

EXPLORATORY FACTOR MODEL OF KNOWLEDGE MANAGEMENT

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ABSTRACT

The pandemic impacted knowledge management through anti-COVID -19 policies of social distancing and confinement. The educational systems moved from the face-to-face classroom to the virtual classroom through self-management of content according to technology, devices and platforms. The aim of this paper was to explore the dimensions of knowledge management in the context of the health crisis. A psychometric, exploratory, correlational and cross-sectional work was carried out with a sample of 100 students selected based on their computer skills, informational entrepreneurship and academic innovation at a university in central Mexico. The results indicate the non-rejection of the null hypothesis regarding the differences between the theoretical structure of three dimensions with respect to the observed empirical structure. In relation to anti-pandemic policies, risk prevention and the promotion of self-management of knowledge are recommended as an extensive factor of the proposed model.

Keywords: *Agenda, Self-management of Knowledge, COVID-19, Factorial Model*

INTRODUCTION

Based on the epidemiological traffic light, the anti-COVID -19 policies defined the degree of confinement, social distancing, and the use of anti-pandemic devices such as face masks. The educational repercussions defined the transition from the face-to-face classroom to the virtual classroom (GARCÍA et al., 2017: p 39). In this sense, the health crisis and the shock policies established a different knowledge management scenario than before the pandemic.

Before the health crisis, knowledge management consisted of the translation of findings and dissemination in the face-to-face classroom (SÁNCHEZ et al., 2018: p. 61). The didactic sequences included knowledge management as a transfer rather than a content production. The face-to-face classroom highlighted the traditional leadership of one-way teaching and learning. In this way, the COVID-19 crisis disrupts the established knowledge structure and chain to move it towards a self-management scenario.

If in the face-to-face classroom the students are knowledge reproducers, then in the virtual classroom the self-production and content management implied a degree of learning focused on the student's skills (GARCÍA & BUSTOS, 2021: p. 1). In the virtual classroom, unlike the face-to-face classroom, the relationship between teachers and students was asynchronous and multidirectional. In other words, traditional management only consisted of search, translation and playback. In contrast, virtual self-management consisted of the production, dissemination, and empowerment of content.

The transition to the virtual classroom from the face-to-face classroom supposes a process of creation, management and transfer of knowledge where entrepreneurship and innovation are central axes in the face of the health crisis (ALDANA et al., 2018: p. 91). In the face-to-face classroom in the face of a risk event such as the pandemic, opportunism emerges as the central theme of the agenda, but in the virtual classroom, entrepreneurship and innovation prevail as damage control and risk prevention.

As the pandemic intensifies, knowledge management is personalized and prevails over the production and transfer of knowledge (GARCIA, 2022: p. 59). Through content entrepreneurship for self-consumption and content innovation for individual satisfaction, knowledge reproduces itself. This is the case of immersive learning such as augmented reality, gamification and interactivity.

Augmented reality allows visualizing risk, threat and contingency scenarios where the learning theme stands out (CARREÓN et al., 2015: p. 1). Gamification is a synthetic way of learning in the face of profit maximization and bias reduction decisions. Both educational tools allow the learning of content in exceptional situations. More reliable is the interactivity that allows the simulation of a topic in the event of uncertainty.

In this way, immersive learning reduces traditional management and increases entrepreneurship and innovation. The self-management of knowledge in the COVID-19 era was consolidated via immersive technology, devices and software.

However, the structure of knowledge self-management supposes an immersive learning in the making (GARCIA, 2020: p. 1). Despite the fact that the pandemic has dragged on, self-management and immersive learning have not been consolidated in the virtual classroom. Rather, the face-to-face classroom was extended to the virtual classroom. That is, teachers and students use the virtual platforms as a content projector, review the content in a traditional way and the exams are applied as in the classroom through the supervision of the teacher.

The immersive learning paradigms, namely: digital culture, information economy and competency-based education suggest that immersive learning can replace face-to-face learning as long as the stakeholders reach a cycle of university governance (GARCIA & BUSTOS, 2021: p. 1). This is the case of knowledge management as a cultural habitus where the emancipation of the student consists of the self-management of their skills and knowledge.

