Critical Thinking Engagement in Online Environments: A Proposal of a Test for Young Mexicans

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Abstract

The use of critical thinking abilities constitutes a key competence in nowadays societies. However, it has been pointed out that when it comes the turn to analyze the data we have available by means of new technologies of information, it may be necessary to reshape these abilities. In this talk, I present my work in conducting a research about applied critical thinking skills in online environments among young Mexicans aged 18–24. I translate into Spanish the free version of the Watson and Glasser critical thinking assessment, and proposed a new assessment to test critical thinking abilities applied in the context of the use of new technologies of information. My proposal is based on the structure of the Watson and Glasser test. However, its reshape includes, among others, the following aspects: items to test reasoning based on images and videos, reasoning made in belief revision, reasoning in testing different sources of information (like X, TikTok, or regular newscasts), reasoning that may hide common misconceptions about the AI. The support of these changes is based on international guidelines for the use of AI in education, existent legislation and academic studies in the topic. I administered both assessments in a pilot sample. My experiment had two random groups: one of control solved the standard test, the other my proposed test. I found good support for the conceptual validity of my proposal as well as information for further research in the factors that may interfere in a critical engagement in online environments.

Keywords: critical thinking, Watson and Glaser test, media and informational literacy, young Mexicans online engagements

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Introduction

> Éste que ves, engaño colorido,
> que, del arte ostentado los primores,
> con falsos silogismos de colores
> es cauteloso engaño del sentido;
> Sor Juana Inés de la Cruz

What would our poet have thought or written upon learning of the colorful deceptions of our era? We live interesting times, undoubtedly we are reaching discoveries that make us dream in solving major problems, at the time that they open possible threatens of the same relevance. To keep abreast of times we need to see the Janus face of some of our technological developments that are changing our daily lives.

A comparison between two pairs of common scenarios in our days can gives us a clearer idea of this.

Scenario A

One of the major American mass media companies, *The Times*, sued to *Open AI* and *Microsoft* for copyright violations. Specifically, *The New York Times* accused these organizations of having inappropriately used thousands of articles in training their automated chatbots, which now compete with the media as a reliable source of information (Grynbaum, 2023; Sánchez-Vallejo, 2023). Attorneys of *Open AI* and *Microsoft* argue that nobody uses their chatbots as a substitute of a newspaper, moreover, *The Times* is pointing a failure they had in their products and they are fixing it, and most of the contents were already public (Chadwick, 2024; Lagos, 2024). Screenwriters, actors, performers, and various film industry unions are staging a strike lasting more than three months to achieve, among other things, regulation of the use of AI in this industry in order to protect them as creators (Dalton, 2023; Porcel, 2023). More than 200 singers are getting together to sign a public manifest against the use of AI to create music and /or virtual singers, and its use to emulate an existent singer (Durán San Juan, 2024; TEC, 2023).

Scenario A'

We have legal access through the web to a huge amount of books, articles, magazines, newspapers, videos, images, etc. Sites like the Digital Public Library of America, The New York Public Library, The British Library, Getty Publications Digital Library, Cervantes Virtual or The Internet Archive, make a non-profit effort to give access to a great amount of bibliographic resources. Databases like Scilit, Springer Link, Gutenberg, Elsevier, and tools like Research Rabbit, Elicit, and many more, not only make possible to consult a huge amount of knowledge, but they give us a tool for processing huge amounts of information, so we can scan in a successful way much more many resources. Even if there can be some selection in our research – as example, Khale (2019) recall us that in that year most of the books of XX century were not online yet – digitalization of contents rise in an exponential way. Rise (2021) comment that: "To mention a few symptoms of the digitalization that has engulfed us, as of 2000, one quarter of global information was digital, but as of 2013, it was 98%" (p. 2).

Scenario B

Elon Musk sued to *OpenAI* for abandoning the non-profit spirit that the company initially had. Musk and Altman have had frictions that are mainly attributed to this debate. Musk invested in a company that started as a research laboratory and therefore its code must remain open, and Altman will have to return the money he has earned once he abandoned this approach, prioritizing commercial interests over the good of humanity (Goldman & Fung, 2024; Pascual, 2024; Satariano, 2024). *OpenAI* argues that Musk wanted to have the total control of the company (Expansión, 2024). Nontheless, some months before, in the *World Economic Forum* in Davos, Altman (2024) himself said that: "… this technology [AI] will have massive effects on the world and it could go very wrong, the technological direction that we've trying to push it is one that we think we can make it safe (...)."

Scenario B'

In the development of new techniques in the design of medicines, vaccines and various procedures, AI has played a significant role both in studying predictions of trends in possible diseases at the population level, and thus pandemics, and in assisting biomedical research. (RNSA, 2020, TechRepublic, 2020). The most recent scenario is the SARS-COV2 virus pandemic, which has provided us with a wealth of information about how this form of information processing was used to rule out possible avenues for vaccine development, thus allowing us to focus on the most likely ones in less time than previously required. AI also helped in this scenario with risk management, surveillance during the pandemic, telecare and services during lockdown, vaccine delivery and provision, automatic disinfection services, and much more, in addition to the uses that opened up new horizons during this intensive period of research (Sujan et al., 2021).

