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Complexity and transdisciplinary in medical curricula committed to Latin American bioethics

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Abstract

Adopting bioethics as the framework, this essay discusses the transformation of medical curricula in Brazil from a multidisciplinary model to an inter- or transciplinary one. The narrative review method is used to discuss the theory of complexity and transdiciplinarity, establishing an analogous understanding between how Latin American bioethics views use this theory to understand reality, creating conceptual framework of a medical curricula that goes beyond fragmentation in training. Complex thought and transdiciplinarity are fundamental for the bioethics views of the global south to understand a non-reductionist reality, one that is open to constructing knowledge that is not isolated in a biomedical understanding of the world. Likewise, to train physicians with a broader view of health and who value the social and subjective determinant aspects in the health-disease process, the curriculum must provide a rekindling of pieces of knowledge. The introduction of complex though in medical curricula can stimulate non-reductionist teaching.

Keywords: Bioethics. Education, medical. Curriculum. Interdisciplinary placement.

Resumo

Complexidade e transdisciplinaridade no currículo médico comprometido com bioéticas latino-americanas

Este ensaio aborda, à luz da bioética, a transformação do currículo médico no Brasil de um modelo multidisciplinar para um inter ou transdisciplinar. Em revisão narrativa, discutem-se a teoria da complexidade e a transdisciplinaridade, estabelecendo analogia entre a maneira como bioéticas latino-americanas usufruem dessa teoria para a compreensão da realidade, formulando bases conceituais de um currículo médico que supere a fragmentação na formação. Para as bioéticas do sul global, o pensamento complexo e a transdisciplinaridade são fundamentais para compreender uma realidade não reducionista, aberta à construção de conhecimentos que não se isolem na explicação biomédica do mundo. De maneira semelhante, para a formação de médicos com visão de saúde ampliada, que valorizem os determinantes sociais e subjetivos do processo saúde-doença, o currículo deve proporcionar a religação dos saberes. A introdução do pensamento complexo no currículo médico pode estimular o ensino não reducionista.

Palavras-chave: Bioética. Educação médica. Currículo. Práticas interdisciplinares.

Resumen

Complejidad y transdisciplinariedad en el currículo médico comprometido con las bioéticas latinoamericanas

Este ensayo muestra, basándose en la bioética, la transformación del currículo de medicina en Brasil del modelo multidisciplinar al modelo inter- o transdisciplinar. Desde una revisión narrativa se discute la teoría de la complejidad y la transdisciplinariedad bajo una analogía de cómo las bioéticas latinoamericanas utilizan esa teoría para comprender la realidad, sentando bases conceptuales para un currículo de medicina que supere una formación fragmentaria. Para las bioéticas del sur global, el pensamiento complejo y la transdisciplinariedad son claves para comprender una realidad no reduccionista, abierta a la construcción de saberes que no se restringen a la explicación biomédica de mundo. Asimismo, para una formación médica con visión amplia de la salud y que valora los determinantes sociales y subjetivos del proceso salud-enfermedad, el currículo debe propiciar la reconexión de saberes. La introducción del pensamiento complejo en el currículo de medicina puede fomentar una enseñanza no reduccionista.

Palabras clave: Bioética. Educación médica. Curriculum. Prácticas interdisciplinarias.

The authors declare no conflict of interest.

Research

In the field of medical education, there has been a long-lasting debate about the harmful effects of the fragmentation of knowledge on the learning and future professional practice of students [1-3]. Consequently, since the 1980s, strategies have been adopted to reformulate curricula and teaching practices in Brazilian medical schools. Despite the different approaches and scope of the initiatives, the overall goal was to prepare future doctors to provide better health care to the population [4].

One of the milestones in this process was the publication of the National Curriculum Standards (DCN) for undergraduate studies in medicine by the Brazilian National Education Council in 2001. This document provided adaptations in medical schools in all regions of Brazil so that their graduates would leave as professionals with *a generalist, humanist, critical and reflective education, able to act based on ethical principles, (...) from the perspective of comprehensive care* [5].

