

## Confirmatory factor model of intellectual capital formation in the COVID-19 era

### Modelo factorial confirmatorio de la formación del capital intelectual en la era COVID-19

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**Abstract:**

The objective of this study is to confirm the factor structure of knowledge creation. A non-experimental, cross-sectional and correlational study was carried out with a non-probabilistic sample of 100 administrators, teachers and students from a public university, considering their interaction in professional practices. The results show a confirmatory structure of three components related to the training, production and transfer of knowledge, although the relationship matrix suggests the inclusion of another factor alluding to the creation of knowledge observed in creative organizations. The contrast of the model in another sample and study context is recommended, as well as the adjustment of the dimensions to a model with the inclusion of a fourth factor.

**Keywords:**

Network, management, administration, knowledge, learning

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**Resumen:**

El objetivo de este estudio es confirmar la estructura factorial de creación del conocimiento. Se realizó un estudio no experimental, transversal y correlacional con una muestra no probabilística de 100 administradores, docentes y estudiantes de una universidad pública, considerando su interacción en las prácticas profesionales. Los resultados muestran una estructura confirmatoria de tres componentes relacionados con la formación, producción y transferencia de conocimiento, aunque la matriz de relaciones sugiere la inclusión de otro factor alusivo a la creación de conocimiento observado en las organizaciones creativas. Se recomienda el contraste del modelo en otra muestra y contexto de estudio, así como el ajuste de las dimensiones a un modelo con la inclusión de un cuarto factor.

**Palabras Clave:**

Red, gestión, administración, conocimiento, aprendizaje.

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### Introduction

The impact of the COVID-19 pandemic on intellectual capital formation has been significant and multidimensional. Intellectual capital refers to the knowledge, skills, innovation, and capabilities of people that contribute to the development and growth of an organization or society (Muñoz, 2023).

Change in learning methods considering the transition to online education and teleworking has been an important response to the pandemic. This has required adaptations in

teaching and learning methods, with greater use of digital tools and online learning platforms. Remote training and virtual collaboration have become more common (Niño, et al., 2021; Ortega, 2021).

Impact on formal education, the case being the interruption of face-to-face classes and the temporary closure of schools and universities, effects of the acquisition of knowledge and skills, especially for students in critical stages of training. The quality of online education has varied and has been a

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challenge for many students and teachers (Félix, 2022; Oxté, et al., 2022).

Inequalities in access to information related to the pandemic exacerbating inequalities in access to education and training. Students from underserved or resource-limited communities face greater difficulty participating in online educational programs due to lack of connectivity and appropriate devices (Oxté, et al., 2022; Schnyder, 2023)

Accelerated digital transformation as the need to adopt technological solutions accelerating digital transformation in many organizations and sectors. This has required the development of new digital skills and greater adaptability on the part of workers (Marquina, 2020; Muñoz 2023).

Emphasis on flexible and adaptive skills in the face of economic uncertainty, highlighting the importance of developing soft skills. Workers need to be prepared to change roles and acquire new skills in response to the demands of the changing labor market (Cortés, 2023).

Innovation and remote collaboration Despite the challenges, the pandemic has driven new content disseminated in real time. Virtual teamwork and creativity have proven to be essential for problem solving in times of crisis (Velastegui, 2021).

Impact on research and development (R&D) as it experiences changes, approaches, and priorities due to the pandemic. They have focused on areas such as public health, biotechnology, and data science to address challenges related to COVID-19 (Portillo, et al., 2020).

The COVID-19 pandemic has challenged and transformed the shape and development of intellectual capital. It has highlighted the importance of adaptability, resilience and innovation in education, work and research. To mitigate negative impacts and take advantage of emerging opportunities, it is crucial to invest in effective learning and professional development strategies that promote strong and diverse intellectual capital (Huayanca, et al., 2022).

Broadly speaking, a knowledge network is a climate of tasks centered on relationships of empathy, trust, commitment, entrepreneurship, innovation, and satisfaction, but in a

complex sense, it is based on vertical and bidirectional communication, with mutually influential leaders and followers, as well as a management and administration system focused on talents (Espinoza, et al., 2023).

