

Análisis de aspectos tecnológicos y educativos que influyen en el ingreso económico en México

Analysis of Technological and Educational Aspects that Influence in Economic Income in Mexico

Análise dos aspectos tecnológicos e educacionais que influenciam a renda econômica no México

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Resumen

El uso generalizado de las tecnologías de la información y comunicación (TIC) ha ocasionado cambios en todas las actividades del ser humano. Dichas transformaciones se expresan de forma especial en los ámbitos educativo y laboral debido a que se encuentran interrelacionados. Diversos factores influyen en el ingreso económico: el nivel académico, la edad y, precisamente, las habilidades en las TIC, entre otros. El objetivo de la presente investigación fue analizar la influencia de aspectos tecnológicos y educativos en el ingreso económico en México con la finalidad de determinar la importancia de estos y así identificar las habilidades que deben desarrollar los individuos para el ambiente laboral. La



investigación es transversal. Los datos se obtuvieron mediante una encuesta semiestructurada y se analizaron a través de una regresión lineal múltiple utilizando el método de mínimos cuadrados ordinarios. En los resultados se encontró que la edad, el uso de redes sociales y el nivel académico (0.50, 0.25, 0.24, respectivamente) son las variables que más influyen positivamente en el ingreso económico de los estudiantes que trabajan. Se concluye que es importante mejorar el nivel educativo y las habilidades en las TIC de la población, pues esto permitirá a los individuos incrementar su ingreso, lo cual coadyuvará a la disminución de la desigualdad.

Palabras clave: edad, impacto, ingreso económico, nivel académico, TIC.

Abstract

The extensive use of information and communication technologies (ICT) has caused changes in all activities of the human being. These changes are expressed in a special way in the educational and labor fields because they are interrelated. Various factors influence economic income such as academic level, age and ICT skills, among others. The objective of this research was to analyze the influence of technological and educational aspects on the economic income in Mexico to determine the importance of these and thus identify the skills that individuals must develop for the work environment. The research is transversal. The data were obtained through a semi-structured survey and were analyzed through a multiple linear regression using the ordinary least squares method. In the results it was found that the age, the use of social networks and the academic level (0.50, 0.25, 0.24, respectively) are the variables that most positively influence the economic income of working students. It is concluded that it is important to improve the educational level and ICT skills of the population, as this will allow individuals to increase their income, which will contribute to the reduction of inequality.

Keywords: age, impact, economic income, academic level, ICT.



Resumo

O uso disseminado das tecnologias de informação e comunicação (TIC) tem provocado mudanças em todas as atividades do ser humano. Essas transformações são expressas de maneira especial nos campos educacional e trabalhista porque estão inter-relacionadas. Vários fatores influenciam a renda econômica: o nível acadêmico, a idade e, precisamente, as habilidades em TIC, entre outros. O objetivo desta pesquisa foi analisar a influência de aspectos tecnológicos e educacionais sobre a renda econômica no México, a fim de determinar a importância destes e, assim, identificar as habilidades que os indivíduos devem desenvolver para o ambiente de trabalho. A pesquisa é transversal. Os dados foram obtidos por meio de um levantamento semiestruturado e analisados por meio de uma regressão linear múltipla, utilizando o método dos mínimos quadrados ordinários. Nos resultados verificou-se que a idade, o uso das redes sociais e o nível acadêmico (0,50; 0,25; 0,24, respectivamente) são as variáveis que mais influenciam positivamente a renda econômica dos estudantes trabalhadores. Conclui-se que é importante melhorar o nível educacional e as habilidades de TIC da população, pois isso permitirá que os indivíduos aumentem sua renda, o que contribuirá para a redução da desigualdade.

Palavras-chave: idade, impacto, renda econômica, nível acadêmico, TIC.

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Introduction

Information and communication technologies (ICT) are those that make possible the transmission, processing and storage of information at any time and in any place, including electronic instruments that allow such procedures (Cacheiro, 2018). The widespread use of these technologies has caused changes in all activities of the human being, which are expressed in a special way in the educational and labor fields.

