La teoría de la complejidad y su influencia en el proceso de enseñanza-aprendizaje de los estudiantes de educación superior: Una sistematización teórica

Complexity theory and its influence on the teaching-learning process of Higher Education Students: A Theoretical Systematization

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ABSTRACT

Este artículo relaciona aspectos del pensamiento teórico y epistemológico de Edgar Morin con el aprendizaje y la producción científica de los alumnos matriculados en un Máster de Gestión Educativa. El objetivo del trabajo es analizar las responsabilidades cognitivas de los profesores universitarios y la formación del pensamiento complejo, considerado un elemento esencial de la educación. Asimismo, el artículo también utiliza el proceso de aprendizaje realizado por los estudiantes matriculados en un máster de Gestión Educativa para comprender la aplicación de la teoría de la complejidad de Morin en el desarrollo cognitivo dentro de los programas de posgrado.

Palabras clave: educación superior, teoría, complejidad, proceso de enseñanza-aprendizaje, pensamiento complejo

RESUMEN

This article relates aspects of the theoretical and epistemological thought of Edgar Morin with the learning and scientific production of students enrolled in a Master of Educational Management. The objective of the work is to analyze the cognitive responsibilities of university professors and the formation of complex thinking, considered an essential element of education. Likewise, the article also uses the learning process undertaken by students enrolled in a master's degree in Educational Management to understand the application of Morin's complexity theory on cognitive development within graduate programs.

Keywords: higher education, theory, complexity, teaching-learning process, complex thinking

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Introduction

According to Morin (1999), seven fundamental dimensions of knowledge should be covered, without exclusivity or rejection, in future education across all societies and cultures. These 'seven lessons' should be taught according to the customs and rules of each society and culture. It is from these seven lessons that are necessary for the education of the future that Morin (1994) calls us to a "reform of thought" to stimulate the debate on the way education can and should act as a force of the future and promote a transdisciplinary perspective in the face of the great challenge of durability.

These seven lessons are: (a) detecting error and illusion; (b) the principles of pertinent knowledge; (c) teaching the human condition; (d) teaching Earthly identity; (e) confronting uncertainties; (f) understanding each other; and (g) ethics of humanity. Given that these concepts have been sufficiently disseminated in Latin America, this paper will not develop these aspects further.

The quality of education has been one of the main concerns and challenges in the higher education debate during the last years worldwide (Singh, 2017; Waller et al., 2019). Concerns that higher education still operates in the national context and concentrates on the dimensions of teaching, research, and university extension are paramount. In today's educational climate, universities must balance quality assurance against the internationalization of education, and the development of critical and fully complex thought is shown through student publications in Indexed Journals. Higher education has been and continues to be a priority among human beings; even now, this era is characterized by difficult and complex moments caused by the dynamics of global transformations. Therefore, teachers must take on the challenge of empowering students with an interdisciplinary approach to complex thinking (Rashid, 2021).

It is highlighted in this scientific article that, in all sectors of contemporary societies, the concern for education arises as a personal or familial awareness of the growing demands posed by life in an environment characterized by signs of social, technological, and environmental change (Desjardins, 2015; Scott & Robinson, 1996). Social transformations force us to ask ourselves about the present and, above all, about the future. On a personal level, everyone worries about whether they are prepared to live in a changing and the transformative world, where uncertainty seems to be constant, and at the same time stable, disturbing. Meanwhile, rapid technological change necessitates constant innovation, flexibility, and adaptability (Scott & Robinson, 1996). Finally, environmental change is connected to both transformations, crucial for combatting its negative impacts (Otto & Pensini, 2017).

We consider in the present research that higher education has been and continues to be a "fundamentally debatable" concept (Castoriadis, 1997). The history of its conception in the social sciences reveals an essential spectrum of meaning, an exciting heterogeneity of meanings, related to the theoretical and epistemological positions of all the disciplines that have been interested in studying it. These different constructed meanings correspond to the different historical epochs and material conditions through which societies in which higher education has taken place have passed.

We theorize that traditionally, education has been defined as transmitting knowledge, beliefs, traditions, and customs from the older, more experienced generation to the next generation to guarantee the continuity of a given society (Larroyo, 1981). Frade's (2016) theoretical contributions are crucial to our thesis that higher education is the basis of what must be transmitted in each moment, and society is determined. In this vision, the center of the debate is: how should higher education respond to that conjuncture of achieving complex thinking in students? To answer this question, the historical patterns of education across cultures and societies must be examined (Frade, 2016).

