

## Exploratory factorial model of innovation in the Covid-19 era

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### Abstract

The objective of the study was to explore the dimensions of innovation in a public university in central Mexico during anti-COVID-19 policies of distancing and confinement of people. A cross-sectional, exploratory, psychometric and correlational research was carried out with a sample of 186, considering their professional practices and social service in public health institutions. The results show a structure of efficiency, usefulness and use. In relation to the state of the art, the structure of acceptance of the technology is corroborated, although in the pandemic scenario the dissolution of the second and third factors is appreciated, as well as the prevalence of the third factor.

**Keywords:** Innovation, Covid-19, Entrepreneurship, Model, Agenda

### Introduction

Process innovation is an emerging phenomenon in public health institutions when they face scenarios of risk of contagion, disease and death. In the case of COVID-19, the impact of this health crisis on the formation of intellectual capital consisted of the transition from face-to-face to virtual classroom (García et al., 2022). In this situation, teachers and students had to innovate in the teaching and learning of contents that suppose an equivalent of practical hours with respect to theoretical hours (García et al., 2019). In this way, the training of talent was at the crossroads of confining and distancing the parties involved, or intensifying its processes in an exceptional scenario of the transmission of the SARS CoV-2 coronavirus (Bustos et al., 2022). Therefore, the dilemma warns of at least three factors to consider: the usefulness, efficiency and intensity of the use of technologies, platforms, devices and networks for the formation of intangible assets.

Efficiency is a factor considered by technology

studies since the 1990s when it was proposed to observe it as a perceived ability to manage technology (Carreon et al., 2014). Research has shown that efficiency is a determining factor in the use of technology, but such anticipatory power increases when it is associated with utility (Sanchez & Rivera 2020). In other words, technology users must believe that their performance will increase significantly in order to develop computational ability and translate such consolidation into an intensive use of technology for self-learning (Hernandez et al., 2019).

If efficiency in positive correlation with utility predicts outstanding behavior, then utility is more than a perception or belief in the development of skills or competencies associated with the use of technology (Elizarraráz et al., 2018). Utility has been studied as a variable correlated with efficiency, but only in models that explain the use of technology (García et al., 2021). In exceptional scenarios such as economic or health crises, utility reduces its association with efficiency and decreases the prediction of the use of technology (Jacinto & Lirios, 2022). Therefore, it is

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necessary to investigate whether utility is a dimension of an emerging process in the face of contingencies.

The use of technology has been predicted from efficiency and utility as a result of the association between both variables (García et al., 2018). Even the literature consulted suggests that utility is an indirect predictor of the use of technology as long as efficiency mediates the relationship (Espinoza et al., 2022). That is, the use of technology is explained from the increase in utility and efficient ability, but the reduction of one and the increase of another do not predict the use of technology and rather opens the discussion if both factors belong to the same process.

The literature has shown that only the positive association between utility and efficiency predicts technology use, but the negative association between utility and efficiency does not explain the decrease or increase in technology use (Hernández et al., 2018). Therefore, it is necessary to investigate whether the three variables are dimensions of the same process (García et al., 2020). In the case of the pandemic, understood as a scenario of crisis and risk of contagion, illness and death, the literature indicates that it has more impact on utility than on efficiency, although such an effect reduces the predictive power of both for the use of the technology.

The literature suggests that the three variables: usefulness, efficiency and use of technology, in contexts of academic, professional or work training, can be assumed as dimensions of a process known as innovation (Juarez, 2020). The human capital theory warns that training is affected by the demands of the environment (García, 2021). An incited increase in requirements reduces the usefulness, efficiency and use of technology.

If a public health center is considered as a setting for the formation of intangible assets, then it is necessary to assume that the demands of the environment underlie the innovation of the processes and with it its effect on the utility, efficiency and use of technology (Mendoza et al., 2016). Understood as risk prevention for self-care, process innovation is appreciated in public health institutions where even essential resources such as gloves, face shields, masks, disinfectants or oximeters are scarce. Therefore, the intellectual capital in formation had to innovate its interaction in order to avoid infections, illnesses and deaths from COVID-19.

In this way, the objective of this work is to explore the dimensions of innovation by considering it as an emerging phenomenon in the health crisis, as well as a reflection of the usefulness, efficiency and use of technology in talent training.

