



RELATIONSHIP BETWEEN TEACHER ETHICS AND TRANSMISSION MATHEMATICAL KNOWLEDGE AT THE UNIVERSITY LEVEL

RELAÇÃO ENTRE A ÉTICA DO PROFESSOR E A TRANSMISSÃO CONHECIMENTOS MATEMÁTICOS A NÍVEL UNIVERSITÁRIO

RELACIÓN ENTRE LA ÉTICA DEL DOCENTE Y LA TRANSMISIÓN DE CONOCIMIENTOS MATEMÁTICOS A NIVEL UNIVERSITARIO

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ABSTRACT: The study was focused on the construction of the foundations of teaching ethics in the transmission of mathematical knowledge, so that they redefine their thinking to teach mathematics. The study was located in the qualitative paradigm, using the bibliographic method, with the design of documentary research, supported by the management of hermeneutics, using underlining, marking, interpretation and analysis as a technique. The information treatment process was validated with categorization, structuring, contrasting, theorizing. The results indicated that teachers work in a linear, reductionist, disciplinary, and fragmented manner. The following reflection was obtained, it is necessary for university teachers trained in other areas of knowledge to reconstruct their thinking to transform their knowledge in terms of how to deliver knowledge, getting rid of old beliefs and traditional unproductive practices, with a transdisciplinary, systemic vision, complex and mainly humanistic.

KEYWORDS: Ethics. Transmission. Mathematical knowledge.

RESUMO: O estudo centrou-se na construção dos fundamentos da ética docente na transmissão do conhecimento matemático, para que redefinam seu pensamento para ensinar matemática. O estudo situou-se no paradigma qualitativo, utilizando o método bibliográfico, com delineamento de pesquisa documental, apoiado no manejo da hermenêutica, utilizando como técnica o sublinhado, a sinalização, a interpretação e a análise. O processo de tratamento da informação foi validado com categorização, estruturação, contraste, teorização. Os resultados indicaram que os professores trabalham de forma linear, reducionista, disciplinar, fragmentada. Obteve-se a seguinte reflexão: é necessário que os professores

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universitários formados em outras áreas do conhecimento reconstruam seu pensamento para transformar seus saberes na forma de ministrar o conhecimento, livrando-se de velhas crenças e práticas improdutivas tradicionais, com uma visão transdisciplinar e sistêmica, complexo e, principalmente, humanístico.

PALAVRAS-CHAVE: *Ética. Transmissão. Conhecimento matemático.*

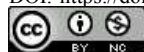
RESUMEN: *El estudio estuvo centrado en la construcción de los fundamentos de la ética docente en la transmisión de los conocimientos matemáticos, para que redefinan su pensamiento para enseñar matemáticas. El estudio se ubicó éste en el paradigma cualitativo, empleando el método bibliográfico, con el diseño de investigación documental, apoyado en el manejo de la hermenéutica, empleando como técnica el subrayado, fichaje, interpretación y análisis. El proceso de tratamiento de la información se validó con la categorización, estructuración, contrastación, teorización. Los resultados indicaron que los docentes trabajan de manera lineal, reduccionista, disciplinar, fragmentado. Se obtuvo la siguiente reflexión es necesario que los docentes universitarios formados en otras áreas del conocimiento reconstruyan su pensamiento para transformar su conocimiento en cuanto a la manera de hacer llegar los conocimientos, deshaciéndose de viejas creencias y tradicionales prácticas improductivas, con visión transdisciplinar, sistémica, compleja y, principalmente, humanista.*

PALABRAS CLAVE: *Ética. Transmisión. Conocimientos matemáticos.*

Introduction

From the Greek mathematician Pythagoras (570 B.C.- 469 B.C.) exalting the famous theorem, with the proof of Fermat's Last Theorem (among many); several mathematical objects were built that allowed, besides the understanding and interpretation of contexts (pure mathematics); industrial scientific development due to its application in other areas of knowledge, resulting in the improvement of the quality of life of society (applied mathematics); thus forming a mathematical episteme with scientific basis to guide and locate the investigative and pedagogical praxis in formal education systems.

