What is the Affective Aspect in Mathematical Learning?  
(Point of View of elementary level teachers up until college level)

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Abstract  
What does “the affective aspect” mean in mathematical learning process and what representation does a group of teachers have about the affective aspect? These questions leads to taking actions: 1) Identifying and characterizing categories that make up the “affective domain”, 2) putting these categories in function. Psychological and sociological aspects are considered, looking for a competence-based approach. Social Representation Theory is applied in the form of focus groups, data are analyzed using grounded theory, obtaining the social representation about what “the affective” is for a group of mathematics teachers since elementary level to college in Mexico. It was found into the constructed representation, that some categories are reported as neglected, disregarded or undervalued, as category of emotions; other visible changes within categories are discussed in detail. This detection strengthens actions towards the establishment of an affective competence in mathematical learning, which leads to the integration of a mathematical learning competence.

Key words: Affective Competence, Competence in Mathematical Learning, Beliefs, Emotions, Attitudes, Attributions, Ethic & Moral Values.

1. Introduction  
In order to consider the mathematical learning as a competence, it is necessary to take into account not only the cognitive side, but the skills and affective aspects too. At this point, it is worthy to note the concepts that Chevallard (1991) provides in relation to the elements which are present in the didactic triangle (teacher, student and knowledge to be learned), elements that are immersed in the “noosphere”, where wise-knowledge turns into a taught-knowledge which is constantly

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adapting to the changing requirements of society. He also notes that the motivational aspects are important. However, to know this motivational aspect involved in detail, require an extensive study. It is also necessary to determine the impact that the motivational aspect has into the didactic triangle, inside and outside, through the “noosphere” to the environment and vice versa. This aspect is discussed in this paper.

1.1 Hypotheses and research questions
The research hypotheses proposed in this work is: “Mathematics teachers leave out, neglect or leave out the affective aspect”.
This leads to two research questions: what is the affective aspect in the process of learning mathematics? Which representation does a group of teachers have about the affective aspect?
Then it describes the two parts in which this report is divided.

2. Identifying and characterizing Categories from Affective Domain in Mathematical Learning
This section is divided in sections: first, 2.1 theoretical findings related to the research are presented. 2.2 Then, the psychological aspects are considered, and the affective competence, cognitive competence and competence in mathematical learning are defined. 2.3 Later, summarizes the research conducted in the context of this study (Rivera 2003, 2006, 2011, 2011a), and next section 2.4 Present considerations on the reason of choosing Social Representations Theory (SRT), to be used in the experimental part of this research.
As an illustration of what will be exposed in the first part of this research report, is presented a conceptual map about the affective domain (figure 2). For further characterization, the content of Figure 1 is immersed in the contents of Figure 2.

Figure 1.-Psychological Aspects in relation with the Affective Aspect

![Figure 1: Psychological Aspects in relation with the Affective Aspect](source: the authors)
2.1 First Contributions

One of the first researches that has been done on attitudes towards mathematics was conducted by Fennema and Sherman (1976, 1976a), among other authors. They developed an affective evaluation tool, taking into account the affectivity as regarded then. This evaluation tool was in effect for ten years. But, there are few studies on affective dimension in mathematical learning, and rarer still are those relating to the study of emotions in those years. Emotions applied to the field of mathematics have been analyzed first by Mandler (1989a) and by authors such as McLeod and Adams (1989), Goldin (1988a) and Debellis and Goldin (1991, 1993).

2.1.1 McLeod’s contributions to knowledge of the affective domain

Earlier, there was a breach with evolutionary psychology and a constructivist approach was adopted. McLeod (1992), is a representative of this current and considers the affectivity as something divided in three categories: beliefs, emotions and attitudes, not only considering the attitudes, as they had been considered before.
2.1.2 General contributions about Beliefs

While Buhel and Alexander (2001) analyzed epistemological and cognitive beliefs taking into account an academic general approach, Schoenfeld (1983), makes an analysis of beliefs in three different ways: considering the individual background of the individual (social cognition), the executive control to take decisions (metacognitive acts); and beliefs about himself/herself about the environment, the topic to be learned and mathematics in general (beliefs systems). The later concept focuses on the beliefs seen from four perspectives: a) the individual's beliefs about themselves (self-esteem or self-concept), b) the beliefs held about their own environment, c) the beliefs held about the particular topic of mathematical study and finally d), the beliefs that an individual has about mathematics. He analyzes them as a belief-system, same that is focused on the affective aspect of mathematical learning in this report.