Several projects and policies were implemented in the following years, aiming at changes in the training of health professionals as a whole, such as the DCN for Healthcare Courses, the Incentive Program for Curriculum Changes in Medicine Courses (Promed) and the National Program for Reorientation of Professional Training in Health (Pró-Saúde) [6].

These new educational guidelines, involving knowledge and practices from both education and healthcare professions, go beyond the classical division of scientific knowledge into disciplines [3]. The break with a traditional model of biology-oriented education aimed to introduce the perspective of integral health, even though this concept has several meanings in healthcare education [7]. This requires changes in the practices of students, teachers and health professionals involved in education, which has been a challenge since the beginning of the process [8] to the present day.

The dispute seems to go beyond the clash between the hegemonic biomedical model and that of integral health. It is important to realize that curricula—and the educational practices stemming from them—result from political processes in specific historical times and social arrangements, expressing principles and theories [9]. Thus, teaching that favors compartmentalized knowledge does not share the same epistemological foundations of teaching based on inter- or transdisciplinary knowledge.

A parallel could be drawn between this ongoing process of paradigmatic change in the education of healthcare professionals and the expansion of the frontiers of bioethics beyond biomedical ethics, encouraged by bioethics trends, especially in Latin America. The perception that principlist bioethics was uncapable of answering several bioethical questions, especially in peripheral countries, led to the search for a new epistemological framework for the field, including the concepts of multi-inter-transdisciplinarity and the paradigm of complexity [10]. Reflecting on this process can help understand the potentialities and challenges of the paradigm shift in the field of medical education.

Brief background of bioethics

There is no consensus as to when exactly the field of bioethics emerged. Most bioethicists believe that its starting point was the publication of the work *Bioethics: bridge to the future*, by Van Rensselaer Potter [11], in which the author defends an ethics applied to life—not only human life—and that such ethics applied to biological facts would ensure the survival of humankind and the ecosystem. In other words, bioethics should monitor scientific development, keeping an ethical eye on it, through the democratization of this knowledge. However, the development of bioethics in Anglo-Saxon countries changed Potter's initial view.

At the same time as Potter's book came out, Henry K. Beecher [12] published a compelling article revealing violations of the human rights of research subjects in 22 studies published in world-renowned scientific journals, funded by government agencies or the pharmaceutical industry. Given the impact of this publication, the US government set up a committee of experts to prevent such abuse, with resulted in the *Belmont Report* in 1978. In this document, the committee argued that research with humans should be guided by the ethical values of respect for people's autonomy, beneficence and justice [13].

The following year, Beauchamp and Childress published *Principles of biomedical ethics*, incorporating the three principles of the *Belmont Report* plus the principle of non-maleficence [14]. This important work was widely accepted not only in Anglo-Saxon countries but also globally.

However, the initial idea of bioethics as an ethics of life was limited to the biomedical sphere, focused on research with humans and the relationships between health professionals and patients, the so-called principlist bioethics [10].

Alongside the global spread and expansion of the field of bioethics, observations about the limits of principlist bioethics began in the 1990s. Initially, criticism from European and US authors questioned the philosophical aspects of principlism, its epistemological foundation and theoretical soundness [15]. Clouser and Gert [16] argue that the existence of ethical principles implicitly denies the idea of morality as a unity. Furthermore, the exclusive use of the four principles as a strategy for the analysis of ethical conflicts could exclude other relevant moral issues, besides being intrinsically linked to the US context, with great difficulties in being directly transposed to other cultures [17].

Next, bioethicists from the global south, especially from Latin American countries, criticized the application of the principles to the region's reality, given the inequality between core and peripheral countries [15]. Those researchers argued that the use of principlism as a tool to analyze individual ethical conflicts is inadequate when applied to moral conflicts in collective health [18]. Furthermore, the diversity of views and thoughts results in different strands of bioethics that go beyond principlism, so that the hegemony of this theory came to be seen by many bioethicists as moral imperialism of economically privileged countries [19].