The university professor bases his attitudes, both axiological and cognitive, to develop in the educational action, through the teaching of mathematical knowledge, without forgetting, that in this field of science, the context is fragmented in a superficial way by the applied methodology, where apparently, manifests the amplitude of information needed to adapt to the most demanding aspects of the current reality. Mathematics is an artificial language of scientific knowledge (science) created by the intellect of man to understand and infer a reality in a socio-historical and cultural moment where he is imbued. Epistemologically, it is constituted by a series of objects through which one can identify, describe, analyze and interpret quantities (numbers), space and shapes, uncertainty, changes and relationships. In this sense, the





mathematical object is an entity of abstract nature: it "represents a function or functionality that organizes or interprets the context" (PECHARROMAN, 2014, p. 78, our translation).

There are situations that develop in the didactic action, originated by the discursive speed in their respective transmission and that tend to be of low application their significance, originated in some cases out of context. Therefore, the teacher has to resize his position, in front of the teaching of mathematics, with an integrative orientation, based on a didactic, human, ethical work towards complexity, transdisciplinarity and their respective mathematical cognitive link; moreover, to observe the spectrum that the perspective of reality presents to the events that identify it, to specify and reorient the elements conducive to the didactic work that facilitate its interpretation from this complexity.

All information in the mind of the human being is received sensory-perceptively or in the form of thoughts as objects to be known or recognized; which implies a processing of the same called in the field of educational psychology as cognition. It should be noted that the word cognition comes from the Latin *cognoscere*, whose meaning is knowing, for which, a series of processes and factors that contribute to the formation of intellect and experience are implemented, such as: language, perception, memory, reasoning, attention, problem solving, decision making, among others.

It should be noted that mathematical activity oscillates between the conventional and the abstract, which is why the mental activity to elaborate such objects requires a series of processes and schemas to build the conceptual networks that form their episteme (institutional meanings). Thus, the discovery of mathematical objects is made when reason seeks to organize and interpret the context and its dynamics (certain characterization), in addition to relating any mathematical object or several of them (existing prior knowledge) of it; that is, from the personal meanings that are held in relation to the new to know. This is why learning a mathematical object requires:

[...] that the meaning or interpretation of the object attends to three aspects: the discriminatory expression, the functional use of the object (which gives meaning to the existence of the object and its learning) and the relations of the object with others of the cognitive structure or previous knowledge of the individual (which favor the incorporation of the object in this structure and its organization) (PECHARROMAN, 2014, p. 5, our translation).

In university settings, mathematical knowledge gives more importance to teaching processes than to the academic intervention of the teacher, which is marked by its positivist position, that is, experience prevailing, so that it displaces the human being and focuses on the product of the natural aspects of mathematics. Rationality finds no place in the respective





transmissibility and this does not lead to analytical or interpretative, much less to rethinking acts of reflective order, so they are repeated in mechanical, behavioral episodes without relevant changes, originating more than absolute knowledge, low importance in the metacognitive structure of mathematical nature. On the other hand, the attitude of the teacher is the product of dogmatic thinking, because they only impose their criteria and laws without allowing reflection on problem solving, because they are also limited to solving exercises without any meaning.

This situation led to the expression of the following questions that guided the study: What is the theoretical foundation related to teaching ethics in the transfer of mathematical knowledge? What epistemological, ontological and axiological structures exist today linked to the transmission of mathematical knowledge? What would be the emerging meanings and significance for establishing the theoretical foundations of teaching ethics in the transmission of mathematical knowledge? What theoretical reflections could be generated on teaching ethics in the transmission of mathematical knowledge?

These questions allowed the construction as objectives of the research: in terms of general, to generate the theoretical basis on teaching ethics in the transmission of mathematical knowledge, and as specific To identify the existing epistemological, ontological and axiological structures linked to the transfer of mathematical knowledge; Likewise, to establish the meanings and emerging meanings for the establishment of the theoretical foundations of teaching ethics in the transmission of mathematical knowledge and, finally, to build theoretical reflections on teaching ethics in the transmission of mathematical knowledge.