Within the framework of the information economy, immersive learning is part of the formation of intellectual capital in specialized and updated software for data processing (GARCIA LIRIOS, 2021: p. 42). In this process, computer skills are competitive advantages in the professional and labor field. In this way, the Internet user habitus is transformed into computer skills in order to be competitive in a data processing market.

Knowledge management, according to the three paradigms of immersive learning, consists of the formation of intellectual capital through technologies, devices and information networks (CORONADO et al., 2022: p. 319). The process begins with the information habitus or the need for data access, continues with computer skills as essential requirements for insertion into the labor market and the consequent professional development. In other words, the formation of intellectual capital is oriented towards its conversion into an intangible asset in the classroom, profession and work.

Therefore, the objective of the present work was to explore the dimensions of knowledge management in the COVID-19 era, comparing the theoretical structure reported in the literature from 2019 to 2023 with respect to the observations in the present work.

Are there significant differences between the theoretical structure reported in the knowledge management literature reviewed with respect to the empirical structure observable in immersive learning or in the extension of traditional learning? anti-COVID -19 policies diversified the risks rather than mitigated them (GARCÍA et al., 2019: p. 105. Consequently, immersive learning should have exacerbated in the virtual classroom, but lack of expertise forced the importation of traditional teaching and learning resources such as the presentation through Power Point. In this scenario of risk of contagion, illness and death from COVID-19, anxiety in teachers and students limits immersive learning and amplifies traditional learning. Therefore, significant differences are expected between the structure reported in the literature with respect to the observations of the present study.

METHOD

A documentary, cross-sectional, exploratory and psychometric study was carried out with a sample of 100 students (M = 21.3 DE = 3.2 age and M = 9'987.00 DE = 765.34 pesos of monthly income), considering the participation of students in technologies, platforms and virtual software.

The Carreón Knowledge Management Scale (2020) was used. It includes three dimensions of immersive learning: augmented reality (“COVID-19 will intensify the use of augmented reality for banknote verification”), gamification (“COVID-19 will increase learning content through emoticons”), interactivity (“COVID-19 will enhance collaborative learning on the wiki”). All items include five response options ranging from 0 = “not at all likely” to 5 = “quite likely”. The reliability reported in the literature oscillates between .764 and .785, although in the present work the general scale reached an alpha value of .774 and the subscales for learning augmented reality, gamification and interactivity obtained values of .754; .769 and .770 respectively. Validity was reported with factorial weights ranging from .354 to .657 but in the present study the values range from .446 to .948

The standards of the American Psychological Association (APA) were followed in its sections on studies with people. Respondents were contacted by institutional mail. The invitation letter was sent, the confidentiality contract. Respondents were emphasized that their answers do not correspond to any remuneration and that the results would not affect their academic status. The homogenization of the concepts was established through focus groups and the Delphi technique.

The data was captured in excel and processed in JASP version 16. They were estimated. The reliability, adequacy, sphericity, validity, adjustment and residual coefficients were estimated in order to be able to contrast the hypothesis of significant differences between the theoretical structure with respect to the empirical observations of knowledge management. Values close to unity were assumed as evidence of linearity, co-linearity, and multicollinearity. Values close to zero as evidence of a spurious relationship.

RESULTS

Figure 1 shows the essential eigenvalues for the analysis of the relationships between factors and indicators. A maximum of two eigenvalues are appreciated to establish the equation that explains the dimensions of knowledge management. The 24 observations or indicators are concentrated around two factors. The result contrasts with the structure reported in the literature where three dimensions related to augmented reality, gamification and interactivity are proposed. From the paradigm of digital culture, knowledge management is an immersive learning of skills and knowledge oriented to the representation of processes and products (JACINTO & LIRIOS, 2022: p. 147). Therefore, the computational skills approach warns that said information representation is a requirement for its processing into data. Once the information processing culture has been achieved, the information market can be reproduced in the classroom through the dimensions of immersive learning in order to complete the cycle of academic, professional and labor training.

