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Research Article

The Education Index and the Knowledge Economy Index for Mexican States

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Abstract

The concept of the Knowledge Economy was initially presented by the OECD in 1996 to name the set of industrialized countries in which knowledge was recognized as the key factor in economic growth. It is defined as the new economy linked to the Internet and whose foundations are the creation, dissemination and use of knowledge. The education index is one of the four indicators of the knowledge economy index and includes the number of years the population has spent in school, as well as current enrollment. The objective of this research is to calculate the education index as part of the knowledge economy index of each state of the Mexican Republic to identify the regions with areas of opportunity for the development of sustainable government projects that allow the inclusion and transformation of the community in an information society in the short and medium term. Using the System for the Census Information Service (SCINCE) of the National Institute of Statistics and Geography of Mexico, low levels were found in various regions of the country, as well as marked inequality between the states, concentrating low rates of education and access to ICT in some regions, historically lagging behind in development.

Introduction

Society enters an era in which the future will be determined, in essence, by the ability of people to wisely use knowledge, an important global resource, represented by human intellect and technology. The knowledge economy attaches great importance to the dissemination, use of information and knowledge, as well as its creation. In this new economy, people and companies are forced to focus on maintaining and increasing their knowledge capital to innovate; and their ability to learn, adapt. Change becomes a core competence for survival [1]. Knowledge is a key business advantage; and its constant increase creates corporate advantages that include management systems, patents, brand identity and corporate reputation. There are many definitions of knowledge, based on the fact that data is considered raw, whereas information is considered as an organized set of data. Knowledge is perceived as information based on personal experiences, skills and competencies. There are two types of knowledge: explicit and tacit: explicit knowledge is described in formal language, such as mathematical expressions and statements in textbooks, and consists of technical knowledge; Tacit knowledge is automatic, like intuition, and it is oral; It is often taken for granted and can be considered less valuable than explicit knowledge. However, the effective use of tacit knowledge is essential, but the problem is that it is difficult to understand [2]. The learning process occurs when people share their data, information and explicit and tacit knowledge [1]. In companies, the new learning processes imply that educators and intermediaries adopt new roles and develop new strategies when intervening with workers. Understanding the dynamics of the demand and supply of knowledge should help navegate the knowledge markets of the new economy [3]. It is clear that the demand for education and instruction will increase, but it is not clear how the new economy will change individuals and companies so that they can better achieve their educational objectives to better satisfy the demand for knowledge. To understand the implications of change, one must have an understanding of economics from a knowledge perspective. In the new Knowledge Economy, individuals and companies must focus on maintaining and increasing their greatest advantage: their knowledge capital [3]. The Information Society refers to the widespread use and transmission of information and seeks that the society is organizing it self on the basis of the generalized use of low-cost information, data storage and transmission technologies. It has also been pointed out that it describes a society and an economy in which the acquisition, storage, transmission, dissemination and use of knowledge and information, in all its forms and without any spatial or temporal restrictions, play a decisive role. Sotres (2010) mentions that the virtual company is a new form of organization thanks to the use of technology and globalization, relying on the use of the Internet to increase its operations in the cyber space market [4]. We recently verified this premise, due to the SARS-CoV-2 pandemic. This model transforms the traditional company, since it turns it into one where transactions are virtual, it does not have a physical space defined as offices or premises, however, the client receives service 24 hours a day, 7 days a week, which increases the satisfaction and security of the same client. With this model, the economy can also be strengthened, the development of the organization benefits and poses a challenge for better performance. In addition, it guarantees that the risk of contact between people is zero, the waiting time in a row is not perceived, there is no displacement, among many other things.

Approach And Justification

In the current era, the transformations caused mainly by the rapid integration of ICTs have made possible the emergence of the so-called Information Society, successor to the Industrial Society. Changes make society no longer exist in traditional way, but constantly seek new ways of living, communicating and transforming society. Geographical dispersion was associated with the globalization of open markets for goods, capital and technology, flows of information and knowledge, new organizational structures, and the increasing intensity of knowledge of goods and services. Therefore, the new economy has produced an increasing intensity of knowledge of goods and services, where the icons of industrial power are replaced by an economic value symbolized by integrated circuits, ideas and software. Most of what we currently perceive as value and wealth are intellectual and impalpable assets. Knowledge embedded in new products and services has become the primary source of wealth creation and the source of sustainable competitive advantage [5]. Business value shifted from high productivity with the use of machines to a shift in information and knowledge, posing significant challenges to creating business value. The production of information and knowledge, being of an immaterial and complex nature, cannot be treated as material economic resources. Knowledge and information are productive in themselves; Putting more information into a service does not make a person perform that