The execution of all the objectives materialized with the application of the qualitative research paradigm, being the nature of the bibliographic research supported in the documental modality, using as technique the underlining, recording, interpretation and analysis, which allowed the management of information that develops hermeneutics, because it was analyzed leaving aside the ideas that did not agree with the reality studied to generate a new thought in relation to the Teaching performance. The information treatment process was validated with categorization and subcategorization, structuring from the ontological components, contrasting with the triangulation of theorists and theorizing, which allowed the theoretical construction of teaching ethics in the transfer of mathematical knowledge.

The results indicated that teachers work in a linear, reductionist, disciplinary, fragmented way, because it does not act based on systemic thinking, that is, it is not transdisciplinary at the time of generating its development for teaching, presenting the contents in isolation from reality and other areas of knowledge, leaving aside the recognition that deserves its commitment to the development of reflective thinking, axiological based on reason





and affectivity. In other words, the teacher must change his thinking where he acts with skills to listen to others for their understanding, shows interest in deep empathy; Likewise, resignify his self-awareness to reconfigure the possible meanings of performance development for the transmission of knowledge.

The relevance of the study lies in the rupture with old (classical) practices in which the teacher dives into positions that do not limit his development or hinder his vision of resolution with transdisciplinary evolution, which means that the teacher must resize his mental structure regarding the teaching of the area of mathematics. This gains strength because it allows a different and more renewed action, where the ethical value transcends in depth the cognitive as a clear structure in the unification of life as personality maturity of meanings that validate the commitment and ethical scientific responsibility of the university teacher.

The teacher and the transmission of mathematical knowledge

Piaget cited by Gutiérrez, Arrieta and Meleán (2018), has sought to explain how the student elaborates this knowledge cognitively, that is, the processes that are performed, to reach the evocation of it; establish schemes or phases that begin with the search for relationships between the new object and existing ones (prior knowledge) to interpret it (assimilation), then comparison, discrimination and validation within these conceptual relationships; discard and take what can help build the meaning of the new object for the insertion (accommodation) of the new conceptual structure in that network.

As stated above, mathematical knowledge is obtained when the conceptual meaning (conceptual clarity) of the object is understood, that is, the inductive and/or deductive use of its properties within a network or mental structures or concepts; which are characterized by the formation of a knowledge "[...] rich in relationships and depends on the amount and intensity of connections that occur between internal representation networks. It is knowledge that cannot be learned without meaning" (SOCAS, 2017, p. 9, our translation).

On the other hand, the ethical attitude stimulates the reflective thinking of the teacher, puts it into practice when he habitually expresses his mathematical cognitivism, directed at different edges to the complexity of thought that represents it, which must be supported in the humanistic vision to exercise with tolerance, honesty, justice, understanding and assistance to teaching that ensures educational quality, which responds to the demands of academic consultancies allowing a transfer of mathematical knowledge for the development of potentialities. The ethical strengthening of the teacher is acquired with the redefinition of his





thinking so that he performs his work in a higher order, where the mystique of the work prevails, so that the behavior is that of a facilitator, who renews his performance from the principles and codes of ethics.

The idea is that he can project a professional behavior from his way of thinking, reflective in the set of processes that will guide the human being in the most correct way so that he acquires mathematical knowledge, in systemic relations with his peers, content and society. From the interpretation of Angulo and Acuña (2015) it is realized that among the duties of the teacher, his practice will revolve around disinterestedness, loyalty, truthfulness, efficiency and honesty, ceasing to be malicious, false and mischievous; he should not engage in procedures of cruel and inhumane treatment; therefore, he must act with dignity without haste or deficiency to fulfill his academic obligations, resizing his thinking permanently for the teaching of such knowledge, being a public servant who contributes to the development for the quality of life of solidarity.

