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Technology Readiness Index: a study applied to students

Complete Research Paper

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Abstract

An online survey was conducted among undergraduate and graduate students in Brazil to identify their access to social networks and technology readiness on digital platforms. The TRI scale (2.0) was used as support, encompassing the dimensions of optimism, innovativeness, discomfort, and insecurity. The results indicated high usage of platforms such as WhatsApp, YouTube, and Instagram. In terms of the dimensions, optimism and innovativeness emerged as important factors, reflecting a positive perception of networks and the belief that they can provide control and freedom in people's lives. Regarding discomfort, respondents did not express difficulties with technical support from service providers, suggesting that the technologies were designed for user-friendliness. However, the dimension of insecurity indicates a certain dependency on technology to perform tasks, such as preferring to send voice messages or texts instead of engaging in personal contact. This behavior may have implications for a decline in personal relationships.

Keywords

Digital social networks, technology readiness index, graduate and undergraduate students in Brazil.

Introduction

The Technology Readiness Index (TRI) is a conceptual framework developed by Parasuraman (2000), which builds upon the Technology Acceptance Model (TAM) proposed by (Davis, 1989). Its purpose is to assess individuals' readiness and inclination to adopt and use new technological devices to meet their everyday objectives, whether at home, work, study, or other daily tasks. TRI was initially introduced as TRI 1.0, by Parasuraman (2000), and subsequently updated to TRI 2.0, by (Parasuraman & Colby, 2015). However, there is a dearth of research employing the TRI 2.0 scale, especially in Brazil (Fujihara et al., 2022).

It assesses an individual's readiness and willingness to adopt and use technology. TRI comprises five dimensions: optimism, innovativeness, discomfort, insecurity, and complexity. Optimism reflects individuals' positive attitudes and beliefs regarding technology and its benefits. Innovativeness measures the extent to which individuals are open to new technology. Discomfort measures the level of ease or discomfort experienced when using the technology. Insecurity examines concerns regarding privacy and security in relation to technology use. Complexity assesses the perceived difficulty in using technology. Given the widespread use of social media and its increasing frequency, there is growing academic interest in understanding the perceptions of social media users.

The popularity of social networks has facilitated increased interaction among individuals, allowing them to share information, news, and opinions at unprecedented speed and ease (Leyrer-Jackson & Wilson, 2018). This phenomenon is driven by the widespread adoption of social networking platforms and their characteristics that promote interaction and provide access to vast amounts of user data (Fine et al., 2016);

This study focuses on undergraduate and graduate students who actively engage in major social networking. Its objective is to explore relevant issues related to social media usage and contribute to a better understanding of user perceptions, both motivating and inhibiting, regarding the technologies employed on various platforms. Within this context, this study aims to evaluate social network users using the technology readiness model (TRI), specifically the 2.0 scale.

2. THEORETICAL FRAMEWORK

2.1 Digital Social Networks

The internet is a global and expanding phenomenon, with an estimated 5.16 billion users worldwide, representing 64.4% of the global population (STATISTA, 2023). According to the "We Are Social" report (2023), Brazil stands out in this scenario as a major adopter of Information and Communication Technologies (ICT) – 84.3% of its users are between 16 and 64 years old, and the average daily ICT usage is 9 hours and 38 minutes, ranking second globally, behind only South Africa.

Out of the total number of users, 4.76 billion use digital social networks, with 70.16% falling within the age range of 16 to 64 years, access digital social networks in Brazil. The average daily usage is 3 hours and 46 minutes across eight different platforms (Facebook, Instagram, WhatsApp, etc.), representing the second highest average usage in the world. Understanding the use of these technologies has become a great challenge, especially for university students, who can tailor their offerings and support to better meet their needs and increase adoption rates.

Students are among the primary users of digital social networks, thanks to the advancements in mobile technology that have made the Internet an inseparable part of their lives. For the new generation of students, social media platforms have become their primary means of contact, social engagement, and communication (Leyrer-Jackson & Wilson, 2018). Platforms like Facebook, Twitter, Tumblr, and Instagram have witnessed significant growth in usage among students, although not all platforms are used simultaneously, as students tend to prefer one specific platform (Ha et al., 2018; Kaushik & Agrawal, 2021).