service more productively. Knowledge only becomes productive when it is delivered at the appropriate time and with an established purpose and, in addition, it is appropriately assimilated to be applied [6]. Information and knowledge have been closely related to educational level. Productive work is linked to people and their capacities to produce innovative services and products. Most service and knowledge work is organized around the people who make the product or carry out the service. This dependence on association and people management causes a low level of productivity, since it is difficult to distinguish productive activity from business [6]. Under these conditions, societies promote economic growth through the application of better targeted reforms in accordance with national capacities, in order to generate more specific knowledge that can be transformed into wealth, which, in turn, allows for an environment of innovation constant. Therefore, societies are the first to seek community development based on the detected needs, however, government programs sometimes do not take into account the specific conditions of the regions and, therefore, generate standardized programs. That is why it is considered relevant to analyze and provide information on the ICT index as part of the Knowledge Economy index. This index is selected, since it is the one that measures development in terms of capacities in the use of ICTs, a basic requirement for the development and well-being of today's societies.

Frame of Reference

One of the most visible differences between the industrial age and the knowledge age is the use of information in companies; In the past, information was power for managers, now it allows everyone to increase their capacities and organizations to improve, above all, the flow of information, knowledge and decision-making [7]. We live then in an era in which changes are constant mainly due to the use of technology as an essential part of society, transforming from an industrial society to an information society, where the main part is the development of society with the use of ICT. This is where two important elements emerge within the information society, the technological gap and virtual companies [8]. Knowledge is the key component to create a competitive advantage in organizations because it is the essential resource that allows to develop better business performance. It is considered an asset that has the ability to generate value and produce wealth, and that has properties that make an organization not fail. Therefore, knowledge is, therefore, a valuable asset in the organization and, as such, must be protected, therefore, nations have legislated the mechanisms for its protection and the means by which the limits of intellectual property, in order to identify the way in which organizations can manage the tangibility and in tangibility of knowledge [9]. Knowledge is a deeper concept than information and different types of knowledge are distinguished in the knowledge economy that include knowing what, knowing why, knowing how and knowing who. The Organization for Economic Cooperation and Development (OECD) mentions that knowledge represents an accumulation of facts and is closer to information. Know why it refers to the scientific knowledge of the principles and laws of nature, which underlies technological advances in development and the product and the process. Know who involves information about what is known and who knows how to do it. It implies the formation of special social relations to guarantee access to experts, which is especially necessary [7]. Organizational knowledge occurs when a worker uses what he knows and the information available to him to carry out his work, solve problems and develop projects. Knowledge is distinguished into explicit and tacit, explicit knowledge is made up of formulas, manuals, processes, etc., while tacit knowledge is one that cannot be captured or recorded as it depends on the individual, see (Figure 1) [10,11]. The society of the new century is the knowledge society, which comes to recognize the fundamental importance that the generation of knowledge and the development of appropriate technologies for the current situation have in the countries. The information society can be considered as a highly dynamic, open and globalized social space with a high use of technology. The interaction of individuals is supported and carried out through information. In this sense, each community may have its own particular form of social organization and may be going through different levels of development: education and information on a technological structure.

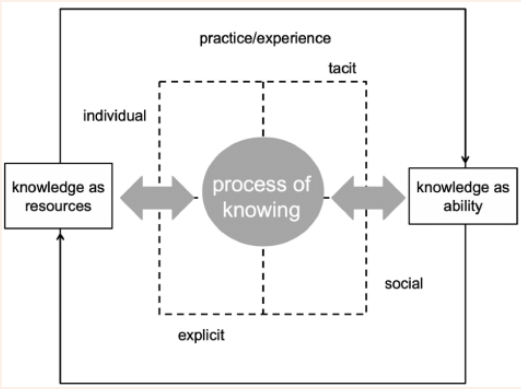

Figure 1: Strategic Dimension of Knowledge in the Organization.

