 2008); Powel and Snellman (2004) affirmed knowledge economy key component is the greater reliance on intellectual capabilities than on physical inputs or natural resources; broadly speaking, it is characterized by its emphasized on investing in human resources, Pursuing continuous learning and training, In addition to that the knowledge economy grows with the increase use of information, product prices decrease (that have a higher knowledge density); in this economy the value of knowledge itself is greater when it comes into operation. There are a number of indicators that are used to measure it (the comparable pillars among countries), The most important is the World Bank one, which is based on four sub-indicators: education and human resources index, technological innovation index, information and communication technology index (Abdul-Hadi, 2017); while the four Component of knowledge pillars according to the European bank for reconstruction and development are: institutions for innovation, skills for innovation, innovation system, ICT infrastructure (world bank and EBRD websites 2020). One initiative presented by the World Bank, directed to help countries to develop strategies that facilitate the transition toward knowledge economy (Olafsen, 2004), the focus in it was on four elements: The first is to create an economic and institutional system that stimulates the use of knowledge; Second, training and qualification of the human resource in order to create, use and share knowledge, this point in particular has received focus from many studies that highlight the core of knowledge society 'human capital' and the main forces of this society are education, science and innovation, because knowledge is the result of learning and internationalization of information, data and experience (Elena, 2019); this initiative also emphasizes on providing a dynamic information infrastructure to facilitate effective communication, dissemination and processing of information, where its importance appears in facilitating the broad distribution of knowledge (Walter and Kaisa, 2004); And finally, stressing the role of research centers, universities etc.

2.2 Higher Education, innovation and human capital:

Education is one of the most important sectors affected by the knowledge economy; what led to crucial changes in its systems, policies and practices (Välimaa and Hoffman, 2008); over the past decades higher education in particular faced challenges, on one hand regarding the requirements of their students who must adapt to the fast changing environment (Bejinaru, 2017; Wells, 2017), on the other hand, the need to move quickly from invention to innovation that presents a strong argument for keeping a reasonably close connection between education and research (Lundvall, 2008); Ruxandra (2018) explained, keeping up with these challenge would enable the university to increase the performance level of its undergraduates and graduates, raise the quality of their research and therefore attract investors, and clients from the business sector, Raise its ranks among universities worldwide etc, From Barbara (2019) point of view, these universities will be able to sell databases, licenses, innovations and to graduate batches of qualified students to occupy positions in private and public institutions. What is agreed upon is that higher education facilitates innovation. In the same context, no one denied that innovative capacity of each country is related to highly educated human resources (Lundvall, 2008), thus Higher education and innovation can be connected in two ways, On one side, universities are the producer of innovative human capital; on the other side, universities can themselves become targets of innovation.The dual function of higher education as both motor and site of innovation is rooted in the fact that education and innovation share a number of characteristics that are deemed necessary for both to operate successfully. José (2020) drew attention to new ideas or products to become adapted, innovation systems need to be capable of learning, and hence require actors who know how to learn and interact.

3.THE DEVELOPMENT OF ALGERIAN HIGHER EDUCATION

After Algeria gained its independence in 1962, several measures have been initiated, according to Publications of the Ministry of Higher Education and Scientific Research, Algeria started with one university (University of Algeria, already founded in 1909 and it was followed by two attached centers at Oran and Constantine), Now Algeria has a large public higher education system, this educational system includes 106 institutions covering 48 states across the national territory (according to the statistics of the Algerian Higher Education and Scientific Research Ministry and the national office for statistics year 2018), distributed to universities, high schools in addition to a number of scientific centers and research laboratories, what is detailed in the Table 1 below; one of the most important reforms applied in the last decade the introduction of LMD system (license, Master, Doctorat) hoping to keep pace with global developments and find solutions to the classic system demerits.

Table 1. Distribution and Evolution of higher education institutions

Year	/2011 2012	/2012 2013	/2013 2014	/2014 2015	/2015 2016	/2016 2017	/2017 2018
University	43	47	47	48	50	50	50
University Center	7	9	10	10	13	13	13
High School	4	4	4	6	10	11	11
Specialized high school	2	1	1	1	1	0	0
National High School	15	17	17	20	20	31	31
Preparatory School	9	9	9	12	12	1	1

Source: Algeria in numbers, 2014-2018, National Office for Statistics N°44, N°47, N°48, Available from : https://www.ons.dz [accessed February 27 2020].

