

Constructivism: An Interpretation from Medical Education

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Abstract:

Background: The foundations of the medical education model include: the foundation in the basic sciences, the acquisition of scientific thinking in the biomedical sciences, and clinical learning in clinical and healthcare fields. When questioning how one learns and what is taught, the search for answers led to the displacement of passive educational models towards active models. Being found the medical education in the constructivist current, the ignorance of this pedagogical current continues, reason for which, a horizon is presented that broadens the understanding of the theoretical-practical relationship of constructivism in medical pedagogy and didactics.

Argument development: Considering that constructivism is configured as a theoretical and practical perspective, where knowledge is an individual, mental process, developed internally as the individual interacts with his environment; it is understood that the student is ultimately responsible for learning; It will be he who builds knowledge from his previous experiences, while the teacher guides the integration of the student's construction processes with culturally organized collective knowledge. In this context, the article develops the following categories of analysis linked to constructivism: principles, educational goals, learning, role of the student, role of the teacher, teaching methodology, learning strategies, and learning assessment.

Conclusion: In medical education, the teacher who incorporates the constructivist approach in his pedagogical practice begins with "knowing how to teach" to conclude in the student that he "knows himself taught". This "didactic transposition" is possible by using different strategies, both teaching and learning, that dialectically resolve the interrelation between teacher, student and content.

Key Word: Constructivism; Medical education; Learning; Teaching; Evaluation of learning.

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I. Introduction

Medical education during the 20th century was developed from the focus of the "Flexner Report", providing the support for the application of the medical-biological model and the basic standards for doctor training at the undergraduate level^[1]. The Flexnerian influence consolidated the foundations of the medical education model in three fundamental aspects: the foundation in the basic sciences, the acquisition of scientific thinking in the biomedical sciences, and clinical learning in clinical and healthcare fields^[2].

On this structural basis, in 1966 McMaster University in Canada introduced the "McMaster Philosophy" to the medical program that included self-directed learning, problem-based learning, and small group tutorial learning^[3]. This approach marked a turning point to open the discussion of medical education by focusing on two fundamental questions: how to learn and what is taught. The search for answers to these two questions allowed the incorporation of different tendencies that started a postmodernist transition process in medical education consisting of the displacement of passive educational models towards active models^[4,5].

Passive models in education are centered on teaching, where educational strategies that revolve around the teacher, that is, how to teach, predominate. Active educational models are oriented to learning, where the student acquires the responsibility of regulating his learning, placing himself at the center of the educational process, that is, on how to learn.

The active learning paradigm became generalized when considering in the educational processes the advances of the medical sciences, the modifications in the models and systems of medical attention, the technological advances applied to education, and the incorporation of new approaches in teaching and learning. International positions in medical education such as the Edinburgh Declaration of 1988^[6], the Bologna Declaration of 1999^[7], the report of the General Medical Council of the United Kingdom published in 2002^[8], the Tunning Project that published in 2007 the final report for Latin America^[9], or the Profile by Competencies

of the Mexican General Physician prepared by the Mexican Association of Faculties and Schools of Medicine^[10], coincide in promoting student-centered learning, so that it actively builds knowledge.

In this sense of reflection, the foundation of the models proposed at the international level in medical education is located in constructivism, a theoretical current on knowledge and learning that is applied in multiple teaching and learning strategies. However, various questions remain in the medical-teaching community in the sense of: what is constructivism? What are its goals? What is the role of the teacher and the student? How is their articulation with medical education?

With the purpose of integrating a horizon that broadens the understanding of the theoretical-practical relationship of constructivism in medical pedagogy and didactics, this communication explores the answer to the questions stated above.

II. Starting Point

Constructivism has its roots in epistemology and is applied in sociology, anthropology, psychology and education^[11]; for this reason, it is necessary to assume a conceptual position related to medical education.

From the historical deconstruction of medical education, it is concluded that it is a cognitively, socially and historically determined process; that allows the individual to adapt and modify the material conditions of life individually or collectively, in order to satisfy basic needs, whether natural or social, from a critical perspective that enables a medical practice oriented to effective action on the dynamics of the process health-disease; that is, it is a social practice, the objective of which is to produce medical professionals capable of contributing to the sustainable improvement of the human condition^[12].

In the 20th century, the orientation of medical education was dominated by two fundamental aspects: Flexnerian model and community model^[13]. In both cases, teacher participation is the central axis of the educational process and induces the increase in the amount of theoretical information that the student appropriates to develop, secondly, skills and attitudes for the practice of medicine.