The UNDP (2010) mentions that the proposal for the new economy and the new competitiveness is the creation of a knowledge society, where the basis of development is that people will have access to create, receive, share and use knowledge, with the use of ICT, This will strengthen the economic, social, cultural and political development of society as a whole [12]. The concept of the Knowledge Economy was initially presented by the OECD in 1996 to name the set of industrialized countries in which knowledge was recognized as the key factor in economic growth. It is defined as the new economy linked to the Internet and whose foundations are the creation, dissemination and use of knowledge. Therefore, in a knowledge economy, knowledge is the most important asset, and the quantity and sophistication of knowledge permeates economic and social activities, reaching very high levels [13]. The knowledge economy attaches great importance to the dissemination and use of information and knowledge, as well as its creation. The determinants of success for companies and national economies are based on the efficiency of the collection and use of knowledge. Strategic knowledge and competencies develop reciprocally and are shared within subgroups and networks, where personal knowledge is significant. The economy becomes a hierarchy of networks with acceleration in the exchange rate and the learning rate. What creates a social network, where the opportunity and the ability to join knowledge and intensive learning relationships determine the socioeconomic position of individuals and companies [5]. Technology platforms can help, but no technology will stimulate the flow of knowledge without paying attention to the cultural and organizational contexts in which people are encouraged to develop and share their knowledge. Creating knowledge communities presents a business challenge, and the results will determine corporate success in the new economy. Technology provides the means to access, process, and distribute larger amounts of data and information than previously imagined, but this remains an almost pointless activity with no management processes to translate data and information into relevant knowledge that can be used. Productively Knowledge management provides the means to generate, distribute and use it, so that it adds value to economic activity and provides new opportunities for the company. However, it is unlikely that any of these benefits will occur without an adequate knowledge strategy [5]. The World Bank, cited by Sánchez and Ríos (2011) mentions that knowledge must be at the center of the strategy, based on four pillars [13]:

a) Education, school education and training, so that the worker is qualified, educated and updated for the development of its activities.

b) Infrastructure for access to information and telecommunications, thus facilitating communication, dissemination, and processing of information and knowledge.

c) The innovation system, made up of all those entities that support the development of knowledge and technology.

Table 1: Knowledge Economy Indexes.

Country	KEI	KI	Economic Incentive Regime	Innovation	Education	ICT	2008 Rank
Denmark	9.58	9.55	9.66	9.57	9.8	9.28	1
Sweden	9.52	9.63	9.18	9.79	9.4	9.69	2
Finland	9.37	9.33	9.47	9.66	9.78	8.56	3
Netherlands	9.32	9.36	9.18	9.48	9.26	9.36	4
Norway	9.27	9.27	9.25	9.06	9.6	9.16	5
Canada	9.21	9.14	9.42	9.43	9.26	8.74	6
Switzerland	9.15	9.03	9.5	9.89	7.69	9.52	7
United Kingdom	9.09	9.03	9.28	9.18	8.54	9.38	8
United States	9.08	9.05	9.16	9.45	8.77	8.93	9
Australia	9.05	9.17	8.66	8.72	9.64	9.16	10
Mexico	5.45	5.48	5.38	5.82	4.85	5.77	60

Source: World Bank (2008).

d) The institutional framework of the government and companies, made up of economic incentives, business incentives and all the processes of trade regulation, for the efficient use of knowledge. The knowledge economy index of top ten economies and that of Mexico are presented in (Table 1). The knowledge economy index is shown as the national average for Mexico is 5.45, but in the case of the education index is 4.85, we start from this base to establish the parameter in which the results can be found in the case of the states of the Mexican Republic.

Method

The objective of this research is to calculate the education index as part of the knowledge economy index of each state of the Mexican Republic to identify the regions with areas of opportunity for the development of sustainable government projects that allow the inclusion and transformation of the community in an information society in the short and medium term. The information is first systematically reviewed and classified, defining as systematic the exhaustive search of the literature for relevant studies on the subject, which play an important role. It is considered a fundamental research activity. Components of a successful review include developing clear goals and methods, searching for potentially relevant articles, using specific criteria in selecting articles for inclusion, and synthesizing individual studies using an explicit analytical basis [14]. Subsequently, the methodology of the Knowledge Economy index developed by UNDP (2010) is taken as a basis, which takes into account whether the environment is conducive so that knowledge can be used efficiently for economic development [12]. The knowledge index measures the capacity of a country to generate, adopt and disseminate knowledge. This indicator shows the general potential to develop knowledge in a given country. The knowledge index methodology is the simple average of the degree of performance index of a country or region with the key variables of the four pillars of the knowledge economy: economic incentives and the institutional regime, education and human resources, innovation and ICT. To calculate the knowledge index and the knowledge economy index, each pillar is represented by three key variables:

- Index of economic and social regime: tariff and non-tariff barriers; quality standards; legal rules.
- Index of education and human resources: average school years; high school enrollment (1-3); high school enrollment (4-6).
- Innovation index: royalties, license fee payments and receipts; patents granted by the patent office; scientific and technical articles.
- ICT Index: telephones per 1000 inhabitants; computers for every 1,000 inhabitants; internet users per 1000 inhabitants.