Working at these institutions 46 454 teachers in the academic season 2011/2012, the number increased by 3 879 teachers in the following season, and the total number reached 61825 in the academic season 2017/2018; the Table 2 explains the evolution of the number of permanent teachers, the participants and the foreign teachers from 2011 to 2018

Table 2. Pedagogical framing

Teachers/Years	2012/2011	/2012 2013	/2013 2014	/2014 2015	/2015 2016	/2016 2017	/2017 2018
Totale	46 454	50 333	53 457	55 906	57 729	59 468	61825
Permanent professors	44 448	48 398	51 299	53 622	56 061	57 628	58647
Foreign professors	68	77	107	93	72	64	120
Associate professors	2 006	1 935	2 158	2 284	1 668	1 840	3178

Source: Algeria in numbers, 2014-2018, National Office for Statistics N°44, N°47, N°48, Available from: https://www.ons.dz [accessed February 27 2020].

Table 3 shows that the number of students enrolled in the graduation and post-graduation stages and the number of graduating students is increasing significantly, where the increase in the total number of students was estimated between 2011 and 2018 at 369181, due to free education, access to higher education in Algeria is guaranteed to all secondary school graduates and there are no tuition fees, although students do pay small matriculation fees; in addition the universal commitment to the knowledge economy has pushed both high- and low-income countries to apply policies to increase the number of doctoral students; what constitutes a challenge for the university, Algeria seeks to overcome it and for this, plans (1998-2002 plan) and (2008-2012 plan) were adopted and accredited by Draft law on amending and complementing Law N°11-98, where they aimed to achieve economic, social, scientific and technological development and advance to sustainable development in the country, and this is by setting ambitious goals and providing the financial and human resources to achieve them.

Table 3. Registered and graduates students

Students /Years	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018
Students enrolled in the graduation phase	1 090 592	1124 434	1 119 515	1 165 040	1 315 744	1356081	1447064
post-graduation Students	64 212	67 671	70 734	76 510	76 961	76 202	76921
Graduated students	233 879	288 602	/	311 976	292 683	303 100	/

Source: Algeria in numbers, 2014-2018, National Office for Statistics N°44, N°47, N°48, Available from: https://www.ons.dz [accessed February 27 2020].

The government has allocated a substantial budget for this sector, higher education budget is often ranked the fifth among 32 ministerial departments; it should be noted that the total funding for this sector is the responsibility of the government (Souleh, 2017). In 2018 expenses totaled more than 313 billion Dz (according to Table 4), these budgets allocated to the research environment, and to supply expenses, compared to developed countries, these amounts remain small, even though they correspond to significant proportions of the total state budget.

Table 4. expenditure on higher education

Year	2011	2012	2013	2014	2015	2016	2017	2018
Higher education budget / billion dinars	212.83	277.17	264.58	270.74	300.33	312.14	310.79	313.33
The proportion of the state budget	6.19	5.62	6.1	5.74	6.04	6.49	6.76	6.83

Source: Finance Law N°08, N°40, N°68, N°72, N°77, N°78. Official Journals of The Algerian Republic, Available from:www.mfdgi.gov.dz(https://www.mfdgi.gov.dz/index.php/ar/com-smartslider3/2014-03-24-14-21-50/lois-de-finances/276-2011-2014) [accessed April 21, 2020].

4.EFFECTIVENESS OF HIGHER EDUCATION

The quality and effectiveness of higher education and could be measured through indicators we mentioned the following sequentially:

4.1 Scientific Publications

It is evident that knowledge economy and the research activities and academic studies devoted to it, have become more and more widespread in the recent times (Borisas, 2018). The data explained below are collected from the Journal & Country Rank portal, which depends on the information contained in the Scopus Elsevier B. database, which can be classified into 27 main fields and 313 specific subject categories. Quotation data is derived from more than 34,100 titles belonging to more than 5,000 international publishers, this indicator also shows the performance of 239 countries around the world from 1996 to 2018. The data indicate that the number of scientific publications investigated by the Algerian researchers estimated at 65714, a slight increase from Morocco, while Tunisia leads the ranking in the Arab Maghreb; for Egypt the number of published researches is estimated at 203952 and 182753 published researches for Saudi Arabia

The countries mentioned in the Table 6 are followed by the Kingdom of Jordan, Lebanon, Iraq, Qatar, Kuwait, Oman, Sudan etc.