From the past until today, the idea that education is the action that has accompanied

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humans throughout their historical trajectory has been strengthened. The need to pass down the history of each generation made education essential in ancient times (Bowen, 1972). Many centuries later, significant production and social organization transformations made education even more relevant, as learning was essential to keep up with the latest social, technological, and environmental changes. Thus, education is necessary to maintain the dynamics of new scientific and technological discoveries. At the same time, through education, man acquires a human face and citizenship, and if education is essential in the context of any society, its leading actor is also essential; hence the need to place the teacher in the analysis of education and school knowledge.

Complexity and learning: an approach to concepts and theories.

The word "complexity" is of Latin origin, and it comes from "complectere," whose root "plectere" means to braid, to link. Thus, it is equivalent to the quality possessed by particular objects, phenomena, and processes which, by their very nature, presuppose limitations inherent in any attempt at understanding.

These limitations can be of two types fundamentally:

Objective limitations: Typical of the human being, to perceive a specific accumulation of information and decipher it at a given time (Organic).

Subjective limitations: Those that are related to the experience and culture of each subject.

For some years now, Complexity Theory has gained strength. It is based on specific historical-scientific antecedents such as the Uncertainty or Indeterminacy Principle, for which Werner Heisenberg won the Nobel Prize in Physics in 1932, and Albert Einstein's Theory of Relativity (Kuznetsov, 1990), and draws on elements from other theories such as the general system, chaos, and fractals, to extrapolate with

different nuances and utilities to other fields of knowledge.

Complexity Theory is conceived by (Edgar Morin, 1994, 1997, 1999) as a factory of events, actions, interactions, feedbacks, and determinations that constitute our phenomenal world. "Complex systems" (be they specific objects, phenomena, and processes) are understood as those that present the following characteristics, qualities, or particularities:

1- Heterogeneity of the parts (diverse and multiple nature).

2- Nonlinear interactions.

3- The richness of interaction between them (includes their contradictory character).

4- Multidimensional and multi-referential character.

5- Commonly present numerous assessable variables.

6- Offer information that, by itself, reveals the measure of its complexity.

7- Rich in multiple and interdependent events that usually manifest with unpredictable, nonlinear, and often asymmetrical consequences.

8- Under an apparent static or simplicity, the true one is often hidden.

9- Influenced by unforeseen factors and circumstances can influence or provoke a change in their behavior and the expected results, altering everything or varying them significantly.

Analysis and discussion:

To develop this scientific research, a qualitative approach was adopted to highlight the application of scientific methods such as historical-logical, hermeneutics, and Theoretical Systematization. These methods are used to determine the main theoretical foundations, principles, antecedents, concepts, and definitions

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of research on Complexity Theory and the formation of complex thought as a critical substantive process in universities. This merits an ongoing, systematic, and permanent treatment in all subjects with an interdisciplinary and transdisciplinary approach. In the present study, a literature review was also performed.

After carrying out a theoretical systematization, we assume in this research that complexity is a way of analyzing and reflecting on specific aspects of nature, society, and thought, which have specific characteristics that classify them as systems of complex behavior. Complexity theory proposes that knowledge production involves desire, randomness, chance, paradoxical, emotion, and uncertainty (Morin, 1997). If we accept that, by the actions carried out throughout its history, the human being is rational, has proven to be sensibly constructive, but is also simultaneously irrational and unthinkingly destructive, we have to ask ourselves about the type of discourse that human beings can develop insofar as we are at the same time rational and irrational.

The complex view incorporates the relationships between opposing elements in a complementary way and not exclusive. This principle, which seeks to minimize the limitations that analytical thinking produces in the absence of synthetic thinking, is a characteristic of integrative thinking (Morin, 1997). From the perspective of complexity, the human being is an indivisibly dialogical biological-cultural subject, where there is no primacy of one aspect over the other but a relationship of mutual and incessant modulation. This relationship represents an open invitation to rethink the human condition and the practices dependent on this consideration, such as health, education, ethics, administration, and other human activities.

Complexity implies transitioning from the essentialist perspective, which asks about the essence of things, to the generative or constitutive perspective, which asks about the genesis of the network of relationships that constitute a given phenomenon. In this way, certain mental habits of the current era are evident, in which

the functioning of humans, nature, and society is reduced, mechanized, or trivialized. Such mental habits include anthropocentric thinking, the habit of analyzing without synthesizing, thinking outside context, and universalizing or standardizing specific cultural codes of a region or a country.