However, in the framework of neoliberal globalization, educational policies have focused on the quality of processes and products according to a system of evaluation, accreditation, and certification. In each of these phases, those who make up an institution or organization dedicated to the management, production and transfer of knowledge are subject to institutional guidelines that determine the financing, subsidy, or forgiveness of payments for public services. To the extent that Higher Education Institutions (HEIs) adjust their capabilities to state requirements, they circumscribe their strategies and functions to an autocratic relationship between leaders and talents by prioritizing unidirectional communication and extrinsic motivation, but if these HEIs compete for financial resources, then they develop cultures of success and climates of innovation oriented to the management, production and transfer of knowledge. Even the formation of knowledge networks is aimed at acquiring competitive advantages derived from a flexible culture, innovative climate and trust for knowledge entrepreneurship, being the commitment and satisfaction of talents key factors in the development of the organization (García, 2021; Garcia, 2021).

However, organizations subject to evaluation, accreditation and certification focus their capabilities on the asymmetric relationship between their leaders and talents, with a vertical decision-making structure prevailing. In this authoritarian scenario, talents are assumed as resources or instruments, reducing their abilities to the execution of knowledge. In contrast, when transformational leaderships emerge that delegate decisions to talents and promote the development of their capabilities, organizations focus on the production of knowledge rather than the reproduction and transfer of knowledge. This is a scenario in which the diversification of strategies and functions in talents and leaders would explain the degree of entrepreneurship and innovation, as well as the commitment and satisfaction of the actors involved. In such a scenario, organizational development has been explained from theories that highlight the importance of human relationships and motivations. From the humanistic approach

of organizations, globalization is a guiding axis of emotions, feelings, and affections. In this sense, the logic of globalization understood as the maximization of production and consumption relations with respect to cost reduction, is disseminated as a basis for management, production, and knowledge transfer. Therefore, individuals are considered instruments of persuasion and dissuasion to arrive at the ends of profit. It is a rational choice process in which two principles prevail; 1) win-win that consists of an intensive negotiation in which those involved end up with a benefit greater than the costs invested and 2) zero sum where they are involved in the dilemma of winning or losing. In this way, the logic of rational choice has been challenged for excluding from benefits those who are involved in the dilemma of winning or losing (Sandoval, 2023; García, 2019).

In contrast, the social capital approach assumes that 1) people who share resources and assets are an end in themselves; 2) the instruments to share goods and resources suppose affections such as trust and cooperation; 3) therefore, the main asset of an organization is in the relationship itself rather than in resources, goods, or people. The theory of social capital considers that relationships between people are networks of production and reproduction of information and knowledge. It is a system of reciprocities in which a sender is a receiver in the process of information dissemination, decision making and execution of intentions. The information and knowledge network includes dissuasion and persuasion processes based on the degree of internal and external expectations of the network. If a climate of trust prevails in the network, then it will be possible to observe cooperation in undertaking and innovating tasks (García, 2018; Sandoval, 2021).

Precisely, continuous relationships –organizations with permanent control, surveillance, and motivation– and discrete relationships –organizations with sporadic and unidirectional climates– determine the complexity of social capital, since the levels and degrees of interrelation affect the structures and phases of organizations –self-regulation, dissipation, adaptation and dynamism–. Complex organizational systems are limited to two relationships: tacit and implicit. Based on their structures and phases, complex organizations generate alternate processes of discretion and continuity. External demands and internal resources are

limited to latent or visible opportunities, as well as real or symbolic capacities. These are rational and affective dimensions in which organizational cultures produce and reproduce information that defines them as autocratic or complex. In this duality, complex organizations determine the quality of their processes and products. Although complex organizations seek to differentiate themselves and integrate with other organizations, the continuity of their processes and the emergence of their resources confines them to complexity. The theory of social capital exalts continuous relationships but considers discrete relationships as the foundation of continuous ones, since organizations produce knowledge from latent processes such as psychological ones (García, et al., 2015; Bustos et al., 2022).