6. Scientific publications presented by the Algerian researchers

	H Index	Cites/ Docs	Total Cites	Citable Docs	Total Docs
Egypt	260	9.48	1933453	195777	203952
Saudi Arabia	309	10.65	1946422	173495	182753
Tunisia	174	7.84	678610	81933	86600
Algeria	157	6.77	444666	63705	65714
Morocco	179	8.11	507921	58839	62636
United Arab Emirates	190	8.90	471192	48750	52931

Source: Ranking de revistas de Scopus, Scimago Journal and Country Rank (SJR), Available from: http://wwww.scmajorjr.com [accessed April 13, 2020].

Algeria's support for this aspect may be demonstrated by the creation of a national platform that includes about 525 scientific journals (ASJP website), including those classified in category B and C.

According to Nazi (2017) statistics issued by Thomson Reuters define Algeria s' strengths in the following specialties: mechanical engineering, material, pallet and material, Fluid mechanics, optics and electronics, general and nuclear physics, technological innovation and economic valuation; followed by mathematics and statistics, automated information, chemistry, ecology; and weaknesses were recorded in researches of oncology, immunology, neuroscience and this will be confirmed when showing eras of excellence in registered patents.

4.2 Patents of inventions

According to Shirley (2019) the stage that precede the development of the intellectual property management system is finding methods to link it with planned goals and the intellectual property that we own, in this way Algeria must think, the latter lacks is not limited to the few registered patents compared to other countries, but also the lack of planning, managing, implementing. Patents for residents are considered as one of the indicators of technological innovation and country's competitiveness. Every year, the Algerian National Institute of Industrial Property handles between 700 and 800 patent certificates, of which only 10 percent belong to Algerian researchers or institutions, and the rest of the patents are for foreign economic agents active on the homeland (Houriya and Mohamed, 2016), and only very small proportions are used, while Kyazim (2019) assumed that growth and value are generated by and through effective intellectual property management.

The evolution of the number of patents obtained by Algerian researchers from 2011 to 2018 can be summarized in the following table:

Table 7. Patents obtained by Algerian researchers from 2011 to 2018

Year	The total number of patents	patents registered in education centers and units outside the higher education and scientific research sector	patents registered by the Ministry of Higher Education And scientific research
2011	116	16	90
2012	134	16	118
2013	168	18	150
2014	174	26	148
2015	200	26	174
2016	237	25	212
2017	254	27	227
2018	275	29	246