Liu (2010), brings evidence of reliability to the study of epistemological beliefs and behavior related to mathematics, obtained in Taiwanese college students about the role that epistemological beliefs have in them when they try to solve well-structured problems, leading these students to have little credibility when trying to perform unconventional tasks. Meanwhile, Fauskanger and Mosvold (2013), in Norway, concluded in relation to epistemological beliefs using focus groups, which are so important for teachers to know and fully understand the origin of the mathematical concept taught, as having pedagogical knowledge to teach, to apply theoretical and practical contexts.


2.1.3 Contributions made by both, Gómez-Chacón and DeBellis&Goldin to the affective domain

Gómez Chacón (2000, 2003, 2008) takes McLeod’s contributions (1992) related to the affective domain, considering the same affective aspect divided into three parts, not just one, as had been seen until then.

She also considers the contributions given by DeBellis y Goldin (1991, 1997), in relation to two new categories about the affective domain: the attributions, and ethic and moral values.

Promptly, the meaning considered for the categories of the affective domain is the same used in the guidance given to this investigation.

A belief is defined as a concept or an idea that a person or group of people have about something and it does not have any justification or scientific validation.

- Epistemological beliefs: is the importance that a person gives to mathematical learning or to a mathematical concept in the context of real, scholar, professional and / or scientific life. A possible indicator is the measure from the degree of importance given to mathematical learning or mathematics itself.
- Cognitive beliefs: indicate the degree of self-esteem or self-concept that the individual has towards mathematics.

The inextricable link between epistemological beliefs and cognitive beliefs needs to be considered, since the former considers the mathematical concept (learning object) and the latest takes into account the individual that learns / teaches or uses mathematics and how he or she does it.

- Didactical beliefs: they indicate the degree of importance that the individual gives to the role of teachers and teaching.
- Social cultural beliefs: they indicate the degree of importance that is considered the social and cultural environment (teachers, peers, school Officials, family, community, government) related to the learning and use of mathematics.
• Emotions: They are defined as a brief agitation or a mood disturbance that presents a variability visible, which can be identified and controlled. It is liable to be measured the degree of identification and degree of control of emotion that an individual has while he/she learns or uses mathematics.

• Attitudes: are behaviors or habitual modes of action that can be observed and reflect acceptance or rejection of from mathematical learning. They indicate the degree of acceptance or rejection that the individual has towards mathematical learning.

• Attributions: They are the reasons that are listed as probable causes for which mathematics can be learned or not. Its causes are discussed below in section Thorough study of the attributions.

In relation to the attributions and evaluation study, there are important contributions that Reeve (compiling works from Arnold, 1960, 1970) and Núñez et al. (2005) consider again. The degree of control of the causes that favor or hinder which may or may not learn mathematics is susceptible to be measured.

• Ethic and moral values: In the appearance of ethics and morals, Dávila and Maturana (2009), affirm that the learning of values is given by a transformation through the daily coexistence, not learned by classroom teaching; and they confirm that this transformation is present in any place where human conviviality is given. They consider that the responsible role of the teacher is fundamental (transformed now into social educator) to achieve this transformation in the values lived by the student. They emphasize about the importance of the coherent teacher’s job and compromised with the role they have, in order to make the transformation possible in the daily conviviality.

In relation to ethic and moral values, it is possible to measure the degree of acknowledgment about the comprehension level of mathematical knowledge that it is been understood into the didactic triangle. Immediately, discusses briefly the psychological aspects that give greater accuracy to the concepts of motivation and emotion that are immersed in the affective aspect, as well as concepts for a deeper understanding of the concept of attributions.

2.2 Psychological aspect, motivation / emotion and a thorough study of the attributions in the context of this work.

2.2.1 Psychological aspect, motivation/emotion

Psychological aspects are presented in relation to affective competence and competence in mathematical learning.

Of the two first tables showed, the first one depicts: the elements that conform the motivation and identifies the links that motivation has in relation to beliefs, which are an integral part of affective aspect in mathematical learning. The table also shows that with needs and objectives guiding human beings, feeds motivation. The motivation is presented in turn, as consisting with a cognitive part (knowledge that is linked to thought) along with the mechanisms of control of emotions (identification -control- regulation -response), and attitudes that are manifested in the form of behavior.

The three elements of motivation (cognition + emotions + attitudes), nurish and represent simultaneously the beliefs of the person (epistemological, cognitive, educational, social and cultural type). The four types of beliefs are considered according to the context of this investigation.

