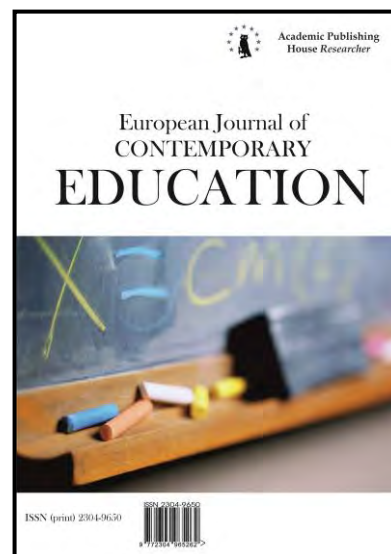




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Internet Addiction Scale: A Parametric Study through the EFA and Polychoric Correlation Matrices

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Abstract

The purpose of the study is to determine the degree of Internet addiction in engineering students. It takes as a theoretical reference the scale proposed by Young (1998), which establish the criteria and ranges of addiction. The instrument is in Likert format with responses ranging from 1 (rarely) to 5 (always). The participants were 306 students of the Engineering career enrolled in the different school grades of the Technological Institute of Tierra Blanca, Veracruz in the 2020–2021 school year. For data analysis, the statistical technique of exploratory factor analysis with extraction of principal components and Varimax rotation is used. In addition, for instruments designed with Likert scales, it is necessary to use the Polychoric Correlation matrices for factor analysis (Richaud, 2005; Ogasawaras, 2011). The main findings are: a factorial structure of six factors was obtained, which explains 63.1 % of the total variance and is in accordance with Young's proposal (1998), however the indicators are integrated differently in each factor. The level of internet addiction of the students does not fall within the normal range; the highest percentage is mild, which does not generate an alert in which immediate attention should be paid. It was also found that there is no difference in internet addiction in relation to gender.

Keywords: internet, addiction, clinical disorder, polychoric matrices.

1. Introduction

Background and problem statement

With the emergence of information and communication technologies (ICTs), there has undoubtedly been a great advance in all human activities worldwide. Of course, the different

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applications in which ICTs are integrated contributed to the innovation of business, government, educational, cultural and domestic sectors to name a few.

Given this, one might think that the Internet has undoubtedly facilitated communication in all aspects of human life. Said in this way, we could think that technologies per se constitute an important bridge for communications, but it also opens the possibility of falling into addictions such as the internet itself, video games, mobile telephony and everything that uses technology in what we now call the digital era.

In this regard, Griffiths (1995) has been pointed out as one of the pioneers in defining technological an addiction as those in which excessive use of technology intervenes. In the same idea, Goldberg (1995) another pioneer, establishes criteria for diagnosing internet addiction disorder. Later, Young (1998) established the criteria for diagnosing Internet Addiction Syndrome (Info Addiction Disorder [IAD]), which were adapted from the criteria used to diagnose Pathological Gambling.

Hence, a question arises in the following terms: If technology generates addiction and this in turn constitutes a bridge for Internet access, and if we consider that the student is permanently in school activities that link him to these technologies, then:

QR1 Do the professional-level students who study engineering show symptoms of internet addiction? In other words, what is the degree of addiction to the internet in engineering students?

QR2. Do the data collected for the empirical study constitute an identity matrix? And QR3. Does the degree of Internet addiction in students differ by gender? These questions lead us to establish the objectives of the study: O1. Determine the degree of internet addiction that is present in engineering students; O2. Analyze if the data matrix is not an identity matrix and O3. Determine if the degree of internet addiction in students differs by gender.

It also seeks to demonstrate: H1: The degree of addiction to the internet that exists in engineering students is normal; H2: The data matrix is not an identity matrix and H3: The degree of internet addiction that exists in engineering students differs by gender.

2. Literature Review

This empirical study is aligned with the theory of Internet addiction proposed by Young (1996), who defined the criteria to identify this phenomenon in people. She considers that addiction is a deterioration in the control of the use of the Internet and that the "netdependent" person distorts her professional, family and of course personal purposes, precisely because of excessive use of the Internet. The criteria defined in the scale designed by Young (1998) are:

1 Do you spend more time than you think you should surfing the net?

2 Do you think you would have a problem if you reduced the time you spend on the Internet?

3 Have your relatives complained about the hours you spend on the computer?

4 Is it hard for you to stay off the web for several days in a row?

5 Do your relationships suffer from spending many hours connected to the computer?

6 Are there areas or files on the network that you find difficult to resist?

7 Do you have problems controlling the impulse to purchase products and services offered on the web?

8 Have you tried unsuccessfully to reduce your use?

9 Do you get much of your life pleasure from being online?

Regarding the state of the art, we can point out that in recent decades, some researchers have been concerned with understanding and explaining the phenomenon of Internet addiction and what it derives from. This includes video games and mobile telephony, among other issues (Echeburúa, Corral, 1994; Echeburúa, Amor y Cenea, 1998; Davis, 2001; Estallo, 2001; Becoña, 2006; Estévez et al., 2009).

In the same way, in relation to addiction to the internet or technology -also called cyber addiction-, **it has been defined in many different ways as referred by Terán (2019). An example of this: addiction to new technologies, compulsive use of the internet, including pathological internet use and addiction to screens to name a few terms.**

In relation to this phenomenon, psychiatrist Ivan Goldberg (1995, cited in Terán 2019) proposed a series of criteria to diagnose internet addiction disorder. Together with the Griffiths (1995), he is seen as a pioneer in defining technological addictions.

An important theoretical reference on this issue has been Dr. Kimberly Young, a psychiatrist at the University of Pittsburgh. Young (1997, 1998) has referred that the problem is not only physical but also psychological. It is derived from internet abuse, that is, excessive use of the computer. It also generates behavioral, physiological and cognitive symptoms in users. In another study by Young (1996) she identified that 51 % of the people surveyed were prone to occupational problems, 52 % were prone to financial problems and a higher percentage (58 %) to academic problems.