This demonstrates the need for transformation of teaching thinking about the transfer of the essence of information involving mathematical content; for this, the change requires a transmission within a culture with an emphasis on ethics not to continue to consider teaching in a unique way of transdisciplinary nature. It is not a matter of empowering the teacher, but as Pecharroman (2014) proposes, the pedagogical and didactic work would no longer be oriented towards the transmission of mountains of insignificant content, but should focus on creative, productive, investigative, interdisciplinary, constructive, conscientizing and emancipatory work. To this would be added transdisciplinary, complex and systemic, with responsible behaviors and attitudes, in proper dialogical dissertation, on the principle of unity of knowledge in the transmission of concepts with absolute clarity.

The transmission of mathematical knowledge requires a treatment for interesting participation, meaningful reflection, research and construction of ideas, for the teaching of mathematics, in a fabric of complex where new properties emerge, which provide high-level performances, which penetrate deep into consciousness with dynamic structures of self-renewal, as a process of autopoietic interaction with all that is intrinsic and extrinsic in the network of relations of oneself and with others. The changes in action trends against teaching mathematical force to rethink the university teacher to generate meaningful learning coexisting with sociocultural dynamics.



Methodology

The methodology compiles the whole compendium of methods, techniques and resources carried out for the development of the research. In this sense, the methodological approach of this study was applied with the management of the qualitative research method, characterized by the descriptive production of the thought of different authors cited in the study, related to teaching ethics in the transfer of mathematical knowledge. In this sense, Macias (2019, p. 19, our translation) states that:

The qualitative methodology is one whose methods, observables, techniques, strategies and concrete instruments are in the logic of necessarily subjectively observing some aspect of reality. Its fundamental unit of analysis is quality (or characteristic), hence its name: qualitative.

Thus, the research is characterized because it starts from the collection of information inductively, but based on a holistic perspective, because it does not lose sight of the interrelationships that occur in the link with the phenomenon, so it becomes naturalistic allowing inquire into the perception of the ideas of the authors worked, profiled in the bibliographic research, by reviewing the printed documents. In this sense, Alfonzo (2019, p. 30, our translation) says:

The essence of this type of research is determined by the bibliographic nature of the sources used to solve a problem. In this regard It is the process of searching that is carried out in printed sources in order to collect the information contained therein, systematically organize it, describe it and interpret it according to procedures that ensure the objectivity and reliability of its results [...].

It consists of the survey made to the books of the authors considered related to the main categories or theoretical constructs, allowing to extract systematically and coherently the ideas of the same, maintaining care in the description and interpretation of thoughts to achieve the construction of the emerging precepts. In this sense, it was based on the documentary design, which for Pérez (2019, p. 26, our translation) "is characterized fundamentally because it performs analysis of secondary sources, that is, materials prepared by other authors in a systematic way. The main sources of information are texts, documents, theses, specialized journals, among others". It uses the consultation of documents such as books, magazines, newspapers, memoirs, yearbooks, registers, codices, constitutions, in addition to those indicated, in short, printed material.

Such a design required its application, according to Pérez (2019) the bibliographic tonnage, selection and organization of information, for which, the use of summary and mixed



sheets were used as resources, in this way, it went through the exploration of the theoretical contributions established by the authors for the description of the categories, once the relevant information was selected and refined, which was reflected in an organized way. The indicated process allowed for the hermeneutic validity and reliability of what was collected. The fidelity of the accurately collected information was ensured from the analyses performed from the hermeneutic. Regarding hermeneutics, says Ordóñez (2017, p. 28, our translation).

The way this method is worked out is as follows: 1) there is a text to interpret, read and analyze from what the text itself expresses; but, 2) taking into account the context in which the writing was developed, and 3) some conclusion is reached. At the end of this process..., there will be a schema or map reflecting the structure of the categories found. Such categories allow, by relating them to each other and to the whole, to explain the interpreted text in depth. The analysis that is done by repeating and deepening more and more the meanings of a reality as an interpretative spiral. [...] They call it the "hermeneutic circle.