In particular, the Flexnerian model of medical education is characterized by a greater emphasis on teaching than on learning, it strengthens the encyclopedic accumulation of knowledge and the power of the teacher, fidelity to established knowledge, the reproduction of hegemonic stereotypes and models of medical practice, the imposition of content, thoughtless memorization and transitory learning to accredit exams^[5,14].

At the end of the 20th century, medical education recognized the need to focus on the student for the acquisition of knowledge, abilities, skills and attitudes; opening an emerging paradigm of medical education^[6,15]. This paradigm promotes comprehensive learning in addition to promoting the maturation of the student as a human being. It is characterized by promoting an education where the student is the axis of the educational process and emphasizes learning focused on the acquisition of methodological and procedural skills that allow building knowledge. The metacognitive skills acquired are oriented towards the systematic questioning of the established knowledge through critical reflection of the stereotypes of medical practice, which enables their participation in the selection of content to develop learning for life^[14-16].

The coexistence of pedagogical practices that have the teacher or the student as the axis of the educational process, generated transition processes of educational models in medical schools^[17]. In order to operate educational models, the hegemony of the paradigm of medical sciences dominated fundamentally by molecular biology is initially recognized; put the need for a change oriented towards inter and transdiscipline that strengthens critical thinking, the acquisition of significant knowledge and student satisfaction is also identified, so as to enable the development of a full life and efficient professional practice^[18]. The answer to the need for change lies mainly in problem-based learning, tutorial teaching, and interdisciplinary learning. In this context, constructivism is the psycho-pedagogical model that allows articulating these pedagogical practices^[18,19].

III. Principles of Constructivism

Constructivism is an intellectual movement related to the problem of knowledge. It is limited to an epistemological trend developed throughout the History of Philosophy from the thought of pre-Socratic philosophers^[11,20,21]. Constructivism as epistemology shows the human being as an active constructor of reality and exposes the following basic principles^[22]: knowledge is a construction of the individual, there are multiple individually constructed realities, science builds, creates and invents scenarios to explain and give meaning to being-in-the-world.

In the educational field, the psychological orientation of constructivism is configured as a theoretical perspective where the knowledge of all things is an individual mental process developed internally as the individual interacts with his environment. The main contributions were provided by Lev Semionovich Vigotsky (1896-1934), Jean Piaget (1896-1980), David Ausubel (1918-2008), Stephen Toulmin (1922-2009), Jerome Bruner (1915-2016), D. Bob Gowin (1961-1990) and Joseph Donald Novak. Piaget's proposal is the turning point where the beginning of a movement focused on the cognitive perspective in the field of the pedagogical

and the didactic is recognized; but it will be Novak, who finally systematically develops a constructivist theory^[23,24].

The reconstruction of constructivism from the cognitive perspective of learning, deepens the implications of the teaching and research methodology that underlie constructivism. This allows articulating conceptual, methodological and attitudinal structures of the teaching and learning processes, linking theoretical approaches that come from epistemology, logic, linguistics, cognitive psychology, pedagogy and didactics; to base the basic principles of constructivism that are expressed in the following terms^[25]:

- Knowledge is built as a result of cognitive processes that translate into human behavior; reason why the knowledge is not a copy of the reality but a construction of the human being.
- There are multiple realities individually constructed and not governed by natural laws.
- Science does not discover ready-made realities; rather, it builds or creates realities, so "truth" is the most informed and sophisticated individual construction on which consensus exists and "facts" are always loaded with theory.

In the construction of these principles, the contribution of Epistemology is directed towards the nature of knowledge and knowledge in individual-community relations; Logic contributes the analysis of the problem of methodical thought and the laws of deduction and the demonstration of hypotheses and Linguistics makes reference to individual and social meanings in the communication process. Cognitive psychology provides the investigation of how and why mental representations and their concepts originate in human consciousness and what relationships they have with the outside world. Pedagogy and didactics make it possible to explore intellectual transformation and learn to read and write in a specialized language^[21].