Source: DGRSDT, Collection of invention patents 2011-2018

In Algeria, only a few number of patents is issued during the years mentioned in the above Table 7 for research centers and institutes outside the Ministry of Higher Education and Scientific Research, including the Research and Development Center (SAIDAL) a foundation for the production of medicines and energy research institutes affiliated with (SONATRACH) the Petroleum company, The rest is obtained by individuals, this is what drives us to expect a new dynamic from industrial companies in the medium and long term. It is noticed that there is a significant increase in the number of patents registered from one year to the next, the latter reached 116 patents on December 15, 2011 while it was about 96 patents in the previous year, distributed as follows: 58 patents from 67 institutions of higher education, 42 patents from 15 research centers and units in the research sector, 16 patents related to research entities outside the Ministry of Higher Education and Research (MESRS) mainly (SAIDAL), in addition to that the largest number of patents obtained by researchers for the same year was in the technical fields: Physics, mechanics, electronics, health, agriculture, and technology in general (DGRSDT, 2011); While the number reached 134 patents for 131 inventors and researchers on December 15, 2012, in reality the number is less than the real capabilities of the scientific community, however, these results must take into account due to several reasons, among them the non-stimulating environment. 66 patents belonging to 56 higher education institutions, which constitute (49% of the total number of patents), 52 patents belong to 15 centers and research units i.e (39%) and 16 patent for research entities outside the Research Center of MESRS, Affiliated with the SAIDAL and SONATRACH, added to the fields of excellence compared to the previous year: hydraulics (water treatment / desalination and sterilization) health and agriculture in general (DGRSDT, 2012). In its third edition of the statistical data collected and presented by the General Directorate of Scientific Research and Technological Development (DGRSDT) there was a significant increase of about (20%) in the number of patents for national researchers in 2013, where 168 patents submitted by 172 inventor researchers were registered in the national territory, and they were distributed as follows: 69 patents belonging to 70 higher education institutions (41%), and 81 patents belonging to 15 research centers and units in the research sector (48%) and 18 patents for research entities outside MESRS (DGRSDT, 2013), areas added to the above mentioned: metallurgy, renewable energies, pharmacology as well as information technology. All sectors combined (MESRS & Outside MESRS) registered 200 patents on December 31, 2015, the driving force behind the overall increase in the number of patents for national researchers was presented by institutions of higher education, where 21 other patents were registered compared to 2014 in the same sector; 200 patents are distributed to national researchers as follows (DGRSDT, 2015): 91 patents belonging to 21 institutions of higher education (45.5%), and 80 patents belonging to 10 research centers and units (40%), 26 patents belonging to research entities outside MESRS mainly SAIDAL (13%), 03 patents of the ANVREDET National Research and Technology Development Agency (1.5%). DGRSDT launched for the sixth consecutive year Patent determination process for 2017 with 83 institutions and research centers in all sectors, including 59 higher education institutions (universities - university centers - national higher schools), 11 research centers affiliated with MESRS, 13 research centers and institutes outside the Center for Regional and Research Studies. In 2016, 237 patents were registered; again the increase in the number of registrations from higher education institutions was the driving force behind the overall increase in the number of patents for national researchers, with 24 other patents compared to 2015. 237 patents are distributed as follows: 115 patents belonging to 24 higher education institutions, i.e. (48.52%), 90 patents belonging to 7 research centers in the research sector are estimated at (37.97%) and 25 patents related to entities research outside MESRS makes up (10.55%) and finally 7 patents that fall under the National Agency for Valuation of Technological Research and Development Results (ANVREDET) approximately (3%) of the total number of patents (DGRSDT, 2017) . while the number in all sectors (MESRS & outside MESRS) reached 254 patents on December 31, 2017; and it reached 275 in 2018.

4.3 Ranking universities

After reviewing the reality of higher education institutions in Algeria, now it is necessary to know about the classification of Algerian universities, where international rankings considered as the most important methods for assessing the quality of universities in terms of scientific research and academic performance that they provide, and according to procedures and conditions objectively determined, in the most important classifications approved globally 'Shanghai's ARWU rankings', 500 universities out of 2000 chosen worldwide, it is checked based on a number of criteria such as number of faculty members who won the Nobel Prize, and the extent to which their researches were cited, among the Arab countries that entered the classification in 2018 Saudi Arabia with four universities, and Egypt with one university (shanghai ranking official site, 2020).

And in the 'QS World Ranking', 800 universities are annually chosen; it aims to identify the universities that rise

from the local to the global level, among the criteria adopted by this classification, academic reputation based on surveys, citations from the scientific research of these universities, the ratio of faculty members to the number of students, proportion of foreign teachers and students, etc. At the level of the Arab countries for the same year 2018, King Fahd University of Saudi Arabia topped the ranking 173, followed by Lebanon and Qatar, the American University in Cairo ranked 395, it was the best ranking Egypt has obtained, then the United Arab Emirates and Oman, as well as Morocco by King Mohammed V University (world-university-rankings site, 2020).

'The Webometrics Ranking' has been adopted by the Algerian Ministry of Higher Education and Scientific Research, Webometrics is a system for evaluating international universities, issued by the Higher Council for Scientific Research in Spain, these classification covers about 25,000 universities and chose 16,000 universities, it is linked to the standard of research and technical files, and updated periodically every six months, it depends in classifying universities on the basis of the latter's presence on the Internet like the universities' website, the visibility of their link etc, considering this classification as the most applicable rankings on Algerian higher education institutions, globally the results of the Algerian universities ranking, shown in the table below:

Table 5. Top 10 Algerian universities ranking according to Webmetrics

Rank	Universities	Rank globally
1.	Oran University 1 Ahmed bin Bella	1935
2.	Constantine University 1	2113
3.	Houari Boumediene University of Science and Technology	2117
4.	Abu Bakr Belkaid University of Tlemcen	2414
5.	Jilali Liabis University in Sidi Bel Abbes	2571
6.	Al-Messila University	2624
7.	Bejaia University	2651
8.	University of Setif 1, Farhat Abbas Setif	2853
9.	Muhammad Khader University in Biskra	2882
10.	Batna University	2986

Source: http://www.webometrics.info/en/aw/algeria

It is noted from the above table that the ranking of Algerian universities is limited between 1935 and 2986 for the universities in the top ten ranks.