These scenarios call us to look for guidelines to act. Even though the law lags behind the events it seeks to regulate, existent legislation may keep us aware of our new rights and obligations. The so called *fourth generation rights* encapsulates key facts about our current interchange with new information technologies, and reshape many rights of the third generation like the right to privacy and the right to information, that now includes, by instance, different expectations of true to consider if we are being flawed by some information site, or the consideration that we cannot expect to think in privacy as we did before, but to take into consideration different degrees of easiness to access to some of our personal information (Hartzog & Selinger, 2013; Riofrío Martínez-Villalba, 2014; Risse, 2021).

To illustrate the relevance of this change, let's just mention that the right to information has been considered a key right, i.e. a right that is the condition to enjoy some other rights like the right of freedom of opinion, or even the right to education (Britz & Lor, 2010).

It is a noteworthy fact that the governance of the internet or the AI is a difficult, hot, current and possibly permanent debate that we as humanity must held, and we are far to come to a satisfactory agreement. However, when it comes the turn to reach agreements in matter of education we are doing it a little bit better. Consider as an example that the Budapest Convention, the first legal multilateral and binding convention on cybercrime, as of August 2025 has been signed by 83 of the 195 sovereign states recognized by the United Nations (Migration and Home Affairs of the European Union, n.d.). Meanwhile, the Beijing consensus on Artificial Intelligence and Education, as been agreed by more than 100 member

states (UNESCO, 2019). Of course, some facts may intervene in this: The Beijing consensus is a non-binding agreement, maybe cybercrime is a more sensitive topic, etc. Nonetheless, as global citizens, we need to be in this debate and take into consideration the agreements we can reach.

In addition to this aspect, we need to be aware of the always changing technical aspects that may affect our personal access to information through the internet. This includes, among others, the following aspects:

- The possible hierarchisation of results that searching algorithms make based on aspects that may depend on the history of my personal choices and/or behavior in the net and/or location, letting aside possible facts or sources that may have some other point of view than mine, creating what is known as the *bubble effect* (Burkhardt, 2017; Jackson, 2022).
- The so called infodemic, that has been typified as a threat even for the WHO, (WHO, w.d.), which is not only the flow of a great amount of misleading information during some outbreak event, but that can be considered as a phenomenon that occurs every now and then in our everyday life in which we need to take decisions. Tristan Harris, former ethic designer of Google, mention that fake news spread six times faster than verified ones (Orlowski, 2020). Baesse de Araujo et. al. (2021) express how worrying is the combination of the exponential access to the internet, the exacerbated flow of fake news and the human tendency to no verify information. Even if we had the disposition to verify something, we may not be in an easy task. Burkhard (2017) points out that:

> Researchers have studied how well humans can detect lies. Bond and DePaulo analyzed the results of more than 200 lie detection experiments and found that humans can detect lies in text only slightly better than by random chance. This means that if a bot supplies a social media user with false information, that person has just a little better than a 50 percent chance of identifying the information as false. In addition, because some bots have presented themselves and been accepted by humans as 'friends,' they become trusted sources, making the detection of a lie even more difficult. (p. 16)

Under this difficult situation, it has been explored the psychological causes that may be behind the tendency to accept something as true. However this avenue is not an easier way to attack this problem. Kanashina et. al. (2023) emphasizes that:

> According to Wisdom, Chor, Hoagwood and Horz (2014), there are about twenty theoretical frameworks that attempt to explain the reasons and precedents for the acceptance of fake news. One of the most popular is the Theory of Reasoned Action (TRA), proposed by Ajzen and Fishbein (1973), which considers attitude as one of the basic antecedents of the intention to use or accept a social behavior. Also, within the field of social psychology is Bandura's (1989) Social Cognitive Theory (SCT), which considers that part of social knowledge is learned by observing other subjects during social relations and through experience with external means. Currently, social media configures a new social framework of a virtual nature, and therefore, some of the tools used to analyze socialization processes in physical environments can be replicated in virtual ones. (Stephen, 2016, p. 537)

In Kanashina et al. (2023) it is found that one of the most difficult tendencies to combat is the one that is called “Perception of richness” which is the tendency to accept some information that comes from a source perceived as trusted. Jost (2020) found that young adults tend to share fake news when they are considered something amusing. Something remarkable is that both studies are focused in young adults, so we may expect a better critical development, and this is not the case.

Additionally, we need to be aware of the technical reports that antivirus companies, or cybersecurity companies publish. They use to offer at least annual reports that informs to the general public some tendencies and novelties in the most common threatens on the net for personal use as well as for big companies or organisms.