However, Carbonell, Fuster, Chamarro and Oberts, (2012) have reported that Internet addiction is associated with the use and time in which users are connected, but that it does not necessarily generate psychological damage. According to them, it has not been shown that there is a cause-effect relationship between connection time and the probable psychological problems of the individuals

The evolution of modern society has led to internet addiction in users of information and communication technologies. Excessive use of technological tools at work, at home, in academic educational institutions, among others, have constituted the door for the use of computers (Griffiths, 2000; Muñoz-Rivas et al., 2003; Johansson, Götestam, 2004; García del Castillo et al., 2008; Greenfield, 2009).

In turn, Davis (2001) classified internet addiction according to the following parameter: Primary addictions, those that correspond to online games on computers, those related to the virtual search for friendships or affective relationships. On the other hand, Secondary Addictions are those whose impulses are focused on online shopping, connecting to the stock markets, gambling and addiction to pornography and virtual sex. A study by Gracia et al. (2002) applied an online test to 1664 users. In their findings, they found recurring thoughts in users that forced them to stay connected to the internet, in addition to experiencing feelings of guilt. They even identified a low social interaction, hence they looked for chats to interact in addition to pornographic pages. This leads to work and school problems in these users.

Chak and Leung (2004) applied an online survey to 722 students who showed that respondents with a greater need to want to be connected to the internet, showed more shyness and little faith. They maintained the firm belief of having control over other people and they place their trust in luck to determine their own life course. In addition, they found that full-time students are more likely to be addicted to the Internet because they have free, unlimited access and a flexible schedule.

Internet addiction grows as they spend many hours connected to the computer, be it due to addiction to games or other topics that have already been mentioned. Addicted users show suicidal ideas, irritability, and affective disorders with antisocial characteristics. This is demonstrated by the work of Cruzado, Matos and Kendall (2006) who carry out a study of 30 patients diagnosed as addicted to the internet. Some had a history of family dysfunction; others had pulmonary **tuberculosis and poor school performance. This last trait agrees with data collected by Sánchez-Carbonell et al., (2008), as well as similar characteristics found by Rial et al. (2015) of family dysfunction and low academic performance.**

The use of the internet makes it easier for the individual to show himself as he is, as long as it anonymously (Cruzado et al., 2006; Jimenez, Pantoja, 2007; Balaguer, 2008; Beranuy et al., 2009; Echeburúa, 2016; Caro, Plaza, 2016). Likewise, it allows the individual to establish or maintain virtual relationships in a fluid way, which implies spending more time than expected using the internet (Young, 1998; Luengo, 2004; Sánchez-Carbonell et al., 2008; Balaguer, 2008; Beranuy et al., 2009; Carbonell et al., 2012; Pérez del Río, 2014; Araujo, 2016; Caro, 2017; Marín-Cipriano, 2018).

Alcohol and gambling have been the gateway to addiction. These activities are accompanied by a sense of pleasure because they generate adrenaline. Internet addiction is similar: it is pleasant and can be used by introverts as a mechanism to evade reality. By becoming immersed in the web, they satisfy their needs indirectly. However, being connected to the internet for a long time can lead to low self-esteem, therefore their way of relating in reality will be superficial and they are probably short-term or unstable relationships.

There is a tendency to think that substance use is implicit with the word addiction. However, when it comes to the use of technology, addiction leads to an activity, being more specific, a compulsion to carry out excessive use of the internet (Balaguer, 2008). In this idea Castillo et al.

(2008) applied a survey to 392 students, mostly women (73.9%), discovering that the surveyed population remains connected to the internet an average of 84.81 minutes a week and that the traits that stand out from those who mostly spend connected to the network are those that tend to introversion, thus avoiding social relationships directly.

Lam-Figueroa et al. (2011) have pointed out that internet addiction is characterized by a high or low involvement in the internet, that is, dependence on the internet and the lack of control in its use, which, depending on their personal needs, can lead them to be uncomfortable, exhausted or distressed.

Gender differences have also been identified in this phenomenon of internet addiction. Some studies have shown that men were those who reflected greater use of the internet (Yang, 2001; Muñoz-Rivas et al., 2003; Fargues et al., 2009; Beranuy et al., 2009; Matalinares et al., 2013; Shek, Yu, 2016; Marín-Cipriano, 2018). On the other hand, Puerta-Cortés and Carbonell (2014) discovered that women use the internet more. In addition, women showed that they use the mobile phone to communicate their emotions (Ling, 2002; Mante, Piris, 2002; Fargues et al., 2009; Beranuy et al., 2009). Other gender studies have shown that men tend to be more aggressive than women, both physically and verbally, hence the greater the aggressive behavior in adolescents, the greater the tendency to become addicted to the internet (Matalinares et al., 2013).

Various studies have agreed that men spend more time in online video games (Muñoz-Rivas et al., 2003; Tsouvelas, Giotakos, 2011; Matalinares et al., 2013; Puerta-Cortés, Carbonell, 2014; Vink et al., 2016), while women spend more time on social networks (Ling, 2002; Marín-Cipriano, 2018). However, their findings differ from the work of Araujo (2016) who showed that men showed a higher degree of obsession with being connected to social networks.

Another variable that has been analyzed in some studies is that which refers to the average age at which internet addiction occurs, which has been identified and is in the range of 14 to 24 years (Echeburúa, 2010; Rial et al., 2015; Araujo, 2016; Shek, Yu, 2016; Padilla, Ortega, 2017; Marín-Cipriano, 2018; Terán, 2019).

Internet addiction as clinical disorder

At present, it is clear that addictions are not limited to the uncontrollable use of substances, but there are behavior habits that seem to be harmless that, under certain circumstances, tend to become addictive and strongly interfere in daily life of affected people. Thus, addiction refers to the irrepressible urge that is often accompanied by loss of control (Shah et al, 2014). In effect, the primary element in addictive disorders is the lack of control, that is, the affected person has a lack of control over a certain behavior, which is initially usually pleasant but then gains ground within the preferences until culminating in mastering their daily activities.