An approach to epistemological contributions from the vision of Edgar Morin:

In a simplified way, complexity theory proposes three logical operators to trace the emergence of complexity as a hermeneutic of the world and of life, which aims to elaborate a propaedeutic of/towards complexity (Gadamer, 1997). These operators are:

1. The dialogic operator: This operator can be defined as the complex association (complementary/concurrent/antagonist) of instances, which are necessary for the existence, functioning, and development of an organized phenomenon (Morin,1994). In other words, the dialogic principle makes sense of how antagonistic or contradictory notions may be made complementary to generate a new understanding of phenomenal relationships. The interrelationships between endogenous pressures to nervous system development and environmental and sociocultural pressures have caused the brain to evolve dialogically (Salazar & Alonso, 2020). Under the dialogic operator, the brain ascribes meaning to the different rules governing knowledge by establishing complementary relationships between opposites under the dialogic operator.

2. The recursive operator describes how brain operators are characterized by self-production, self-organization, and processes that feedback on themselves (Salazar & Alonso, 2020). The image of a whirlpool clarifies this idea of recursion (a whirlpool is a stationary organization, which presents a constant form, although it constitutes an uninterrupted flow). In recursive processes, the effects or products simultaneously are causative and producers of the process, while the final states are necessary to generate the initial states. The ontological

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aspect of a recursive process is that a system that loops itself creates its autonomy. Thus, it becomes visible in the physical universe, in the biological universe. Most importantly, it allows us to conceive the organization of perception and thought as they exist in a recursive loop in which computation – cogitation generate each other.

3. The hologrammatic operator: This operator describes how each point of the hologram contains the object's presence in its entirety. The brain can be thought of as a hologrammatic entity because each part constitutes the totality of the brain (Salazar & Alonso, 2020). As a result, the different parts of the brain are interdependent, inter-complementary, and self-organizational. Just as the sociological axis shows that society is made in everyone through language, culture, and norms, education is a hologram of the superstructure of the system in question, as an uncritical reproduction of statutory parameters. This operator addresses the relationship between forms of knowledge and reasoning, discovering the role of parameters in defining the difference between knowledge and reasoning.

Education remains an irreplaceable system within a society in which the individual has become an object abstracted from the totality of meaning to which they belong. In the context of a society that presumes to be global and binding but that raises its project on a broad base of misery and pain, the social sciences have not closed their dialogue about the scientific scope of their propositions and their epistemological status as independent disciplines. Its object of study, social action, has also occupied an important place in the theoretical discussion about those disciplines' processes for their construction and interpretation. In the framework drawn by these circumstances, the dialogic that the social sciences experience in its course takes shape, and the dense complexity in which those who dare, through education, to recognize and assume the density of scientific knowledge of all kinds can be involved.

In these circumstances, change is a phenomenon inherent in the person and society. Of course, there have always been educational changes, but the last generation of teachers at all levels of education are currently experiencing educational reforms intensely and dramatically. These reforms can necessitate a fundamental reset in how some teachers think if they clash with the conceptual, ideological, and technical orientations in which they were trained. With this culture of change, teachers face the accelerated pace of the new era, marked by the empire of new communication technologies and the need to learn in ways other than traditional ones.

Epistemological changes in different areas of knowledge imply changes in the ways of learning and teaching. In addition, technological advances entail new forms of professional socialization, and, for this, it is necessary to reconstruct essential processes. This can entail continuous training, modifying the structure, reconfiguring work situations, or generating new educational professions. According to Hargreaves (2005), there are two recurrent explanations for this problem: professionalization and intensification.

The argument that teachers must assume more remarkable professionalism in their role as a teacher is linked to curricular reform processes occurring across the globe. This reform is demanding a continuous improvement and more excellent exercise of pedagogical leadership in schools. According to this approach, teaching is becoming increasingly complex and more technical and demands what is now called "extended teacher professionalism" (Hargreaves, 2005).

Undoubtedly, teacher training can be oriented to their personal development and their professional development. Nevertheless, as Soto (2002) points out, this training can respond to needs of the education system, needs that are real and objective, even if teachers do not feel as such.

We highlight as a valuable aspect what was contributed by (Imbernón, 2005) in a work presented to the Technological Institute of Monterrey that points out that the educator of the 21st century must acquire not only

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professional skills in their training but also competencies in citizenship and social skills to interact with others. These competencies are crucial for carrying out successful interactions in various sociocultural contexts. An issue of equal importance is defining the role of the teacher and the exact kind of professional learning they will receive in initial training. Accordingly, it must be recognized that teachers are no longer the only repository of knowledge.