The troubled sea described before is more navigable with some training on analytic skills, some general knowledge of the way the algorithms we work with function, and in general with what the UNESCO calls the *media and informational literacy* (MIL), that is conceived as an umbrella concept, involving explicitly at its core critical thinking abilities. By instance, UNESCO (2023) states that “MIL empowers citizens with critical thinking and other necessary competencies to enable their informed and ethical engagement with the integration of content, institutions providing content (…) and digital technologies” (p. 6). However critical thinking abilities may not just be directly applied in a crystal-clear way on these scenarios (Burkhard, 2017; Jackson 2022; Jost, 2020; Kanashina 2023; UNESCO 2023a). The key fact that this work addresses, not pointed out in the literature revised, is a shift in the logical backbone of critical thinking. What are the core principles of an apparent diversity of conceptions of critical thinking (Zhou, 2022) are tied with a classical view of logic, giving a great weight to deduction reasoning. Nonetheless, by the aforementioned circumstances, it is needed to involve non-classical ingredients, and in my proposal I include the framework behind the non-classical logics of belief revision, which is a necessary kind of reasoning to confront the vast majority of circumstances involved in our interchange of data on any new technology of information. In addition, we need to consider that the source data of an inference, many times is now an image or a video. Even with the difficulty and reticence to consider this kind of reasoning, it is by far necessary to begin considering this circumstance. Another fact considered in this proposal, is that we need to have material considerations in the application of critical thinking abilities in these scenarios. Typical conception of the evaluation of a deduction may be confined to a formal revision, and the fundament of a standardised evaluation involves as well some abstraction of the contents of the evaluation, while the material revision is left as a matter concerned with the subject of the matter in both cases. Even though this point of view is appropriate in some circumstances, when we deal with application of the reasoning, we may be in need to consider at least some key aspects of the material of the reasoning. For instance, we may be in need to be aware of the most common phenomena that may hide misconceptions about the AI, as this phenomenon may prevent a fruitful use of it. As well, in the case of the present work, it has been noted that there were a few of more common fallacies presented in the interchange on social media in México, and the literature emphasizes the statistical fallacies.

The Local Reflect of the Global Scenario

How does the need of a critical engagement in online environments is lived in México?

Some Conceptual Remarks

The notion of critical thinking has been widely discussed and used in many different areas. For this reason, it may be thought that there is no well-defined concept, or even that there is no consensus on what is meant when we talk about critical thinking. For example, fields such as psychology and sociology emphasize or include contexts or dispositions that favor the use of analytical skills, while philosophy emphasizes working with the skills themselves and the ability to apply logic (Zhou, 2022). This last is the paradigm in which the present proposal is situated.

This paradigm is chosen because the history of the study of these areas in México is such that specialists in the field recommend adopting what is called a *narrow conception* of critical thinking (Vega Reñón, 2015), which grosso modo is the one taken in the above mentioned paradigm. This conception allows the existence of well-established test to measure critical thinking abilities (Ossa-Cornejo et al., 2017). For this project, I used Watson and Glaser tests (Glaser, 1941; Watson & Glaser, 1980) as a test for a group of control, and as a skeleton to construct my proposed test.

The Watson and Glaser (W&G) tests were originally created in English and validated in the United States without considering a particular age group or cultural contexts. Some work has been done to adapt these tests to a specific language or culture (Da Dalt de Mangione & Difabio de Anglat, 2007; Gerdts-Andersen et al., 2022; Palma-Luengo et al., 2021). Nonetheless, as far as our knowledge let us see, no work on adapting this test to an application in online contexts has been done.