Now, from a behavioral point of view, all addictive behaviors are initially activated by pleasure or euphoria, but as the behavior is perpetuated, said behavior becomes negative and thus guarantees the need not to experience discomfort (abstinence) that is experienced by not performing such behavior. A non-addict person can be connected to the web by functionality of their own behavior. However, an addicted person connects to soften or alleviate some emotional discomfort and thus obtain tension relief that culminates in affecting a personal, social, family or work level.

According to the frequency, intensity and even money invested, all normal behavior can become abnormal if we exceed these guidelines. There are some risk factors for internet addiction such as: depression, introversion, low self-esteem, social anxiety and shyness. The subjects most likely to present this type of problems are those who present some specific deficit in their relationship and communication skills. In this regard, Young (1998) supports it by demonstrating in her study, "Personality traits associated with their development" that dependents are usually people with a strong preference for solitary activities, who tend to restrict social outings. According to statistical analysis, they seemed less compliant with social conversation and more emotionally reactive towards others. This with the aim of knowing the personality traits through the use of the so-called **16 Personality Factor Inventory** (16PFI), to determine the pathological use of the Internet.

As our society evolves, studies on behavioral changes emerge, one of them is the study of addictions and in particular that of the internet. These studies seek to determine the risk factors that add to excessive use of the internet. Recent studies have shown that participating in online games increases the 64 % higher risk of addiction when combined with a greater openness to the experience according to the NEO-FFI openness subscale (Kuss, 2013).

It was also discovered that online purchases constitute a significant risk factor for internet addiction in 81 % (Kuss, 2013), having its origin in the absence of social interaction and the possibility of buying without being observed facilitates compulsive online buying behavior.

The globalized world has favored the use of the internet, which means that it is widely disseminated. This great tool, whose main objective is to make improvements in our daily lives, has also caused its use to be carried out for recreational purposes in an excessive and persistent way, which has led to an addiction. Hence, the importance of its study, since it has been considered an emerging pathology with great impact in our current century.

For this reason, the so-called Pathological Gambling where internet addiction disorder is included by the DSM-IV-TR, (Diagnostic and Statistical Manual of Mental Disorders, 2001) has become part of the new chapter on Addictions of the DSM-V, into a new subcategory called non-substance addictive disorders.

In the same idea, behavioral addiction can frequently be combined with one or more substance addictions; pathological gambling is generally associated with smoking and alcohol abuse. When behavioral addiction becomes acute, behaviors are triggered by emotions and impulses, with low cognitive control and poor self-criticism about them. It has already been mentioned that, indeed, addiction to internet games causes decision bias and deterioration in executive control (Zhou et al., 2012). From here we start to point out that people with internet addiction disorder, in the future will have mental health problems related to excessive computer use.

However, due to the great importance of the subject, the "Internet Addiction Diagnostic Questionnaire" (IADQ) has been developed as an initial detection instrument which is used for initial and rapid diagnosis (Young, 1998), and based on the DSM-IV guidelines. The diagnostic questionnaire developed by Young is the most widely used instrument to measure Internet addiction. It provides a modified cut-off point for the diagnostic criteria for pathological gambling in DSM-IV (Ko et al., 2005). Over time, modifications were made to the IADQ scale, which is why the 20-item IAT arises, which not only assesses dependency and compulsiveness, but also includes aspects related to personal, occupational and social functioning issues (Young, 1998).

In the vast majority of cases, people who suffer from an addiction do not follow a certain treatment, but there is evidence that people who request support are able to significantly improve their quality of life. Due to the delicacy of the subject in question and the implications it has on people's lives and how this can have an impact, it is recommended that the treatment be based on several psychotherapeutic strategies that are usually more effective than a single approach (Dong, Potenza, 2014). Recommended approaches include Cognitive Behavioral Therapy (CBT), Cognitive Enhancement Therapy (CET), Cognitive Bias Modifications (CBM), and Mindfulness-Based Stress Reduction (MBSR) methods (Dong, 2014). This must be personalized in each case and always seek to restore and improve each important area of the individual: physical and mental health, work, social and family relationships.

Nowadays, we can know the personal antecedents, the risk factors and the alarm signals when we find ourselves in a situation of internet addiction. As it is a subject of increasing importance, it is expected that the development of new techniques for better diagnosis and comprehensive treatment will continue. Past research serves as a tool to anchor ourselves and continue in the search for more data that will support us in prevention, to diagnose and be able to treat this condition from the field of medicine.

Finally, we point out that perhaps the most important thing is to consider that the intervention is not proper to the individual. We must also encourage the participation of their environment to decisively collaborate in the therapeutic process to improve the quality of life and obtain people with harmony and fullness.

3. Methodology

Non-experimental design study without manipulation of variables (**X**), cross-sectional, focused on determining the degree of addiction to the Internet. Therefore, it is approached from the hypothetical-deductive method, since it seeks to test the hypothesis which suggests that engineering students are addicted to the internet (Young, 1997). The type of study is descriptive, correlational and explanatory. The factorial structure that is obtained will be the basis to demonstrate that the data matrix is not an identity matrix, to be able to explain the variance of the matrix of components that yield the results, and if they differ by gender.

Where $F_1 \dots F_k (K \ll p)$ are common factors; u_1, \dots, u_p they are specific factors and the coefficients $\{a_{ij}, i=1, \dots, p; j=1, \dots, k\}$ are factor loads. Assuming that the common factors have been standardized or normalized, $E(F_i) = 0, Var(f_i) = 1$ then the specific factors will have a mean equal to zero, so both factors will have a correlation $Cov(F_i, u_j) = 0, \forall i=1, \dots, k; j=1 \dots p$. with the following consideration: if the factors are correlated ($Cov(F_i, F_j) = 0, \text{ if } i \neq j; j, i=1, \dots, k$), then we would be facing a model with orthogonal factors, but if they are not correlated, it is a model with oblique factors. Therefore, the equation can be expressed as follows:

$$x = Af + u \quad \hat{U} X = FA' + U \quad (4)$$

Where:

Data matrix	Factorial load matrix	Factorial matrix
$x = \begin{pmatrix} x_1 \\ x_2 \\ \dots \\ x_p \end{pmatrix}, f = \begin{pmatrix} F_1 \\ F_2 \\ \dots \\ F_k \end{pmatrix}, u = \begin{pmatrix} u_1 \\ u_2 \\ \dots \\ u_p \end{pmatrix}$	$A = \begin{pmatrix} a_{11} a_{12} \dots a_{1k} \\ a_{21} a_{22} \dots a_{2k} \\ \dots \\ a_{p1} a_{p2} \dots a_{pk} \end{pmatrix}$	$F = \begin{pmatrix} f_{11} f_{12} \dots f_{1k} \\ f_{21} f_{22} \dots f_{2k} \\ \dots \\ f_{p1} f_{p2} \dots f_{pk} \end{pmatrix}$

With variance:

$$Var(X_i) = \sum_{j=1}^k a_{ij}^2 + \Psi_i = h_i^2 + \Psi_i; i = 1, \dots, p \quad (5)$$

Where: $h_i^2 = Var\left(\sum_{j=1}^k a_{ij} F_j\right) \dots \Psi_i = Var(u_i) \quad (6)$

This is the equation of the communalities and the specificity of the variable X_i , therefore the variance of each variable we may divided into two parts: a) in the communalities h_i^2 corresponding to the variance explained by the common factors and b) the specificity Ψ_i which is the specific variance of each variable. In this way, we obtain:

$$Cov(X_i, X_l) = Cov\left(\sum_{j=1}^k a_{ij} F_j, \sum_{j=1}^k a_{lj} F_j\right) = \sum_{j=1}^k a_{ij} a_{lj} \quad \forall i \neq l \quad (7)$$

Then, with the transformation of the determinant of the correlation matrix, we obtain the Bartlett's test of Sphericity, from the following equation:

$$d_R = -\left[n - 1 - \frac{1}{6}(2p + 5)\ln|R|\right] = -\left[n - \frac{2p + 11}{6}\right] \sum_{j=1}^p \log(\lambda_j) \quad (8)$$

$$\left[n - \frac{2p + 11}{6}\right] \log \left[\frac{1}{p - m} \left(\text{traz}R^* - \left(\sum_{a=1}^m \lambda_a \right) \right) \right]^{p-m} \quad (9)$$

$\frac{|R^*|}{\prod_{a=1}^m \lambda_a}$

With the EFA, the set of observed variables is reduced in a factor structure (Kline, 2000–2005), in order to the covariance of each item of the scale can be empirically identified (Yela, 1966). In addition, considering that it is a scale designed in Likert format, it is suggested to use Pearson's correlation for continuous variables, the Tetrachoric matrix (TCC) for dichotomous variables and a Polychoric correlation matrix (PCC) if the variables are composite, dichotomous or ordinal. Even, if they are all ordinal or if there is a combination of ordinal and continuous (Richaud, 2005; Ogasawara, 2011; Timmerman, Lorenzo-Seva, 2011). Finally, the analysis of variance (ANOVA) was used to verify if there is a difference in relation to gender.

4. Results and discussion

The data collected in the field study were analyzed to determine the validity and reliability of the instrument. For this, the internal consistency of the instrument was measured, which shows a Cronbach's alpha of .851 in all items of the scale. This is a very acceptable value according to the theoretical criteria suggested by Hair, Anderson & Tatham, (1979). The total participants were 306 students of engineering, 155 were male (50.7 %) and 151 females (49.3 %), whose ages were: 18 years old 52.3% (160), 19 years old 14.1 % (43), 20 years old 6.9 % (21), 21 years old 9.5 % (29), 22 years old 7.8 % (24) and the rest 9.5 % from 23 to 35 years old.

As we can see, Figures 1 and 2 show the mean and standard deviation of total items of the scale, as well as the scores obtained from the 306 cases observed, according to Young's (1997) criteria.

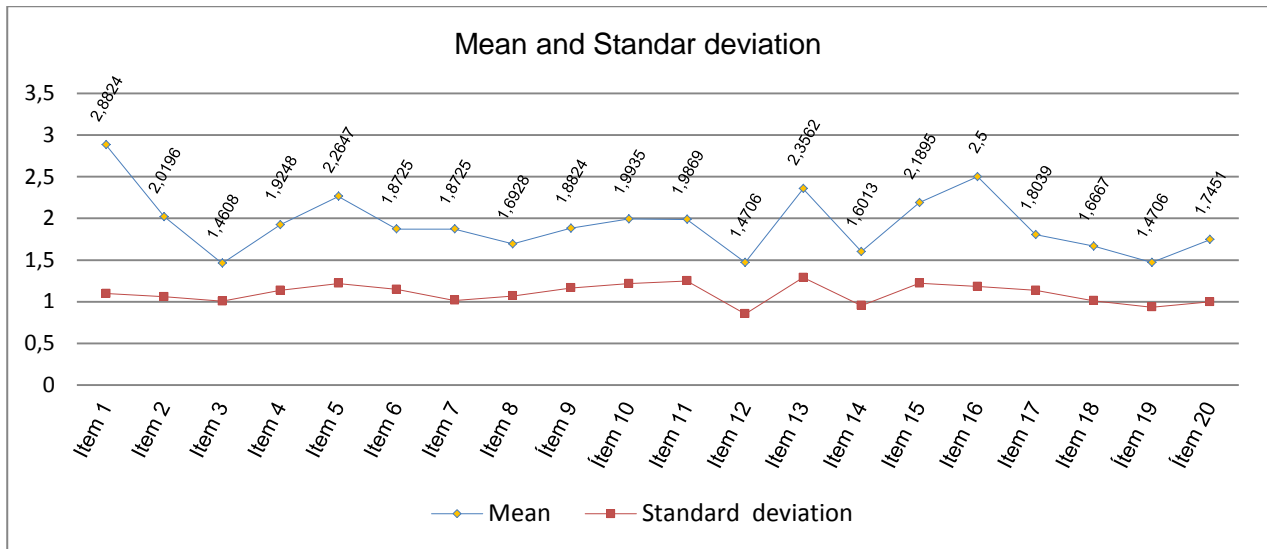


Fig. 1. Mean and standard deviation path (own)