However, network analysis theory studies the structure of social capital, which it identifies as a graph. It is a conglomeration of implicit or tacit relationships that organizations establish as the objectives and goals are adjusted to the demands of the environment and the corresponding innovations. Consequently, the graph includes nodes and arcs or instances and relationships of knowledge production in the case of departments or task teams. Unlike social capital theory that focuses on relationships or arcs, network analysis theory considers that nodes are more relevant than arcs, since it is these instances that establish innovations and anticipate changes without the need to act. into account the arches. In this way, the associated nodes can be identified as dyads or triads, but if they share an organizational culture such as quality or success, then they are unimodal, configuring an order or number of total nodes included in the graph. Once the order or number of nodes has been established, the density estimate is established by dividing the existing relations by the possible relations. Such relationships can be unidirectional –twitter– or bidirectional –Facebook–. In both cases it is possible to calculate the directional weight (García, et al., 2019; García, et al., 2022).

In the case of organizations that require other organizations, their directional weight can be significant and close to one, but if rather other organizations are the ones that need to establish relationships with it and such matter does not imply a benefit for it, the directional weight is determined by

connection demands more than by connection needs (Quintero, et al., 2017).

In the case of bidirectional or multidirectional nodes, the estimation is divided into the information inputs and outputs, the sum of both connections establishes its directional weight. If such estimation is higher with respect to other nodes, then it is considered that such organization is preponderant in the graph. Implicit processes can also be established by calculating the directional weight required for an organization to link with another distant or selective organization. In this way, organizations configure a graph of estimated relationships and another graph of latent relationships (Cervantes, et al., 2019; Garcia, et al., 2022)

In the case of estimated relations graphs, they provisionally define the conjunctural power of a node, but the latent relations graph determines the historical influence of the node. The difference is substantial because conjunctural power refers to the probability that an organization must respond to external demands based on its intermediation, but historical influence determines the potential that an organization would have if its resources would establish a unimodal culture (Carreón, et al., 28).

This is how organizational complexity alludes to power and influence represented in knowledge graphs, information networks, production nodes and relationship arcs. Social capital theory and network analysis theory explain the complexity of organizations as graphs, nodes, or arcs, while describing cultures and exploring meanings between actors (Espinosa, 2020).

If an organization is the result of the relationships between its talents, then its culture reflects the type of graph that it builds in response to the demands of the environment and internal resources. Organizational cultures allude to their uses and customs, values and norms inferred from the meanings of their symbols, their symbolic structure materialized in rituals, their autonomous or semi-autonomous sectors, their internal and external dialectics, their representations concerning surrounding information and their social identity. Based on these characteristics, the analysis of complex organizations is limited to their culture, leadership, and climate (García, et al., 2021).

Thus, autocratic organizational cultures depend on leadership and task climates more than their talents and motivations. In contrast, complex organizational cultures are encouraged by the production of knowledge of their talents and the motivation of their leaders. Autocratic cultures form graphs in which the continuity of discourses, conformities and isomorphism prevails, while complex organizations develop cultures and relationships and are sporadic in their processes that not only guide them in their adaptation or self-regulation, but also define them as emerging and dynamic. The leaderships of autocratic cultures are predominant nodes of decision but confined to values and norms of obedience and conformity. In complex organizational cultures, their nodes are latent leaderships that emerge when external demands exceed internal resources, or when relationships between nodes require innovative processes that generate opportunities and capabilities (García, et al., 2021; (García, et al., 2021).

Regarding information and knowledge, autocratic cultures reproduce arcs while complex organizations generate latent and observable relationships, while structuring their objectives and goals based on the contingencies of the market or state institutionalism. In other words, autocratic organizations make up power structures and cultures of domination, while complex organizations structure cultures of innovation oriented towards influencing their talents and leadership (García, et al., 2018).