As informações foram tomadas, organizadas e processadas pela leitura, análise e interpretação com base nas principais categorias de análise relacionadas aos pressupostos teóricos epistemológicos, ontológicos e axiológicos da realidade existente, para os quais foram aplicados os processos de categorização de pesquisa qualitativa, estruturação, contraste e teorização. Portanto, essas informações foram revisadas e interpretadas quantas vezes for necessário para compreender o pensamento das ideias do autor citado de forma adequada, racional, a fim de construir conhecimento com uma visão holística, mas a partir da perspectiva humanista.

Regarding the stages of processing and interpretation and subsequent theoretical construction, Martínez, Arrieta and Meleán (2012, p. 170, our translation) point out that these constitute categorization, structuring, contrasting and theorizing. For the same cited author, categorization is linked to the "effort to "dive" mentally, as intensely as possible, into the reality expressed there"; it was to reveal in detail the ideas that make up the phenomenon studied from the dialogical dissertation with the theorists cited. As for the structuring, it represents the diagramming of this information obtained; Martínez, Arrieta and Meleán (2012, p. 172, our translation) state:

Interpretation implies a "fusion of horizons," a dialectical interaction between the expectations of the interpreter and the meaning of a human text or cato ... it is to follow the process of integrating smaller or more specific categories into more general and comprehensive categories ... it could be considered as a "big category," broader, more detailed, and more complex ..., frequent graphic sketching should be considered an invaluable aid [...]. It allows you to integrate and relate many things and help you capture them simultaneously.





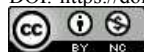
It is the systematic representation of ideas that reflect reality in an integrated way, linked in interconnections where the relations of teaching ethics are seen in the transfer of mathematical knowledge, from the perspective of the theorists established in the theoretical assumptions. From each author's representation, the comparison of ideas is made, checking where they converge and where they diverge, and to what extent, with the contrast. For Martínez, Arrieta and Meleán (2012, p. 172-173, our translation) "it will consist of relating and contrasting our results with those parallel or similar studies that were presented in the referential theoretical framework"; To do so, the triangulation of theoretical sources was used. Once completed with the aforementioned steps, theorizing was given, which is for the same author the "process that will try to integrate the results into a coherent and logical whole"; it was to present a new position from my position.

Results, analysis and interpretation

The results obtained emphasize that university scenarios develop aspects by their very nature, such as: educational, political, economic, social humanist among others that surround the work of university education. When knowledge appears in these scenarios, according to Macias (2019) it is realized through protagonists who facilitate their own knowledge and who dilute it in thoughts that go in different directions, occurring in this way due to the breadth and magnitude that cognitive contextualization carries, also including the means or tools necessary for teaching to achieve purposes that reorder the genesis based on the Theories of knowledge.

Currently, university education is linked in different ways to its development, either in its extension or by the spaces they occupy, due to the fast approach of its actors, that is, that teaching combines situations that affect with repercussion the knowledge society itself. The dynamism present in these latitudes delineates the strata corresponding to the educational matrices, placing in large proportions that this covers different edges, influenced by external agents involved in them.

Likewise, the transmission of knowledge according to Martinez (2013) is an argument that dives into mathematical environments that facilitate the fluidity of cognitive interpretation with comprehensible management tools to support the strengthening of its potentialities framed by elements that open the conception of knowledge dissemination interconnected or intercrossing for visualizations of structures with axiological spaces, which reflect the act of thinking with enriching processes of the current trends of dynamism that is constantly





experienced. Moreover, these contexts are globalized by innovative factors, with a projection for growth, favoring the need for the transfer of new knowledge, with impactful propagation alternatives.

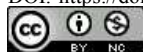
The teaching ethic, in this sense, in its training aspect, has been subject to transformations that allow determining the viability of educational projections, where each element that composes it is characterized by providing the respective importance in its entire context, conceiving the generalization that knowledge contributes a lot to evolution.