2.2.2 Thorough study of the attributions

The attributions are reasons to which is attributed that an individual may or not learn mathematics. These reasons can be controllable, uncontrollable, stable or unstable (Reeve, 2003). This stability is considered
something that stays for a long time with not danger of disappearing, changing or decreasing. More details about this issue are listed below in section Previous work in the context if this research.

Table 1 shows examples of cases where different types of attributions may favor or interfere with mathematical learning.

Table 1- Internal and External Attributions

<table>
<thead>
<tr>
<th>INTERNAL ATTRIBUTIONS</th>
<th>Stable</th>
<th>Unstable</th>
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<tbody>
<tr>
<td>Controllables</td>
<td>Concentration</td>
<td>Strategy to take</td>
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<td>Uncontrollables</td>
<td>Multiple intelligences</td>
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<td></td>
<td>Aptitude, preferences</td>
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<td>Character of the person</td>
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<td>Moods</td>
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<td></td>
<td>Effort required</td>
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<td></td>
<td>EXTERNAL ATTRIBUTIONS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stable</td>
<td>Unstable</td>
</tr>
<tr>
<td>Controllables</td>
<td>Environment</td>
<td></td>
</tr>
<tr>
<td>Uncontrollables</td>
<td>Attitudes of other people</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Influence of other people</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Difficulty of the task</td>
<td></td>
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<tr>
<td></td>
<td>Circumstances</td>
<td></td>
</tr>
</tbody>
</table>

Source: the authors

2.2.3 Affective Competence in Mathematical Learning and Competence in Mathematical Learning

A way to introduce these two concepts is distinguish first two terms useful for this purpose: motivation and emotion, “two sides of a same coin”.

Considering the importance that the motivation has, Reeve (2003), stands out the role that it plays representing both sides from a coin. On one side, the aspect of motivation (linked with the cognitive and behavioural aspect of the individual); and on the other side emotion (linked with the affective aspect from the same individual). In this connection, it can speak about the relationship that these terms have with those who define both, the affective competence and the cognitive competence, aspects that are detailed immediately.

2.2.4 Affective Competence and emotion

Gómez-Chacón (2000, 2003) considers as affective competence: the identification, control or regulation and answer to the individual emotion (in the individual role) and the interaction with the affection from others (in the social role) when someone is using or learning mathematics. This implies the consideration from individual aspects (identified, controlled and regulated by emotion) and social aspects (answering to the others’ emotional condition from). The authors consider also the local affectivity aspects (the individual and the cognition) and the global aspects (the individual and the others). She concludes that the student’s social identity is a basic element for the predisposition towards mathematics and that this predisposition is shaped by four aspects indicated about the beliefs.

Once presented the definition of affective competence from the emotional approach, it is possible to focus on the cognitive or behavioral aspect of the affective competence in mathematical learning, this is the cognitive competence.
2.2.5 Cognitive competence and motivation

The focus on “the other side of the coin”, now leads to visualize the competence, but as a cognitive competence, it is to say, on how the individual thinks and the attitude that he or she expresses and materializes in the form of behavior present in the same individual or community.

2.3 Previous work in the context of this research

Mexican background in the context of this research

Table 2 shows significant dates and details for this report, it shows data corresponding to the works done in the context of this research, conducted between 2003 and 2011a. More details in this regard are listed below.

Table 2.- Contributions in the context of this investigation

<table>
<thead>
<tr>
<th>Year</th>
<th>Categories from affective domain considered</th>
<th>Reliability Cronbach's Alpha test</th>
<th>Type of research performed</th>
<th>Type of experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>Beliefs-emotions-attitudes</td>
<td>.91</td>
<td>Quantitative experiment *</td>
<td>quantitative</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- course-online*</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td>.85</td>
<td>reliability calculation from quantitative assessment tool built</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>Beliefs-Emotions-Attitudes attributions ethic &amp; moral values</td>
<td>.94</td>
<td>-</td>
<td>Qualitative transformation Qualitative questionnaire with discussion topics</td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td>-</td>
<td>Quantitative questionnaire</td>
<td></td>
</tr>
</tbody>
</table>

* Source: Rivera (2003, 2006 and 2011a [p.211-218])

Two works were developed between 2003 and 2006 in Mexico. Among them, an assessment tool of affectivity was constructed and tested especially for the case. This instrument is a multiple choice quiz with nominal variables, that include the categories of beliefs, emotions and attitudes (following signalizations done by Polit&Hungler, 1997 and Hernández, Fernández&Baptista, 2006). The questionnaire was tested twice on its reliability, obtaining a Cronbach’s alpha of .91 and .85

In that paper, the author addresses the problem of high failure and dropout rates presented in the field of mathematics at university students from recent entry. That study was applied to undergraduate students in business administration from Universidad Veracruzana, located on the east side of Mexico, Campus Coatzacoalcos (2003).