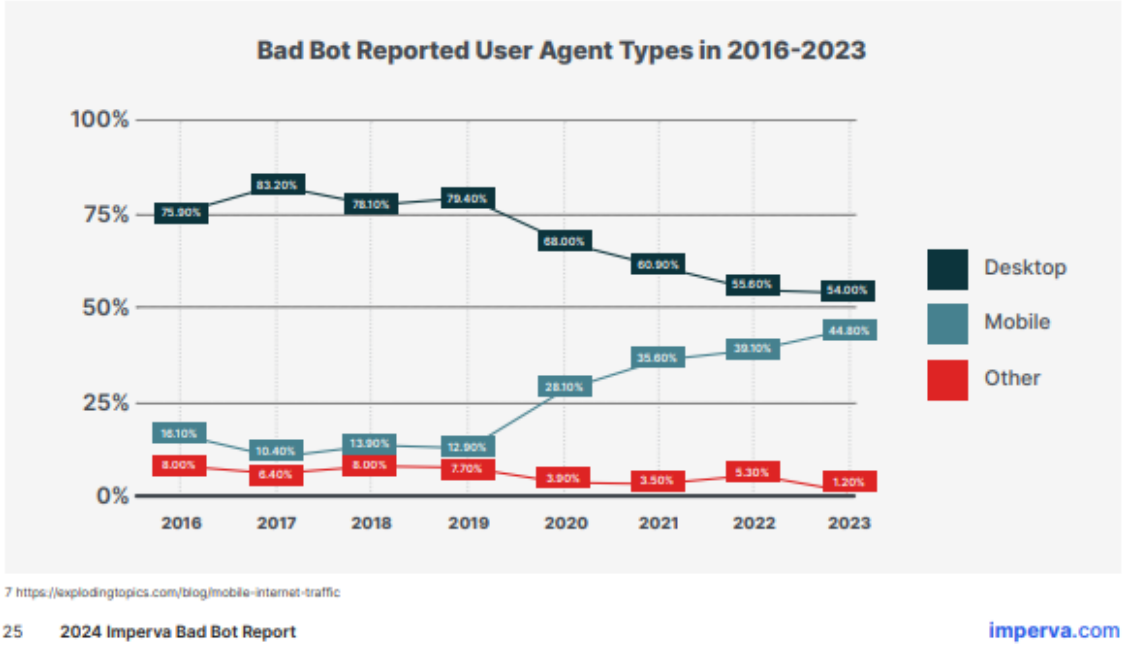
The Target Population

The participants in the pilot sample are randomly selected Mexicans aged 18 to 24 who use new information technologies. The reason to select this target population is of interest. Let´s give some context to explain it. Baesse de Araujo et. al. (2021) tell us that the vast majority of access points to fake news are intelligent mobile phones and social networks. Kanashina et al. (2023) tells us that young people spend the most time on the internet on social media:

> This environment [of circulation of large amounts of fake news] poses a great social challenge, particularly in the decision-making processes of young people, who are strongly influenced by the information distributed online, and are unaware of the volume of fake news they consume (Kim, Song, Liu, Liu & Grimm, 2018; Ng, Lee, Wong & Lam, 2020). Regarding online news consumption, data from GlobalWebIndex (GWI) reveals young people aged 16–24, are the cohort that spends the most time-consuming social media, at 58%. (GWI: Definitive Social Media Trends Report, 2023, p. 535).

They also tell us that one of the most common ways young people accept fake news is when a friend or contact suggests it to them, and they tend to get most of their information from their mobile phones. To this confluence of adverse factors, we must add that one of the biggest factors in the spread of fake news and information theft is the use of bad bots. The Imperva report (2024) tells us that the use of bad bots has increased on mobile phones:

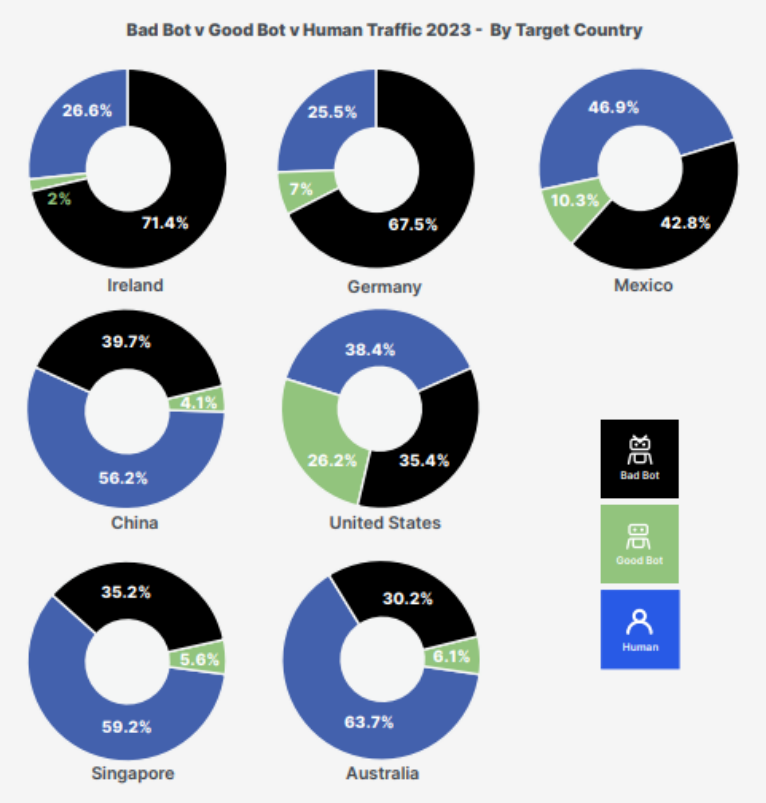
Figure 1
Bad Bot Traffic From 2016 to 2023



Source: Imperva (2024)

In addition to this, in México, the bad bot traffic is almost the same than the one of humans. Hereby the data:

Figure 2
Bad Bot, Good Bot and Human Traffic in 2023



Source: Imperva (2024)

This means that there is a very high probability that a young Mexican will come into contact with a bot that distributes fake news or manipulates what they receive or see on their social media, and that they may end up believing false or biased content.

Due to the above mentioned facts, in order to fully characterize the relevant features of the target population for this study, we will provide some data on the general population dynamics in terms of access to and use of new information technologies. See details in the appendix.

Research Design

My research is a true experiment with two random groups, one of control. For the time being, I present evidence for the validity of the conceptual construct, with evidence of content, of process, and of relation with other variables (Sánchez Mendiola & Martínez González, 2022). I administered a translation into Spanish of my own of the free version of the W&G assessment of critical thinking to a control group, and my proposed test to the other group. Both groups conform a pilot sample and were administered under same circumstances.