However, complex organizations differ from each other based on the relationships between their nodes and their contact intentions. Organizational avoidance is assumed as a factor of complexity since it involves the establishment of latent relationships. In autocratic organizations, contact avoidance refers to a negative task and relationship climate, but in complex organizations it implies a culture of entrepreneurship and latent innovation in parallel to the relationships established with the other nodes. Autocratic organizations assume that contact can be superficial or intimate as arcs intensify, but complex organizations consider contact avoidance as a preliminary assessment of the node towards leadership and talent. Therefore, the avoidance of contact implies a latent relationship that will materialize in influence and innovation rather than in a relationship of power, obedience, and conformity. Contact

avoidance is subject to a series of internal processes in the organization such as categorization and identity. By the nodes establish membership categories to exclude other nodes and avoid correspondence, organizations become more complex based on the differentiation of their talents and leadership (Cruz, 2020; Bustos, et al., 2021).

In contrast, an organization that includes its talents and leadership in the same category not only generalizes its opportunities and capabilities, but also promotes superficial or autocratic relationships. Therefore, organizational cultures are structured in networks from their internal differentiations and the choice of contact relationships. A greater number of connections or arcs supposes a greater complexity, but also a latent structure of relationships. Complex organizational cultures generate information from arcs, nodes and graphs, but limited to the categorization and identity of their leadership and talents rather than external demands and internal resources, market opportunities or institutional guidelines. In such a process, complex organizations produce information to influence other similar organizations, although organizational cultures around power –obedience and conformity– coexist with complex organizations (Chacara, et al., 2022).

The objective of this work is to confirm the factor structure of knowledge creation considering the reviewed literature that suggests three dimensions: Management, production and transfer (Espinoza, et., 2023).

Are there significant differences between the three-dimensional theoretical structure reported in the literature with respect to the structure observed in the present work?

Given that the knowledge network develops a culture of success directed at quality; evaluation, accreditation and certification of its processes and products, the weighting of its learning, indicated by self-regulation, dissipation, adaptability, and dynamism will be adjusted to its work culture. Although the knowledge network is guided by a culture of success in response to quality educational policies, the management, production, and transfer of knowledge, measured in its incoming, hidden and outgoing layers, are different from its self-regulation, dissipation, adaptability and dynamism (Sandoval, et al., 2022).

The relationship between network theory and factor analysis lies in their shared focus on understanding and representing complex structures and relationships between variables. Although they are different disciplines, both have applications in the modeling of complex systems and in the analysis of multidimensional data (Sandoval, et al., 2022).

Network theory includes the representation of relational structures. Network theory focuses on the study of interconnected structures, where nodes represent entities and links represent relationships between them. This representation is useful for visualizing and understanding the topology and dynamics of complex systems, such as social networks, supply chains, biological systems, among others. The analysis of network properties is interpreted from network theory because it uses metrics and algorithms to analyze structural and dynamic properties of networks, such as node centrality, modularity, connection density, community detection, among others. These analyzes allow us to identify patterns, key characteristics and emerging behaviors in networks (García, 2014).

Regarding factor analysis, it seeks to reduce the dimensionality of data sets by identifying latent variables (factors) that underlie multiple observed variables. These factors represent underlying patterns or structures that explain variability in the data. The interpretation of multidimensional structures suggests a factor analysis because it facilitates the interpretation of complex structures by identifying relationships between variables and grouping them into meaningful latent dimensions. This allows complex information to be summarized and hidden relationships between observed variables to be discovered (Aldana, 2018).

Network theory and factor analysis can be combined to study multidimensional network structures. For example, factor network analysis integrates dimensionality reduction methods with network analysis techniques to identify complex patterns and key characteristics in interconnected systems. Modeling organizational networks in practical applications, the combination of factor analysis techniques and network theory can be used to model and understand information flows or organizational structures. This allows us

to study how variables are grouped and interrelated in complex contexts (García, 2021).

Network theory and factor analysis are complementary approaches used to study and analyze complex systems from different perspectives. The integration of both disciplines offers powerful tools to visualize, model and understand relationships between variables in multidimensional and dynamic environments (García, 2023).