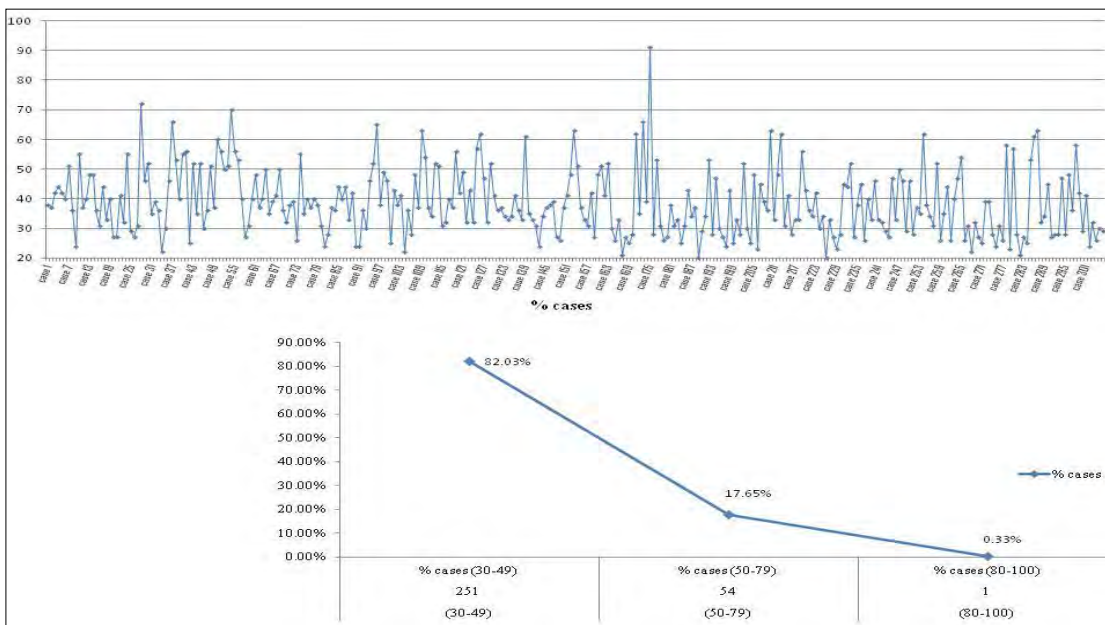


Fig. 2. Scores of the 306 cases observed (own)

As we can see in Figure 1, the mean values become more frequent among the options “rarely and occasionally”. Similarly, Figure 2 shows the score of each of the 306 cases, which do not

present a serious situation of internet addiction, according to the criteria proposed by Young (1997) whose addiction ranges are: up to 29 points is normal user, average user (30-49 points), user with occasional or frequent problems (50-79 points) and user with major problems (80-100 points). In summary, 82.03 % (251 cases) are in the range of 20-49 points (normal ones are included), called average users, 17.65 % (54 cases) who are considered users with occasional problems and only a case that is severe according to the score obtained (0.33 %).

Table 1 shows the polychoric correlation matrix, of the 20 items of the scale used and Table 2 shows the result of the Bartlett test of sphericity with Kaiser and the Chi² goodness-of-fit test with sig. < 0.05.

Table 1. Polychoric correlation matrix

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
V 1	1.000									
V 2	0.372	1.000								
V 3	0.227	0.287	1.000							
V 4	0.201	0.127	0.241	1.000						
V 5	0.361	0.442	0.306	0.257	1.000					
V 6	0.230	0.157	0.159	0.164	0.133	1.000				
V 7	0.203	0.392	0.147	0.168	0.295	0.027	1.000			
V 8	0.152	0.340	0.298	0.236	0.430	0.130	0.320	1.000		
V 9	0.203	0.384	0.420	0.330	0.421	0.076	0.283	0.368	1.000	
V 10	0.269	0.192	0.208	0.280	0.256	0.290	0.132	0.363	0.239	1.000

Table 1.b. Polychoric correlation matrix

	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
V 11	1.000									
V 12	0.372	1.000								
V 13	0.227	0.287	1.000							
V 14	0.201	0.127	0.241	1.000						
V 15	0.361	0.442	0.306	0.257	1.000					
V 16	0.230	0.157	0.159	0.164	0.133	1.000				
V 17	0.203	0.392	0.147	0.168	0.295	0.027	1.000			
V 18	0.152	0.340	0.298	0.236	0.430	0.130	0.320	1.000		
V 19	0.203	0.384	0.420	0.330	0.421	0.076	0.283	0.368	1.000	
V 20	0.269	0.192	0.208	0.280	0.256	0.290	0.132	0.363	0.239	1.000

Source: own

Table 2. Adequacy of the polychoric correlation matrix with KAISER

Adequacy of the polychoric correlation matrix	
Determinant of the matrix	= 0.000659168996615
Bartlett's statistic	= 2179.0 (df = 190; P = 0.000010)
Kaiser-Meyer-Olkin (KMO) test	= 0.85521 (good)
BC Bootstrap 95 % confidence interval of KMO =	(0.864 - 0.872)

Source: own

As we can see in [Table 1](#) the polychoric correlation matrix shows acceptable correlations, which gives evidence of not being an identity matrix. Therefore, it is pertinent to carry out the adequacy of the polychoric correlation matrix by contrasting the Bartlett's test of sphericity. The values obtained are: Chi² of 2179.0 with 190 degrees of freedom and significance = 0.00 which is < 0.05, KMO test of 0.85521 which in theoretical terms is good ([Timmerman, Lorenzo-Seva, 2011](#)).

This result allows rejecting HO, which states that the data matrix has no correlation, on the contrary, it was shown that it is a matrix with acceptable correlations; in addition the value of the calculated Chi² exceeds the value of the Chi² of tables. Once this requirement is covered, it is now possible to analyze the factorial structure of the database, so the adequacy of the sample and the variance are calculated using parallel analysis. Thus, [Table 3](#) shows the weights of the robust rotation (*h*, *w*) of each variable.