Some Details of My Proposed Test

Socrates already warned us that the first step to achieving knowledge is to come to know what we do not know. To guide social media users to measure their critical thinking skills will be a great first step in fostering these abilities. Having a test as the one proposed is a convenient step to improve critical thinking skills in the target population largely because there is not necessarily an awareness of the potential deficiency in these skills, or they do not even consider it relevant at times. Uiterkamp et al. (2020) mentions that many young Mexicans 13–14 years aged, despite having some awareness of the possible falsity of some content, this do not necessarily deterred them from sharing it because they do not consider its verification a priority, especially if they think the topic is relevant. For example, they might share any content about climate change without necessarily verifying the source because they consider the topic more important than the source. Jackson (2022) and Burkhardt (2017), among others, warn us about the so-called Dunning-Kruger effect, which barely speaking, consists in overestimating one's own abilities regarding a topic or a specific skill.

Critical thinking skills are acquired to some extent through knowledge, but primarily and decisively through practice. Thus, a test, in addition to raising awareness of certain weaknesses, gives us the opportunity to practice these skills in a controlled environment.

Moreover, a test has an additional advantage with respect to the target population. Adult learning requires, among other things, to detect established patterns or ideas that are inadequate, which is one aspect of incompetence in a skill. Fostering these skills in the target population can be modeled by the acquisition of a skill in adult population actively engaged in their learning process. A recurring model of this kind of skill acquisition is the one introduced by DePhillips et al. (1960), which mentions four phases in learning or acquiring skills:

> It is characterized by a passage through four stages: (1) the individual is at first in a state of *unconscious incompetence*, in which he is not even aware of his lack of knowledge; (2) when he becomes aware of his ignorance and the need to do something about it, he enters the stage of *conscious incompetence*; (3) with effort, he

> succeeds in reaching the third stage, *conscious competence*, in which his knowledge is deliberately and often woodenly applied; (4) continued effort may bring him to the level of *unconscious competence*, in which he utilizes his knowledge easily and gracefully. (p. 69)

In this sense, I designed my proposed test as an *assessment tool for learning and as learning* (Sánchez Mendiola & Martínez González, 2022). The test is designed to be implement online, so feedback in each item has been worked out as an immediate source of information about one's mistakes, including sites on the web to consult and follow the required documentation to be more critical on that specific point. So this is a tool for self and auto-regulated learning, available there where it is more needed: the new technologies of information.

Some Examples of the Items Constructed

As an example of a key change in the items constructed, we have a shift in the way we confront the information we need to take a decision or to make an inference of whichever kind in several ways. One, is given by the fact that internet users will be mostly confronted to take a decision based on information that do not fall within their radio of expertise, nonetheless, they need to do something about that information, based on what some third person says about it, an expert or an actor involved in the topic or debate. So, exercises to consider the scenario mentioned include what can be inferred from the fact that a particular person states some information.

Some other way in which we need to confront the information we have at hand, is by considering its source, and in this case we need to know whether we consider the source reliable enough to state some inference based on the information provided by that source, so the reasoning has a composed mechanism: the test of the source and the test of the inference based on the first step. So by instance, an item can provide you with an X of TikTok profile with some information, like the following, form the PROFECO (Federal Consumer Protection Agency):

Figure 3
An X Post of the PROFECO, México

So in the instructions for these kind of exercises, participants need to think whether they consider the source *reliable, barely reliable or not reliable at all* to keep the proposed inference made based on the information of the post.

As a final example, I present one item treating with the use of the AI, and testing the awareness that participants may have in possible biases of these algorithms. So, an input item has an image created with AI, and the following information: *Artificial intelligence Artguru, was asked to create an image with the following description:"Create an image of successful and happy people working collaboratively," and the result is as follows:*

Figure 4
An Image Created With Artguru

Source: Artguru

Participants are asked to think about the possible biases present in the image, as the prototypical phenotype or others.

Some Evidence of Validity of the Conceptual Construct

As for the attitude of young people when taking the tests, it should be noted that in general, their attitude was favorable and/or interested. Nonetheless, there were two cases in which the examination was left unfinished, one with the W&G translation and the other with my proposed test. It is plausible to think that this indicates that the length of the test is a significant factor for young people who are not used to reading extensively or focusing their attention on a single activity for too long, and who are more familiar with quick content. (Burkhard, 2017; Kovač & van der Weel, 2020). Some studies state that users tend to remain in a page less than a minute (Nielsen, 2011).

Regarding the relationship between the results obtained from the W&G test and my proposed test, one remarkable fact is that the section in which participants performed most poorly was the non-deductive arguments section in both tests. Conversely, the section in which they performed best was the information interpretation section in both tests. This indicates that despite the differences between the tests, these skills are adequately represented in the instruments used. In my test the section concerning non-deductive inferences, was dedicated to statistical fallacies exclusively, inferences absent in the W&G test. The section of interpreting information was totally new as is considering the sources of information.