Thus, in this context of criticism of the inadequacy of the principlist theory, which reduced Potter's initial idea of an ethics of life to biomedical ethics, new conceptual bases had to be proposed for the field. The multiple moral perspectives, influenced by different historical and cultural contexts, justify the need to define new epistemological foundations for bioethics in order to meet the specificities of the different moral dilemmas in different regions of the world.

New conceptual framework

Bioethics and complexity

Sotolongo [20] argues that bioethics emerged within a broader movement of change that went beyond the classical ideal of rationality, whose components are the primacy of reason, the objectivity of knowledge and knowledge at the service of the good of humanity, with the dominance of nature. The situations addressed by bioethics that stem from the interactions between humans and other living beings, human or not, influence each other: small initial variations may produce large effects, for which a solution is not always envisaged or conceived. This would be the manifestation of the paradigm of complexity in the field of bioethics.

This paradigm has been seen as a possible way to reconnect knowledge in human sciences and natural sciences that has been fragmented since positivism. Edgar Morin [21] criticizes this contemporary secular culture for being incapable of solving problems arising from diversity, unforeseen circumstances and indeterminacy, that is, from human factors, just as bioethical principlism is unable to address moral pluralism, cultural variety and the major social problems of peripheral nations [10] considered from the viewpoint of bioethics.

Thus, complexity theory carefully analyzes the interdependencies and interconnections between facts, since the ways in which ethical conflicts are perceived in any society are influenced by elements deriving from the various spheres of life of those involved in such conflicts. This cultural environment is formed by partial cultures, corresponding to different classes and social groups, which, in turn, influence culture as a whole. In this sense, it is impossible to predict how changes in these partial cultures affect the overall cultural environment.

Furthermore, even in its entirety, any culture is incomplete [22] and such cultural incompleteness in itself requires the establishment of meeting places that enable intercultural dialogue. However, viewed in a same culture, this inherent incompleteness will hardly be identified, because the permanent yearning for totality results in using parts to represent the whole [23]. Therefore, the perspective of complexity shows that it is not enough to study the parts to understand the whole [24].

Morin [21] argues that, in the rational method, the "comprehensive" understanding of things—of the whole—requires understand the parts, and not only the knowledge produced by scientists, historians and artists, but also the epistemic issues involved [21]. Thus, the analytical approach to knowledge seeks the primary causes in an attempt

to dissect complexity and reduce it to simple elements. The systemic approach, in turn, aims to organize and interconnect different kinds of knowledge, tending to a synthesis of complexity [25].

A concrete example is the bioethical reflection on the introduction of genetically modified organisms into the environment without a clear idea of their effects on the ecosystem, including in the long term. From the positivist perspective, the risks are evaluated separately, inferring that the sum of their effects represents their consequences. However, this approach is insufficient to evaluate complex issues, as it does not consider the relationships that are established in this system [26].

Classical, or first-order, epistemology of modernity emphasizes the role of the object of inquiry and the inquirer's desire to achieve pure objectivity. For non-classical, or second-order, epistemology—from which stems global bioethics, insofar as it emphasizes the interconnection between values and knowledge and the accountability of individuals to one another, nature and the future—the inquirer is intimately involved with the object of inquiry in a specific context that always conditions the inquiry process. The inquirer is part of the inquiry as a process, which has characteristics of reflectiveness [20].

From this point of view, there is a need to reflect on the concept of reality, not only in its phenomenal aspects but also in its essence. In this perspective, reality is a dynamic, integral and structured ensemble, the concrete whole, and not just the set of facts. Hence, knowledge of this reality becomes a journey of concretization from the whole to the parts, but also from the parts to the whole, not limited to their analysis but also ensuring their dialectical nature [27]. This process of becoming aware of integrated and dynamic reality can be viewed as a spiral of mutual understanding and clarification of concepts [10].