A quantitative experiment that involved an experimental group and a control group, with application of a pretest and post-test in both groups was conducted. The Student T test statistic with a significance level of 99% was applied, which led to the conclusion that it was possible to favor positively the affectivity of students towards mathematical learning in the present case. Later, it was found that affective change was
reflected entirely in students’ achievement (Rivera, 2006). While these results were applied to a population at an specific time and context, taking into account indications by Joshua (1996), -in relation to what an outcome represents in Mathematics Education, there is evidence that favored the affective change in students, as well as an improvement in school performance.

It is worth clarifying that the affective evaluation questionnaire used in 2003 (which includes the categories of beliefs, emotions and attitudes), was modified in the context of this research. The categories of attributions and ethic and moral values, previously identified DeBellis and Goldin (1997) were included there after, yielding a new questionnaire which recorded a reliability Cronbach’s Alpha .94 (Rivera, 2009. Data not published).

The reason of not including the categories from attributions and ethic and moral values in the works done in 2003 and 2006, was because these categories were itemized completely with evidence of its reliability until 2009 by the author. It was after this that these variables were included in the assessment instrument.

By adding these categories, is possible to have a more complete picture of the affective domain (see Rivera, 2011a. p. 211 -218).

This questionnaire was developed as part of this research in 2009 (assessment tool affectivity), is useful in the present work, because the categories considered for the realization of the present paper have their origins in the previous questionnaire obtained then.

This assessment tool has undergone a transformation process. The transformation was used on a quantitative experiment that measures the change in the affective aspect of the students after receiving an affective treatment in learning mathematics through a course which speaks explicitly about affective aspects. Now it has a qualitative approach as discussed below in second section.

2.4 Social Representation Theory (SRT) and focus groups with deep interviews

Something similar to what happens in life happens with mathematical learning: individual believes of mathematics what the environment or their own or previous experience has made them as an idea formed in his/her mind (Abric, 2001).

The SRT states that the individual or group of individuals behaves in all aspects of their lives, not based on scientifically proven knowledge, but on the representation that these aspects have in their minds. Is for this reason, that it is possible to study the affective aspect of mathematical learning employing this theory. This examines cognitive, affective and social aspects (image represented and thinking) that are linked to mathematical learning, considering also psychological and sociological aspects (cultural and ideological).

This work follows the structural approach proposed by Abric (2001), focusing on cognitive processes (structural approach), which considers the steps of: detecting, characterizing, relationship, hierarchy and structure of the elements that comprise it.

The technique of focus groups in-depth interviews was used to collect and analyze the information obtained, with participants between three and seven people maximum.

Abric (2001), indicates that the elements that give meaning to the representation are the main core (resistence to change and independent of the immediate context) and the peripheral core (more responsive and adaptive to change).

The methodology of this work is defined in relation to the issues raised, developing a qualitative research that focuses on the three types of aspects mentioned above.

The second part of this report is developed below. This stage is divided in two parts: Building discussion topics and the application of dynamics in the form of focus groups with deep interviews putting in function the categories that conform the affective domain.
3. Methodology
The second part consisted in two steps: A construction of discussion topics (instrumentation stage) and The dynamics in the form of focus groups with deep interviews (experimental stage).

3.1 Instrumentation stage
For the construction of discussion topics, a previous multiple choice questionnaire, appendix 1 (Rivera, 2011a, p. 211-218) was converted in this investigation into a questionnaire that contains several topics of discussion.

Transformation from a quantitative to a qualitative questionnaire with topics of discussion
Steps taken towards the processing of the questionnaire:
• Identify on each question what is expected to know in relation to each category of the affective domain with such information
• Grouping the questions from the quantitative questionnaire by affinity. Total time of implementation of the dynamics must be between one and a half to two hours maximum.
The qualitative questionnaire finally obtained is presented in appendix 2.