In the articulating context of these elements, the application of constructivism to different pedagogical objects specific to each of the fields of knowledge addresses three fundamental perspectives: "what is built", "how is it built" and "who builds"^[26]. As these perspectives are developed in the dialectic of the teaching-learning process, constructivist approaches that offer different theoretical, conceptual and methodological positions multiply to base both teaching and learning. The analysis of contemporary constructivist versions leads to locating them in explanatory horizons that make it possible to move from the theoretical foundation of learning to educational practice through the following constructivist currents^[24,27,28]:

- Psychogenetic constructivism, current derived from Piaget's educational theory.
- Sociocultural constructivism, a current derived from the thought of Vygotsky, who places interest in the development of domains of social origin.
- Radical constructivism, supported by Von Glasersfeld and Maturana who argue that the construction of knowledge is subjective.
- Social constructionism, a constructivist trend derived from the social theory of Berger and Luckmann, integrated into the understanding of knowledge as a discursive practice.

Considering the influence of educational psychology on the teaching of experimental sciences^[29], medical education appropriates constructivism from the theoretical foundations of the Piagetian psychogenetic approach, the theory of cognitive schemas, the Ausubeline theory of assimilation and meaningful learning, and Vigotskian sociocultural psychology^[30]. It also assumes the following principles: the student is ultimately responsible for their own learning, the student's constructivist mental activity is applied to content that already has a considerable degree of elaboration and the teaching function is to integrate the student's construction processes with knowledge culturally organized collective^[31]. These principles translate into the practice of placing the student at the center of the educational process so that he builds his own knowledge; Thus, the teacher participates in the teaching-learning process as a mediator; while learning arises from learning needs, so it is linked to learning in clinical settings (hospital, community and patient's home), the activity is substantive in the learning process, favoring that error is a source of construction of knowledge.

IV. Goal of Education

The fundamental objective of medical education is the training of human resources capable of diagnosing, treating and preventing diseases, both individually and collectively, from a scheme of modern scientific rationality, through the linkage of various basic, clinical and sociomedical disciplines, where clinical teaching is of special importance^[32]. To achieve this objective, educational institutions adopted the Flexnerian approach to medical training and from that context, they have initiated processes of educational innovation focused on constructivism that leads to asking the following question: what is the educational goal offered by the constructivism?

Considering the principle that the student builds significant knowledge for himself from his previous experience, obtained individually or socially, and bearing in mind that the meaning of knowledge is closely related to experience, constructivism allows the student to be guided in his transit through the learning process

(knowing what is known, as a metacognitive activity) and incorporating new knowledge into preliminary experiences^[33,34], which makes it possible to make sense of the cognitive triangle (teacher-student-content triad)^[35].

On the other hand, the human being in community builds knowledge as conceptual, methodological and attitudinal structures, which are related to their culture and make it possible to regulate relationships with oneself, with society and with nature. Following this line of reflection, constructivism allows us to clarify and maintain the language and the means of communication between the teacher and the student, as well as between students^[33,36], making it possible to assign symbolic contents to the learning experiences that give meaning to the affective-relational triangle (teacher-student-goals triad)^[35]; that is, meaning is attributed to the cognitive experiences that derive from the pedagogical relationship of learning.

Students participate in the construction of knowledge during the educational process with their life experience and a preconceived cognitive structure based on it, which is associated with memory. Through the perspective of constructivism, the student can reformulate their existing structures linking information and recently acquired experiences to existing knowledge in memory. Thus, the student actively learns when he incorporates new information into his existing mental structure, linked to his previous experience, according to his own learning style and giving meaning to the acquired learning^[16,30]. This perspective offers the possibility of understanding the dialectic of the instructional triangle (student-content-goal triad)^[35].

In this context, the educational goal of constructivism is shown as the process that makes it possible to reconstruct, through the experiences of vital situations, the attribution of meaning that the student makes when interacting with reality. In this process, conceptual, methodological and attitudinal structures are incorporated, which account for integral learning in the humanistic, scientific and technological training of the subject. Thus, according to Ortiz Granja^[22], through the construction of significant knowledge, the student achieves cognitive understanding that favors conceptual change and enables adaptation of what has been learned to the subject's context with adequate well-being. Thus, the application of constructivism to medical education is located in a learning by discovery, which uses a "curriculum for thinking", from an inter and transdisciplinary perspective, which strengthens meaningful learning and the development of general and specific strategic skills that allow the student to carry out an efficient, effective and humanistic medical practice.

In this context, the goals of medical education from a constructivist perspective is to favor and enhance the general development of the student through the acquisition of knowledge, skills and values to practice medicine, also promoting the moral and intellectual autonomy of the students.