Taking as an example the performance of increasingly specialized health professionals, the positivist division of knowledge into parts renders incomprehensible the dynamic relationships that the patient establishes with society, the environment and the whole. Thus, the more knowledge is specialized, the more "asocial" it becomes, removed from the whole, and the professionals that apply it, in turn, become increasingly disconnected from reality, of which their patients and they themselves are part [10].

Another relevant aspect to understand bioethics based on complex thinking is the incorporation of the perspective derived from systemic thinking, from open and closed systems and their non-linear interrelationships. Taking the patient-health professional relationship as an example, viewed from a rational analytical perspective, it will be seen as a closed system, in which relationships only occur between those two individuals. However, such interactions are influenced by family, health institution, funding bodies, among other agents, whose non-linear relationships make it an open system [28].

From the perspective of complexity there is no disorder, but rather a complex order formed by non-linear interactions and the physico-chemical worlds of non-human plants and animals and of humans and societies that self-organize in such interactions. Consequently, methodological reflection on bioethics from the perspective of complexity requires the study these non-linear interactions, their attractors, their bifurcations and the emergence of such self-organization of the world around the subject being studied, without losing sight of the researcher's own place in these processes from a transdisciplinary point of view. One must be open to incorporating new methods for new questions, understanding the epistemological equivalence between the ability to predict and unpredictability [20].

Thus, the perspective of complexity provides a theoretical framework that makes it possible to envision bioethics as an open system of "meta-points of view," in which it can be seen through a theoretical prism of coordinated interdisciplinary knowledge, beyond the strict normativism of technical or moral regulation [29]. The intention is to build an expanded bioethics, more committed to persistent ethical issues in peripheral nations, in which dilemmas are studied not only from the perspective of ethical theories, principles and rules, but also of complementarity between empirical ethics and ethical reflection. In other words, their is a need for contextualization, with contributions from social sciences, without forgoing the typical universalization of normative ethics [30].

Bioethics and transdisciplinarity

A specific field of knowledge, defined and legitimized by a scientific community, is considered

a discipline [31]. Its origins lie in the positivist division of knowledge into parts, which hinders the understanding of the relationships of humans with their social setting, with the natural environment, with the whole.

In multidisciplinarity, used here as a synonym for pluridisciplinarity, different kinds of knowledge are juxtaposed to address the subject of a discipline [32]. Therefore, any multidisciplinary approach is a corollary of the insufficiency of the single-discipline approach to most issues that arise in this complex world. Currently, scientists cannot afford to rely only on their own disciplines, which distances them from the real, complex world [33]. By enhancing the understanding of problems, multidisciplinarity aims to support the development of better solutions [31].

Nevertheless, multidisciplinarity generates accumulation rather than integration of different kinds of knowledge, while interdisciplinarity provides dialogue between disciplines, with the transfer of methods between them [32] and even the emergence of new disciplines, such as medicine and law. Bioethics can be considered interdisciplinary from birth, uniting biomedical knowledge with moral values, since, in bioethical analyses, concepts from different disciplines are required to deal with current issues [34]. Thinking about solutions for old and new bioethical challenges will require diversified knowledge, values and experiences [33], interacting with each other.

However, interdisciplinarity does not dissolve the spatial boundaries between disciplines, since complex thinking requires viewing transdisciplinarity between, across and beyond disciplines [32]. For classical thinking, this idea makes no sense, as the space between disciplines is a void, with no object. However, owing to the various levels of reality, such space is not a void, which makes transdisciplinary research interested in the dynamics of the interaction of these various levels at the same time [31]. Therefore, its three pillars are levels of reality, complex thinking and the principle of the included middle [10].

Thus, the goal of the transdisciplinary outlook is to build knowledge as broadly as possible, without neglecting the uniqueness of experiences, capable of interacting with different kinds of knowledge, including those that are not considered scientific, in order to expand the possibilities of addressing the problems observed by complex thinking [31]. For bioethics, such an outlook is essential, because trying to solve moral issues stemming from different contexts with a single tool, as in principlism, will definitely not bring solutions that are acceptable to local morality [33].

