

E-learning and economics: knowledge dissemination through social networks

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Abstract

Increasing digitalization has led to a shift from learning and knowledge transfer based on reading texts, books and/or journals, to the use of virtual platforms. These changes represent future challenges for the acquisition, appropriation, and dissemination of knowledge. According to the Availability and Use of Information Technologies in Households National Survey (ENDUTIH, 2021), in Mexico there are just over 88 million Internet users and more than 91 million cell phone users. This survey also shows that more than 94% of users use social networks. The objective of this work is to measure the reach that the publication of infographics with scientific content through social networks has had. Using an analysis of variance (ANOVA) and controlling for characteristics of the publications, it was possible to estimate statistical differences between groups. The results indicate that the classification by control groups: people reached, and interactions; show differences in means between groups and years of publication, demonstrating positive results for the dissemination and acquisition of scientific knowledge through infographics.

Keywords: *Social networks; knowledge dissemination; infographics in education.*

1. Introduction

In recent years changes in the learning process have encouraged many students to complement their own process in the classroom with digital tools. These learning media represent an opportunity for students to access knowledge faster and with better results. Much of the change in the digitization process boomed during the COVID-19 pandemic. According to the National Survey on Availability and Use of Information Technologies in Households (ENDUTIH) 2021, in Mexico, just over 55.3% of homes with young people had internet access, representing more than 11.8 million people. The same survey found that more than 24 million young people searched the internet for information on education, research, and homework. Regarding internet use, just over three million people between 25 and 29 years of age use this medium for training. Among the most used social networks are: WhatsApp, Facebook, Instagram, Messenger, and YouTube.

The digitization process has given rise to new means of disseminating and spreading knowledge. Significant changes have been observed in students, teachers, researchers and all Internet users. However, a positive acceptance has been found in infographics, whose main feature is to summarize extensive information in a template that can be consumed through social networks. Infographics are considered part of information visualization. It is a field of research that focuses on patterns and trends in abstract data sets and can help design content with maximum effect (Naparín and Saad, 2017). In this sense, infographics become an attractive medium to disseminate knowledge, becoming an ideal method of dissemination and knowledge transfer for all audiences. This is the reason why infographics have greater acceptance when they meet visualization requirements, such as colors, images and text.

In the understanding that didactic and fast learning strengthens soft and hard skills in university students. The development and dissemination of infographics can reduce knowledge gaps in adults and young users of social networks. The dissemination of knowledge through digital media can contribute to the Sustainable Development Goals of the United Nations 2030 Agenda, whose goal is to "leave no one behind"; and in goal 4, quality education, efforts are sought to ensure inclusive, equitable and quality education that provides opportunities for all.

With this philosophy of bringing knowledge to all, in 2019, through a call for professional social service, a research project on Financial Inclusion for Development is created, this initiative consists of participatory action research to promote financial education. The project in addition to having a research agenda, consists of a professional social service program where students put into practice their communication skills, design and dissemination of science through infographics in a project called "Econographic". With the intention of analyzing the reach and reactions that the infographics published during the period 2019-

2022 have had. This document aims to measure the effect that the publication of infographics with scientific content has had through the social networks of the "Econographic" project.

2. New ways of learning

Studies show that the use of modern technologies in the classroom offers them the opportunity to learn faster, with better results and with greater satisfaction. The appeal of infographics seems to be inherent in their nature, as users are attracted to visualization, colors and images. An infographic can transfer knowledge about a subject quickly and massively, however, this condition depends on the quality and presentation of the infographic.

The use of this medium to transfer knowledge has become increasingly popular among the academic community, however, the speed of learning depends on multiple factors. The process of acceptance, assimilation, appropriation and absorption of knowledge is heterogeneous in each individual. Returning to the theoretical contributions on learning, from Piaget's cognitive theory (1969), also known as evolutionary, learning focuses on a gradual and progressive process, i.e., it is directly related to the individual's biological process and the environment in which he/she develops, however, much of learning depends on adaptation.

On the other hand, from the approach of *Watson's behaviorism* (1913), the learning process is obtained from behavior, in this sense, the observable and measurable behavior of an individual is analyzed until it becomes repetitive. In this sense, the individual can, through adaptation, generate his own learning. This is undoubtedly closely related to the theoretical approach of *cognitivism or Information Processing Theory*, where one of its authors Neisser (1967) states that the observation of new patterns of behavior leads to the construction of new learning. This learning includes how information is interpreted, processed and stored in memory. Furthermore, this approach is based on the philosophy that the human differential processes information through symbols, logical rules and external reality that is perceived and processed by individuals.