3.2 Experimental stage
3.2.1 Participants
The participants in this study were 24 teachers who taught mathematics from elementary level (7), middle level (3), high school level (6 and 5; two dynamics), and college level (3). Only teachers pertained to elementary level and one teacher from middle level work private education system, others work in governmental educative system. Once the five dynamics were applied, the information was recorded in video and transcribed into a word processor. The affirmations were all enumerated consecutively and exhaustively. In this way, five files were obtained, one by each dynamic applied.
The analysis from the information transcribed was made.
For this analysis stage, the classification of information was divided in two steps: considering each individual scholar level and considering all the scholar levels taken as a whole for each category.

3.2.2 Considering each individual scholar level for each category
For this step, was generated another file for every dynamic with the affirmations organized by category of the affective domain to which they do explicit or implicitly reference. Five files were generated with three columns each. In the first one, the affirmations enumerated consecutively. In the second column, the crucial information followed by the key words that identify such statement. The third column shows an analysis of the second column.
Proceeds the same way with all the dynamics.
A new file was generated where affirmations were organized according to the category of the affective domain to which they refer.

3.2.3 Considering all the scholar levels taken as a whole for each category
A scheme or representation was build for every category with the affirmations of the dynamics of all school levels taken as a whole but now organized by category.
A new representation was constructed with the synthesized information of all the dynamics taken as a whole. In this representation, the main core and peripheral core are showed. This representation is showed in scheme one.
4. Results
A comparative chart showing on one side the different scholar levels and on the other side the different categories in order to detect either if each category remains important, or it increases or decreases according to the scholar level.

According to this table, can be observed that Epistemological Beliefs and Beliefs in the Didactic Aspect remained its importance throughout all school levels, indicating that the importance of mathematical learning and the teacher's role remained still considered important in all grade levels.

Regarding cognitive beliefs, its importance declined at the university level since students often then prioritize other aspects, such as: getting a better paying job or passing grades, even over the same learning mathematics.

Social cultural beliefs and ethic and moral values (within the didactic triangle –internal part-) categories showed that in elementary level there are more supervision of parents or guardians in education from students (students of up to 12-15 years of age) than in those who are older age.

In relation to the categories of emotions and attitudes was observed that there is a similar change in both. This change is detected from high school in considering the way in which the student is excited and modifies its behaviour towards learning mathematics, from an interest in learning fun to a greater appreciation interest in giving the student to his professional vocation.

As for the internal and external attributions, manifested a marked change with a tendency to be more important internal attributions from middle education, with major external attributions importance when the student is under that age (from elementary level until middle education level).

Finally, ethics and moral values category(outside the didactic triangle -external part-). This category had a greater importance as the school level advances, having a greater importance at the university level, where the student already has been transformed into a citizen immersed in the problems of their social environment. This is seen in table 3.

Table 3.- Comparative table of the affective domain categories

<table>
<thead>
<tr>
<th>Level</th>
<th>eB</th>
<th>cB</th>
<th>dB</th>
<th>nB</th>
<th>Emotions</th>
<th>Attitudes</th>
<th>Atributions Internal</th>
<th>Moral</th>
<th>Ethic &amp; Moral Values</th>
</tr>
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<tbody>
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<td>internal</td>
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</table>

E=elementary level; M=Middle level; Hs=High school; C=university level; eB= epistemological Beliefs; cB=Epistemological Beliefs; dB=didactical Beliefs; nB=socio-cultural Beliefs; i=internal from didactical triangle; ext=external from didactical triangle

Source: the authors.
A global scheme that shows the representation of the affective domain taking into account at the same time all the categories and all the scholar levels seen as a whole, is showed below in figure three. In this scheme we can see a main core formed by the binomial epistemological beliefs and cognitive beliefs, and a peripheral core that includes the didactical beliefs and social cultural beliefs. The other categories cross through the first categories listed.

**Figure 3.- Affective Domain Representation**

![Diagram](image)

EB= epistemological beliefs CB= cognitive beliefs DB= didactical beliefs SB= social cultural beliefs iE= identification emotions cE= control emotions iA= internal attributions eA= external attributions A+/− = positive attitudes or negative attitudes

Source: the authors.