Both spheres, educational and labor, are interrelated: the skills and abilities developed through education must correspond to those required by institutions and companies in the



workplace. Therefore, formal education complemented with training in ICT will allow individuals to increase their income (Dutton and Reisdorf, 2016).

There are several factors that influence the economic income of the Mexican population, such as educational level, age, experience and skills in ICT, among others. Shahabadi, Nemati and Hosseinidoust (2016) indicate that in order to achieve an increase in income and to reduce inequality, we must invest in human capital; If the increase in the adoption of technology in different economic areas is considered, the investment in human capital should focus on the development of skills related to ICT. Considering these factors will allow identifying thematic axes for the development of policies that are aimed at increasing skills to reduce inequalities.

In order to get a greater number of people qualified for jobs with better salaries, the Mexico FIRST project was developed, which offers certification programs that increase the quality of Mexican human resources (World Bank, 2014). However, despite these efforts, it is observed that in 2016 Mexicans invested little in education, since they allocated only 12.42% to educational and recreational services (National Institute of Statistics and Geography [Inegi], 2016).

Due to the importance of the development of the ability to maneuver ICT in the educational field to obtain the benefits in the labor market and, therefore, in the economic income, it was decided to analyze the influence of technological and educational aspects on the economic income. in Mexico in order to determine the importance of these and thus identify the skills that individuals must develop for the work environment.

The research questions were as follows: How do technological aspects influence economic income? What percentage of university students who work use social networks? What effect does the use of social networks have on economic income? How much does the possession of a Smart TV affect economic income? How much does the possession of a mobile phone affect economic income? What is the effect of the labor use of mobile devices on economic income? Do educational aspects influence economic income? What is the age range of university students that work? What is the effect of the age of university students working on economic income? What is the effect of the academic level in the economic

income ?, what is the effect that the school use of mobile devices has on the economic income?

The hypothesis of the work is that the academic level, the age and the development of ICT skills are important for individuals to increase their income and be able to reduce inequality.

ICT

ICT are considered as a set of transformative tools that can cause systemic changes, because they connect people with jobs, markets and social services (United Nations Educational, Scientific and Cultural Organization [Unesco], 2015). Therefore, the World Bank (2014) seeks to support ICT and skills development for jobs related to them with the intention of improving productivity, competitiveness and accelerating innovation in the economy in general.

ICT have spread in the lives of Mexicans, since in 2001 only 11.8% of households had computer equipment, while in 2017 they were 45.4%; In the case of Internet access, the increase is greater, since in 2001 only 6.2% of households had this service, however, in 2017 that figure was increased to 50.9% (Inegi, 2017).

Education and ICT

ICT have been recognized as facilitators of future learning because they allow people to learn at any time, in any place and with all the content they may need (Unesco, 2015). These tools provide education and society with flexibility, as well as the ability to adapt to a changing environment (Hernández, 2017).

Currently, in the public policy agenda of Mexico and Latin America are considered ICT integration policies in education systems, in order that students have the opportunity to develop skills that allow them to improve not only in the academic field , also in the workplace. In 2017, the Inegi reported that of the total number of computer users, 46.8% used them as a tool for school support.

In order to properly handle the information tools known as ICT, more qualified workers are required, with higher levels of education and who have developed technological skills; Obviously, requiring better qualified workers will imply an increase in salaries (Mendoza and Crespo, 2015).

Some studies by Dutton and Reisdorf (2016), Shahabadi et al. (2016) and Serrano, Muñoz and Brusca (2018) indicate that the higher the level of study of the individual, the higher the level of use of the Internet, since it performs activities such as information retrieval, communication and access to financial services. This shows the importance of access and the development of skills around ICT, which will allow specifying the type of work and level of payment as a sign of capacity and productivity, and thus reduce the income inequality of the population.

Work and learning can be integrated through ICT, because they can be used to develop critical thinking, as well as other skills needed to work in diverse environments. However, special attention must be paid to the manner in which these capacities are taught, since inappropriate educational methods could cause a significant equity problem (Unesco, 2015).

