ACADEMIA | Letters

THEORY OF MATHEMATICAL LEARNING

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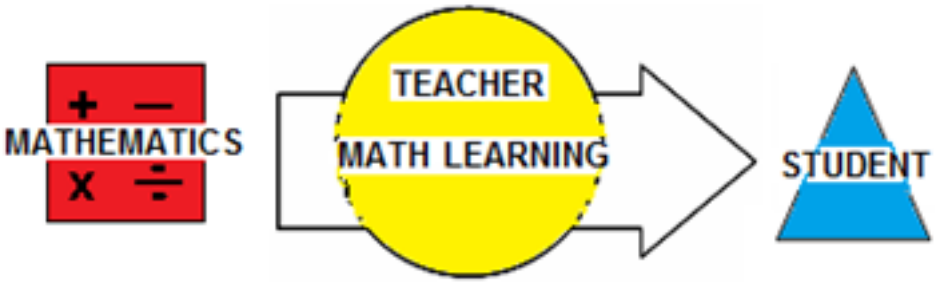
EDUCATION IN THE TWENTIETH CENTURY

At present, in some educational institutions a formative criterion of the industrial era still prevails, where a significant number of apprentices are prepared with a standardized didactics, fulfilling a pre-established schedule and training them so that in a given time they can be integrated into productive activity. In this educational model, the teacher is the center of the activity as the provider of knowledge and the student is a passive participant who simply receives the information. Below you can see what has been referred to.

Figure I

The current academic community of mathematical learning



Note: Prepared by the author (2015)

This representation shows that there is usually no direct communication between the object (mathematics) and the subject (student) within the learning process, and if it exists, it may

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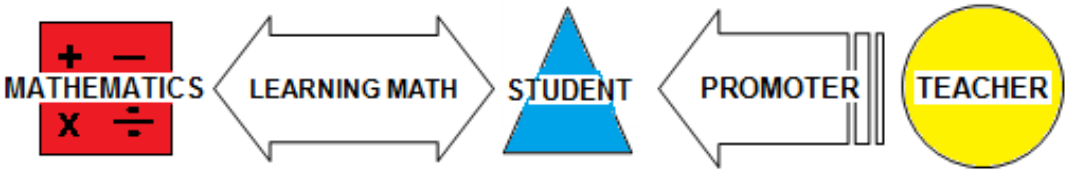
not be well understood by some students; Therefore, the teacher as an intermediary of the educational activity behaves as a translator between mathematics and the student.

EDUCATION FOR THE 21ST CENTURY

In contrast to the educational model of a master class, the constructivist approach proposes that the student becomes the builder of his own learning process and the teacher is the promoter, organizer and channel of this activity. The following figure outlines the constructivist transformation of the triadic structure of mathematical learning.

Figure II

The constructivist community of mathematical learning



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21st century education must be envisioned in the coming years with a new conception that goes beyond the current paradigm, where the objective should not focus on teaching but on student learning. Looking for him to acquire better knowledge (**knowledge**), better skills and abilities (**know-how**), better attitudes and values (**being**).

Epistemological foundation

Psychology as a science seeks to understand the mental processes that occur in humans, studying the way they think and learn (Know), what their emotions and motivations are (Being) and how they behave in relation to their environment (Act). In this process, the structures of Knowledge and Being interact in some way with each other, directing the behavioral actions of the individual. The following represents the trinity of homo sapiens:

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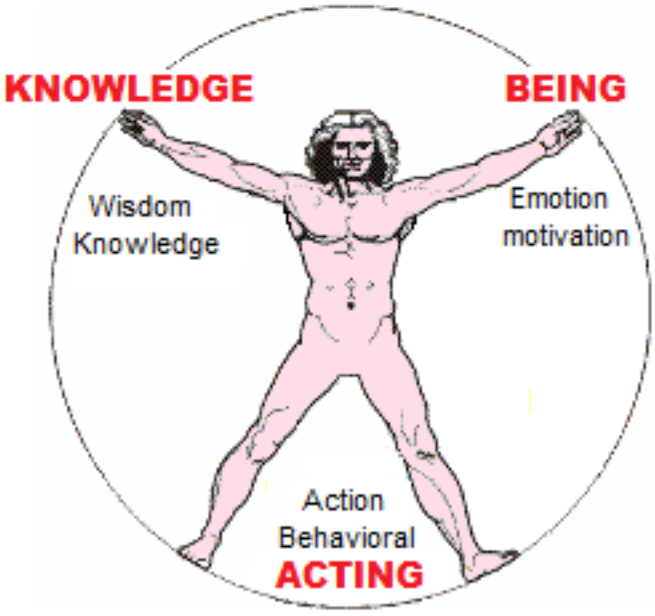
Figure III