**5. Conclusion**

Four aspects were considered mostly neglected or left behind by teachers: 1) the fact permanently indissoluble link that occurs between epistemological categories (what is learned and its importance in different contexts) and cognitive beliefs (the learner and how does he or she learn); 2) with regard to the aspect of emotions, teachers leave them aside or neglect due to three main reasons: ignorance of how to treat the problem, due to time of the numerous school calendars or class groups, 3) in the appearance of ethical and moral values, lack of honesty at all levels within and outside the didactic triangle devastates the appropriate scope for mathematical learning, and finally 4) the social-cultural environment in which learning takes place, with the complex and unpredictable implications this may lead it not only to the affective aspect of mathematical learning, but also the cognitive and mathematical learning skills that it entails. The results encourage further research in several directions, with focus on finding different mechanisms to correct deficiencies found in the categories that were put into analysis in this investigation.
6. Distinctions received
Research in the context of this investigation received the following distinctions:

7. References


Appendix 1.-Affective Evaluation Tool towards Mathematical Learning

Participants
(Name and surname):
Ages:
Date and city:
Profession or scholar level:

Instructions:

Carefully review each of the following questions and choose by checking the option that best fits your opinion about each of the points expressed here:

Beliefs
a) Mathematical beliefs

Indicator: degree of usefulness of mathematical learning

1) Mathematics is currently applied to the knowledge of all areas of science
   ( ) Strongly ( ) In ( )Can be yes ( ) Desagree ( ) Strongly
   agree accordance or no disagree

2) Mathematics has direct application in solving everyday problems
   ( ) Strongly ( ) In ( )Can be yes ( ) Desagree ( ) Strongly
   agree accordance or no disagree

3) Mathematics is a subject that is worth studying
   ( ) Strongly ( ) In ( )Can be yes ( ) Desagree ( ) Strongly
   agree accordance or no disagree

4) Working well using mathematics is important for my future
   ( ) Strongly ( ) In ( )Can be yes ( ) Desagree ( ) Strongly
   agree accordance or no disagree

5) I study mathematics showing interest because I know how important they are
   ( ) Strongly ( ) In ( )Can be yes ( ) Desagree ( ) Strongly
   agree accordance or no disagree
b) **Belief on oneself**

Indicator: Degree of self-esteem and self-confidence of an individual towards mathematical learning.

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<td></td>
<td>Strongly</td>
<td>In accordance</td>
<td>Can be yes or no</td>
<td>Strongly disagree</td>
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<tr>
<td>( )</td>
<td>agree</td>
<td>( )</td>
<td>Desagree</td>
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1) I think I'm capable of learning mathematics
   - ( ) Strongly agree
   - ( ) In accordance
   - ( ) Can be yes or no
   - ( ) Desagree

2) Mathematics is easy for me
   - ( ) Strongly agree
   - ( ) In accordance
   - ( ) Can be yes or no
   - ( ) Desagree

3) I feel confident of myself by using mathematics
   - ( ) Strongly agree
   - ( ) In accordance
   - ( ) Can be yes or no
   - ( ) Desagree

4) I'm good at mathematics
   - ( ) Strongly agree
   - ( ) In accordance
   - ( ) Can be yes or no
   - ( ) Desagree

5) I'm the kind of person who works well in mathematics
   - ( ) Strongly agree
   - ( ) In accordance
   - ( ) Can be yes or no
   - ( ) Desagree

c) **Beliefs about teaching mathematics**

Indicator: Degree of importance of the role of the teacher and the pedagogical aspect in achieving of mathematical learning.

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<td>Strongly</td>
<td>In accordance</td>
<td>Can be yes or no</td>
<td>Strongly disagree</td>
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<td>( )</td>
<td>agree</td>
<td>( )</td>
<td>Desagree</td>
<td></td>
</tr>
</tbody>
</table>

1) From the knowledge, skills and affectivity that the mathematics teacher has, depends I, as student can learn mathematics.
   - ( ) Strongly agree
   - ( ) In accordance
   - ( ) Can be yes or no
   - ( ) Desagree

2) If teacher connects the new knowledge I am acquiring with what I already know, this encourages my learning
   - ( ) Strongly agree
   - ( ) In accordance
   - ( ) Can be yes or no
   - ( ) Desagree

3) If the teacher is confident that I can learn math, generally this is true
   - ( ) Strongly agree
   - ( ) In accordance
   - ( ) Can be yes or no
   - ( ) Desagree
4) Using an appropriate teaching method connecting with my way of learning, encourages me to learn

( ) Strongly ( ) In ( ) Can be yes or ( ) Desagree ( ) Strongly agree accordance no disagree

5) The class that stimulates my favorite way to learn, really helps me learn

( ) Strongly ( ) In ( ) Can be yes or ( ) Desagree ( ) Strongly agree accordance no disagree

d) Belief in the social context

Indicator: Degree of dominance of the social context

1) A stable family situation benefits me to succeed in learning mathematics

( ) Strongly ( ) In ( ) Can be yes or ( ) Desagree ( ) Strongly agree accordance no disagree

2) The commitment of the teacher in my learning directly influences my mathematical learning

( ) Strongly ( ) In ( ) Can be yes or ( ) Desagree ( ) Strongly agree accordance no disagree

3) An environment where parents work professionally using mathematics, fosters the children also arrive in appreciate its worth.