Table 1. Kaiser-Meyer- Olkin test

	MSA
Overall MSA	0.816
r1	0.591
r2	0.904
r3	0.820
r4	0.834
r5	0.892
r6	0.745
r7	0.686
r8	0.890
r9	0.843
r10	0.822
r11	0.863
r12	0.649
r13	0.659
r14	0.819

Table 1. Kaiser-Meyer- Olkin test

	MSA
r15	0.880
r16	0.869
r17	0.849
r18	0.801
r19	0.817
r20	0.847
r21	0.633
r22	0.819
r23	0.850
r24	0.846
r25	0.926
r26	0.851
r27	0.738
r28	0.806
r29	0.779
r30	0.824
r31	0.896
r32	0.743

Source: Prepared with study data. Suitability: KMO (.522 to .947). Sphericity [$\chi^2 = 2939.802 (276) p < .001$]

Figure 2 shows the positive (green lines) and negative (red lines) relationships, as well as significant (thick lines) and spurious (thin lines). The prevalence of the first factor is appreciated, but since it is not associated with the other two factors, it is considered a dual structure. Knowledge management in the COVID-19 era includes learning through augmented reality, although it is not linked to learning through gamification and interactivity. This finding explains why augmented reality is more used in risk exposure in order to promote a digital culture of deterring risk behaviors such as the reuse of face masks (BUSTOS AGUAYO, JUÁREZ NÁJERA & GARCÍA LIRIOS, 2022: p. 60). In the case of gamification and interactivity, it is more used in the dissemination of preventive strategies such as isolation or distancing from people.

Table 2. Factor Loadings (Structure Matrix)

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
r1					-0.724			
r2	-0.842							
r3		-0.600				0.697		
r4				0.540	-0.440	0.442		
r5	-0.927							
r6	0.692				0.628	0.695		
r7			0.679					-0.446
r8	0.827		-0.427					0.429
r9		0.550		-0.689		-0.478		0.422
r10			0.754		-0.440		0.425	
r11	-0.523	-0.568	0.499					
r12	-0.488			0.607				
r13					0.887			0.434
r14		0.608		-0.605		-0.663		0.475
r15			0.839					
r16	0.902							
r17	0.747	0.598					0.422	
r18		-0.638	0.666					
r19	-0.902							
r20	0.873							
r21		0.466	0.550	0.486				
r22			-0.736					
r23			-0.905					0.410

Table 2. Factor Loadings (Structure Matrix)

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
r24		-0.456		0.534		0.736		
r25		0.871						0.436
r26		-0.418	0.791				0.505	-0.487
r27	0.574						0.588	
r28		-0.763	0.432					-0.402
r29		0.838						
r30				0.877		0.486		
r31		0.823	-0.404					
r32				0.866				

note. Applied rotation method is promax .

Source: Prepared with study data. Fit [$\chi^2 = 825.913$ (207) $p > .001$; RMSEA = .135; TLI = .683; BIC = -247,876]

The adjustment and residual values warn of non-rejection of the null hypothesis regarding the significant differences between the theoretical structure with respect to the observed structure. In other words, the knowledge management dimensions reported in the literature were observed in the present study as an exploratory model of three factors where augmented reality learning prevails, but dissociated from gamified and interactive learning. From the computational skills approach, augmented reality reveals object representations and relationship skills between spaces (SÁNCHEZ et al., 2022: p. 312). Therefore, the literature published from 2019 to 2023 and the observations of the present study seem to reflect the impact of anti-COVID -19 policies consisting of distancing and confinement strategies. In other words, the surveyed sample reflects the representations and skills that are required for the prevention of COVID-19 and that can be learned through augmented reality.

DISCUSSION

The contribution of this work to the state of knowledge lies in the exploration of the dimensions of knowledge management in the context of the pandemic and with a sample of students from a public university in central Mexico. The results show a three-factor structure where learning through augmented reality prevails, but not linked to learning through gamification and interactivity. In this sense, the findings contravene the reported structure where the perceptions of benefits, risks and intentions allude to knowledge management oriented by the exceptional situation (QUIROZ et al., 2020: p. 12).