## **Method**

The study followed the ethical guidelines of the Helsinki and Barcelona protocol regarding due process of information about the project, presentation of those responsible, unpaid or conditional participation of the respondents and dissemination of the results 44.

A non-experimental, cross-sectional, and exploratory study was carried out. A non-probabilistic selection of 100 administrators, students, and teachers from a public university in Estado de México was carried out.

67% are women and 33% men. 59% mentioned being between 18 and 22 years old ( $M = 21.34$ ;  $SD = 0.12$ ), 20% declared being between 22 and 29 years old ( $M = 25.23$ ;  $SD = 0.25$ ), the remaining 21% indicated an age greater than 29 years ( $M = 33.12$ ;  $SD = 0.32$ ). 33% stated that they had not completed university studies, 32% have completed bachelor's degrees, 20% master's studies and 15% doctorate

studies. 32% declared family monthly income of less than 3,500 pesos ( $M = 3,254$ ;  $SD = 21.23$ ), 55% said that their family earned between 3,500 and 7,000 pesos per month ( $M = 4,562$ ;  $SD = 234.12$ ) and the remaining 13% indicated that their family earned more than 7,000 pesos in the last month ( $M = 8,712$ ;  $SD = 243.14$ ). 66% stated that they were single, 20% in a free union and 14% were married.

The Organizational Complexity Scale of García et al., (2016) was used, which includes four dimensions related to self-regulation, dissipation, adaptation, and dynamism. Each item is answered with one of five options ranging from 0 = strongly disagree to 5 = "strongly agree". The Delphi technique was used for the homogenization of the words included in the reagents. The confidentiality of the answers to the written survey was guaranteed, informing them that the results of the investigation would not affect their academic or employment status. The surveys were conducted in the lobby of the university library. The information was processed in the Statistical Package for Social Sciences (SPSS) version 20.0. Mean, standard deviation, KMO, Bartlett's test, factor weights, and synapse weights were estimated.

## **Results**

Figure 1 show fit and acceptance of the null hypothesis, that is, the possible theoretical relationships, show a structure similar to the weighted relationships. Scree allowed the estimation of the instrument was established with formation, production and, transfer.

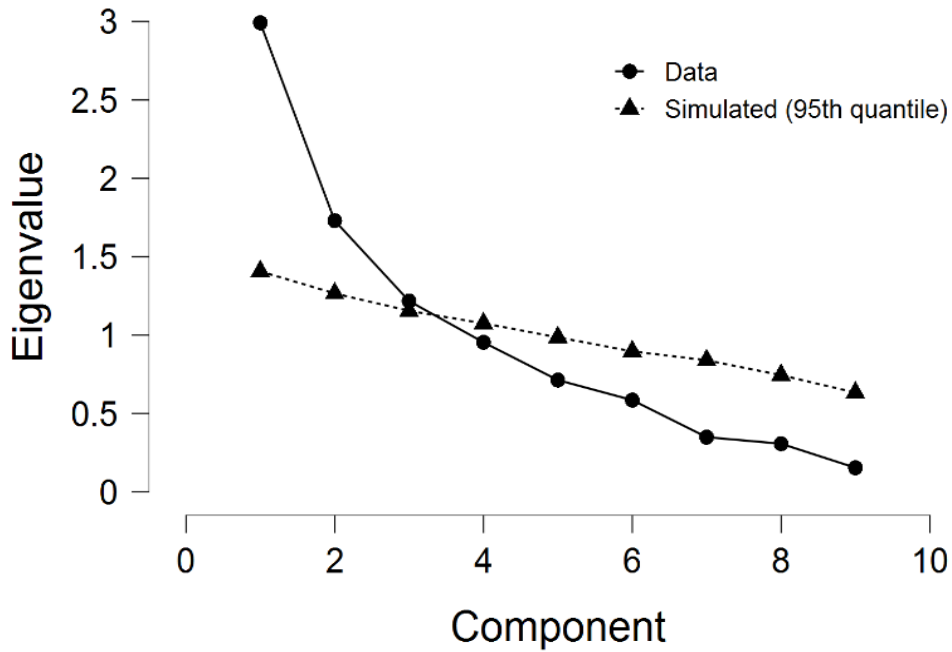


Figure 1. Eigenvalues to deduce the permissible number of factors from the number of observable variables relative to intellectual capital formation in the COVID-19

Note: The analysis of the eigenvalues defines the number of factors that correspond to the reagents included in the instrument. Fig. 1 shows the correlation between the possible factors and the observations carried out. For 10 observations three factors correspond.