V. The Learning

Constructivist theories of learning derive from cognitive theories that culminate primarily in objectivism, a philosophical source of behaviorism, and from cognitive theories that have guided educational practice during the 20th century, when constructivism developed from theories proposed by Jean Piaget, Seymour Papert, Jerome Bruner, Lev Vygotsky and John Dewey. Faced with such diversity, the question arises: what is the conceptual structure that makes it possible to recognize educational proposals as constructivist?

A central position in the different interpretations and applications of constructivism is the conception of learning that is stated as an active process; that is, a social activity, a contextual process, a life experience and a construction of meaning systems, where motivation plays a transcendental role^[31,37].

In constructivism, the reflective application of knowledge is integrated into learning, which, being active, allows the student to develop metacognitive structures and construct meanings outside of it, through the use of sensory stimuli; that is to say, the student must use the significant knowledge that he has learned through interaction with the physical and social environment in which medical practice takes place, so that learning becomes a life experience^[5,38].

From this perspective, the construction of linked systems of significant knowledge is the nodal point of student learning; so it is essential that you "learn to learn", that you reflect on your own learning process. The student learns to learn how he has learned, in addition to learning in relation to what he knows, his interests, prejudices or fears^[39]; in short, learning is recreating knowledge itself^[40].

In the constructivist approach to learning, prior knowledge plays a determining role, since it indicates what is necessary to know in order to learn; that is to say, a detailed structure of previous knowledge is required on which the new knowledge that is acquired is built and incorporated. To learn significantly, it is necessary to review ideas, ponder the truth of them, play with them and use them, to contrast them based on your previous knowledge and experience, applying these to new situations and integrating new knowledge with pre-existing intellectual constructors, so learning is not instantaneous and it takes time to learn.

Medical education is aware that learning is a relatively permanent change in mental processes, emotional and/or behavioral functions that result from experience, so it is a dynamic process that is generated throughout life by which Individuals acquire new knowledge or skills that induce changes in their thoughts,

feelings, attitudes, and actions^[41]; which implies that learning is conceptualized as an evolutionary, progressive, permanent, participatory, contextualized and distributive process^[15].

The central axis of medical education is precisely the learning of the clinic. The constructivist perspective enriches the clinical training of the student since it makes it possible to rescue the general and specific strategies of mastery that the student possesses as a product of his previous learning experiences, regulated through metacognitive processes to develop the ability to appropriately use acquired knowledge, skills and attitudes, to every situation that comes up in your medical practice.

VI. The Role of the Student

Assuming that constructivism is oriented towards the construction of knowledge through the attribution of meaning from experience, induces to question the role that the student performs; for in the field of constructivism, you will be ultimately responsible for your own learning process. This implies that they actively participate in learning, that is, in the process of attribution of meaning to their experiences derived from interaction with the world, passing through knowing what and knowing how to arrive at reflection-in-practice^[42].

To finally operate a reflective practice derived from constructivist learning, students participate in their training process with an established world view, made up of years of previous experience and learning, through which they filter all new experiences by modifying the interpretation. of your observations, in the sense of acceptance or not of the newly acquired information.

In a constructivist teaching environment, the student trusts to perform effectively from the initiative, is aware of different alternatives and options to make decisions, and acquires the personal feeling of being trained and independent. This involves the ability to predict the results or consequences of their actions, to understand and express personal needs, in addition to taking care of their needs without harming themselves or harming others. The student commits to his homework, experiencing the result of positive choices through the responsibility derived from his decisions and behavior^[15,43].

In the field of medical education, the student builds his knowledge through "manual" and "behavioral" experiences in different pedagogical settings (classroom, laboratory, clinical field or community); understand the thematic contents and learn to work collaboratively with adults and to solve problems in professional life. The responsibility for learning falls on the student, who must be characterized by being active and participatory^[5], motivated by internal factors, with high self-esteem that allows him to operate from a system of internal values. In this context, the medical student thinks to obey; strengthens logical reasoning to make clinical-therapeutic decisions, through collaborative work teams aimed at solving health problems.

These characteristics allow the student to follow a problem or clinical activity to apply their previous knowledge and integrate it with new alternatives presented by other team members, sources of information or daily experiences. Through trial and error, the student makes a balance between pre-existing approaches and new learning experiences that allow them to constitute a new level of understanding and the development of more complex skills.

In the different educational settings used in medical education to make sense of learning situated from the constructivist vision, the student must be an active subject with the interest of strengthening their cognitive competence to learn and solve problems in order to enhance, induce or train cognitive and metacognitive skills; reason why it must have the opportunity to participate actively in the development of the curricular contents (declarative, procedural and attitudinal knowledge) that will train him as a general practitioner.