While Saudi Arabian universities top the rankings starting from 428 registered by King Saud University, Morocco begins with the ranking 1275 by Al-Qadi Ayyad University.

The irony is that UNESCO reports consider Algerian universities a center for training researchers and innovative brains (UNESCO Science Report, 2010), while they are at the bottom of the global ranking and do not occupy advanced positions even among the best 100 African universities, and this is confirmed by (Table 5).

5. ALGERIA GLOBAL RANKINGS

5.1 Algeria's ranking according to the Global Competitiveness Index with reference to higher education:

The Global Competitiveness Report for the year 2017-2018 revealed that the best of what Algeria achieved in 2016 was in the indicators of the Macro-economic environment, health, primary education and markets index (Appendix1).

As for the higher education index, Algeria ranked 92nd according to the following details (Global competitiveness Index report): it is ranked 74 in terms of the number of registered students (quantitatively) in higher education institutions, and ranked 105 in terms of the quality of education taking into account the educational systems, scientific disciplines, mathematics, business administration, and 124th in terms of training and the level of graduate students.

And it appears from (Appendix 2) that Tunisia ranked before Algeria, by a difference of three ranks at the level of the Arab Maghreb, they are followed by Morocco, on the top three at Arab level, Qatar, the United Arab Emirates and Bahrain ranked respectively 30, 34 and 44.

5.2 Algeria's ranking according to the Global Innovation Index with reference to higher education:

The Global Innovation Index, in its eleventh edition in (2018), a report jointly published by Cornell University, the European Institute of Business Administration (INSEAD) and the World Intellectual Property Organization (WIPO), which is a specialized United Nations agency, this index reviews global innovation for over 140 economies

The 2018 Global Innovation Index indicated the persistent gap in innovation capacity between developed and underdeveloped countries, and the exceptional growth rates for research and development activities at both the government and business levels.

The UAE ranked first in the Arab world, the third at the level of North Africa and West Asia and the 38th globally; In North Africa Tunisia ranked first, the 9th among North Africa and West Asia countries, and the 66th (INSEAD, 2018).

The worst rank Algeria obtained in the years mentioned in the Table 8 was 138th in 2013 (out of 142 countries), but Algeria reversed the situation to progress gradually until it reached the 108th rank in 2017 (out of 127 countries) and 110th in 2018.

Algeria ranked according to the innovation index at the global level for the years 2011/2018:

Table 8. Algeria's ranking according to the Global Innovation Index

Year	2011	2012	2013	2014	2015	2016	2017	2018
Global ranking	125	124	138	133	126	113	108	110
Score from 100	19.8	24.4	23.1	24.2	24.4	24.5	24.3	/
Ranking in North Africa And West Asia	16	18	19	18	18	18	18	18

Source: Global Innovation Index reports for the years 2011-2018

The Global Innovation Index uses dozens of Indicators, including:

the number of patents registered, infrastructure, expenditure on education, human capital, scientific research, institutions, creative outputs, knowledge and technology outputs, business and market sophistication and others, from them we focus on four that are mentioned in the Table 9 below since they are the closest to our study topic.

Table 9. Algeria's higher education ranking according to the Global Innovation

Index / year	**2011**	2012	2013	**2014**	**2015**	**2016**	**2017**	**2018**
Human capital and research	81	77	79	82	82	79	86	80
Tertiary education	72	63	79	77	69	64	63	37
Research & development	107	126	107	111	115	115	115	117
University / Industry research collaboration	114	128	136	135	128	122	108	111
Infrastructure / Information and Communication technologies	102	112	111	116	119	116	113	113
knowledge outputs	125	108	115	114	115	100	107	111