The objective of this research is to calculate the education index as part of the knowledge economy index to identify areas of opportunity by region. As well as providing information that can be used in strategies to incorporate regions into the information society. For the above, the information from the 2015 Population and Housing Census, carried out by INEGI (2015b), was used [15]. Said census uses surveys to count the country's resident population, locate its distribution in the national territory and update information on its main demographic and socioeconomic characteristics; in addition to listing all the houses and capturing data on basic aspects of the people. This information is presented in the Census Information Consultation System (SCINCE 2015 version, INEGI, 2015a), from which the necessary information is obtained to calculate only the educational index, such as the possession of fixed and mobile telephones, the number of computers and the total number of Internet users [16].

Results

The education index, as part of knowledge economy index, show the level of create, share, transfer and use of knowledge, so is very important because is the base of knowledge. The education index is calculated from three variables: average years of schooling (15 years old and above), this variable measures the number of average years of the educational stock in the country; the second variable is the gross enrollment ratios and the third variable is the gross secondary enrollment, both are calculates by flow rate, and its important because is the foundations for lifelong learning, give more skills and human development. The value of each variable was obtained from government statistical information but is required to transform them into normalized values. The normalized value is calculated with the number of states classified in order of the highest value and is divided by the total number of states and multiplied by ten, the index is the simple arithmetic mean of the normalized values. The calculation of the educational index based on the data extracted from the Population and Housing Census of 2015, carried out by INEGI (2015b) [15]. They are presented in version 05/2015 of SCINCE. The results of the education index for the states of the Mexican Republic are shown in (Table 2) [17].

The lowest level of education index is for Michoacán de Ocampo, it is a state in the

Table 2: Educational Index.

State	Average of Year Schooling		Gross sec. Enrolment		Gross tertiary enrolment		Average	KE-I
	Actual	Normalized	Actual	Normalized	Actual	Normalized		
Aguascalientes	9.7	7.1429	0.0572	5.4545	0.044	7.2727	6.6234	7
Baja California	9.8	7.619	0.0593	6.9697	0.0451	7.8788	7.4892	1
Baja California Sur	9.9	8.0952	0.0551	2.4242	0.0431	6.6667	5.7287	12
Campeche	9.1	4.7619	0.0539	1.2121	0.0383	1.2121	2.3954	31
Chiapas	7.3	0	0.0598	7.2727	0.0443	7.5758	4.9495	18
Chihuahua	9.5	6.1905	0.0537	0.9091	0.0421	5.7576	4.2857	23
Ciudad de México	11.1	9.5238	0.0541	1.5152	0.0531	9.697	6.912	3
Coahuila de Zaragoza	9.9	8.0952	0.0582	5.7576	0.0387	1.8182	5.2237	16
Colima	9.5	6.1905	0.0524	0.6061	0.0402	3.3333	3.3766	28
Durango	9.1	4.7619	0.0585	6.0606	0.0469	9.3939	6.7388	5
Guanajuato	8.4	2.381	0.0621	8.7879	0.0393	2.4242	4.531	21
Guerrero	7.8	0.9524	0.0623	9.0909	0.0405	3.6364	4.5599	20
Hidalgo	8.7	3.8095	0.0603	7.8788	0.0452	8.1818	6.6234	8
Jalisco	9.2	5.2381	0.0563	3.9394	0.0393	2.1212	3.7662	26
México	9.5	6.1905	0.0559	3.3333	0.0383	0.9091	3.4776	27
Michoacán de Ocampo	7.9	1.4286	0.0523	0	0.0381	0.6061	0.6782	33
Morelos	9.3	5.7143	0.0562	3.6364	0.0437	6.9697	5.4401	14
Nayarit	9.2	5.2381	0.0553	2.7273	0.0425	6.3636	4.7763	19
Nuevo León	10.3	9.0476	0.0565	4.2424	0.0353	0	4.43	22
Oaxaca	7.5	0.4762	0.0587	6.3636	0.0372	0.303	2.381	32
Puebla	8.5	2.8571	0.0627	9.3939	0.0455	8.7879	7.013	2
Querétaro	9.6	6.6667	0.06	7.5758	0.041	4.5455	6.2626	10
Quintana Roo	9.6	6.6667	0.0567	4.5455	0.0384	1.5152	4.2424	24
San Luis Potosí	8.8	4.2857	0.0637	9.697	0.0397	2.7273	5.57	13
Sinaloa	9.6	6.6667	0.0542	1.8182	0.0461	9.0909	5.8586	11
Sonora	10	8.5714	0.0587	6.6667	0.0411	4.8485	6.6955	6
Tabasco	9.3	5.7143	0.057	4.8485	0.0452	8.4848	6.3492	9
Tamaulipas	9.5	6.1905	0.0524	0.303	0.0398	3.0303	3.1746	29
Tlaxcala	9.3	5.7143	0.0607	8.4848	0.0423	6.0606	6.7532	4
Veracruz	8.2	1.9048	0.0544	2.1212	0.0409	4.2424	2.7561	30
Yucatán	8.8	4.2857	0.0554	3.0303	0.0414	5.1515	4.1558	25
Zacatecas	8.6	3.3333	0.0603	8.1818	0.0408	3.9394	5.1515	17