In addition, as mentioned by Stoyanova and Kommers (2002), the cognitivist approach states that information is stored in memory through a pattern of nodes that creates a network, in which the nodes are connected to each other through relationships. This process is nothing but an interconnected learning process, in this sense, recently e-learning developers adopt the *constructivist approach*, where knowledge is interpreted through individual perceptions (Pange and Pange, 2011).

However, the learning process has been adjusting to the needs of users. Much of this new approach alludes to the intensive use of the Internet. The concept of *e-learning*, beyond. One of the main approaches that enable a teaching and learning process is *Active Learning*. According to Bonwell and Eison (1991), it consists of an educational strategy that involves

students in the learning process. In this sense, this method requires the active participation of individuals in the construction of learning, i.e., *learning by doing*.

However, the learning process has been adjusting to the needs of users. Much of this new approach alludes to the intensive use of the Internet. The concept of *e-learning*, beyond focusing on the individual's learning process, is focused on the means used to achieve that learning. This approach is based on the intensive use of information and communication technologies (ICT) to disseminate knowledge. In addition, learning design using digital media, such as the use of infographics, can encompass the theoretical approaches mentioned above.

3. Transferring knowledge through "Econographic"

Infographics assist people to make informed and quick decisions about a specific topic. Using the constructivist approach and active learning, where university students can build and disseminate knowledge, in 2019, a project was created to produce and disseminate infographics on economic, social, political, and cultural topics regarding the Mexican context. "Econographic" is a project devised by students and supervised by teachers of Faculty of Economics and International Relations of the Autonomous University of Baja California.

The main objective of this project is to disseminate scientific knowledge concerning social sciences. The process of knowledge transfer is massive and fast. The project uses social networks to publish infographics, the platforms used are Facebook, Twitter, and Instagram. Regarding the reach of the infographics depends on multiple factors, such as the type of social network where it is published, the time of publication of the infographic, the number of followers, and the quality and visualization of the infographic.

In theory, an infographic is considered a means of visualizing information. It is a medium used by research to connect patterns and trends in abstract data sets and can help design templates for greater effect (Naparín and Saad, 2017). An infographic is considered a collection of information (Krauss, 2012), this data is interconnected into a representation or a set of ideas (Polman and Gebre, 2015). In this sense an infographic is integrated by a set of texts, drawings, paintings, graphics and images (Taspolat, Kaya, Sapanca, Beheshti, and Ozdamli, 2017). The use given to infographics is diverse, depending on the intended purpose.

The "Econographic" project is based on the 5E instructional model, which is based on the cognitive principle. In this phase, the student engages in a topic of their own interest, followed by an exploration stage of the different explanations and relationships that interact with the topic, then explains a complex process in a synthesis process with which they

elaborate an original iconography. Finally, this effort is evaluated directly by the teacher, and the success of the dissemination objective is measured through the number of people reached.

4. Methodology and results

The methodology used was chosen to analyze the following variables the reach of the infographics published and to identify whether there are significant differences in the results when controlling for the characteristics of the publications. For the first objective, a graphical analysis was performed, and for the second objective, the analysis of variance technique (ANOVA) was used to estimate whether the group averages were similar or statistically different.

As a variable to approximate the dissemination of content, two metrics published by the social network were used: interactions and people reached by each of the publications. Interactions are understood as the actions that people perform with the publication, which include reactions, comments, sharing the content, clicking on the photo or link. On the other hand, the people reached are defined as those who see the publication, either because they are followers or because a user shared the content. The difference between both metrics lies in the fact that an interaction requires some type of participation by the users of the social network to be counted that's not the case to count a person reached. In the period analyzed, 210 infographics were published, 169,588 people were reached and obtained 14,786 reactions.

The variables of dissemination were grouped into three categories: lexicon, topic, and year of publication. The lexicon of the publications was subdivided into positive, neutral, or negative, iconographies with a positive approach are those that address content associated with entrepreneurship, economic recovery or technological advances, the negative approach focuses on phenomena related to the loss of welfare or natural disasters and the neutral approach only presents information without the intention of generating a judgment on it. The groups and categories were constructed after the publication of the content.