Source: Global Innovation Index reports for the years 2011-2018

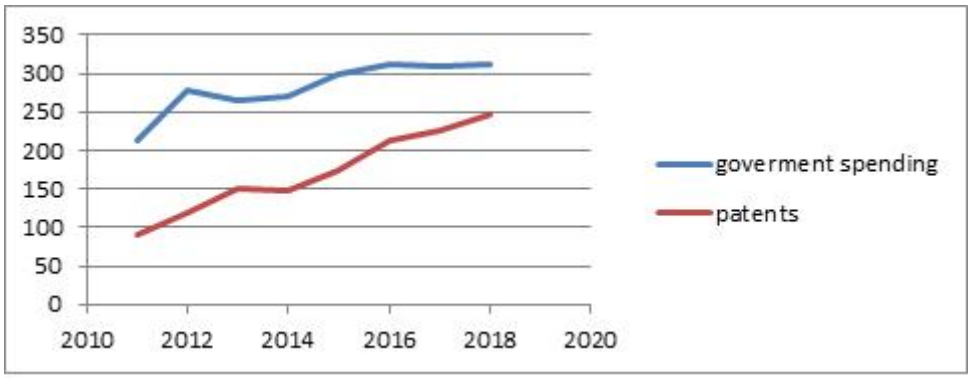
Global innovation reports for 2014 and 2015 indicate strength in human capital and research indicator. In the tertiary education sub-indicator, a significant progress has been registered since 2014. The sub- indicator cooperative relationship between universities and the business sector, Algeria's rank was very low 128th, 135th, 136th, 122th from 2012 to 2016, compared to 2011, 2017 and 2018; As for the sub-indicator of infrastructure (information communications and technologies) Algeria had scored during the eight years the highest rank 102nd that was in 2011, and the lowest was 119th in 2015, then it improved in the last two years. Despite this, reports indicate that Algeria recorded positive results in the basic index of infrastructure for the years 2012, 2013, and 2014. Concerning knowledge outputs index (creation of knowledge, impact of knowledge, diffusion of knowledge), it is noted through the years mentioned in the Table 9 that the best ranking was recorded in 2016, and reports mentioned Algeria's good performance in 2012 in the field of computers, communications and services exports and in 2015 the performance in the fields of high and medium-high-tech manufactures, cited research and the H index; while it recorded weakness in 2013 in the field of high-tech exports. In the research and development indicator which includes the number of researchers in each one million, the total expenditure on research and development and its percentage of GDP, universities ranking etc, the best rank was recorded at 107th in 2011 and 2013, the lowest rank in 2012, despite the fact that Algeria achieved Positive increase in the sub-index related to the increase in the number of students graduating from scientific disciplines and engineering, in the years 2013, 2014, 2015 The ranks of the Algerian University deteriorated in the QS classification; unlike in 2013, the sub-index related to education in general in 2017 witnessed a positive increase and a deterioration in the basic index.

6. ANALYSIS AND DISCUSSION

Analyzing the relationship between the study variables

We confirmed (Saad et al., 2015) results where they have noted a correlation between different types of higher education systems and the innovation capacity of a country; at the same time they concluded that there is a correlation between innovation and successful higher education expansion. According to the data collected that extend from 2011 to 2018, we tried to analyze the relationship between government expenditure on higher education and the number of patents produced at the level of the same ministry 'higher education and scientific research ministry' and we have reached an annotated conclusion in the figure below; generally we can notice that from 2011 there was a continuous increase in government expenditure, accompanied by an increase in the number of patents produced until 2018; Despite this, expenditures recorded a decrease in 2013 due to the deterioration in the oil price, which affected the number of patents produced, the latter witnessed monotony between the years 2013 and 2014, where the number was estimated at 150 and 148 respectively. In the same context, we calculated the correlation between the two variables result was strong and positive (0,892) and it was significant at the 0.01 level,

Figure1. Correlation between expenditure on higher education and number of Patents produced 2011-2018