Employment and ICT

The use of ICT directly influences employment, as well as the inclusion of disadvantaged groups in the labor market (Evangelista, Guerrieri and Meliciani, 2014), so it is considered that these can be used to increase the income of individuals . However, Frey and Osborne (2013) indicate that computers, as an example of technology, are a complement for highly qualified workers and a substitute for workers who are poorly qualified.

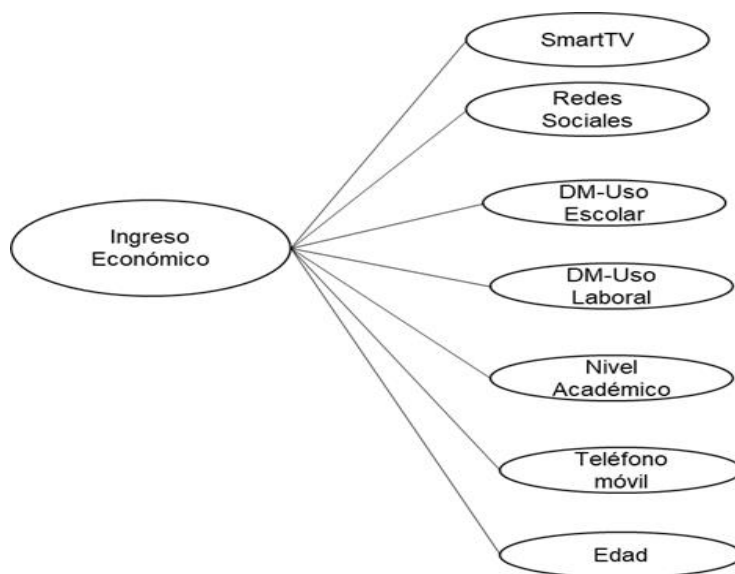
Islam and Slack (2016) mention that ICT provide access to information that positively affects the livelihoods of the population, mainly economic opportunities. ICT not only provide information on possible jobs, they also allow access to financial and commercial information for entrepreneurs and self-employed persons.

Regarding the use of ICT, specifically in the case of the Internet, this allows the individual to sell their work online, obtain information about employment opportunities in different industries and supplement their monthly income mainly through the sale of products. (Islam y Slack, 2016; Huws, Spencer y Syrdal, 2018).

Materials and methods

The investigation was of exploratory type to know the impact of technological and educational aspects that influence the economic income; was a cross-sectional study conducted in Mexico City in 2017. The study was aimed exclusively at university students who work, including the following independent variables: "Smart TV", "Social networks", "DM-School use", "DM -Use for work ", " Academic level ", " Mobile phone "and" Age ". These same variables are presented in Figure 1 and are described in Table 1; As a dependent variable we have the economic income. A simple random sampling was carried out by means of which a sample of 247 people who study at the undergraduate level and work in the Mexican capital in 2017 was obtained. The instrument and the proposed model are described in the following sections.

Figura 1. Variables del modelo



Fuente: Elaboración propia

Tabla 1. Explicación de las variables del modelo

Variable	Descripción	Tipo y relación
Ingreso económico (Y)	Ingreso económico mensual de personas que estudian y trabajan. Esta variable fue clasificada en ocho niveles de ingreso mensual personal	Dependiente: Variable principal para analizar los factores tecnológicos y de dispositivos móviles (DM) que influyen en el ingreso económico
Smart TV	Personas que tienen una Smart TV (Televisión con internet)	Independiente: Variable considerada por ser un dispositivo que se conecta a Internet y puede influir en el ingreso económico, pues el tener este tipo de conexión le puede otorgar al usuario, a través de una capacitación, mayores habilidades para la vida y el trabajo
Redes sociales	Personas que hacen uso de las redes sociales	Independiente: Variable considerada debido a que en las redes sociales se oferta contenido relacionado con ofertas laborales o capacitación para el trabajo o estudios y esto puede influir en el ingreso económico
DM-Uso escolar	Dispositivo móvil para uso escolar	Independiente: Variable tecnológica debido a que se conecta al Internet y puede buscar contenidos académicos para actualizar sus estudios, además de que puede repasar sus notas de estudio y esto influye en el ingreso económico
DM-Uso laboral	Dispositivo móvil para uso laboral	Independiente: Variable tecnológica debido a que se conecta al Internet y puede usarse para actividades laborales y esto influye en el ingreso económico
Nivel académico	Nivel académico, incluye primaria, secundaria, bachillerato superior y posgrado	Independiente: variable utilizada para ver la relación entre el nivel académico y el ingreso económico
Teléfono móvil	Cantidad de teléfonos móvil que tiene una persona	Independiente: variable importante de igual forma por ser un dispositivo móvil con acceso a internet y a diversas aplicaciones como las redes sociales, foros, entre otras
Edad	Edad de las personas en número entero	Independiente: se consideró esta variable para ver la relación entre ingreso económico y edad