Table 1. Divulcation variables, all categories.

Topic	Year		Lexic		
Economy	76	2019	33	Negative	62
Politics	88	2020	39	Neutral	100
Other	34	2021	103	Positive	48
Entrepreneurship	12	2022	35		
n	210		210		210

When comparing the evolution by year, an increase in the number of people reached is identified, but an opposite trend in interactions. This indicates the relationship between the frequency of publication and the increase in average reach, even though users tend to interact

less with the publications. Graphically, no different average is identified when grouped by type of lexicon or topic. The outliers observed are found in both criteria of disclosure classification and all the groups constructed.

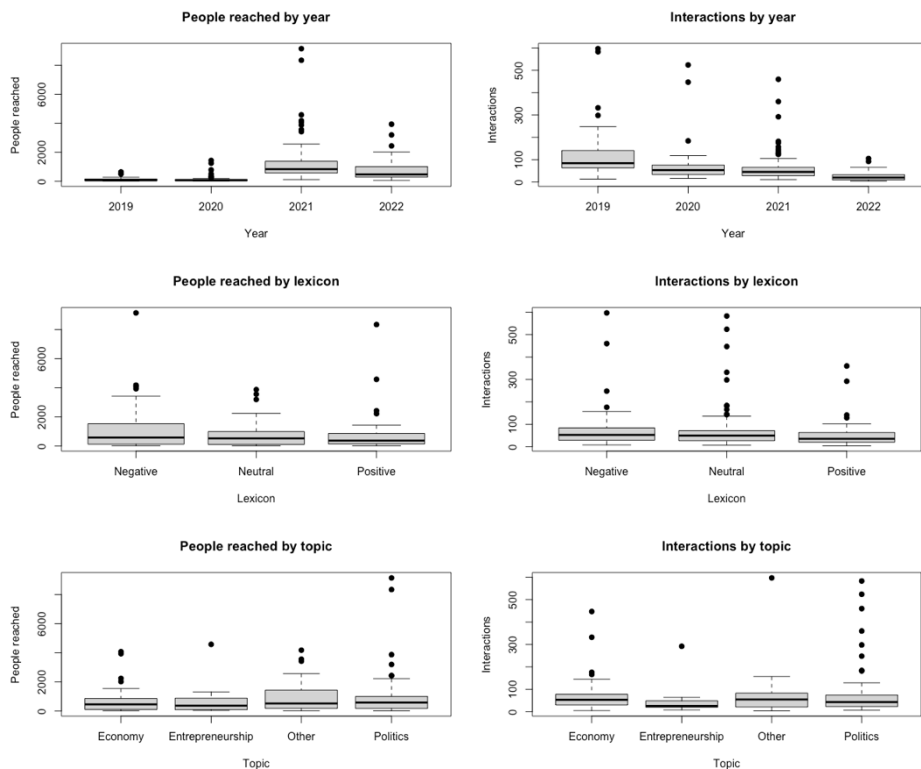


Figure 1. People reached and interaction by topic, lexicon and year. Source: Own elaboration.

The null hypothesis (H_0) of the ANOVA is that there is no difference in the means, and the alternative hypothesis (H_1) is that the means are different from each other. Table 2 shows that the differences between the means are significant when grouped by year of publication for both individuals reached and interactions, something that was apparent from the graphical analysis. When comparing the means of the 6 groups constructed using the criteria topic and lexicon, statistically significant differences were also identified with 95% confidence.

The ANOVA technique identifies whether there are differences between group means, but not the magnitude of the differences. A Tukey's Honestly Significant Difference (Tukey's HSD) post-hoc test was performed to identify the difference between the groups. Table 3 shows that the average number of people reached in 2021 was higher than 2020 and 2019, and the 2022 average was higher than 2020 and 2019. When performing Tukey's HSD using

interactions as the dependent variable and the between the subject and lexical categories with no significant differences found.

Table 2. Divulcation variables, all categories.