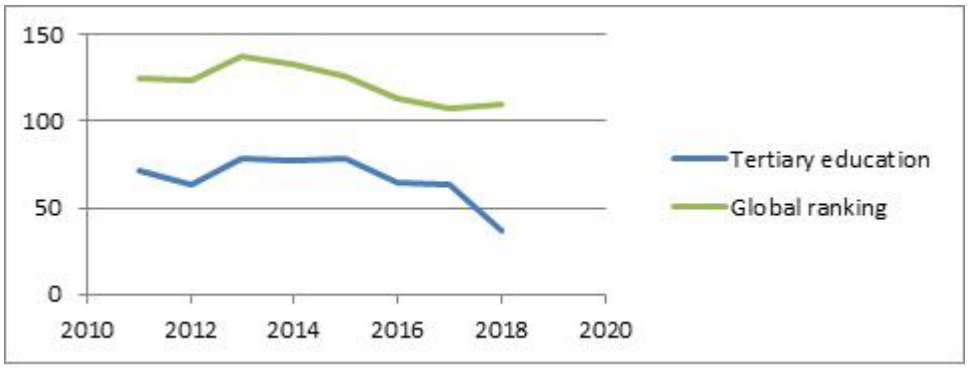


On the other hand we tried to clarify the relationship between Algeria's ranking on the global innovation index and the sub-indicator tertiary education. The GII reports considered the performance of higher education from 2014 on as strength for Algeria, where it recorded progress from 77 passing through 69, 64, 63 and up to 37 in parallel with the final arrangement of Algeria, where it moved from 138th to 110th in 2018. The worst performance for the higher education during this period was in 2013 and 2014 (figure 2), We also mentioned earlier that expenditure on this side decreased in the same years (figure 1); To delve deeper into the relationship between the two variables, we calculated both correlation and regression; correlation result was strong and positive (0,756) and it was significant at the 0.05 level, then we extracted the regression equation:

$$Y = 82{,}659 + 0{,}591X$$

Means that the independent variable (higher education) may explain the value (0,591) of the dependent variable (Algeria's global ranking at the level of GII).

Figure2. Correlation between higher education and Algeria's global ranking 2011-2018



7. CONCLUSION AND RECOMMENDATIONS

The establishment of many universities, research centers and various pedagogical structures, provision of thousands of jobs in these structures, recruitment of professors, investment in scientific research and technological development, demonstrate the intention of government to make a paradigm shift in higher education, despite of this follow-up and increased attention is demanded because this sector is still below the required level;

Published scientific researches, patents of invention and the totality of research outputs, do not fulfill aspirations nor rise to the challenges of knowledge economy, in addition failure to value these outputs, and the lack of cooperation between the business sector and the higher education sector, will lead to lost effort i.e it is not possible -in the era of knowledge economy- to accumulate and store knowledge on universities shelves, in particular, we have noticed a significant decrease in the production of patents outside the Higher Education.

Developing the educational process, raising the level of services and improving the quality of the outputs of higher education institutions require the cooperation of all: politicians, business man, managers, teaching staff, researchers, and students.

Through our study, we also found that the ranking of tertiary education contributes to the interpretation of a significant percentage of the ranks that Algeria obtained at the level of the GII, and therefore it is considered a reliable pillar for improving its ranking in the future.

Innovation is considered to be the basis for strengthening the competitiveness of countries in the knowledge economy, our study also showed clearly that the relationship is direct and strong between government expenditure on higher education and the number of Patent produced at the level of this sector, Therefore, Algeria should adopt policies that bring about fundamental changes in the framework of developing the national innovation system.

We notice that both Algerian scientific researches and patents of invention are strong in specific areas thus they should be well oriented to take advantage of them to the maximum extent.

Success on the global level is due to the conditions and characteristics that distinguished the countries that ranked first, but this does not prevent us from benefiting from these successful experiences without reproducing them completely. Especially for Algeria, which has been unable to move toward knowledge economy until now, despite the natural, financial and human capabilities it has. In the last part we would suggest recommendations to develop the Algerian university performance that may facilitates the integration into knowledge economy:

- Create cooperative relationships with other universities inside and outside the country (orientation towards the outside world) to exchange experiences and information and gain new knowledge.
- Monitor the degree of economic institutions' satisfaction with the quality and efficiency of university outputs' and the extent of the graduates' integration in the labor market.
- Strongly support and encourage companies that rely on research laboratories or that work in coordination with the centers of technical resources and innovation.
- Documenting the cooperative relationship between the university institution and the business sector
- Politicians and managers should have a clear vision in order to provide the requirements for developing creativity and knowledge innovation.
- The necessity of introducing modern methods in setting development policies and the necessity of their conformity and consistency with educational policies.
- Take advantage of the migratory brains that have registered many patents, Algeria should create a number of incentives for inventor researchers, scholars to return homeland.
- Establishing a database that keeps university institutions abreast of the latest developments in the areas of quality education, management systems etc.
- Introducing information and communication technologies to the university, and in the educational process, as it is considered a fundamental pillar of creativity and innovation in knowledge based economy.
- Diversifying the patterns of education, knowing that Algeria does not adopt neither private universities nor virtual universities.
- Motivating researchers financially to contribute with their experiences, their intellectual capabilities and providing them with opportunities to present their ideas and suggestions.