The application of constructivism to medical education allows the active and reflective participation of the student. Being the builder of his own knowledge, he is directed to the reconstruction of the content he is facing. The student will start learning taking into account their cognitive development and previous learning experiences, which allows them to acquire the ability to apply the knowledge they have learned to each and every one of the health problems that they will have to solve in their professional practice. You will also have the ability to learn from those new health problems and improve performance in solving the most frequent health problems. In this process, the teacher guides and accompanies the student to strengthen their cognitive development, their intellectual and moral autonomy.

VII. The Role of the Teacher

If the educational process is based on the principles of constructivism, the teacher's role transitions from a simple information dispenser to the communication provider of structured activities that challenge students' notions, in a way that makes it possible to help them review their worldview^[44]. The constructivist approach strengthens student-centered learning by requiring, as indicated by Grennon and Brooks, that the constructivist teacher^[45]:

- Encourage and accept the initiative and autonomy of the student.
- Use information from primary sources in addition to manipulative, physical, material resources.

- Use cognitive terminology, for example: classify, analyze, predict, create.
- It allows student responses to drive learning, induce changes in instructional strategies, and modify content.
- Explore students' understanding of concepts, prior to sharing their own understanding of concepts with them.
- Encourage participation through dialogue with the teacher and collaboration between students.
- It stimulates the investigation in the student elaborating reflective questions, without fixed limits and promotes the elaboration of questions.
- It promotes the elaboration of initial responses of the students.
- It encourages discussion through learning situations and experiences that generate contradiction with the student's initial hypotheses.
- Provides time for the student to reflect on the question posed and develop the answer.
- Provides student time to build relationships, create metaphors, and build analogies.
- Encourage students' natural curiosity through frequent use of the three-step cyclical model of learning: discovery, conceptual introduction, and application of concepts.

In this sense, the role of the teacher is oriented to organize the information around conceptual groups of problems, questions and discrepant situations that motivate the student to generate and increase interest in learning. Their participation is essential to support the student in the development of new approaches and connections with previous learning. Presenting ideas in a holistic way allows the student to inductively elaborate the transfer of knowledge through broad concepts that, when analyzed in parts, make it possible to apply them in solving problems. This implies that the teacher is a facilitator, a guide in meaningful learning, to stimulate the student and contribute to the development of critical, analytical and synthetic thinking through the educational process^[5]. In this sense, the teacher is a co-learner^[46].

To achieve this, the teacher must be interested in the students as people, recognize their academic characteristics, understand and adopt an attitude that is sensitive to perceptions and feelings, rejecting authoritarian and egocentric positions. Thus, it responds to the student's queries, shares responsibility for the content to be taught, follows the student's learning rhythm, guides him through the course to effectively achieve the objectives, helps him to learn to study by himself and through problem solving supports you to overcome your own difficulties^[43,44].

In response to the incorporation of integrated teaching, problem-based learning, community-based learning, and curricular flexibility approaches that led to the promotion of self-directed study, Harden and Crosby described 12 roles of the teacher involved in training medical and are grouped into 6 areas attending to the activities of the teacher; each of the areas is subdivided into 2 roles^[47]:

- Facilitator: mentor and learning facilitator.
- Role model: on-the-job role model and teaching role model.
- Information provider: lecturer and clinical or practical teacher.
- Resource developer: resource material creator and study guide producer.
- Planner: course organizer and curriculum planner.
- Assessor: curriculum evaluator and student assessor.

Considering the horizon that the roles of Harden and Crosby^[47] open in pedagogical practice, the teacher who incorporates the constructivist vision into his pedagogical practice, selects and organizes educational experiences for the student that allow promoting learning to learn (learning strategies linked to the declarative knowledge of fundamental medical knowledge), learning to do (learning strategies related to the acquisition of procedural knowledge for the practice of medicine) and learning to be (learning strategies that allow the development of attitudinal knowledge for a humanistic medical practice).

VIII. Teaching Methodology

The teaching methodology indicates the way in which the development of the educational process will be carried out; implies the integration of objectives, content, techniques, instruments and resources. This integration is expressed in the design of teaching strategies and learning strategies. The design of the educational methodology from the constructivist approach considers the following elements: the context, the previous learning, the practical activities, the construction of cognitive structures, the dialogue in the Socratic style, the use of the workshop and the laboratory, the intellectual operations of inductive type^[22].