Therefore, transdisciplinarity is essential for the fields of knowledge that are dedicated to understanding the relationship of science with the social, cultural, philosophical and spiritual aspects of humanity. Seeking to morally reflect on scientific, medical and health interventions in individuals and groups, bioethics must strive to understand reality from a view that goes beyond all disciplines.

New epistemology for medical education

Complexity in medical education

Complexity as an epistemological position involves numerous distinct elements whose reading must aim at totalization (globalization), which occurs as a synthetic reading procedure in which the more analytical explanation of the parts (positivist) is as inseparable from the whole as the whole from the parts. Thus, the globalization of the ensemble, more than its totality, makes up a unit in which there is not necessarily a hierarchy of components but rather a reaffirmation of their interdependence. In this way, the whole will be different from the sum of the parts [35].

This relationship between fragments and ensemble contributes to the reflection on a medicine that does not view humans as a mere ensemble of cells, tissues and organs.

Ardoino states that *the ensemble must still assume, in order to be recognized as complex, the intelligence of a plurality of heterogeneous constituents, inscribed in a history, which is itself open to the possibilities of a becoming* [36]. The author revives the idea of an open epistemology, in which this ensemble is a relatively autonomous unit, which considers that the elements of a given object can be decomposed—like the living being in its physico-chemical materiality—while preserving the interactive nature of its heterogeneous traits.

Complex thinking moves away from an idea of mastery over a certain field of knowledge, ascribing much greater legitimacy to uncertainty, remaining open. Supporters of this way of thinking prefer the idea of multireferentiality to that of multidimensionality, since the latter seems to reinforce analytical thinking (of the dimensions of the object).

Ardoino refers to the existence of two competing imaginaries in complex thinking—one of a logical-mathematical nature and the other of a bio-socio-anthropological nature—that interact with each other with common representations and also with contradictions that must be deepened in order to establish "world views" [35].

In this same perspective, Le Moigne [37] draws attention to the need to propose other epistemological paradigms and some procedures that legitimize the knowledge taught. He criticizes the Aristotelian axioms and points out limits of deductive logic—so predominant that he considers it the "archetype" of perfect reasoning. To this end he advocates the teaching of the systemic approach as a new rhetoric, expanding knowledge beyond deduction, since argumentation prevents one from believing in an eternal, absolute, categorical truth, thus preventing it from being imposed.

Le Moigne [37] considers that systemic modeling starts out from the contextualization of the object of study, raising arguments to relativize analytical decomposition, which was the basis of teaching for more than two centuries. It is possible to learn to model, to represent phenomena, perceiving them as active in their context, in relation to some project they form, turning into them over time. The kinds of knowledge in question are available, accumulated over at least 2,500 years of human history. All it takes is to look at them, recognize them, mobilize them [37].

Medical education in Brazil has been undergoing an epistemological change [2] with the aim of adapting graduates to the needs of the Unified Health System (SUS) and its principles. The choice of this essay of focusing on the physician's view also finds meaning in these transformations. The current DCN for the profession, as will be explored further on, instruct medical schools to educate graduates who are increasingly able to work in this context.

Four principles guided the Brazilian health reform (ethical-normative, scientific, political and health). The ethical-normative and political principles consolidate health as a human right, as a right of every citizen in a democratic state. The scientific principle expands the concept of health, understanding the health-disease process as determined by social and cultural aspects, and the health principle protects health in a comprehensive way [38]. This transformation of the view of health seems to require professionals with a broader outlook, whose education needs curricula that consider the theory of complexity.

The emphasis on community-based health care, seeking comprehensive care, requires new skills from physicians to deal with reality, since the exclusively biomedical and hospital model of thinking and acting is unable to meet the new demands of a "new" field of work, closer to the reality of the Brazilian population. Therefore, physicians found themselves more and more having to deal with typical problems of most Brazilians: poverty, exploitation, oppression, violence, lack of education, among others.

In this way, medical care cannot evade the need to contextualize the social determinants of health. Considering complexity as epistemology and humans as singular individuals, the role of medical schools should be to teach professionals to understand each person as a whole, whose health-disease process requires a complex thinking perspective.