Are there significant differences between the theoretical structure reported in the literature with respect to the observations to be made in this study regarding the training innovation of talents in the face of the pandemic?

The literature suggests that there are significant differences if we consider that the literature reports structures of utility, efficiency and use of technology in scenarios where the demands of the environment and the optimization of resources are in balance, but if there is an imbalance, it is possible to see more similarities. what differences (Carreón et al., 2019).

### Method

There were 186 students selected from the Metropolitan Autonomous University. 65 men (25 studied in CBI, 26 in CBS and 14 in CSH) and 121 women (22 in CBI, 59 in CBS and 40 in CSH)

The validity was carried out in a first phase with the exploratory factorial analysis technique of main axes with promax rotation (García et al., 2016). In the first phase, the reliability and validity of the instruments that measured the five variables was built and established (Hernandez & Valencia, 2016). In the second phase, the likelihood of adjusting indirect and direct, negative and positive, and significant causal relationships between the study variables was modeled and demonstrated.

From the Mobile Consumption Theory, twelve indicators were established that configured three dimensions for the five variables of the measurement model that were subjected to an exploratory factor analysis of the main components with promax rotation (Quintero et al., 2016). The results reject the hypothesis of factorial unidimensionality for three variables of the measurement model.

*Scale of the perception of the level of utility.* 12 items with response options from “strongly disagree” to “strongly agree” (Robles et al., 2016). The table shows the convergence (indicated by the factor weight) of the reagents with respect to the factor.

*Scale of the perception of the degree of efficiency.* 12 items with response options from “never” to “always” (Sales et al., 2016). Considering the factor weights of the perceptual variable of self-efficiency, the convergence of four reagents is demonstrated.

*Scale of the level of use.* 12 items with response options from “less than ten minutes” to “more than twenty minutes” (Sánchez et al., 2018).

Because the three scales have interval levels, their equivalence was not necessary, but if there were any asymmetry, it was cleared by multiplying it by a constant (García et al., 2019). The psychometric

properties of the instruments that measure the study variables are detailed in the table where they meet the requirements for multivariable analysis (Vazquez et al., 2016). During the first week of the spring quarter of 2022 at the UAM-I library, students were asked how often they used their phone to download images, sounds and speeches to select the ideal sample. Subsequently, the questionnaire was provided indicating a response time of 30 minutes to answer it.

**Results**

From the Innovation Theory, a new model was designed with the variables that met the criteria of reliability and validity (see Table 1).

Multiple linear regression was calculated to establish the determinants of the dependent variable and the non-linear relationship between independent variables.

The scheme shows that the perception factor of academic utility is the main determinant of the level factor of Internet use for academic purposes (see Table 2).

**Table 1.** Kaiser Meyer Olkin test

	MSA
<b>Overall MSA</b>	0.783
<b>r1</b>	0.769
<b>r2</b>	0.824
<b>r3</b>	0.782
<b>r4</b>	0.907
<b>r5</b>	0.829
<b>r6</b>	0.725
<b>r7</b>	0.778
<b>r8</b>	0.866
<b>r9</b>	0.742
<b>r10</b>	0.840
<b>r11</b>	0.827
<b>r12</b>	0.804

Source: Elaborated with data study, Bartlett's test 1783.936 (105 df) p < .001.

**Table 2:** Factor loadings

	Factor 1	Factor 2	Factor 3	Uniqueness
<b>r1</b>			0.857	0.353
<b>r2</b>	0.521	-0.581		0.407
<b>r3</b>	-0.952			0.153
<b>r4</b>	0.564	-0.587		0.311
<b>r5</b>		-0.481	0.453	0.313
<b>r6</b>		0.605		0.531
<b>r7</b>		-0.966		0.106
<b>r8</b>	0.917			0.194
<b>r9</b>			-0.710	0.312
<b>r10</b>		0.838		0.155
<b>r11</b>	1.023			0.021
<b>r12</b>	-0.887			0.102
<b>r13</b>	0.789	0.573		0.051
<b>r14</b>		0.617		0.427
<b>r15</b>			0.829	0.367

**Source:** Elaborated with data study,

**Note:** Applied rotation method is promax. RC1 = Efficiency, RC2 = Utility, RC3 = Use

This finding indicates a modification of the TCM measurement model by proposing a direct, positive and significant effect of the utility factor on the use for