The holistic trinity of homo sapiens



Note. Adaptation by the author (2015)

But considering each one of them separately would not allow us to understand the reasons that lead an individual to act in a particular way, or to understand why a student shows some kind of attitude and behavior towards learning mathematics. Seeking in this case to relate each structure of the trinity, an attempt was made to link some theories related to the educational area. The following figure shows how cognitive and motivational theories, problem solving techniques and ICTs were linked in the mathematical learning process.

Starting from the structure of Knowledge, so that mathematical learning occurs in a meaningful way as suggested by D. Ausubel (1918 - 2008); The learning process of the student does not start from a condition of cognitive absence, the knowledge and previous experiences are involved that serve as a basis to relate it to the new knowledge and thus achieve significant learning. This initial structure is essential and functions as an anchor for the knowledge to be learned, the interaction between the new knowledge and the previous ones becomes an integration of both, modifying the cognitive structure of the student; this restructuring is a

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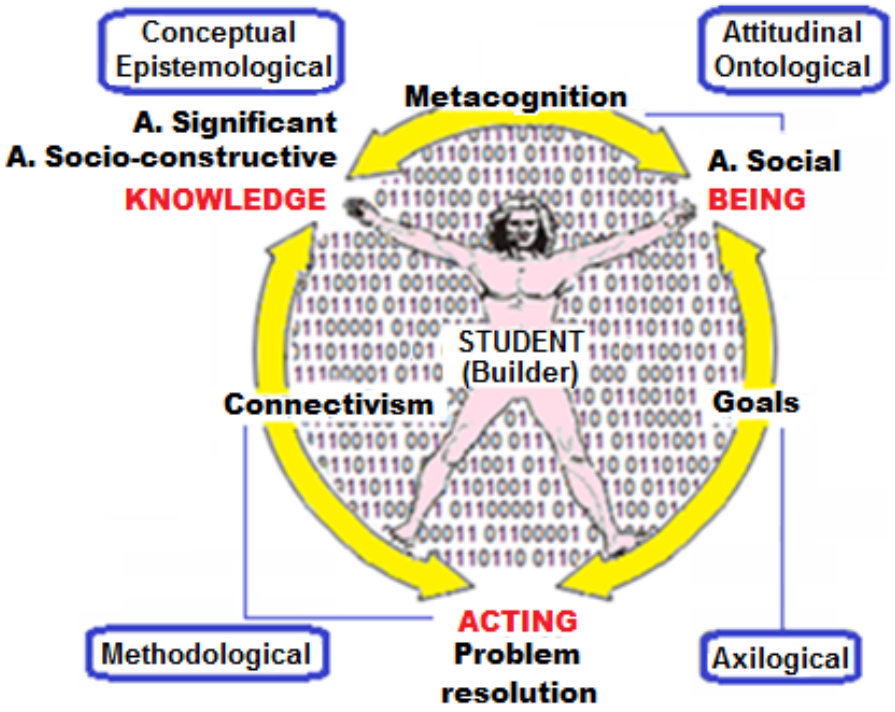
dynamic process of continuous construction of knowledge.

Figure IV

The Trinity for Mathematical Learning



Note. Adaptation by the author (2015)

For this integration of Knowledge to occur, it is important that the student knows their own cognitive abilities, that is, their mathematical metacognition, realizing their potential for how to 'know how to do' and what skills they have to develop a search activity to solve a mathematical problem. You must 'know how' and what strategies you should use and 'know why and when' you should apply the procedures. Metacognition facilitates the interaction between the structures of Knowledge (cognitive) and Being (motivational), by considering the knowledge that the same individual must have about its potential in the process of solving mathematical problems.