Research by Su e Chan (2017) has indicated that college students perceive current social media platforms, such as Facebook, as tools for information sharing, self-presentation, and expressing opinions. These findings suggest that college students have a positive perception of social media as communication tools, which is influenced by their interactions and constant usage (Ha et al., 2018).

However, studies examining digital social networks and users' perceptions of the technologies employed on these platforms (such as Facebook, Instagram, WhatsApp, and others) are still in their early stages and under active development. In this context, the technology readiness index (TRI 2.0) could be a valuable tool for addressing this issue. The TRI is a robust and established model that has been widely applied across various fields since its initial version, TRI 1.0, was introduced in 1999, and its subsequent revised and updated version by Parasuraman and Colby in 2015.

The increasing popularity of social media platforms has led to the emergence of new digital social networks where individuals can interact, share information, news, and opinions at an unprecedented speed and ease (Housley et al., 2018). As a result, the use of these technologies has the potential to transform current social settings and relationships. Different users, also known as actors, may have varied positive and negative reactions to the access and use of online service offerings. Users also face trade-offs in their attempts to maximize the value derived from technology-based services without encountering frustration or failure. In a study by Kaushik & Agrawal, 2021 on the technology readiness of Indian students in digital learning, it was found that they generally exhibited optimism and innovativeness but also experienced inhibiting aspects related to discomfort.

Technology readiness represents the motivating and inhibiting mental factors that collectively determine an individual's inclination to use new technologies (Parasuraman, 2000). Peixoto (2022) suggest that a positive view towards technology acts as a motivating factor, while a negative view contributes to inhibiting or reducing technology use. This construct is multifaceted, encompassing positive and negative factors associated with accessing technology, and consists of four dimensions: optimism, innovativeness, discomfort, and insecurity (S. Ali et al., 2019). In summary, the constructs of the TRI model can be described as follows:

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Optimism: This dimension reflects a positive view of technology and the belief that it provides people with greater control, flexibility, and efficiency in their lives. Optimistic individuals are more inclined to embrace new technologies as they perceive them to be useful and easy to use. They view technology as a means to gain greater control over their lives (W. Ali, 2019).

Innovativeness: This dimension refers to the tendency to be an early adopter of technology and innovative leader. For example, individuals who were the first to use a newly launched virtual social networking platform by technology companies fall into this category. They readily engage with new technologies even if the benefits or uncertainties surrounding a particular technology are not yet fully known (Ali et al., 2019).

Discomfort: This dimension represents the perceived lack of control over technology and the feeling of being overwhelmed. People may experience a certain level of anxiety or discomfort when dealing with technology and its complexities.

Insecurity: This dimension reflects distrust in technology resulting from skepticism about its proper functioning and concerns about potential negative consequences. The level of confidence in using a new technology is inversely proportional to the degree of insecurity. Individuals with high levels of insecurity tend to have less trust in technological devices and are hesitant to adopt them.

Since the initial introduction of the scale in 1999 by Parasuraman and Colby, known as TRI 1.0, there has been a significant technological evolution, such as the widespread use of smartphones, new social media platforms, cloud applications, and numerous other innovations. The authors recognized that the original 36 questions in the scale could be condensed based on studies conducted by researchers from various countries, including Brazil. In addition to reducing the scale, the items pertaining to the four constructs must be updated to incorporate new and emerging themes related to technologies and new forms of access, such as social networks. According to Parasuraman and Colby (2015), of the 16 items in the updated scale, 11 remained from TRI 1.0, while five new items were added (two in the optimism dimension and three in the insecurity dimension). This update involved two phases: a qualitative phase involving discussions with American adult participants over a week.

The study started with the hypothesis that the application of the TRI scale (2.0) can indicate the positive and negative aspects of the use of digital social networks in the perception of higher education students in Brazil.

3. METHODOLOGY

To assess the use of technology in digital social networks, a survey was conducted among undergraduate and postgraduate students (both lato and strictu senso) from Higher Education Institutions in Brazil (HEIs). The survey was administered in July 2021 through online questionnaires following a pre-test with seven students.