Variables	# of Groups	Df	People Reach		Interactions	
			F value	Pr(>F)	F value	Pr(>F)
Topic	4	3	1.206	0.309	0.268	0.849
Year	4	3	13.967	3.32e-08*	10.08	3.65e-06*
Lexicon	3	2	2.283	0.105	0.609	0.545
Topic and Year	9	8	4.49E-01	0.89	1.026	0.418
Topic and Lexicon	6	5	1.946	0.0891**	1.526	0.184
Year and Lexicon	7	6	1.48	0.1874	1.188	0.315
Topic, Year and Lexicon	8	7	0.396	0.9041	0.754	0.626
Residuals			175			

*Significativo al 99%, **Significativo al 95%

Table 3. Tukey's Honestly Significant Difference.

Comparisson	People Reach				Interactions			
	diff	lwr	upr	p	diff	lwr	upr	p
2020-2019	41	-590.08	672.13	0.99	-54.79	-106.43	-3.159	0.03*
2021-2019	1099.6	565.9	1633.3	0.000*	-70.90	-114.57	-27.24	0.000*
2022-2019	710.4	63	1357.8	0.02*	-106.8	-159.86	-53.92	0.000*
2021-2020	1058.6	556.9	1560.3	0.000*	-16.11	-57.15	24.93	0.73
2022-2020	669.4	48.1	1290.6	0.029*	-52.09	-102.93	-1.26	0.04*
2022-2021	-389.2	-911.2	132.8	0.21	-35.9	-78.70	6.72	0.13

* Statistically significant

Graphical analysis and ANOVA were performed, eliminating the data of persons reached and interactions above the upper interval defined as third interquartile +(1.5 *interquartile range), without modifying any of the results.

5. Conclusions

The results show that the "Econografico" social service project has fulfilled its objective of popularizing science. Students designed and published 210 infographics, reached 169,588 people and obtained 14,786 reactions. Positive and significant differences were identified in the average number of people reached in 2021 compared to 2019 and 2020. Negative and

significant differences were identified in the average number of interactions for 2022, 2021 and 2020 publications compared to 2019. No differences in average person reach or average interactions per publication were identified if grouped by topic or lexicon.

Future analyses should consider as grouping factors a more specific time element, the profile of the users reached or some approximation of the context to identify the elements that allow publications to be more successful in their outreach objective.

References

- Bonwell, C. C., & Eison, J. A. (1991). *Active learning: Creating excitement in the classroom. 1991 ASHE- ERIC higher education reports*. ERIC Clearinghouse on Higher Education, The George Washington University, One Dupont Circle, Suite 630, Washington, DC 20036-1183
- National Survey on the Availability and Use of Information Technologies in Households (ENDUTIH, 2021). INEGI.
- Jaleniauskiene, E., & Kasperiuuniene, J. (2022). Infographics in higher education: A scoping review. *E-Learning and Digital Media*. Doi: 20427530221107774.
- Krauss, J. (2012). More Than Words Can Say Infographics. *Learning & Leading with Technology*, 10- 14.
- Naparin, H., & Saad, A. B. (2017). Infographics in education: Review on infographics design. *The International Journal of Multimedia & Its Applications (IJMA)*, 9(4), 5.
- Neisser, U. (2014). *Cognitive psychology: Classic edition*. Psychology press.
- Pange, A., & Pange, J. (2011). Is e-learning based on learning theories? A literature review. *International Journal of Educational and Pedagogical Sciences*, 5(8), 932-936.
- Piaget J. (1969) *Psychology and Pedagogy*. Barcelona: Ariel.
- Polman, J. L., & Gebre, E. H. (2015). Towards Critical Appraisal of Infographics as Scientific Inscriptions. *Journal of Research in Science Teaching*, 52 (6), 868-893. <http://dx.doi.org/10.1002/tea.21225>
- Ruiz-Martín, H., & Bybee, R. W. (2022). The cognitive principles of learning underlying the 5E Model of Instruction. *International Journal of STEM Education*, 9(1), 21.
- Stoyanova, N., & Kommers, P. (2002). Concept mapping as a medium of shared cognition in computer-supported collaborative problem solving. *Journal of interactive learning research*, 13(1), 111-133.
- Taspolat, A., Kaya, O. S., Sapanca, H. F., Beheshti, M., & Ozdamli, F. (2017). An Investigation Toward Advantages, Design Principles and Steps on Infographics in Education. *International Journal of Sciences and Research*, 73 (7), 157-166.
- Watson, J. B. (1913). Psychology as the behaviorist views it. *Psychological Review*, 20, 158-177.