Table 3. Weights of robust rotation

Variable	<i>h</i>	<i>w</i>	Variable	<i>h</i>	<i>w</i>
V 1	1.4416	0.2970	V 11	1.4346	0.3004
V 2	1.4113	0.3117	V 12	1.8201	0.1124
V 3	2.0504	0.0000	V 13	1.3896	0.3223
V 4	1.7360	0.1534	V 14	1.5741	0.2323
V 5	1.2663	0.3824	V 15	1.3425	0.3453
V 6	1.7704	0.1366	V 16	1.6756	0.1828
V 7	1.6469	0.1968	V 17	1.5843	0.2273
V 8	1.6312	0.2045	V 18	1.5018	0.2676
V 9	1.5169	0.2602	V 19	1.7942	0.1250
V 10	1.6012	0.2191	V 20	1.5362	0.2508

Source: own

Where: *h*: average of the diagonal values in the asymptotic variance/covariance matrix for each variable. *w*: Robust weight value for each variable.

As shown in [Table 3](#), the variable with the least stable set of correlations – the one with large values of *h* – will have a weight (*w*) close to zero. Otherwise, if a variable shows a very stable set of correlations, then it will have a weight (*w*) of one. In this idea, the criterion is defined as follows: if *w* is >, then it will be the most important variable that defines the simple structure of the factorial solution. Now in [Table 4](#) the total variance explained is described.

Table 4. Total variance explained

Variable	Eigenvalue	Proportion of variance	Cumulative proportion of variance
1	6.691	0.335	0.335
2	1.416	0.071	0.405
3	1.278	0.064	0.469
4	1.187	0.059	0.529
5	1.091	0.055	0.583
6	0.955	0.048	0.631
7	0.866	0.043	0.674
8	0.819	0.041	0.715
9	0.737	0.037	0.752
10	0.680	0.034	0.786
11	0.653	0.033	0.819

12	0.529	0.026	0.845
13	0.516	0.026	0.871
14	0.470	0.024	0.894
15	0.441	0.022	0.916
16	0.425	0.021	0.938
17	0.395	0.020	0.957
18	0.362	0.018	0.976
19	0.315	0.016	0.991
20	0.175	0.009	1.000

Source (own)

The eigenvalues that describe the explanatory power of the assimilable variance extracted, which are described in Table 4, give the explanation of 63.1 % of the total variance of the studied phenomenon, which is represented by six components extracted under the factor criteria.

Now in Table 5, the result of the matrix rotated by the Varimax method, is described. The purpose was to obtain a better fit of the variables on one axis, in addition to reducing as much as possible the number of uncorrelated variables, which facilitates their interpretation. The items 05, 08, 13, 18 and 19 did not have loads greater than 0.5, therefore, are excluded. At the end, the six components are integrated as shown below.

Table 5. Rotated component matrix^a

Variables	Component					
	1	2	3	4	5	6
VAR00012	.774					
VAR00014	.666					
VAR00015	.524					
VAR00011	.517					
VAR00007		.748				
VAR00020		.701				
VAR00009			.788			
VAR00003			.573			
VAR00001				.785		
VAR00002				.523		
VAR00006					.764	
VAR00010					.582	
VAR00004					.512	
VAR00017						.688
VAR00016						.676

Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser Normalization. ^a The rotation has converged in 5 iterations.

Source: own

As we can see, the six components described in table 5, were integrated as follow:

Component 1. This component combines (12, 14, 15, 11) the feeling of fear that life can be boring without internet, even empty and unhappy. In addition, the internet causes them to lose sleep due to being connected, to which is added the feeling of worry when they are offline and finally, they often anticipate when they will connect again, this is a feeling of addiction that is present in the mood and feeling of the student.

Component 2. The indicators that make up this component (7 and 20) indicate that they frequently check their email, putting other things that they need to do before them. They also feel depressed, moody, or nervous when they are offline, which is remedied once they get back on the internet.

Component 3. This component is made up of items 9 and 3, which describe the student's feeling about the annoyance they feel when being questioned about what they do while connected, they become defensive, they even prefer the emotion of being connected than intimacy with his couple.

Component 4. The indicators that make up this component (1, 2) reflect a more prolonged use of the internet, since the student remains connected more than he had planned, that is, the connection time is prolonged and that generates a carelessness in the Housework assigned at home.

Component 5. School work and students' grades are often affected by prolonged use of the internet; however, being online helps the student to relax and thus blocks disturbing thoughts that happen to them in life. Similarly, when they connect to the internet, this helps them establish new relationships online (6,10, 4).

Component 6. Finally, a component that is made up of items 17 and 16, in which the student frequently states that they are connected to the internet for a few more minutes, despite trying to reduce the time they spend online. This feeling seems to contrast between wanting to do things and having the decision to do them.

To test H1: The level of internet addiction of students is normal; the classification criterion of Young (1998) was used, based on the values of the internet addiction scale described in Table 6:

Table 6. Score and addiction level

Score	Addiction level
0-29	Normal
30-49	Mid level of addiction
50-79	Moderate level
80-100	Internet dependency

Source: own

As we can see, table 7 shows the scores for men and women. Both have mild addiction levels, slightly higher in men (28.8 %). The highest percentage was obtained in this range. Furthermore, we can see that a lower percentage has a moderate level. The t-test results and their significance (0.00) indicate that are significant. In other words, the level of internet addiction in students is not within a normal range, they present mid-level internet addiction.

Table 7. Score male and female and test t.

Score	Male	Female	Total	Interpretation
0-30	12.7%	13.1%	25.8%	Normal
31-49	28.8%	26.8%	55.6%	Mid level of addiction
50-79	8.8%	9.50%	18.3%	Moderate level
80-100	0.3%	0%	0.32%	Internet dependency
Total	50.6%	49.4%	100%	
	<i>t</i>	13.434		
	<i>Degree of freedom</i>	305		
	<i>Sig</i>	0.000		

Source: own

To test hypothesis H3: There is a difference in the level of Internet addiction in relation to the gender of the students. The Kruskal-Wallis test (by William Kruskal and W. Allen Wallis) was applied; this is a non-parametric method to test if a group of data comes from the same population. The results give evidence that there is no difference between men and women in internet addiction.