The educational intention of constructivism is located in the promotion of meaningful learning, in the induction and integration of knowledge in a more schematic, elaborate and rich way; in teaching cognitive or metacognitive strategies or skills to "learn to learn"^[39]. In this sense, the constructivist teaching methodology is

oriented to promoting the mastery of cognitive, metacognitive and self-regulatory strategies; as well as in the induction of the representation of knowledge.

The didactic value of teaching techniques and support resources is in the possibility it offers the student to build and make use of cognitive structures; in addition to the inherent ability of teaching techniques to present information in contexts of didactic communication. This context is reflected in the design of learning situations, where the student's previous experiences are integrated and the attribution of meaning to the new knowledge that is incorporated into their experience is promoted.

Cesar Coll stresses that there is no constructivist teaching methodology, but rather a general strategy of a constructivist nature that is governed by the principle of "adjustment of pedagogical aid" and that can be specified in multiple particular teaching methodologies as the case may be^[48]. Following this line of reflection, it is understood that the best way to conduct the pedagogical relationship in the constructivist classroom is one that is consistent with the mental activities that are intended to be developed, considers the student's learning styles, adapts to school tasks and it takes into account the psycho-evolutionary characteristics of the student^[46].

Beyond the theoretical principles of constructivism, the practical concern of teachers is located in the selection of a methodological approach to conduct student training and with it, the teaching strategies they can use^[49]; as well as the learning strategies that they will promote among the students^[50]. In response to these concerns, an extensive literature has been produced that seeks to systematize the general principles of teaching strategies into general constructivist models^[51], in particular disciplines^[14] or for the development of specific content.

Currently, it is recognized that the teacher, by incorporating the constructivist vision into his educational work, starts from the characteristics of the group of students that the subject will guide in the development of the learning objectives. Subsequently, it selects teaching strategies considering: the type of knowledge that the student must develop (declarative, procedural or attitudinal knowledge), the time of its presentation in a teaching sequence (pre-instructional, co-instructional and post-instructional), and the cognitive process that is wanted develop^[37,49].

Among the teaching strategies used by the teacher, the pre-questions, the interleaved questions, the advance organizers, the concept maps and semantic networks^[23], the Gowin's V heuristics^[52], Rosalind Driver's alternative schemes^[53,54], the summaries, the analogies, the method of change stand out. Conceptual proposed by Posner^[55], activity guides, application of transformation theory, research as a learning tool^[43,49,56,57].

In the case of medical education, knowledge of the environment of the pedagogical scenarios (classroom, laboratory, clinical field and community) is an essential didactic instrument, since the wealth of training possibilities of the different pedagogical scenarios should support the book of text. Study in the clinical^[32,58] and community fields^[59,60] are an excellent didactic resource for teaching, because it helps prepare students to adapt to the living conditions that await them in their professional lives. The knowledge that the student builds during medical training is based on the development of the self-regulated learning capacity (self-learning)^[61], and in the development of strategies that promote the acquisition of relevant bodies of knowledge that will be retained in long-term memory for their constant use in medical care. In this sense, the conception of two approaches is currently being strengthened: evidence-based teaching^[62] and patient-centered teaching^[63].

In this context, the strategies used preferably for the teaching of medicine, from a constructivist approach, include: clinical case method^[64], problem-based learning^[65], community-based learning^[66], clinical simulation method^[67], use of virtual patients, learning based on projects.

IX. Learning Strategies

Learning strategies are abilities, habits, techniques and skills, used by the student to facilitate their learning ("learning to learn"), in such a way that they explore the material to be known, making it meaningful, easy to remember and use. The learning strategies are translated into a set of steps to organize, focus, elaborate, integrate and verify the information, allowing you to better assimilate, understand and remember the information; with the purpose of guiding you to take charge of your own learning process and, with it, improve your academic performance^[68,69].

To achieve this purpose, it is essential to put into practice the knowledge and skills acquired, which can be done through various moments in the learning process:

- Early phase: occurs shortly after learning the material.
- Delayed practical phase: it is proposed to achieve a clear difference between different contents.
- Application phase between partial contents of a broad material.
- Last phase, happens at the end of complex learning content.

The different methods that are included among the learning strategies stand out: the methods to study better, identify key ideas (grasp the essentials of the content), use mental images, inferences, categorize, analogies, questions and answers^[43,49]. These learning strategies are closely related to the learning styles of the students^[70].