Figure 2 show structure of relationships between the nodes is grouped and focused on four three phases: formation, production and transfer Knowledge management is

reproduced and transferred from the balance that its differences suppose in the COVID-19 era. The ability to adapt to risks and the dynamics of academic training are other features that distinguish the learning structure.

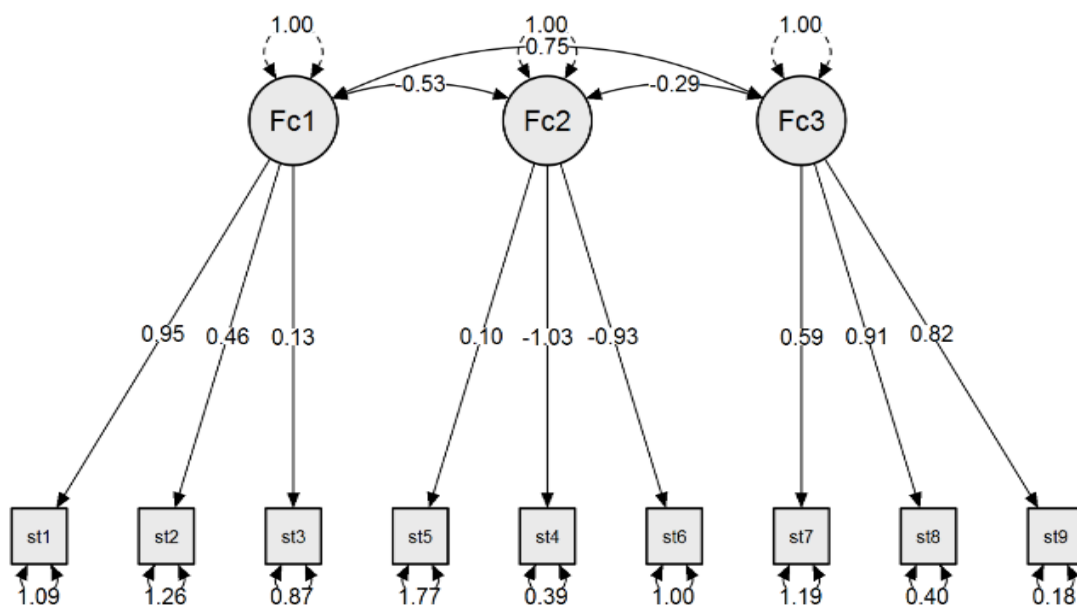


Figure 2. Confirmatory factor model of the intellectual capital formation in the COOVID-19 era

Note: Confirmatory factor analysis is distinguished by establishing dimensions based on correlations between items. Fig. 2 shows confirmation of three factors from nine observations. The first factor related to knowledge production is correlated with items 1, 2 and 3. The second factor related to knowledge management was associated with 5, 4 and 6. The third factor linked to knowledge transfer was correlated with items 7, 8 and 9.

Figure 3 show covariance matrix shows the prevalence of the factors and indicators of knowledge management. In this sense, it is possible to appreciate that a fourth factor related

to the creation of knowledge that explains management in creative organizations would increase the relationships, the explained variance and the confirmatory predictive power of the model.

	satlab1	satlab2	satlab3	satlab5	satlab4	satlab6	satlab7	satlab8	satlab9
satlab1	0								
satlab2	.05	0							
satlab3	.08	.22	0						
satlab5	.25	.04	.08	0					
satlab4	.02	.03	.22	.04	0				
satlab6	.09	.19	.07	0	0	0			
satlab7	.11	.11	.26	.07	.01	.27	0		
satlab8	.04	.2	.3	.39	.1	.08	.01	0	
satlab9	.02	.06	.15	.41	.1	.05	.03	0	0

Figure 3. Matrix of correlations between observed variables and relative to intellectual capital formation in the COVID-19 era

Note: The matrix of relationships between indicators allows establishing the factors that would correlate with the items. In this way, the darker shaded area shows the correlations favorable to the establishment of factors considering the relationship between reagents.