In the Table 8 entitled "Contrast statistic" the value of the H statistic is observed, which measures the level of Internet addiction in students in relation to gender, this is 0.013 with one degree of freedom and its significance (.910).

Therefore, we can say that, since the value of *p* (Asymptotic significance) is greater than 0.05, then the null hypothesis is not rejected and we may concluded that there is sufficient evidence to

suggest that the median of the students does not differ between the groups, with a significance level of 5 %.

Table 8. Contrast statistic Kruskal-Wallis test

Value H	df	Significance	Average score	
			Male	Female
0.013	1	.910	152.94	154.08

Source: own

Finally we have the summary of the results, which allow us to answer each research question and achieve each objective, based on hypothesis tests; hence the following is now discussed.

In relation to the **QR1** about: what is the level of addiction to the internet in engineering students?, we establish the purpose **O1**: Determine the level of internet addiction in engineering students. For this, we assumed that **H1**: The level of addiction to the internet in engineering students is normal.

According to the *t* test and the significance value described in [Table 7](#), it was found that the level of addiction to the internet of the surveyed students is not in the normal ranges; however the highest percentage showed a mild level of Internet addiction according to the Young scale (1998). Despite not being the normal level, it is not a serious level for which an alert state should be generated.

Furthermore, the factorial structure of six factors described in table 5, coincides with other works such as the study by Wydanto and McMurrin (2004) and **García-Santillán, (2020)**, who's reported a similar structure of six factors, although the integration of each factor differs in its indicators, even Young's seminal work (1998) in which reports the six-factor structure measured by the test (Internet Addiction Test). Therefore, [Table 9](#) shows a comparison of the findings reported by these reference studies, including Young's seminal referent versus the results obtained in this study.

Table 9. Factorial structures

Structure resulting from the empirical study					
Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Saliency	Excessive use	Neglect work	Anticipation	Lack of control	Neglect social life
X12, X14, X15, X11	X7, X20	X9, X3	X1, X2	X6, X10, X4	X17, X16
Reported by García-Santillán (2020)					
Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Saliency	Excessive use	Neglect work	Anticipation	Lack of control	Neglect social life
X12, X14, X15, X19, X8	X9, X18	X20, X7	X2, X1, X5	X6, X4	X17, X16
Seminal work of Young (1998)					
Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Saliency	Excessive use	Neglect work	Anticipation	Lack of control	Neglect social life
X10, X12, X13, X15, X19	X1, X2, X14, X18, X20	X6, X8, X9	X7, X11	X5, X16, X17	X3, X4
Reported by Wydanto & McMurrin (2004)					
Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Saliency	Excessive use	Neglect work	Anticipation	Lack of control	Neglect social life
X19, X13, X12, X15, X10	X2, X14, X20, X1, X18	X6, X8, X9	X11, X7	X17, X5, X16	X4, X3

Source: own

The factorial structures previously described in Table 9, which were obtained with the use of the exploratory factorial technique with extraction of components by the factor criteria, coincide in relation to the number of factors (six). However, the integration of the components of the study by **García-Santillán (2020) differs from those reported by Wydanto & McMurrin (2004) as well as** from the seminal proposal of Young (1998), since there is a significant difference in the integration of the scale items. For example, in the Saliency factor that Young (1998) originally integrated with items X10, X12, X13, X15 and X19, in the result reported in this work, it is only comparable in items X12 and X15, same case in the Excessive factor use that only matches in item X20.

In this idea, the result of this work differs from the one recently demonstrated by Navarro-Ibarra, **García-Santillán & Molchanova (2020), who carried out a study on college students in** Sonora, Mexico. This state is located in the northern region of Mexico, is different in cultural traits versus the southeast region of the same Mexican country. The study focused on determining levels of internet addiction and whether there was a difference in relation to gender. To do this, the Young's IAT test (1998) to a sample of 463 students, was used. For data analysis, the EFA with the use of polychoric matrices for a better fit was used.

In their results they report a factorial structure of four factors that explain 50.35 % of the variance of the phenomenon; in addition they did not find evidence that supposes a difference in relation to gender. The results are homogeneous in men and women. In the four-factor structure, they are grouped as follows:

Factor 1	Factor 2	Factor 3	Factor 4
X15, X20, X12, X13, X10, X11, X9, X19	X2, X1, X8, X16, X6	X7, X3	X17, X18

With these results reported by Navarro-Ibarra et al., (2020), which differ from those cited in Table 9, we can see how complex it is to analyze the scale designed by Young (1998), using this factorial technique. In addition, other studies have shown different structures, for example the structure identified by Alavi, Eslami, Maracy, Najafi, Jannatifard and Rezapour (2010) who identified five factors called social problems, effects on performance, lack of control, pathological use of chat and neglect in education and occupational duties. Similar case reported by Guan, Isa, Hashim, Pillai and Singh (2012) who identify a structure of five factors.

Similar structure of four factors reported by Navarro-Ibarra et al. (2020), was also reported by Lee, Lee, Gyeong, Yu, Song and Kim (2013), Kaya, Denle and Young (2016), Samaha, Fawaz, Yahfoufi, Gebbawi, Abdallah, Baydoun, Ghaddar and Eid (2018), Ndasauka, Pitafi and Kayange (2019), the four factors were identified as prominence, conflict, tolerance, and mood modification.

On the other hand, the same scale has generated three-dimensional structures, such as those reported by Chang and Law (2008), Tsimtsiou, Haidich, Kokkali, Dardavesis, Young and Arvanitidou (2013), Lai, Mak, Cheng, Watanabe, Nomachi, Bahar, Young, Ko, Kim and Griffiths (2015), Mohammadsalehi, Mohammadbeigi, Jadidi, Anbari, Ghaderi and Akbari (2015) and Neelapaijit, Pinyopornpanish, Simcharoen, Kuntawong, Wongpakaran and Wongpakaran (2018). Other works have reported two factors, such as the study by Barke, Nyenhuis and KronerHerwig (2012), **Jelenchick, Becker and Moreno (2012), Fernández-Villa, Molina, García-Martín, Llorca, Delgado-Rodríguez and Martín (2015).**

With a single factor, studies with good psychometric properties have been reported by Khazaal, Billieux, Thorens, Khan, Louati, Scarlatti, Theintz, Lederrey, Van Der Linden and Zullino (2008), Pontes, Patrao and Griffiths (2014), Dhir, Chen, Nieminen (2015), Panayides and Walker (2012), Waqas, Farooq, Raza, Javed, Khan, Ghumman, Naveed and Haddad (2018).