Source: Authors' Elaboration based on Data from INEGI (2015a).

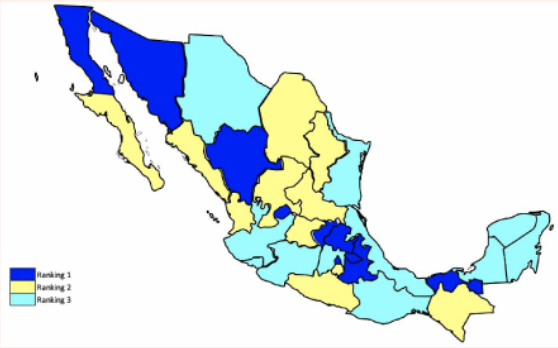

Figure 2: Ranking of Education Knowledge Index by State.

south of the country and the highest level is in the state of Baja California, which is in the north of the country. We can observe a noticeable contrast, and this means that there are 6.8 points of difference between both points and this is because there are more people studying at the highest educational level. It is important to mention that three of the states with the most populated cities in Mexico, such as Mexico City, Jalisco and Nuevo León, are not at the top of the ranking, and this is due to gross tertiary enrollment. (Figure 2) shows that there is no pattern on the map. There is no specific area with a high, medium or low level. However, it should be mentioned that the central states, as well as two adjacent to the United States of America, have high levels. Also, that most of the states of the Gulf of Mexico have low levels, presenting values from 2.3 to 4.15. On the other hand, the states that are in the central north have an index of average level of education with results from 4.43 to 5.56.

Conclusion

The results show that although the education index worldwide is 9.8, the adjusted value of the states of the Mexican Republic shows an average maximum value of 7.48 and the lowest is 0.67, which allows us to have evidence of the Current situation. It is necessary for Mexico to pay special attention to policies, programs and actions in order to insert each state in the information society. With this, the foundations are laid to advance, in the medium and long term, towards the knowledge economy. Establishing the objective of this research to calculate the education index as part of the knowledge economy index for each state of the Mexican Republic in order to identify the areas of opportunity for the development of state projects that allow society to be inserted into an information society in the short term, and therefore about which special care must be taken for the development of sustainable programs that allow increasing the level of knowledge and therefore improving the development capacity of the state and therefore the country. Thus, by identifying the areas of opportunity for the development of state projects that allow society to be inserted into an information society in the short term, with the information already presented it is possible to meet the objective, which is why the states that require it can be identified, mainly for the primarily develop projects related to education. The objective of this research is to calculate the education index as part of the knowledge economy index for each state of the Mexican Republic. Regions with areas of opportunity for the development of state policies, programs, projects and actions oriented to education are identified, which allow establishing the conditions for society to approach the information society in the short and medium term. Therefore, it is considered necessary to pay attention to the planning and implementation of programs contextualized and adapted to the particular conditions that allow increasing the rates studied. The vision must be to improve the development capacity of the state and, therefore, of the country. In addition to education, public actions must be oriented towards the development of capacities for the use and implementation of ICTs, since, together with education, they are pillars of the knowledge economy. On the other hand, innovation must also be supported, because by training and improving its educational level, society can improve its own processes and develop new ideas. On the other hand, it is important to recognize that the indicator studied not only shows the delay that states have in the access and use of ICTs, but also provides a better vision for the government to identify exactly which municipalities focus their attention and work plans. In addition, with the specific monitoring of this indicator, you can see the result of the application of social programs. Some additional advantages detected with this information is that the indicator allows identifying the effect of public policies to achieve a knowledge economy. For future research, it is considered to analyze the relationship between GDP by state and the education index to have a more robust information system that allows decision-making. Finally, this first approach towards a more specific index, and applied to the entire Republic, can support the development of government programs that benefit people's quality of life. Applied to specific areas, it allows the development of government programs that benefit the population and does not apply standardized programs when society itself does not need them.

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