### Discussion

The results show three predominant factors: training, production and transfer of knowledge. Each factor explains the factorial structure of knowledge management. From the confirmatory factorial model it is possible not to reject the hypothesis regarding the significant differences between the

structure reported in the literature with respect to the observations made in this study.

Studies of organizational complexity and knowledge networks warn that learning processes suppose a latent instance that would correspond to a manifest instance. In this sense, the complexity would refer to the learning processes and implicit knowledge that only the labor systematization



grants, but it would be a manifest complexity if such information processing, elaboration and implementation of strategies are established in the tasks. The present work has found a prevalence of learning focused on the dissipation of information and knowledge rather than self-regulation, adaptation or dynamism. This is so because educational quality policies seem to spread asymmetrically among teachers, students and administrators, since the knowledge network they build seems to emerge from the diversity of contributions and the multiplicity of functions of its members rather than from a management system. production and transfer of leaders to talents (García, 2022; Martínez, 2022).

HEIs adjust their capacities to evaluation, accreditation and certification policies, they tend to innovate by assuming that the quality of processes and products are a requirement for the provision of funds. In this dynamic, HEIs are in a process that goes from institutionalism to governance or consensual management of the production and transfer of knowledge (Lirios, et al., 2022).

In the same sense, the present work has shown that dissipation as an indicator of the management, production and transfer of knowledge explains a dimension of its culture of success directed more as an innovation strategy than as a response to educational policy (García, et al., 2016).

The opposite process to the establishment of a knowledge network would be in the management, production and transfer of stigmas that, in the case of administrative stigmas, not only inhibit knowledge management but also reduce it to its minimum expression by canceling the climate of collaboration and innovation necessary for the production and transfer of knowledge from teachers to students (Cruz, 2020).

In the present work, dissipation would not only explain the organizational culture of the knowledge network, but would also explain how stigma underlies more authoritarian than democratic work cultures, distinguishable by their degrees of control over processes and production (Carreón, et al., 2022).

The organizational climate of a knowledge network, indicated by the climate of relationships, support, innovations and goals, reflects the incidence of educational quality policies on

the collaborative dynamics of an HEI. In other words, state institutionalism, close to an authoritarian rather than democratic culture, encourages collaboration and guides it towards success in evaluation, accreditation and certification, but limits its climate of innovation, thereby reducing the importance of dissipation in functions as in management strategies, production and transfer of knowledge (García, et al., 2020).

It is a crossroads, which on the one hand lies in the adjustment of the capacities to the state requirements to achieve accreditation and certification, but in another sense, it consists of the innovation of the processes as a competitive advantage of the HEI regarding to its competitors in raising funds (Zallas, et al., 2023).

In the HEI of this study, it has achieved the quality of its processes by adjusting its capabilities to state requirements, while generating a climate of innovation focused on the dissipation of its processes and products, strategies, and functions (Carreón, et al., 2020).

Therefore, it is advisable to incorporate the organizational climate and its indicators of collaboration, innovation, tasks, goals, and relationships in the knowledge network model, focused on the complexity of organizational dissipative learning. This supposes the observation of two processes: one institutional focused on the climate of tasks and goals with respect to the educational quality policy and another inter-institutional focused on a climate of entrepreneurship and innovation related to the contingencies of the environment and the capacities of the organization (García, et al., 2022).

The impact of COVID-19 on the management, production and transfer of knowledge has been significant in relation to the formation of intellectual capital.