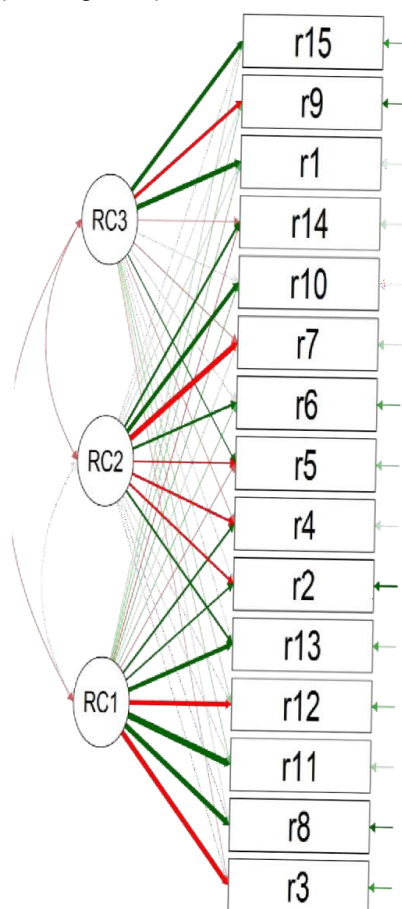
academic purposes. That is, a person looking to buy for example a book, could get it if there was a virtual library connected to the mobile phone (see Table 3).

**Table 3:** Factor correlations

	Factor 1	Factor 2	Factor 3
Factor 1	1.000	0.031	-0.261
Factor 2	0.031	1.000	-0.264
Factor 3	-0.261	-0.264	1.000

**Source:** Elaborated with data study. RC1 = Efficiency, RC2 = Utility, RC3 = Use

Similar reasoning would imply the perception factor of self-efficiency as a determinant of academic mobile use. An individual looking for academic information could find it through his mobile phone. However, the causal relationship lacking the required significance suggests the exclusion of the variable (see Figure 1).



**Figure 1:** Path diagram

**Source:** Elaborated with data study,  $\chi^2$  411.837 (63 df)  $p < .001$ ; TLI = 0,646; RMSEA = 0.248. RC1 = Efficiency, RC2= Utility, RC3 = Use

The strength of association between independent variables indicates its spurious implication. Finally, the level of mobile Internet use for academic purposes is explained by the two independent variables in percent of their variability. From the original measurement model only two variables maintain a causal relationship that selects them for inclusion in another measurement model. These consequences and implications are discussed

below.

**Discussion**

The objective of the present work was to specify a model for the study of the perception of utility, considering the dimensions reported in the literature, as well as those established in the present work, but its design limited the contributions to the analyzed sample, suggesting the extension of work towards other scenarios and other study samples.

In relation to the perception of utility that literature identifies as concomitant to the perceived ease of use (Martínez et al., 2019). The present work has shown that it affects, together with the perception of efficiency, the intensive use of electronic technologies, devices and networks.

Regarding the perception of effectiveness that literature links to the perception of control (Villegas, 2019). The present study has shown that when interrelated with the perception of utility generates a predictive structure of Internet use.

In relation to the use of the Internet, literature stands out as a result of the interrelationship between perceptions of utility, ease, efficiency and control (Villegas et al., 2019). The present work has shown that the perception of utility associated with the perception of effectiveness generates a structure that determines the use of the Internet.

Research lines concerning the associative structure of the perception of utility with the perception of efficiency and these as determinants of the use of the Internet will explain the rational, deliberate, planned and systematic process of acceptance of technology.

**Conclusion**

The objective of this paper was to specify a model based on the theory of mobile consumption, which highlights the relationship between perceptions as determinants of the use of technologies, devices and networks.

However, the present work proposed a modification of the perceptual structure in order to increase the predictive power of the theory of mobile consumption, highlighting the association between the perception of utility and the perception of efficacy as predictors of behavior.

Research lines concerning the predictive structure of electronic consumption will explain the associative relationship between utility and perceived effectiveness, as well as its impact on the use of the Internet.

**Conflict of Interest**

The author declares that he has no competing

interests.

**Informed Consent**

N/A

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