The twentieth century witnessed several scientific revolutions, and with these came the emergence of the sciences of complexity and the approach of dialogical-complex thought. In this way of thinking, the convergence of different theoretical perspectives that generate new explanations of actual processes is noticed. This is the case of critical-dialogical thinking and complex thinking. In this approach, the categories of totality, movement, and contradiction social reality are analyzed and converge with the basic postulates of complexity theory. From this perspective, in the present decade, emerging social changes are taking place with an optimistic and innovative vision that generates alternatives in all areas, hoping to transform this world into one where the mentality of innovation and change also permeates the educational field from a dialogical-complex thought.

With complex thinking, certainties and absolutes are denied (Morin, 1999). Thus, the complete possession of truths is denied, and the presence of uncertainties and errors in any human knowledge is recognized. Morin develops the idea of uncertainty in knowledge. Along with this idea, the philosopher also defines the limits, blindness, and miseries of knowledge and invites us to recognize the multiple uncertainties that prevent knowledge from being absolute, specific, and immovable. Furthermore, he describes error as a constant companion in the process of approaching knowledge.

(Morin, 1994) also states that:

[...] knowledge entails relations of uncertainty, and in its exercise, a risk of error. It can indeed acquire innumerable

certainties, but it will never eliminate the problem of uncertainties. Uncertainty is both risk and possibility for knowledge, but it does not immediately become a possibility, but when through, it is recognized. The complexity of knowledge is precisely what leads to this recognition; it is what makes it possible to detect these uncertainties better and correct errors [Morin, 1994].

To recognize uncertainty in higher education is to realize that teaching requires an awareness of unfinishedness. It assumes a demanding, difficult position that avoids simplifications, fictitious facilities, and gross inconsistencies. Teaching in higher education involves avoiding a fallacious superiority that is assumed by teachers who perceive themselves as the sole sustenance of authority in the classroom.

Let us examine some principles that, according to complexity theory, govern learning:

The multiple and diverse nature of what is studied: each person is in themselves, a unique being of a multidimensional nature, in which the biological, the psychological, and the social are differentially shaped. Thus, both the object of study and the subject who learns are subject to multiple and diverse specific natural and circumstantial conditions. Furthermore, each human being appropriates a socially constructed culture with a multiform nature, which is expressed in the diversity of its contents (Aguirre, 1998). Thus, human learning cannot be weighed, measured, or controlled absolutely, as we do with other phenomena or processes less influenced by the external environment.

The configuration of distinct and contradictory elements is related to the individual, unrepeatable, and dialectical character that has the development of the personality of each one (Delgado, 2007) and the teaching-learning process that involves it. The wealth of perspectives that are often antagonistic or complementary when approaching learning, as well as the absence of a unifying theory, are closely related to the range of theoretical

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precepts, positions, and interpretations that, according to different philosophies, ideologies, and methodologies assumed, are made concerning human development and the process of knowledge construction.

The presence of the unforeseen also governs learning. Aware of the complexity of reality, the only thing that seems inevitable is change and, with it, the emergence of the unforeseen. These two factors arise both about the development of any social research and the learning processes and the performance of the subjects during the process.

Learning is also governed by an open conception of the subject-object relationship. This conception indicates the study within the framework of the ecosystem in which both are located and the interdependence between the individual and the social.

From all the above, we assume the following conclusions:

1- Human learning is a complex process. Therefore, it must be further studied, and the nuances of complex thinking must be further explored to achieve more outstanding scientific production.

2- Complexity theory constitutes a necessary theoretical-methodological basis and psycho-pedagogical tool that can promote human learning and evaluation when applied during teaching.

3- The fact that a unifying theory on how intellectual and scientific learning occurs is not available so far does not nullify or detract from the value of those already existing, nor does it justify the illegitimate separation or fractionation of human learning.

4- It is crucial that an interdisciplinary approach can be given to Complexity Theory as a systemic process and influence the learning process of students in higher education to encourage critical thinking.

5- According to Morin, the fragmentary way of understanding the human condition has become invisible and fading. Therefore, the human condition must be vindicated.

6- Faced with the reality of dissociated, fragmented knowledge and the gulf between these and the increasingly multidisciplinary, transversal, multidimensional, transnational, global, and planetary problems, Morin calls for the need for the reform of thought. Higher education is one platform in which complex, critical, and pertinent thinking can be constructed and performed.

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