In fact, the studies presented that endorse ethics, such as transdisciplinarity, which develop multireferential annexes in large dimensions, that sensitize the links of knowledge transmissibility of the different disciplines or areas of the sciences, with respective balances, from the faculties of thought, which can lead to the dissemination of knowledge through new realities, oriented to the production and reaffirmation of knowledge that value Teacher management, promoting new developments to form structures that tend to develop capabilities, with efforts of innovation and participation, subject to strategic changes necessary to allow very broad complex evolutions.

Current teaching standards must be strengthened in university spaces, characterized by principles based on needs, expectations that establish a relationship with reality, involving ethical aspects, oriented towards behavior based on the dimensional knowledge that the most immediate future demands. The demand of the university sector will diversify into a fundamental organization in socio-cultural development, allowing the integration of knowledge, for the production and application in a distinctly globalized society, arguing answers with social, cultural, humanistic needs that make reality with a certain quality.

By focusing on the results of the task, doing, as the axis of teaching, is combined a set of contributions, both academic and curricular that allow the fragmentation of it, through the discipline, which means according to Macias (2019) that: the transdisciplinary is urgent with characteristics of participation, interaction, interconnection of the broad and complex points of view, combined with new techniques, strategies, paradigms, dogmas, the ontologies themselves. This further expands the knowledge with specific elements in collaborative spaces, interdisciplinary demands, disclosures in knowledge, which are subject to transformations in the improvement of assembly with rigorous impacts for the exploration of new conceptions in the methodological views of the teacher by his acting intuitively, logically and dynamically.

Active teaching must be framed in a world of complexity in relation to areas open to new ways of dosage of knowledge with pedagogical challenges with social cohesion, identified with themes of constructivist approaches for analysis of current knowledge managers. With the





trends that have become involved in globalized environments, they maximize a great effort to design the changes in teacher performance in which the sciences are subjected, so that the understanding and distribution of knowledge in the university environment leads to a permanent introspective review and leads it to the true essence of teaching.

Conclusions

The teacher must have a pluralist character to transmit his cognitive capacity, in a coherent and explicit way, with an application outcropping to expand his criteria to other frontiers of educational spaces, which require broad foundations in descriptive conceptions of mathematical knowledge. It must possess an ethical naturalistic character, oriented to the wisdom of the encounter with the transferability of thought to its understanding, which makes it intuitive and very observant, in a human praxis that conceives reality from referential elements, in the evolution of the activity of thought apprehended by its intelligence through reflection and scientific investigation, determined by the interior of its conscience that recognizes its precepts in formalities of ethical actions.

The aspects of knowledge framed in the affectivity, originality and effectiveness of the internal capacity of his consciousness, describe new attitudes before different processes, to establish according to Martínez (2013) the links, with the way to transfer the mathematical context. Reconnected with the progression of thinking to the understanding of the need for the transformation of that linear, reductionist, disciplinary, mechanistic, orthodox thinking. It is necessary to rethink to reform thinking towards a liberating educational praxis, with the capacity to unite in harmony, beauty and elegance, in deep thinking, in the scale of ethical values, of high level of complexity so that it reaches its fullness challenging realities.

The ethical commitment is reflected in the dedication to the work that is performed, always in search, growth, improvement of the joint activity, where the teacher must seek through vocation and virtue always directed to the pursuit of a common happiness, reaching in his education the full awareness of duty fulfilled to himself and to others regarding the management of mathematical knowledge, thus contributing to the holistic development of students.

The search for mathematical knowledge through holistic thinking provides resources for epistemic understanding, in structures infused in the knowledge itself that make room for the transcendental; That is why ethics and transference in the teaching of university teachers must go together without contradictions, constituting ideas and values, realizing a free knowledge





guided by the knowledge of the coordinates of expression, thought and action, through its intellectual ideology, subject to the contextualizations produced by the educational events of the teaching action with a creative character, symbolic, innovative and heuristic perspective. This holistic thinking values the providence of knowledge with continuous expressions that underlie the approaches originated in the teacher's psyche.

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