The different factorial structures obtained in the different studies is an indication of the complexity of the construct, hence the importance of expanding this type of study in different populations.

In relation to the **QR2**: Do the data collected for the empirical study constitute an identity matrix? It is established as purpose **O2**. Analyze if the data matrix is not an identity matrix, hence we assume **H2**: The data matrix is not an identity matrix.

The results of the data analysis, through the use of polychoric correlation matrices, did not provide evidence to demonstrate that the data matrix constituted an identity matrix as assumed by

the **H0** about the non-existence of correlations. On the contrary, it was found that there are acceptable correlations in the suggested theoretical terms, so **H2** is accepted. Furthermore, the values of the Bartlett's test of sphericity with Kaiser and the Chi² test confirm this.

Finally to answer the **QR3**: Does the level of Internet addiction in engineering students differ by gender? The objective was **O3**: determine if the level of internet addiction in engineering students differs by gender. Hence we assume that H3: The level of internet addiction in engineering students differs by gender.

For these purposes, the corresponding hypothesis tests were carried out, and the results allowed us to assert that there is no difference in relation to gender in all the indicators of the Young (1998) scale on Internet addiction. Regarding this, it is important to point out that the percentage of participation of the respondents was 49.3 % women and 50.7 % men, which shows that the sample was balanced in relation to gender.

In this way, this work differs from other studies that have been consulted from the **specialized literature, for example the studies of Yang (2001); Muñoz-Rivas, Navarro and Ortega (2003); Fargues et al. (2009); Beranuy et al. (2009); Matalinares et al. (2013); Shek and Yu (2016); Marín-Cipriano, (2018)**, who have reported evidence that shows that men use the internet more.

In addition, men tend to be more aggressive in verbal and physical aspects, in the study by Matalinares et al. (2013), they found that the more aggressive men, specifically in adolescents, the probability of becoming addicted to the internet, will be greater.

Another aspect related to the gender variable that has been empirically demonstrated is when they want to communicate emotions, in this aspect women are the ones who use the mobile phone more frequently than men, according to the works carried out by Ling (2002); Mante and Piris (2002); Fargues et al. (2009) and Beranuy et al. (2009).

6. Conclusion and recommendations

From the results of this empirical study, we can observe how complex the interpretation of the indicators of the Young scale (1998) is. On the one hand, the six factors proposed by the author are obtained; on the other hand, the interpretation given by the surveyed students makes the integration of the factors not be similar to the structure proposed by Young (1998). The complexity of these tests is associated with multicultural aspects of the regions, countries and in general of the context.

The factorial structures reported in different studies provide us the basis for this work. In addition, we may see how complex it is to analyze the different populations, both those have already been studied and others in the process of analysis, in a particular way, those that have begun to develop in Latin contexts.

In addition, the current situation derived from the health contingency, has contributed to the need for communication through digital platforms, and thus to the need to use the internet, from fixed devices at home, offices among other places, or in the mobile devices such as cell phones, **called Smartphone's. This topic has generated the interest of researchers and academics studying** the field of people's behavior, as well as organizations, such as the Center for Internet Addiction founded by Dr. Kimberly Young in 1995.

Future lines of research must be in the order of the same line of the internet addiction and its relationship with the current situation that we live today, derived from the COVID-19 epidemic. It's very important to develop, studies in the Latin contexts that will provide evidence that allows for the construction of a new structure of factors, which may be applied in general, in the populations of Latin students.

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Appendix 1

INTERNET ADDICTION TEST

Name _____ Male _____ Female _____
Age ___ Years Online _____ Do you use the Internet for work? _____ Yes _____ No

This questionnaire consists of 20 statements. After reading each statement carefully, based upon the 5-point Likert scale, please select the response (0, 1, 2, 3, 4 or 5) which best describes you. If two choices seem to apply equally well, circle the choice that best represents how you are most of the time during the past month. Be sure to read all the statements carefully before making your choice. The statements refer to offline situations or actions unless otherwise specified.

- 0** = Not Applicable
- 1** = Rarely
- 2** = Occasionally
- 3** = Frequently
- 4** = Often
- 5** = Always

1. _____ How often do you find that you stay online longer than you intended?
2. _____ How often do you neglect household chores to spend more time online?
3. _____ How often do you prefer the excitement of the Internet to intimacy with your partner?
4. _____ How often do you form new relationships with fellow online users?
5. _____ How often do others in your life complain to you about the amount of time you spend online?
6. _____ How often do your grades or school work suffer because of the amount of time you spend online?
7. _____ How often do you check your email before something else that you need to do?
8. _____ How often does your job performance or productivity suffer because of the Internet?
9. _____ How often do you become defensive or secretive when anyone asks you what you do online?
10. _____ How often do you block out disturbing thoughts about your life with soothing thoughts of the Internet?
11. _____ How often do you find yourself anticipating when you will go online again?
12. _____ How often do you fear that life without the Internet would be boring, empty, and joyless?
13. _____ How often do you snap, yell, or act annoyed if someone bothers you while you are online?
14. _____ How often do you lose sleep due to being online?
15. _____ How often do you feel preoccupied with the Internet when off-line, or fantasize about being online?
16. _____ How often do you find yourself saying "just a few more minutes" when online?
17. _____ How often do you try to cut down the amount of time you spend online and fail?
18. _____ How often do you try to hide how long you've been online?
19. _____ How often do you choose to spend more time online over going out with others?
20. _____ How often do you feel depressed, moody or nervous when you are off-line, which goes away once you are back online?