( ) Strongly ( ) In ( ) Can be yes or ( ) Desagree ( ) Strongly agree accordance no disagree

4) The fact that I live with people who appreciate the use of mathematics, fosters my learning of the subject

( ) Strongly ( ) In ( ) Can be yes or ( ) Desagree ( ) Strongly agree accordance no disagree

5) If the environment where I live, mathematics are valued, in the long run I also appreciate

( ) Strongly ( ) In ( ) Can be yes or ( ) Desagree ( ) Strongly agree accordance no disagree
Attitudes

Indicator: Degree of acceptance or rejection of the subject
(Affective component and intentional)

1) Mathematics is useful for my professional development
( ) Strongly ( ) In accordance ( ) Can be yes or ( ) Desagree ( ) Strongly agree no desagree

2) I like learning mathematics
( ) Strongly ( ) In accordance ( ) Can be yes or ( ) Desagree ( ) Strongly agree no desagree

3) Learning mathematics can give me the way to make a living
( ) Strongly ( ) In accordance ( ) Can be yes or ( ) Desagree ( ) Strongly agree no desagree

4) If I could choose, I would choose a profession that would support about mathematics as work support
( ) Strongly ( ) In accordance ( ) Can be yes or ( ) Desagree ( ) Strongly agree no desagree

5) Predict the existence of reality events using tools like mathematics, it helps to solve an endless number of real-life situations
( ) Strongly ( ) In accordance ( ) Can be yes or ( ) Desagree ( ) Strongly agree no desagree

Emotions

Indicator: Degree of identification (5 questions) and control (5 questions) that emotions have on the student while learning mathematics.

1) I feel emotion when give a satisfactory solution to a mathematical problem
 ( ) Always ( ) Almost always ( ) Regularly ( ) Sometimes ( ) Never

2) I am aware of the emotion that causes me to satisfactorily resolve a mathematical problem
 ( ) Always ( ) Almost always ( ) Regularly ( ) Sometimes ( ) Never

3) Is easy for me perceive the emotions that causes to try unsuccessfully to solve a mathematical problem
 ( ) Always ( ) Almost always ( ) Regularly ( ) Sometimes ( ) Never
4) I realize the emotion that causes me not to find the quick solution to a mathematical problem
( )Always ( )Almost always ( )Regularly ( )Sometimes ( ) Never

5) It gives me satisfaction to solve mathematical problems
( )Always ( )Almost always ( )Regularly ( )Sometimes ( ) Never

6) I feel frustrated if I find setbacks when I’m trying to solve mathematical problems
( )Always ( )Almost always ( )Regularly ( )Sometimes ( ) Never

7) If I get impatient when I’m trying to solve a mathematical problem, I easily achieve control myself
( )Always ( )Almost always ( )Regularly ( )Sometimes ( ) Never

8) If I can not solve a mathematical problem to the first attempts, I have a lack of control that not last long
( )Always ( )Almost always ( )Regularly ( )Sometimes ( ) Never

9) If I have trouble solving a mathematical problem, I control the emotion I feel meanwhile
( )Always ( )Almost always ( )Regularly ( )Sometimes ( ) Never

10) If I worry about not finding soon a solution to a mathematical problem, I get past this quickly
( )Always ( )Almost always ( )Regularly ( )Sometimes ( ) Never

Attributions

Stables Internal Attributions

Indicator: Grade control stable internal attributions

1) I get focus when I'm solving a mathematical problem
( )Always ( )Almost always ( )Regularly ( )Sometimes ( ) Never

2) Regardless of the combination of senses I use while I’m learning mathematics, I learn
( )Always ( )Almost always ( )Regularly ( )Sometimes ( ) Never

3) My temper helps me to persevere to find a solution to a mathematical problem
( )Always ( )Almost always ( )Regularly ( )Sometimes ( ) Never

4) I have succeeded in solving mathematical problems using my preferred mode of learning
( )Always ( )Almost always ( )Regularly ( )Sometimes ( ) Never

5) I have the innate ability to solve mathematical problems, which allows me to do
( )Always ( )Almost always ( )Regularly ( )Sometimes ( ) Never
**Internal Unstable Attributions**