Fuente: Elaboración propia

Instrument

A semi-structured survey was used as an instrument, with sections of questions related to the independent variables and the dependent variable. The survey was randomly applied to the sample size. The questionnaire has two sections. The first one with open questions designed to obtain general information about the individual: name, age, place of origin, level of studies, occupation, etc.; the second, with multiple-choice closed questions, captured economic aspects of the individual and their management of ICT: economic income, availability and frequency of use of mobile devices and the purpose of using them. The questionnaire was validated by applying it to a pilot sample and subsequently obtaining the Cronbach's alpha. Respondents were asked to indicate the frequency of use of technological tools (Smart TV, social networks) for academic activities; Likewise, the survey includes the use of mobile devices (DM) for school and work use, as well as general data on their academic level, number of mobile phones and age. The frequency of use included the numbers 0, 1, 2, 3, 5, 6 and 7, which indicate the frequency of use in days a week, where 0 is never and 1 is a day and so on.

To determine the impact of the independent variables mentioned above on economic income (dependent variable), the concept of elasticity was used. The elasticity quantifies the change in the dependent variable before changes in the independent variables, that is, how sensitive is the economic income to Smart TV, social networks, among others.

The elasticity (E) at any point on the curve is given by (Gujarati, 2010):

$$E = \left(\frac{\partial Y_t}{\partial X_{t-1}} \right) \left(\frac{X_{t-1}}{Y_t} \right) = b_1 \left(\frac{X_{t-1}}{Y_t} \right) \quad (3)$$

Where: $\left(\frac{\partial Y_t}{\partial X_t} \right)$ is the slope of the curve (b_1) y X_t y Q_t are the means of the independent variables and the dependent variable, respectively.

Results

With the variables identified to capture the technological and educational aspects and economic income, a model was developed to analyze the interaction of variables: a multiple linear regression model estimated by the ordinary minimum method was generated, with the corresponding procedure (MCO) in SAS software version 9.0. The analysis was based on the use of a statistic called p-value, which corresponds to the probability of accepting the null hypothesis, compared to the level of significance α ($\alpha = 0.05$ was used). Also, the validity of the model is checked with the proof of F.

The proposed model of multiple linear regression has as a dependent variable the economic income of the students. Also, we have the independent variables already specified above: "Smart TV", "Social Networks", "Dm-School Use", "DM-Labor Use", "Academic Level", "Mobile Phone" and "Age". The work is specified under the function indicated in equation 1.

$$\text{Ingreso Económico} = f(\text{SmartTV}, \text{Redes Sociales}, \text{DM} - \text{Uso Escolar}, \text{DM} - \text{Uso Laboral}, \text{Nivel Académico}, \text{Teléfono móvil}, \text{Edad}) \quad (1)$$

We also have equation 2, which represents the theoretical model that is presented and that analyzes the economic income with the variables already mentioned in table 1.

$$Y = \beta_0 + \beta_1 \text{SmartTV} + \beta_1 \text{RedesSociales} + \beta_2 \text{DM} - \text{UsoEscolar} + \beta_3 \text{DM} - \text{UsoLaboral} + \beta_4 \text{Nivel Académico} + \beta_5 \text{Teléfono móvil} + \beta_6 \text{Edad} + u_1 \quad (2)$$

A reliability analysis of the data obtained from the questionnaire was carried out considering the Cronbach's alpha: it was equivalent to 0.811. From the data analysis it was found that the respondents were university students who work and who are between 18 and 61 years old, of whom 55% are men. Regarding the monthly economic income, it is observed that the university-worker student population obtains between 3000 and 7000 pesos on

average. Regarding the use of social networks, 69% of the respondents reported using them 7 days a week, mainly for social-labor communication and entertainment purposes.