It should be mentioned that one fact that resulted significant was the difference between rural and urban areas in the application of critical thinking skills to contexts involving the use of new technologies. I took the 27% of participants with the highest scores and the 27% with the lowest scores, and there are certain trends that should be mentioned for confirmation in future work. This percentage is used to calculate the discriminatory power of the items (Sánchez Mendiola & Martínez González, 2022). Among this number of participants, it was found that

77% of those who obtained the highest scores in my test had primarily lived in a metropolitan area, whereas for the W&G test this percentage is only 44%. As expected, the proportion of people with lower scores in my test in a rural environment is much higher than that of the W&G test, in which this variable does not seem to have any impact: 44% of participants from metropolitan areas are also among the lower scorers on the W&G test, while only 22% of metropolitan participants are among the lower scorers on my proposed test.

This variable impact as well in the measurement of the heterogeneity. The target population can be considered homogeneous with respect to both test: the measure of heterogeneity is of 12.295% in my proposed test, whereas in the W&G test is of 15.265%, less than 30% in both cases. However if we consider the homogeneity of the population only in the metropolitan areas the heterogeneity in the W&G test is much greater, while the homogeneity in my proposed test is much greater. This will undoubtedly have to be studied in future work.

This finding is quite striking, as even schooling didn't have such a significant impact. Social media use neither appear to be a determining factor at this time.

Conclusions

To close, it is important to emphasize that one of the areas where greater critical thinking skills are needed, given its prevalence and potential for negative effects, is the ability to critically engage with the news received. Within the detection of assumptions section, those concerning news biases presented the greatest difficulty for the target population. On the other hand, there is some awareness regarding specific actors that are considered reliable, such as PROFECO (the Federal Consumer Protection Agency). However, we are not so fortunate when it comes to discerning unknown sources, as there is a tendency to think that the public nature of a company or profile makes it trustworthy or less likely to engage in deception, especially in the case of corporations or profiles that "seem serious."

The data found so far makes it plausible to put forward several hypotheses that would be desirable to verify in future validation work. First, we would have to consider why the variable related to urban areas is so significant. I believe that a key factor may be the greater access to services that facilitate the everyday use of various information technologies, as this can occur even in unfavorable economic circumstances. In other words, in metropolitan areas, there can be greater access to technological resources even without necessarily being economically advantageous. This results in a greater awareness with the use of new information technologies, which could facilitate their more critical application.

On the other hand, exercises that included images or videos were generally answered correctly, which speaks about the familiarity of the target population with content transmission through these channels (Burkahard, 2017; Howarth, 2024; Kovač & van der Weel, 2020). However, it remains a factor to explore: how effectively this type of transmission can foster certain cognitive processes (Kovač & van der Weel, 2020), and therefore it is of interest to explore how skilled are users who primarily use platforms or networks whose predominant means of expression is visual (Uiterkamp et al., 2020). Among these types of networks, TikTok is undoubtedly very popular today (Howarth, 2024). A key task for future work within information processing theory is to delve deeper into how learning processes occur through these media.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that DeepL, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from DeepL, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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Appendix

Hereby, data from INEGI & IFT (2024) about target population. This includes socioeconomic strata, level of education, type of access to new information technologies, type of device used to access them, etc.

This is the general landscape:

Table 1

Internet Users, By Age Group, From 2015 to 2023

Year	6 to 11 years	12 to 17 years	18 to 24 years	25 to 34 years	35 to 44 years	45 to 54 years	55 to 64 years	65 years or more
	%	%	%	%	%	%	%	%
2016	10.9	18.6	18.9	20.2	15.5	9.6	4.5	1.9
2017	10.1	17.6	18.3	20.2	16.5	10.8	4.9	1.6
2018	10.1	16.4	17.5	20.2	16.1	11.7	5.7	2.3
2019	10.1	15.0	15.9	19.3	17.3	12.8	7.1	2.5
2020	11.0	14.7	15.7	19.1	16.4	13.0	6.9	3.4
2021	10.8	14.5	15.6	18.9	15.9	13.0	7.5	3.8
2022	9.7	14.0	14.9	18.9	16.3	13.9	8.0	4.4
2023	9.3	13.2	14.9	18.2	16.2	14.0	9.1	5.0

Source: INEGI & IFT (2024)

The number of mobile phone and internet users has increased in our country, whereas the number of users of computers has decreased, showing us the tendency of the population to access to the net via mobile phone:

Table 2

Users of Computers, Internet or Mobile Phone From 2015 to 2023

Year	Computer users %	Internet users %	Mobile Phone users %
2015	51.2	57.4	71.4
2016	46.8	59.4	73.5
2017	45.2	63.7	72.1
2018	44.7	65.5	73.3
2019	42.4	69.6	74.9
2020	37.5	71.5	75.1
2021	37.4	75.6	78.3
2022	37.0	78.6	79.2
2023	37.3	81.2	81.4

Source: INEGI & IFT (2024)

Hereby the possible reasons for not having a computer. Although almost half of population mention economic reasons for not having a computer, 31.9% mention that it is because they are not interested in having one or do not need one:

Table 3

Householders Without Computer, By Principal Reasons 2023

Socioeconomic strata	Economic reasons	They are not interested or do not need one	They don't know how to use it	They use a smartphone or some other device	It is broken
	%	%	%	%	%
National	**45.8**	**31.9**	**13.1**	**7.4**	**1.0**
Low	56.7	21.9	15.7	4.1	0.6
Medium Low	45.8	32.5	12.5	7.5	0.9
Medium High	32.0	43.2	11.4	10.6	1.6
High	22.5	48.9	10.0	15.7	1.8

Source: INEGI & IFT (2024)

Meanwhile, the mobile phone is most commonly perceived as necessary. The possible relationship between computer or mobile phone use and schooling appears to be inversely proportional in agreement to the data shown: the higher the level of education, the lower the percentage of use, both for computers and mobile phones.

Table 4

Mobile Phone Users by Schooling From 2015 to 2023

Year	Primary School	Secondary school	High school	Major degree	Postgraduate degree	Other/Not specified
	%	%	%	%	%	%
2015e	24.9	29.8	23.9	17.1	1.4	3.0
2016e	24.4	30.5	22.5	18.4	1.3	2.9
2017e	22.2	30.0	22.8	21.1	1.6	2.5
2018e	21.7	30.0	23.4	20.4	1.4	3.1
2019f	20.8	29.3	25.1	20.7	1.7	2.4
2020g	20.7	29.2	23.9	21.9	1.7	2.7
2021h	21.1	28.4	24.9	21.7	1.6	2.3
2022f	20.3	29.0	24.5	22.1	1.6	2.4
2023f	20.7	28.4	24.8	21.6	1.7	2.8

Source: INEGI & IFT (2024)

Table 5

Computer Users by Schooling From 2015 to 2023

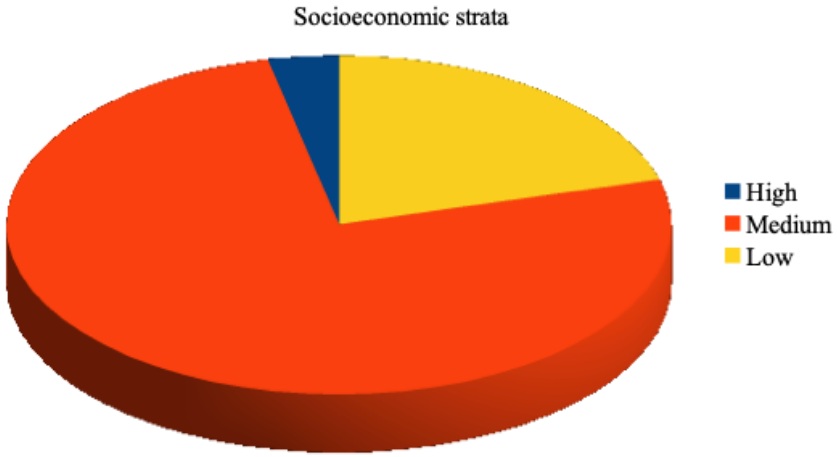
Year	Primary school	Secondary school	High school	Major degree	Postgraduate degree	Other/Not specified
	%	%	%	%	%	%
2015	21.4	24.4	27.2	22.8	2.0	2.3
2016	20.2	23.3	25.5	26.2	2.0	2.7
2017	18.3	22.0	25.4	29.6	2.4	2.4
2018	17.4	21.6	26.2	29.8	2.3	2.7
2019	15.9	20.2	28.1	31.9	2.9	1.0
2020	14.0	18.4	26.2	36.7	3.2	1.6
2021	12.9	16.6	28.7	37.5	3.3	1.1
2022	11.5	16.9	27.8	38.8	3.4	1.7
2023	11.6	16.2	27.8	39.1	3.5	1.7

Source: INEGI & IFT (2024)

Finally, to close this section, hereby some information about the composition of the participants in the pilot sample, in agreement with the assessing variables mentioned in

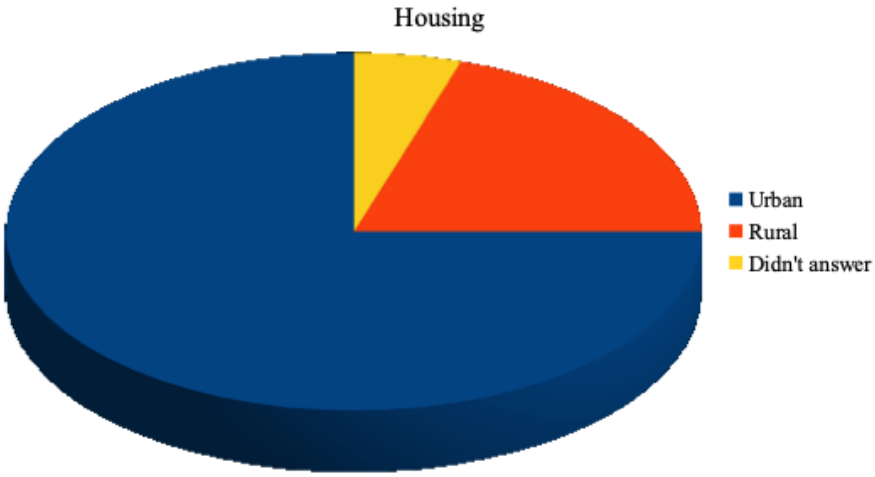
literature. Brithplace of the participants were the following. *Ciudad de México*: Xochimilco, Iztapalapa, Benito Juárez, Coyoacán and Gustavo A. Madero. *Estado de México*: Tultitlán, Tenayuca, Nicolás Romero and Ixtapaluca. *Hidalgo, Zacatecas*: Jerez, Guadalupe, Trancoso, Morelos and Zacatecas. The composition is the following:

Figure 5
Socioeconomic Strata of Pilot Sample



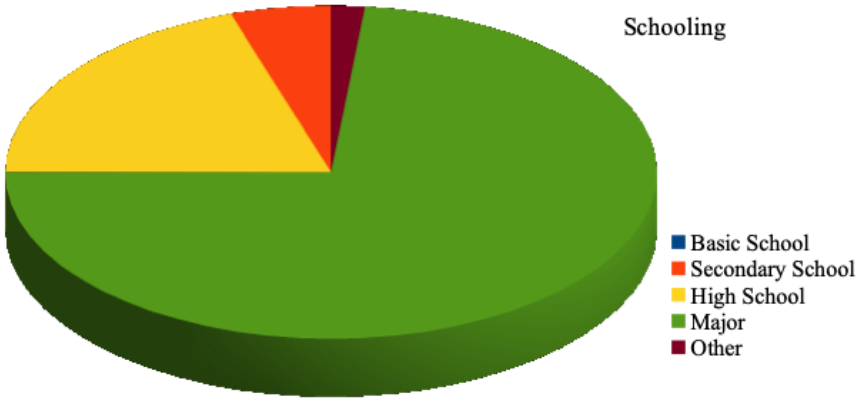
Own elaboration

Figure 6
Housing of the Pilot Sample



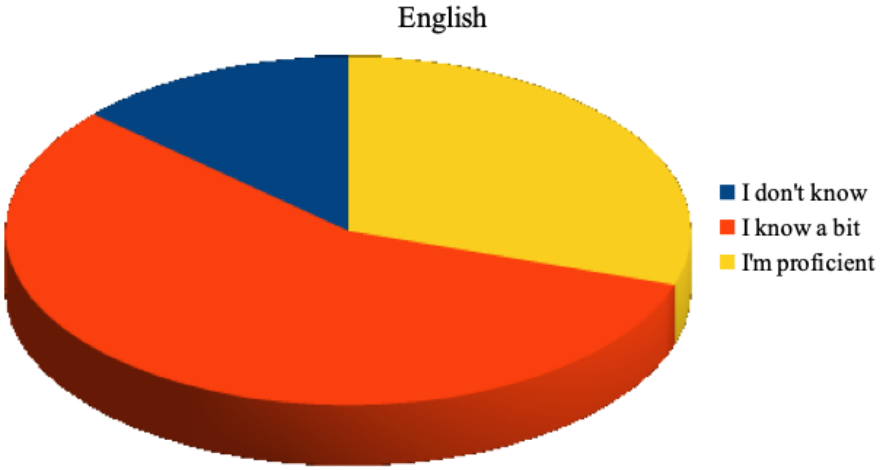
Own elaboration

Figure 7
Schooling of the Pilot Sample



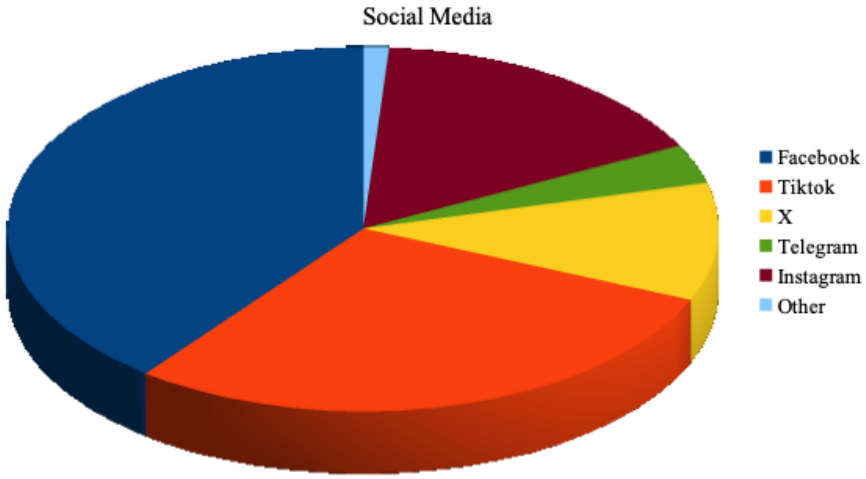
Own elaboration

Figure 8
Knowledge of English



Own elaboration

Figure 9
Principal Social Media Used by the Pilot Sample



Own elaboration