Furthermore, the most widely used innovative and constructivist learning strategies in medical education include: team-based learning^[71], problem-based learning^[14,72], community-oriented learning^[73], critical reading^[74], case analysis^[75], medicine based on clinical competencies^[76] and evidence-medicine based^[77].

X. Evaluation in Constructivism

The evaluation of learning is defined as that process oriented towards the determination, search and obtaining of evidence of the appropriation of knowledge that the student has made. This evidence is related to the degree and quality level of student learning. Furthermore, the evidence makes it possible to judge whether the student's learning is adequate or not, and to take the corresponding measures considering: the purpose of the evaluation, the learning to evaluate, the collection of evidence suitable for what is being evaluated and for the purpose of patterns of confrontation, the use of the results in a way that enables feedback to the student's training process^[78].

From the field of constructivism, the evaluation values "the degree of significance and functionality of the learning constructed and the ability to use the knowledge gained to solve different types of problems"^[79]. In terms of training, the evaluation values both the results obtained and the cognitive and socio-affective processes that the student developed. Thus, the constructivist evaluation is based on the following principles: principle of rationality, principle of responsibility, principle of collegiality, principle of professionalism, principle of perfectibility, principle of exemplarity^[22]. These will regulate the why, what for and how of learning assessment.

Why evaluate student learning? The evaluation of learning in the field of constructivism is characterized according to the purpose, length, evaluating agent, time of application and comparison criteria. Integrating these components, the why and the why of the learning assessment is specified in three levels of assessment. These levels are in accordance with the learning objectives of the course. In order to achieve consistency between the learning objective and the evaluation, Bloom's Taxonomy is traditionally used^[80]; although the Taxonomy of Marzano and Kendall is also useful^[81]. An exceptional case for establishing consistency between learning objectives and their corresponding evaluation is found in clinical teaching; where the Miller pyramid is usually used^[32,82].

In the constructivist context, to operate the why of learning assessment, it is important to have the following^[83]:

- Of the objectives related to the knowledge level, it is desirable to evaluate the memory of the information, through activities aimed at defining, describing, identifying, among others.
- For the objectives grouped at the level of comprehension, the evaluation is oriented towards obtaining evidence from the student to process the information from the material studied. Thus, evaluations can be used where the student explains, interpret, infer, among other activities.
- The objectives that correspond to the application level, it is possible to evaluate learning through reagents or situations where the information learned from a new context is used, so that the student applies, builds, solves, makes use of, among other activities evaluation.
- At the levels of knowledge, understanding and application, the construction of concept maps is useful.
- The objectives corresponding to the levels of analysis, synthesis and evaluation, are usually evaluated through the preparation of monographs, original products and essays. Activities such as analyzing, breaking down, organizing, planning, elaborating, evaluating, criticizing may also be involved.

The purpose of the learning assessment is implemented through diagnostic, formative and summative assessments. The diagnostic evaluation, also known as initial or predictive evaluation, is carried out at the beginning of the course in order to obtain information from the students that will be relevant to the fulfillment of the learning objectives. The importance of this evaluation lies in exploring the level of mastery that students possess of the previous knowledge (cognitive, procedural and methodological) that is essential to internalize the new knowledge that they will learn. In case of identifying deficiencies, the acquisition of the minimum knowledge required to properly start the learning activities is promoted.

The formative evaluation has a relevant role in monitoring the student's academic performance. In this case, the evaluation is permanent; allowing to identify the relationship between learning objectives and the results achieved by the student; in a way that makes it easier to adjust the development of the learning activities that the student must carry out, considering their characteristics and their own rhythm^[84]. Thus, the formative evaluation becomes an instrument of feedback to the student, which is why it constitutes a self-regulated learning process. Self-assessment in this type of assessment, encourages creativity, self-criticism and self-confidence in students. The following strategies can be used^[14]:

- Self-report questionnaires, where students self-evaluate, keeping in mind the usefulness of the strategies, as well as their improvements in learning situations.
- Tasks that require the use of "learn to learn" strategies.
- Evaluation of the progress of the final products.

The summative or final evaluation is carried out at the end of the course, in order to identify the level of appropriation that the students achieved from the teaching and learning activities carried out during the course.