The estimated model shows a calculated F of 23 with a p -value equivalent to 0.000, so the null hypothesis is rejected in favor of the alternative hypothesis and it is concluded that at least one of the parameters of the equation is different from zero.

Student's t -values indicate that all the coefficients of the explanatory variables of the model are statistically significant, because they were greater than 1 in absolute terms and with p -value less than 0.05; In addition, the signs agree with the empirical analysis proposed. Therefore, all the explanatory variables within the model are considered. Table 2 shows the estimated coefficients in the model.

Tabla 2. Resultados estadísticos y coeficientes del modelo en su forma estructural

Variable dependiente	Constante	Variables independientes						
		Smart TV	Redes sociales	DM- Uso escolar	DM- Uso laboral	Nivel académico	Teléfono móvil	Edad
Coefficiente estimado	0.029	0.366	0.142	-0.816	0.833	0.481	-0.121	0.067
T	0.050	4.253	2.260	-3.307	4.637	3.661	-2.530	4.760
Valor- p	0.960	0.000	0.025	0.001	0.000	0.000	0.012	0.000
F	23.005	prob F 0.000						

Fuente: Elaboración propia con datos del modelo

The estimation of the regression allows us to indicate the effect of the use of social networks, the most used digital devices, as well as the purpose of their use, the academic level and age in the personal monthly income of the individuals who study in the Bachelor's degree and work.

The coefficients obtained show that there is a direct relationship between the personal monthly income and the frequency of the days that social networks use, the amount of Smart TV that they have in their home, the labor use of digital devices, the academic level and the age; On the other hand, there is an inverse relationship between the school use of mobile devices and the number of mobile telephones that workers who study have.

Table 3 shows the elasticities that were calculated taking into account the estimated parameters and the average of the variables involved; the above with the intention of analyzing the impact that variables have on personal monthly income.

Tabla 3. Elasticidades calculadas

Variable	Smart TV	Redes sociales	DM-Uso escolar	DM-Uso laboral	Nivel académico	Teléfono móvil	Edad
Elasticidad	0.10	0.28	-0.21	0.15	0.24	-0.06	0.50

Fuente: Elaboración propia con datos del modelo.

The results obtained indicate that digital devices such as Smart TV have a positive effect on personal monthly income. If the amount of Smart TV in the home increases by 10%, the personal monthly income will increase by 1%. In the case of mobile phones, this has a negative effect, since a 10% increase in the number of mobile phones would cause a 0.6% decrease in personal monthly income.

Discussion

In the results it was found that the use of digital devices such as Smart TV contributes positively to economic income. In contrast, the mobile phone has a negative effect. This may be due to the fact that, when implementing computer media, wages decrease and mainly affect workers who are moderately qualified, which increases income inequality (Yeaple, 2005; Frey and Osborne, 2013; Santos, Sequeira and Ferreira, 2017). The negative effect of mobile phone ownership differs from that obtained, since several authors mention that mobile phones can be used to increase the income of the population because they provide information on economic opportunities (Hübler and Hartje 2016, Islam and Slack, 2016). It

is worth mentioning that in order to obtain the benefits of ICT, skills must be developed to manage it. And currently the improvement in mobile devices has caused individuals to constantly improve their skills.

It is also observed that the days of use of social networks positively influence the monthly personal income; if the days of use increase by 10%, then the monthly personal income will increase by 2.8%. Considering that the use of social networks is one of the variants of informative wealth, the data agree with the European Commission, who mentions that per capita income correlates positively with informative wealth (Mendoça and Crespo, 2015). However, Wu (2013) indicates that in his study no correlation was found between future billable revenues and the use of a social network within an organization.