Knowledge management is an enterprise oriented towards knowledge innovation, both observable in the habitus or community responses to contingencies for local development (BUSTOS et al. 2021: p. 1). If the habitus is an entrepreneurial and innovative factor that emerges in the face of risk events, threats or contingencies, then knowledge management and immersive learning are indicators of the habitus that communities or localities develop in the face of crises such as the pandemic (ESPINOZA et al., 2022: p.73). Knowledge management guides entrepreneurship and innovation through learning capacities, capitals, and representations associated with habitus (MARTÍNEZ et al., 2019: p. 135). The factors that determine a collective response to the pandemic and affect knowledge management explain a civil influence process known as Bottom up. In contrast, the impact of anti-COVID -19 policies consisting of distancing and confinement explain a process known as Top Down (from top to bottom). anti-COVID -19 policies on knowledge management (JACINTO & LIRIOS, 2022: p. 147). Therefore, lines of research related to habitus will clarify the relationship between the two approaches. The observation of the theoretical dimensions for the empirical contrast will allow anticipating learning scenarios in the face of health crises.

However, the results of this study indicate that augmented reality prevails over gamification and interactivity (GARCÍA, BUSTOS & SANDOVAL, 2023: p. 1). This is so because gamification involves representations and skills that allude to identification in spaces. If the anti-COVID -19 strategies were distancing and confinement, then it is possible that in the virtual classroom not only the curriculum topics were disseminated . In addition, learning about spaces and objects complements deterrent strategies for exposure and risk behaviors such as infection, illness, and death from COVID-19. In other words, the formation of human capital in the pandemic reproduced educational content and anti-COVID -19 policies that guided an immersive learning of risk prevention.

anti-pandemic policies and strategies would have been reduced to preventive messages, but it is in the prevalence of augmented reality where the sample surveyed seems to reflect risk aversion (QUIROZ et al., 2022: p. 147). In this way, future research on the impact of containment and mitigation policies in the virtual classroom will make it possible to detect the immersive learning that would guide risk communication. The prevention of COVID-19 can be disseminated through the spread of symptoms on objects where its magnitude and growth can be appreciated.

However, immersive learning offers more and more alternatives for knowledge management (GARCÍA LIRIOS, 2023: p. 1). Augmented reality will soon be replaced by another learning style or mode. Faced with a risk event such as the pandemic, immersive learning can be an instrument of prevention, but its effects on the formation of intellectual capital are unknown. It is

possible that any mode or method of immersive learning is only a complement to other learning such as collaborative or critical thinking. Therefore, models that explain the impact of a containment strategy will need to be comprehensive.

CONCLUSION

The objective of the study was to explore the dimensions of knowledge management through immersive learning as a reflection of the impact of anti-COVID -19 policies in the virtual classroom. The results corroborate the structure of three learning factors through augmented reality, gamification and interactivity. In relation to the state of the art where community habitus stand out as responses to contingencies or risks, the extension of the model is recommended in order to predict a hybrid learning of entrepreneurship and innovation through immersive technology.

Knowledge management as risk prevention involves the development of skills such as opportunism, optimization or innovation, but its translation into immersive learning is preferably oriented from augmented reality. In this sense, the confinement and distancing strategies were adopted because they allude to spaces and contagion risks that were quickly assimilated by users. On the other hand, the strategies for the use of anti-COVID -19 devices such as face masks, gloves, odometer, thermometer or alcohol gel were not fully adopted due to their cost. In this sense, the immersive learning of risk prevention through augmented reality opens the discussion on the magnitude and avoidance of infections, diseases and deaths.

However, a greater diffusion of risk prevention learning through augmented reality implies a reduction in opportunism, optimization and innovation skills. In fact, if augmented reality precedes risk exposure and behavior, then immersive learning and knowledge management would not be aimed at preventing infections, illnesses, and deaths from COVID-19.

Because immersive learning coexists with other forms of learning such as collaborative work and critical thinking, knowledge management in the COVID-19 era would be carried out through gamification, interactivity and augmented reality as long as they are perceived as useful and easy to use.

In the case of risk prevention in the face of the pandemic, knowledge management finds tools for translating skills and knowledge in immersive learning and augmented reality. The formative structure of intellectual capital, when impacted by the confinement and distancing strategies, revealed the inclusion of other collateral learning styles to the immersive teaching of content in the virtual classroom.

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