The online form (Google Forms) consisted of three sections. The first section included questions about the usage of major virtual social network platforms such as Facebook, Instagram, YouTube, and others. It also included an open-ended question for respondents to indicate other social networks not listed in the answer options. The second section comprised 16 closed-ended questions based on the TRI 2.0 scale, which assessed access to technologies available on digital social networks. These questions underwent a process of translation from English to Portuguese and back to English (Parasuraman & Colby, 2015). A 5-point Likert scale ranging from "strongly disagree" to "strongly agree" was used. The third section included closed-ended questions about respondents' demographics (age, gender), educational background (private or public school), and ongoing higher education and postgraduate studies.

Table 1 presents the profiles of the 152 valid questionnaires received. A significant proportion of the respondents (41%) fell into the 18-24 age bracket. When considering the 25-35 age bracket as well, the total reached 75%, representing the majority of undergraduate students in HEIs. These findings align with the higher education census of 2019, which revealed that the university population predominantly consisted of students aged 18 to 34, accounting for 80% of the total enrollment (National Institute of States and Educational Research Anísio Teixeira, 2019). Only a small percentage (13%) of the respondents were older than 51 years. In terms of gender, the sample was balanced with 51% female participants.

Regarding high school education, 53% of the respondents completed their schooling in public schools, potentially indicating a correlation with enrollment in public HEIs for higher education (66%). The Administration course had the highest representation among respondents, with 27% of the participants, and over 90% of these students were enrolled in public HEIs. A total of 29% of the respondents did not specify their courses. Furthermore, 22% of the survey participants completed their undergraduate studies and were currently engaged in a postgraduate course.

Age	Group Characteristics	Frequency	Percentage
	18-24	62	41%
	25- 35	51	34%
	36- 50	20	13%
	over 51	19	13%
Gender	Female	78	51%
	Male	71	47%
	Prefer not to answer	1	1%
	Other	2	1%
High School	Private School	71	47%
	Public School	80	53%
	Other	1	1%
Education	High Level Private	9	6%
	Higher Level Public	100	66%
	Has completed undergraduate studies and is currently pursuing postgraduate studies.	34	22%
	Other	9	6%

Table 1 - Profile of respondents

In terms of platform usage on digital social networks, table 2 presents the estimated access rates for each platform. Analyzing table 2, it can be observed that TikTok had the lowest usage among students at the time of the survey, followed by Telegram and Twitter. On the other hand, despite Facebook having a large user base and being around for many years (since 2004), 42% of student respondents reported not using it, while a significant portion accessed the platform for up to an hour per day. Instagram and WhatsApp were primarily used for 1 to 3 hours per day. WhatsApp, in particular, had high usage rates (99% access) and was used throughout the day, with 43% of users spending 4 to 12 hours per day on the platform, indicating a constant and extensive usage compared to others.

Digital Social Networks	Do not use	Up to 1 hour/day	1 a 3 hours	4 a 7 hours	8 a 12 hours	More than 12h/day
TikTok	78%	13%	7%	1%	0%	1%
Telegram	74%	21%	4%	0%	0%	1%
Twitter	66%	20%	11%	1%	1%	1%
LinkeIdn	49%	45%	5%	0%	1%	1%
Facebook	42%	39%	14%	3%	1%	1%
Instagram	18%	30%	41%	9%	1%	2%
Youtube	8%	39%	34%	12%	3%	4%
WhatsApp	1%	13%	42%	28%	9%	8%

Table 2 - Platform Usage Profile

YouTube stood out as the second-most accessed platform (92% usage), with usage concentrated in the ranges of up to one hour (39%) and one to three hours per day (34%). Data from the Center for Learning and Performance Technologies (2020) indicate that YouTube has consistently ranked as the top digital tool for education for the past five years, thanks to its user-friendly interface and the availability of video resources for learning. LinkedIn appears in the eighth position and Twitter in the ninth position. Apart from the networks mentioned in the survey, the respondents were given the opportunity to mention the use of other sites in an open-ended question. Some of the additional platforms mentioned include Popot, Reddit, Discord, Spotify, Signal, TwitchTv, Kwai and others.