For Ardoino, education must offer opportunities for complex thinking practices, as it *is always miscegenation, the invention of a commitment in favor of a duration* [39]. Considering that, in school, besides acquiring "knowledge" and learning "how to do," individuals are taught "to be." Thus, the epistemological foundations that support traditional teaching are challenged. Teaching based on the theory of complexity removes education from the place of learning only "what the past was about," coming to understand it as the "discovery of the future."

Paraphrasing the author [39], for the education of health professionals, complexity shifts the teaching of isolated disciplines that lead to the understanding of an anatomical, physiological and pathological body, analogous to all humans, to the discovery of the unique demands of each individual in their place in the world.

Transdisciplinarity in medical education

Transdisciplinarity in medical education seems to be the only way possible to guarantee the profile of graduates required by the current DCN. Their Article 3 provides that medical graduates shall have a general, humanistic, critical, reflective and ethical education, with the ability to work at different levels of health care, with actions to promote, prevent, recover and rehabilitate health, at the individual and collective levels, with social responsibility and commitment to the defense of citizenship, human dignity, comprehensive health of humans, drawing always on transversality in their practice for the social determination of the health and disease process [40].

The DCN advocate the inclusion of human and social sciences as a transversal axis in professional training. According to what has been discussed above in relation to bioethics, the existence of these disciplines without their interconnection to each other and to the other disciplines of the medical course does not seem to be useful for a real transformation of the fragmented view of humans.

With regard to the teaching-learning process, Rosnay believes that *teaching must offer references from the analytical approach, but for the systemic approach, such references must lead to a relationship with action* [41]. Incorporating a culture of complexity does not mean knowing everything about small details or small details about everything. The culture of complexity relates to building a sense of reality based on knowledge integration.

The medical course, then, must come up with solutions to interrelate the different kinds of knowledge about humans and formulate ways of thinking about the individual as a complex and singular ensemble. Finding teaching methods for this purpose is a challenge for educators. The DCN provide the use of methods that favor the active participation of students in the construction of knowledge and integration of contents [40]. The use of active teaching methodologies and the problematization of real situations, among others, can contribute to this change of thinking.

Final considerations

Batista [3] argues that one of the challenges for medical schools is to incorporate the expanded concept of health in their curriculum frameworks, with the consequent change in care practices, in addition to teamwork training. Therefore, the fragmentation of knowledge into separate disciplines goes against this need for professionals to work in a world with complex problems.

As with bioethics, which aims at workers who ask themselves what they should or should not do when faced with moral dilemmas, not because they may face lawsuits or have problems with their professional advice, but because they are "guided by the value of humans" [34], an effort is required to transform the concepts and practices of medical education in order to effectively educate health professionals according to these new bases.

Thinking of the teaching of bioethics, new educational technologies are proposed that allow the acquisition of different kinds of knowledge, but also of critical thinking skills, so that graduates are able to reflect on the moral issues of their future professional practice [34], which is in line with the proposal for changes in the curriculum frameworks and teaching methods of medical schools, already provided in the first National Curriculum Standards for the teaching of medicine [5].

However, these changes alone are not enough; it is necessary to expand the way of thinking, complexly and by interrelating knowledge, in an interdisciplinary manner, aiming at future transdisciplinary. Manchola-Castillo suggests that this can be put into practice by creating new methods and goals, changing the focus from the disease to the diseased person, sharing the responsibility for decisions and care between professionals, people, family members and the community, and recognizing other kinds of knowledge and perspectives besides those already scientifically validated [31].

In this way, it is believed that, as has been happening with bioethics, the incorporation of complex thinking and the ideal of transdisciplinarity into medical education has the potential to transform minds and hearts, which will naturally lead to new teaching and care practices. Just as it revives the original meaning of bioethics—as a bridge to the survival of life on Earth—such systemic thinking can help build a medical education that contributes to a fairer and more caring future.

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