In the case of the use of technological devices, it is observed that the school use of said devices has a negative effect on personal monthly income; On the other hand, the employment of digital devices influences positively. If school use increases by 10%, then the monthly personal income will decrease by 2.1%. This is in agreement with what was shown in the study by Álvarez, Vega and Álvarez (2011), who indicate that the training that actors receive in universities and teaching institutions is not valued as something useful since the consolidation in the management of TIC was given outside the school. For its part, Unesco (2015) indicates that the way in which ICT skills are taught can cause a significant equity problem when linked to the socioeconomic status of individuals. Therefore, attention should be paid to the way in which the digital divide is being reduced, not only in issues of access to hardware and the development of skills to exploit the use of ICT.

And on the contrary, if the labor use is the one that increases, then the monthly personal income will increase by 1.5%. This shows the importance of digital devices as a tool to increase the income of different sectors and the way in which ICT are penetrating all aspects of daily life. This agrees with that mentioned by Huws et al. (2018), who indicate that in Europe some workers obtain additional income by selling their workforce through the use of mobile devices, as well as social networks. On the other hand, Álvarez et al. (2011) indicate that some entrepreneurs consider ICT as an important factor for their businesses to grow, while others conceive their importance in the ease of accessing job offers and thus

increase their income. However, as mentioned by Lugo, Kelly and Schurmann (2012), it will be necessary to think about which devices can be integrated to obtain the best results, not only economic, but also in terms of adaptability and sustainability. In this sense, Fairlie and Bahr (2018) indicate that some studies found that workers with computer skills had higher salaries.

On the other hand, it is distinguished that the academic level has a positive influence on the monthly personal income, since an increase of 10% in the academic level would cause an increase in the monthly personal income of 2.4%. The above agrees with the analysis made by Preoțiu, Volkova, Lampos, Bachrach and Aletras (2015) because they discovered correlations that show that a higher educational level indicates higher income. As mentioned by Picatoste, Pérez and Ruesga (2018), the higher level of education in a country leads to a higher level of per capita income, because a higher level of education translates into higher labor productivity and a higher level of education. acting throughout society. Therefore, it is considered, as well as to diverse actors, to the educational level as a fundamental piece to determine the monthly personal income. Several authors mention that by investing in human capital (education and skills for learning) income can be improved and considered one of the most effective ways to reduce income inequality in the long term (Jaumotte, Lall and Papageorgiou, 2008). ; Abdullah, Doucouliagos and Manning, 2011; Gruber and Kosack, 2013; Shahabadi et al., 2016). In addition, it is considered that a higher level of education allows an effective use of technology, which in turn gives the individual the possibility of accessing different sectors of production and increase their income. (Islam y Slack, 2016).

Finally, age is the variable that has the greatest influence on personal monthly income, since a 10% increase in age will result in a 5% increase in personal monthly income. Age has an important role in income, since it is considered that, on average, the older the experience, training or education, which translates into higher income (Preoțiu et al., 2015).

The present investigation allows to clarify the importance of the academic level, the age and the development of abilities in relation with the TIC so that the individuals can increase their income. However, in the sample only the university students who work are contemplated, therefore, the workers in general are not being contemplated. The main

strength of this research is that it can be a basis to make a characterization of workers in Mexico and the skills they have in ICT and complement it with the design and implementation of educational programs that allow individuals to access their levels better Of income.

Conclusions

It was found that the monthly personal income of working students is negatively affected by the ownership of mobile phones and the use of mobile devices for school purposes. However, variables such as age, days of use of social networks and academic level have a positive and significant influence on economic income. This agrees with what was stated by other authors because the use of social networks is used as a means to supplement income; On the other hand, a higher academic level generally translates into higher labor productivity and, therefore, a higher level of income.

The results of this research allowed us to identify the importance of improving the level of education and the ICT skills of the population, mainly those related to the use of social networks, because, in order to obtain the economic and social benefits of the adoption of These tools must design, implement and evaluate appropriate educational programs that allow individuals to develop technological skills necessary for the work environment.

Therefore, the development of policies aimed at better access to ICT, as well as the development of capacities to make use of these technologies, will allow individuals to increase their income, which will contribute to the reduction of inequality.

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