3.1 Construct Validity

Factor analyses were conducted using the principal component method; the factor loadings are listed in Table 3. It is important to note that these questions have been previously tested in other studies and yielded satisfactory results.

item	Optimism	Innovativeness	Discomfort	Insecurity
OPT1	0.52	-	-	-
OPT2	0.61	-	-	-
OPT3	0.69	-	-	-
OPT	0.70	-	-	-
INN1	-	0.68	-	-
INN2	-	0.59	-	-
INN3	-	0.72	-	-
INN4	-	0.76	-	-
DIS1	-	-	0.54	-
DIS2	-	-	0.61	-
DIS3	-	-	0.63	-
DIS4	-	-	0.58	-
INS1	-	-	-	0.63
INS2	-	-	-	0.61
INS3	-	-	-	0.72
INS4	-	-	-	0.67
Cronbach's alfa	0.72	0.78	0.68	0.72

Table 3 - Factorial loads of the 16 items of the TRI 2.0 scale

Based on Table 3, which presents the results of the factor analysis with varimax rotation, the constructs are well separated, confirming the initial analysis. Most factor loadings were above 0.59, indicating consistency in the results. However, the question related to discomfort (DIS 4) had a lower loading, suggesting the need for revision.

The dimension of innovativeness stands out with the highest factor loadings compared to the other dimensions, indicating that the research participants have an innovative understanding of the technologies present in digital social networks. The reliability of the constructs was assessed using Cronbach's alpha coefficients, which were all within the acceptable range of 0.60–0.70 (Hair Jr. et al., 2007). This indicates good convergent validity and is comparable to the scores obtained in TRI 2.0,

developed by Parasuraman and Colby (2015). Specifically, the Cronbach's alpha coefficients were 0.80 for optimism, 0.83 for innovativeness, 0.70 for discomfort, and 0.71 for insecurity.

3.2 Data analysis on the TRI 2.0 scale

The questions pertaining to Group 2 (TRI 2.0) were derived from a reverse translation of the original scale developed by Parasuraman and Colby (Table 4). Each construct (Optimism, Innovativeness, Discomfort, and Insecurity) consisted of four questions, resulting in a total of 16 questions. The results indicate significant congruence between the factors of optimism and innovativeness and the data collected from the research sample (n=152).

Optimism		Averages	Innovativeness	Averages
OPT1 New technologies contribute to a better quality of life		3.87	INN2 In general, I am among the first in my group of friends to acquire a new technology as it appears	3.02
OPT2 Technology gives me greater freedom of movement		3.99	INN3 You are usually able to assimilate products and services of new technologies without the help of other people	2.06
OPT3 Technology gives people greater control over their daily lives		3.06	INN4 You keep up to date with the latest technological developments in your area of interest	3.32
OPT4 Technology makes me more productive in my personal life		3.02	INN1 Other people call me for advice on new technology	3.02
Constructs Averages		3.48		3.07
Discomfort			Insecurity	
DIS1 When I receive technical support for a high-tech product or service from a provider, there are situations that I feel that someone who knows more than I do is taking advantage of me		2.49	INS1 People are too dependent on technology to do things for them	3.88
DIS2 Tech support calls are not helpful because they don't explain things in terms, I can understand		2.69	INS2 Too much technology distracts people to the point of being harmful	4.14
DIS3 I sometimes think that technology systems were not designed to be used by ordinary people		2.58	INS3 Technology diminishes the quality of human relationships by reducing personal interaction	3.72
DIS4 There is no manual for a high-tech product or service that is written in easy-to-understand language		2.77	INS4 I don't feel safe doing business with a company that can be contacted only "online"	2.40
Constructs Averages		2.63		3.53

Table 4 - List of questions per construct and averages obtained

The questions related to the constructs of optimism and innovativeness were designed to assess the utilization of technology in digital social networks, utilizing a 5-point scale, where a higher score indicates a greater understanding and acceptance. On the other hand, questions pertaining to the dimensions of discomfort and insecurity were scored in reverse, meaning that a higher score indicated a lower level of agreement with the statements.

In the online questionnaire, respondents were asked to provide their honest opinions regarding their access to technologies available on digital social networks (such as Facebook, WhatsApp, YouTube, etc.) and the services offered by these platforms using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Table 4 presents the formulated questions for the four constructs, along with the corresponding dimensions and average scores obtained on a 5-point scale.

It can be inferred that over the years, the technologies disseminated have facilitated access to various services on the Internet without the need for involvement from third parties or technical experts to fully utilize them. Table 5 displays the factors derived from the TRI 2.0, along with the average scores obtained for each factor based on the 152 responses, which will be further evaluated below.