Finally, we invite researchers to pay attention to knowledge dissemination and impact, for many reasons neglecting the latter will omit the production achievement.

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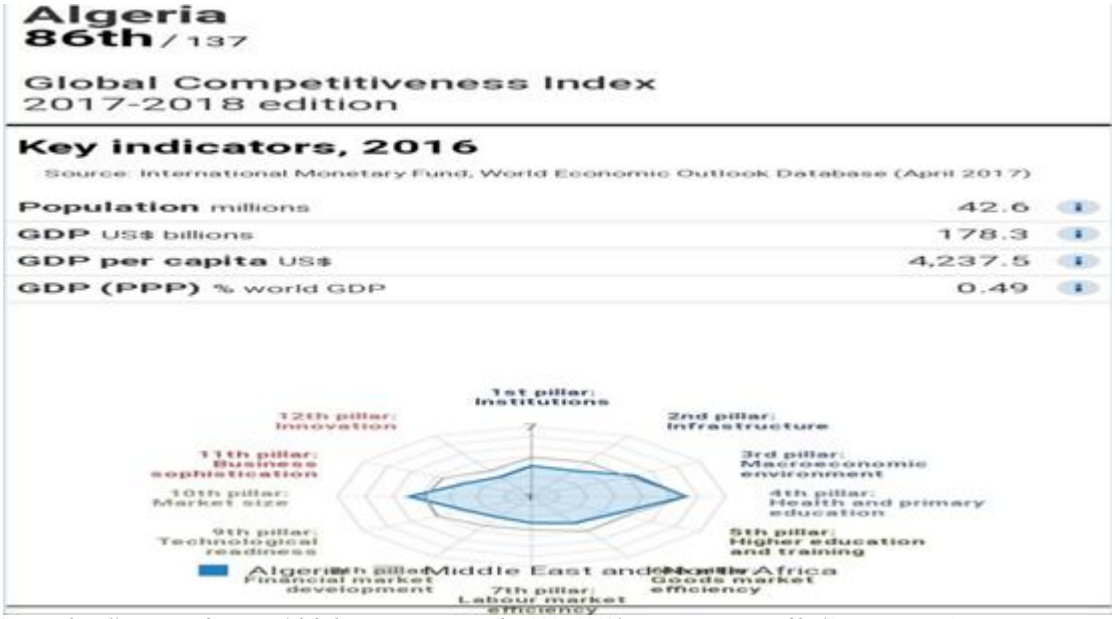
APPENDIX

Appendix 1: The Higher Education Index in Algeria among 12 other Index



Source: http://reports.weforum.org/global-competitiveness-index-2017-2018/countryeconomy-profiles/#economy=DZA

Appendix 2 Countries of the Middle East and North Africa according to the Global Competitiveness Report 2016/2017

Figure 17: GCI rank of oil importers and oil exporters in the Middle East and North Africa, 2016–2017 edition

	Country/economy	Global Competitiveness Index	PILLARS											
			Institutions	Infrastructure	Macroeconomic environment	Health and primary education	Higher education and training	Goods market efficiency	Labor market efficiency	Financial market development	Technological readiness	Market size	Business sophistication	Innovation
Oil-exporting economies	United Arab Emirates	16	7	4	36	40	34	3	11	28	18	27	13	25
	Qatar	18	10	18	2	27	30	7	17	21	33	50	18	18
	Saudi Arabia	29	24	31	66	51	46	41	65	47	41	14	31	42
	Kuwait	38	59	52	6	76	94	85	115	65	60	51	61	110
	Bahrain	48	25	32	113	34	44	22	35	43	37	92	33	45
	Oman	66	28	38	81	69	85	51	82	56	57	68	66	76
Oil-importing economies	Israel	24	31	28	46	28	24	32	21	19	22	57	21	2
	Jordan	63	34	56	118	80	51	43	67	66	75	75	36	40
	Morocco	70	50	58	49	77	104	64	124	83	81	55	76	96
	Algeria	87	99	100	63	73	96	133	132	132	108	36	121	112
	Tunisia	95	78	83	99	59	93	113	133	119	80	69	101	104
	Lebanon	101	119	117	136	52	66	55	104	69	72	76	50	58
	Egypt	115	87	96	134	89	112	112	135	111	99	25	85	122
	Yemen	138	137	136	138	117	136	131	137	138	136	89	129	138

Courtesy Image