Knowledge Management in the transition to remote work because the pandemic has accelerated the adoption of technologies, which has changed the dynamics of how knowledge is managed in organizations. Digital collaboration and communication have largely replaced in-person interactions, requiring new tools and platforms to effectively share information and knowledge. Focus on organizational resilience as universities have had to adapt quickly to ensure

continuity of operations and knowledge management in a remote and dynamic environment. This has highlighted the importance of organizational resilience and responsiveness to unexpected crises. Knowledge retention strategies, such as the departure of experienced and retired personnel, increasing concern for the retention and transfer of knowledge within organizations. Strategies have been implemented to capture and preserve critical knowledge before it is lost with the departure of employees (García, et al., 2022).

Production of knowledge observable in the majority of research efforts that have focused on the study of COVID-19 and the development of treatments and vaccines. This has temporarily reoriented knowledge production towards specific areas of public health and epidemiology. Global scientific collaboration forcing the pandemic to greater collaboration between scientists, academics and research institutions internationally. Data and knowledge have been shared more openly and rapidly to address urgent challenges related to the pandemic (Carreón, 2020).

Knowledge transfer such as online education and training. Educational institutions have had to adapt to online teaching, which has impacted the transfer of knowledge from teachers to students. The use of digital platforms and interactive tools has been essential to maintain educational continuity. Virtualization of events and conferences where the transfer of knowledge in the academic and professional field has moved to virtual environments through webinars, online conferences, and virtual events. This has expanded the reach and accessibility of these events but has also changed the dynamics of interaction between participants. New modalities of collaboration where universities and companies have explored new forms of collaboration and knowledge transfer through digital tools and collaborative work platforms. Open innovation and virtual networking have become more common to foster innovation and knowledge sharing (Jacinto, 2022).

The COVID-19 pandemic has transformed the management, production, and transfer of knowledge in multiple sectors and areas. It has driven the adoption of digital technologies and promoted greater global collaboration to address emerging

challenges and strengthen intellectual capital formation in a changing and challenging environment.

## **Conclusion**

The contribution of this work to the state of knowledge lies in the validity and structure of the confirmatory model relative to organizational complexity. The three factors found – formation, production, and transfer– correspond to a structure of possible relationships that explain organizational. In this way, the objectives, goals and achievements are part of an informational and communicative process from which knowledge management is learned. Such a process is observable in creative process.

The conclusions on the impact of the pandemic on the management, production, and transfer of knowledge as axes of the formation of intellectual capital are diverse and reflect the significant changes that have occurred in response to the global health crisis.

Accelerated digital transformation because the pandemic has forced the adoption of digital technologies in the management, production, and transfer of knowledge. Organizations and educational institutions have had to quickly adapt to virtual environments to facilitate remote collaboration, communication, and learning.

New forms of collaboration such as remote work that have redefined traditional management and collaboration models. Knowledge production has become decentralized and has opened new opportunities for global collaboration between researchers, academics and professionals from different disciplines.

Emphasis on resilience and adaptability because organizations and individuals have demonstrated greater capacity for adaptation and resilience in the face of unexpected challenges. The ability to learn and adjust quickly has been critical to maintaining continuity in knowledge management.

Innovation in online education and training, with the development of digital skills being priorities in the formation of intellectual capital. Educational institutions have had to

innovate their teaching methods to offer effective and accessible educational experiences.

Greater collaboration and transparency since the pandemic has promoted an adjustment to ethical protocols in scientific research. Advances in knowledge about COVID-19 have been shared more openly and quickly.

Challenges of inequality and access Despite technological advances, challenges related to inequality in access to knowledge and education persist. The digital divide and socioeconomic disparities can limit the ability of some people to fully participate in the formation of intellectual capital.

The COVID-19 pandemic has deeply impacted the management, production, and transfer of knowledge as fundamental pillars of the formation of intellectual capital. While it has created significant challenges, it has also catalyzed positive innovations and changes that can influence the way organizations and universities develop and use knowledge in the future. Adapting to these changes and taking advantage of emerging opportunities will be crucial to strengthening intellectual capital in a post-pandemic world.

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