4. DISCUSSION OF RESULTS

Regarding the survey results, one notable finding was the "Insecurity" factor, which received one of the highest average scores (3.53) among the four dimensions of the TRI model. This observation prompts an important reflection, considering that the sample consisted of young college students, with 75% of them between the ages of 18 and 35. Individuals in this age group with a high level of education are often expected to hold a positive view of digital technology. However, in the case of the "Insecurity" factor, the key points of concern include (1) the distraction caused by technology, (2) the dependency it creates among people, and (3) the negative impact on the quality of personal interactions due to a decrease in face-to-face communication. Notably, the inhibiting factor of "Discomfort" has also been recognized in the existing literature. Kaushik and Agrawal (2021) also identified feelings of technological discomfort when using e-learning platforms in a survey of Indian students. These authors suggest that user friendliness, particularly in relation to teachers and students, is crucial for the adoption of such platforms.

It is undeniable that digital technology has the potential to distract individuals from their activities, especially younger people who are more connected to gadgets and applications. In this study, the statement about technology-causing distractions received the highest average score among all 16 items in the TRI model (4.14).

A study conducted in the Netherlands Siebers et al. (2022), investigated whether youths who spend more time on social media are more prone to distraction. The results indicated that students who spend more time on these platforms generally experience higher levels of distraction than their peers. The study also found that this distraction is particularly pronounced during periods of heightened alertness when young people are heavily engaged with what is happening in the networks at that specific time. The issue of attention competition among students was also observed in a study by Van Allen and Katz (2019) in the Netherlands, which identified tension between the educational use of social media and the temptation for distraction posed by these platforms.

In terms of addiction, which received a high average score in this study (3.88), Ryzhanova et al. (2021) in Ukraine also confirmed that there is a certain addiction among the younger generation to virtual social media. This study emphasizes that educational institutions, the government, and families should take action to prevent this addiction from negatively affecting young people's concentration on their most important activities, such as their studies. Tan et al. (2022) focused on students in Malaysia and found that the excessive use of smartphones for various activities, including accessing and using social media, is associated with neglecting academic studies. In other words, high dependence on technology can impair dedication to academic pursuits.

5. CONCLUSION

The survey results indicated a significant use of virtual social network platforms by the student respondents, with a particular emphasis on highly interactive networks such as WhatsApp, which is used by a large portion of respondents throughout the day. Regarding Facebook, 42% of the respondents did not use it despite its widespread presence and longevity, suggesting a possible migration to other social networks. YouTube and Instagram are popular networks. The majority of access was through mobile devices, such as smartphones, primarily using local networks and the WiFi mode.

Based on the analysis of the perception of technology employed in digital social networks by undergraduate and graduate students, it can be concluded that the constructs of optimism and innovativeness were important factors in the analysis. Optimism can be understood as a positive view of the technology used in digital networks, and the belief that it can provide greater control and freedom in people's lives. The average scores for the innovativeness factor were slightly above the midpoint of the scale (3.02), indicating a tendency among students to seek updates and adopt new technologies embedded in the platforms according to their areas of interest without necessarily relying on others for assistance.

In terms of the discomfort construct, respondents did not express difficulties with potential technical support from service providers, suggesting that the technologies employed on various platforms were designed for suitable use by their user profiles. However, the responses related to insecurity indicate a certain dependence on technology to perform tasks, such as preferring to send voice messages or texts instead of engaging in personal contact, even when the individuals are in close proximity or face to face. This behavior may have implications for the quality of human relationships as personal interactions are reduced. There is widespread agreement regarding excessive use of technology as a source of distraction.

In summary, the revisited model helps to explain the motivating and inhibiting factors perceived by undergraduate and graduate student respondents when using technologies available on digital social networks. This understanding can contribute to improving the services offered and expanding them to new platforms.

Technology plays a crucial role in this process, and when combined with various virtual platforms, it can enhance the relationships between network participants and all those who engage with it. It was observed that some platforms, such as Telegram and TikTok, were not widely used by the students at the time of the research, despite their popularity on social media.

The limitations of this study include the use of a non-probabilistic sampling method, which restricts the ability to make inferences to the entire population. It is suggested that the number of respondents, including both private and public higher education institutions, should include other student groups such as high school students from Generation Z, who frequently and intensively use digital social networks for learning, information sharing, social engagement, and other purposes.

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