Defined the why and the why of learning assessment, the approach to the how of assessment requires recognizing that learning assessment is a central axis in the teaching-learning process during student training. In this sense, evaluation is a means to an end, not an end in itself^[85]. Considering this horizon of understanding, the evaluation instruments for constructivist environments are grouped into^[86]:

- Written evaluations: essays, direct short answer questions, multiple choice exams, column relationships, dissertations, reports, concept maps.
- Practical evaluations: oral exams, practical with cases, problem solving.
- Observation: teacher report, checklists, rubrics.
- Performance record: record books, portfolios, procedure record.
- Self-evaluation and peer evaluation.

The planning of the evaluation has become a complicated aspect when looking for the congruence between the contents to be evaluated and the way to evaluate; questioning the reliability and validity of the instruments used, especially when addressing the need to explore, objectively, the learning achieved by each of the students. In the case of medical education, the scenario is even more complex, since it involves evaluating the learning of the clinic in addition to the integration of biomedical sciences with the clinic and theory with practice, which requires knowledge, attitudes and specific values of the medical profession. How to evaluate the learning of medical students from a constructivist approach?

Medical education continues under the impact of the Flexnerian approach. Taking into account contemporary educational paradigms, the integration of the fundamental areas of medical training is promoted: biomedical area, clinical area and sociomedical area. Each of these areas is developed in specific educational settings: the classroom-laboratory, the clinical field and the community. The learning assessment continues using two fundamental instruments: the multiple-choice written exam and the clinical exam with the patient.

But the incorporation of information and communication technology, as well as the "pedagogical revolution" and the incorporation of educational models focused on the student or the patient, led to the analysis of the evaluation of learning from the Miller pyramid^[82]. These events allowed to incorporate instruments of a constructivist nature in the evaluation of medical science learning, among which the following stand out: the use of concept maps^[87], written exams based on clinical situations or cases^[88], registration of activities through the use of the portfolio of evidence^[89], registration of clinical and practical activities through the use of rubrics^[90]. The evaluation of learning through Objective Structured Clinical Examination (OSCE)^[91] and using clinical simulators^[92] stands out in medical education.

XI. Conclusion

The challenge of medical education in the 21st century lies in the progressive application of innovations derived from epistemological change to learning processes in the field of medicine, in such a way that they respond to new trends in the postmodern world: society of knowledge, the global village and the transitional paradigm. To face this challenge, it is necessary to apply to the field of medicine those innovations of the educational process based on learning for life and meaningful learning, by introducing the constructivist approach in the training of human resources for health.

In the field of medical education, the constructivist approach tries to combine the what and the how of teaching medicine. It is recognized that the student is ultimately responsible for his own learning. This is a product of the mental activity derived from contents that have a previous level of elaboration (previous learning). The learning of medicine guides the teaching practice to direct it towards the integration of the student's construction processes with the culturally organized collective medical knowledge.

In medical education, the teacher who incorporates the constructivist approach in his pedagogical practice begins with "knowing how to teach" to conclude in the student that he "knows himself taught". This "didactic transposition" is possible by using different strategies, both teaching and learning, that dialectically resolve the interrelation between teacher, student and content. The methodology of teaching medicine is where teaching is transformed into practical knowledge, which crystallizes in the art of teaching an art: the art of the clinic. The teaching of the clinic is developed through the strengthening of "zones of proximal development"; that is, of those actions that the student can only carry out initially with the collaboration and guidance of the teacher, achieving learning when it is carried out autonomously. Constructivism in medical education contributes to promoting significant learning. A learning will be meaningful when the new knowledge is linked in a clear and stable way with the student's previous knowledge.

From the complexity of the constructivist approach in education, the methodology of teaching medicine is situated in the conduct of the educational process. When placing the process in the learning scenario, the

teaching strategy depends on the content to be learned, the moment in which it is wanted to be used and the cognitive process that is to be developed in the medical student. This provides a wide range of strategies, ranging from oral presentation and lectures to research as a learning tool.

Given the importance of facing the challenge of doctor training for the 21st century, it is necessary to build, in a collegiate way, an educational model that responds to the medical labor market without ignoring the needs of our society. One option for reflection is constructivism. Reflection that opens the analysis of teaching practice to the possibilities of applying constructivist metatheory, in addition to renewing the meta-narrative of Flexnerian medical pedagogy, to develop a project that incorporates trends in medical education (problem-based learning, community-oriented learning, critical reading, competency assessment, and evidence-based medicine).

Finally, let us remember Joseph Novak, who pointed out that constructivism, as an intellectual current, is limited to an emerging conceptual and methodological framework, which is awakening consensus among those who have been seeking solutions to the limitations created by traditional teaching.

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