The motivation on the part of the student to solve mathematical problems is influenced in some way by his perception of himself of his abilities to solve such eventualities. The motivational construct proposed by A. Bandura (1925) states that personal and social experiences

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can influence their development in the learning process and where interaction with the teacher and classmates can encourage them to work to find the answers requested.

The resolution of a mathematical problem that has a correlation with reality involves the student reaching a goal that is usually interesting, as long as the answer is achieved in a peremptory time. Setting goals such as problem solving, graduating from a university degree, or any other personal goal requires the individual to focus his or her attention and effort for achievement, and by achieving it, it gives him personal satisfaction that motivates him to continue in the pursuit of other goals.

The theory of goals allows to link the structure of the Being (motivational) with the Behavioral (problem solving), by establishing academic objectives that motivate him to act to achieve them. It is important to highlight that the pursuit of problem solving entails a series of aptitudes and skills in the learner such as: order, planning, discipline, perseverance, among others, which activate the metacognitive processes in the learner, thus favoring the internalization of knowledge.

The incorporation of ICTs as a tool for learning based on problem solving favors educational activity in an interesting way. On the one hand, ICTs have specialized operational tools in the area of mathematics that provide excellent support in the learning process of this subject, freeing the student from repetitive operations, as well as showing conceptions that were difficult to appreciate before. This allows the student to focus his attention on the relationships between the variables involved in the mathematical operations that she is developing, facilitating conceptual understanding, a strategic analysis of resolution and flexible reasoning. In this activity, it is the student who solves the problematic approach and ICTs are the instruments that facilitate operational work.

On the other hand, ICTs have electronic instruments and specialized computer programs for the operation of an academic network, facilitating the possibility for students to connect with their fellow students through the web, from their home or from a nearby site. to your residence, without the need to physically move to your study center. This interconnection can occur synchronously by establishing a schedule for the meeting on the web or asynchronously by sending information and comments to the digital mailboxes of their colleagues, which will be read and responded to when each of them has the availability of do it.

The actors involved in the educational process in general and mathematical learning in particular can benefit from this connectivity through the network of networks, the interconnection between the members of the academic activity make up a network where each of them is an information node and communication with other colleagues. This activity could be fluid at the communicative level, so the teacher is required to be the tutor and channel of the knowledge network; focusing communication on the search for the knowledge required to

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achieve the proposed objectives. It is interesting to highlight how the connectivism proposed by Siemens can serve as a link between solving mathematical problems and the formation of new knowledge with ICTs.

It is worth highlighting at this point the presence and importance of language in the cognitive process of the human being, as has been suggested by philosophers such as: Wittgenstein, Apel, Heidegger, Vygotsky, among many others. Within an educational debate, language is present. It is therefore necessary the presence of a spoken and written language according to the academic level, allowing the student to express his thoughts with precision and clarity in a way that his interlocutors can understand, promoting an enriching and constructive dialogue of the concepts to be learned.

The interaction between the members of the network specialized in mathematical learning is a community educational activity as proposed by L. Vygotsky (1896 - 1934), where it is possible that the proposed problem situations are discussed and analyzed, thereby seeking to achieve meaningful learning. cooperatively. The knowledge search process carried out by a team of students would provide the possibility not only of contrasting different visions to face a problem raised by the teacher, but also the academic discussion among the members of the group on how to approach the exercise would facilitate learning; first socially, then introspectively, as Vygotsky suggested.

Vygotsky uses the figure of 'scaffolding' to represent the structure that the teacher must use to assist the learner, in those cases where the student on their own cannot achieve knowledge; The teacher is applying the necessary scaffolding that adjusts to the way in which each student conceives reality, using the time that the student requires to achieve it, and thus achieve a meaningful learning; that is, a pre-established time or period should not prevail for it. The academic can resort to a variety of scaffolds, such as: guides, books, audiovisual resources, dialogue, web pages, specialized computer programs in the area, among many others.

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