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Research Article

Exploratory Factorial Model of Innovation in the Covid-19 Era

Gilberto Bermúdez Ruíz [1], Arturo Sánchez Sánchez [2]*, Celia Yaneth Quiroz Campas [3], Cruz García Lirios [4]

[1]Universidad Anahuac del Sur

[2]Universidad Autónoma de Tlaxcala

[3]Instituto Tecnológico de Sonora

[4]Universidad Autónoma de la Ciudad de México

***Corresponding Author:** Arturo Sánchez Sánchez, Universidad Autónoma de Tlaxcala.

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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 the anti-COVID-19 policies of distancing and confinement of people. A cross-sectional, exploratory, psychometric and correlational investigation was carried out with a sample of 186, considering their professional and social service practices in public health institutions. The results show a structure of efficiency, utility 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 predominance of the third factor.

Key words: innovation; covid-19; entrepreneurship; model, agenda

1.Introduction

Process innovation is an emerging phenomenon in public health institutions when faced with risk scenarios 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 the face-to-face classroom to the virtual classroom (García et al., 2022). Faced with this situation, teachers and students had to innovate in the teaching and learning of contents that represent an equivalent of practical hours compared 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 their processes in an exceptional scenario of transmission of the SARS CoV-2 coronavirus (Bustos et al., 2022). Therefore, the dilemma warns of at least three factors to consider: the utility, efficiency and intensity of the use of technologies, platforms, devices and networks for the formation of intangible assets.

Efficiency is a factor considered by technological studies since the 1990s when it was proposed to observe it as a perceived ability to manage technology (Carreón et al., 2014). Research has shown that efficiency is a determining factor in the use of technology, but that anticipatory power increases when associated with utility (Sanchez & Rivera 2020). In other words, technology users must believe that their performance will increase significantly to develop computational capacity 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 necessary to investigate whether utility is a dimension of an emergent process in the face of contingencies.

The use of technology has been predicted based on 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 to the extent that efficiency averages the relationship (Espinoza et al., 2022). That is, the use of technology is explained from the increase in utility and efficient capacity, but the reduction of one and the increase of the other do not predict the use of technology and rather open the discussion if both factors belong to a same process.

The literature has shown that only the positive association between utility and efficiency predicts the use of technology, but the negative association between utility and efficiency does not explain the decrease or increase in the use of technology (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 this effect reduces the predictive power of both for the use of the technology

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

If a public health center is considered as a scenario for the formation of intangible assets, then it is necessary to assume that the demands of the environment underlie the innovation of processes and with it their effect on the utility, efficiency, and use of technology (Mendoza et al. 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 training had to innovate its interaction to avoid infections, diseases and deaths from COVID-19.

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

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 utility, efficiency and technology use structures in scenarios where the demands of the environment and the optimization of resources are balanced, but if there is an imbalance it is possible to see more similarities than differences (Carreón et al., 2019).

Method

186 students from the Autonomous Metropolitan University were selected. 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 technique of exploratory factor analysis of principal axes with promax rotation (Garcia et al., 2016). In the first phase, the reliability and validity of the instruments that measured the five variables were built and established (Hernandez & Valencia, 2016) . In the second phase, the probability of adjusting indirect and direct, negative and positive, and significant causal relationships between the study variables was modeled and demonstrated.

Based on the Theory of Mobile Consumption, 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 factorial unidimensionality hypothesis for three variables of the measurement model.

Utility level perception scale. 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 items with respect to the factor.

Efficiency perception scale. 12 items with response options from "never" to "always" (Sales et al., 2016). Considering the factorial weights of the self-efficacy perceptual variable, the convergence of four items is demonstrated.

Level of use scale. 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 was any asymmetry, it was clarified 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 multivariate analysis (Vázquez et al., 2016). During the first week of the spring 2022 semester at the UAM-I library, students were asked how often they used their phones to download images, sounds, and speeches to select the ideal sample. Subsequently, the questionnaire was delivered indicating a response time of 30 minutes to answer it.

Results

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

	MSA
overall WSA	0.783
r1	0.769
r2	0.824
r3	0.782
r4	0.907
r5	0.829
r6	0.725
r7	0.778
r8	0.866
r9	0.742
r10	0.840
r11	0.827
r12	0.804
r13	0.798
r14	0.640
r15	0.485

Source: Prepared with study data, Barttlett test 1783.936 (105 df) p < .001

Table 1. Kaiser Meyer Olkin test.

A multiple linear regression was calculated to establish the determinants of the dependent variable and the non-linear relationship between the independent variables. The diagram shows that the perception of academic utility factor is the main determinant of the level of use of the Internet for academic purposes (see Table 2).

	Factor 1	factor 2	Factor 3	Uniqueness
r1			0.857	0.353
r2	0.521	-0.581		0.407
r3	-0.952			0.153
r4	0.564	-0.587		0.311
r5		-0.481	0.453	0.313
r6		0.605		0.531
r7		-0.966		0.106
r8	0.917			0.194
r9			-0.710	0.312
r10		0.838		0.155
r11	1,023			0.021
r12	-0.887			0.102
r13	0.789	0.573		0.051
r14		0.617		0.427
r15			0.829	0.367

Source: Prepared with data study,

Note. The rotation method applied is promax . RC1 = Efficiency, RC2 = Utility, RC3 = Usage

Table 2: Factor loadings

This finding indicates a modification of the MTC measurement model by proposing a direct, positive, and significant effect of the utility factor on use for academic purposes. That is, a person looking to buy a book, for example, could get it if they had a virtual library connected to their mobile phone (see Table 3).

	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: Prepared with data study. RC1 = Efficiency, RC2 = Utility, RC3 = Usage

Table 3. Factorial correlations.

A similar reasoning would imply the perception of self-efficacy factor as a determinant of the academic use of the mobile. An individual looking for academic information can find it through their mobile phone. However, the causal relationship that lacks the required significance suggests the exclusion of the variable. Adjustment: [χ2 411.837 (63 gl) p < .001; IRR = 0.646; RMSEA=0.248]

The strength of the association between the independent variables indicates their spurious participation. Finally, the level of use of mobile Internet for academic purposes is explained by the two independent variables as a percentage 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 the work towards other scenarios and other study samples.

In relation to the perception of usefulness that the 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 technologies, devices and electronic networks.

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

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

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

Conclusion

The objective of this work 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 usefulness and the perception of efficacy as behavioral predictors.

The lines of research on the predictive structure of electronic consumption will explain the associative relationship between usefulness and perceived efficacy, as well as its impact on Internet use.

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