Indicator: Degree of control of the unstable internal attributions

1) I can diversify the strategies to follow to solve mathematical problems solving them successfully
   ( ) Always ( ) Almost ( ) Regularly ( ) Sometimes ( ) Never
   ( ) Always

2) Despite the changes in my state of mind, I get successfully solve mathematical problems
   ( ) Always ( ) Almost ( ) Regularly ( ) Sometimes ( ) Never
   ( ) Always

3) I'm willing to perform variable amount of effort that involves me learn mathematics
   ( ) Always ( ) Almost ( ) Regularly ( ) Sometimes ( ) Never
   ( ) Always

4) Use an endless supply of resources, as required, to get to solve problems that require the use of mathematics
   ( ) Always ( ) Almost ( ) Regularly ( ) Sometimes ( ) Never
   ( ) Always

5) If solving a mathematical problem I use various sources of information or people, I do easily
   ( ) Always ( ) Almost ( ) Regularly ( ) Sometimes ( ) Never
   ( ) Always

**External Unstable Attributions**

Indicator: Degree of control of stable external attributions

1) Adverse situations in my environment (eg. climate, noise) that occur when I learn math, are circumstances which I solve
   ( ) Always ( ) Almost ( ) Regularly ( ) Sometimes ( ) Never
   ( ) Always

2) I manage my family environment, this is an element that favors me to learn
   ( ) Always ( ) Almost ( ) Regularly ( ) Sometimes ( ) Never
   ( ) Always

3) I control the school environment around me while I learn
   ( ) Always ( ) Almost ( ) Regularly ( ) Sometimes ( ) Never
   ( ) Always

4) I get that the group of people who I frequent respected me to learn math
   ( ) Always ( ) Almost ( ) Regularly ( ) Sometimes ( ) Never
   ( ) Always

5) I get that the teacher's moods (while he/she teaches me) encourage me to learn the mathematics
   ( ) Always ( ) Almost ( ) Regularly ( ) Sometimes ( ) Never
   ( ) Always
External unestables attributions

Indicator: Degree of control of unstable external attributions

1) The way I react to the attitudes displayed by the mathematics teacher (while he/she’s teaching me), allows me to have control over my learning
( )Always  ( )Almost ( )Regularly  ( )Sometimes  ( ) Never
always
2) Attitudes have my colleagues toward mathematics are a factor I control to promote my learning
( )Always  ( )Almost ( )Regularly  ( )Sometimes  ( ) Never
always
3) The way I react to the behavior of my relatives to mathematics, favor my learning of the subject
( )Always  ( )Almost ( )Regularly  ( )Sometimes  ( ) Never
always
4) I consider my friends behavior towards mathematics in a way that my mathematical learning to favored
( )Always  ( )Almost ( )Regularly  ( )Sometimes  ( ) Never
always
5) I consider the conduct of members of the institution where I study mathematics as something that benefits my learning of the subject
( )Always  ( )Almost ( )Regularly  ( )Sometimes  ( ) Never
always

Ethic and moral values

Indicator: Degree of acceptance of the level of understanding of knowledge

1) When the teacher asks me if I'm understanding what I am learning about a subject or mathematical concept, I acknowledge only what I really understood
( )Always  ( )Almost ( )Regularly  ( )Sometimes  ( ) Never
always
2) In the saying that "the questioner a question may doing appear someone like an ignorant once and not ignorant whole life" in relation to mathematical learning, I apply this to myself asking my questions in class and beyond
( )Always  ( )Almost ( )Regularly  ( )Sometimes  ( ) Never
always
3) I prefer to accept openly when I have not understood well a mathematical concept, that not doing
( )Always  ( )Almost ( )Regularly  ( )Sometimes  ( ) Never
always
4) Recognizing the depth and clarity in my level of understanding of a mathematical concept, future benefits me
Always ( ) Almost ( ) Regularly ( ) Sometimes ( ) Never always

5) I recognize the convenience of expressing sincerely how much I understand or I don´t, about a mathematical knowledge
Always ( ) Almost ( ) Regularly ( ) Sometimes ( ) Never always

APPENDIX 2: Topics of Discussion

"Affective aspects in the activity of the teacher of mathematics"

First of all: Oral an individual presentation to the audience of each teacher

Topics of discussion

1. Epistemological Beliefs
   Reasons that drive people to become teachers of mathematics.

2. Cognitive Beliefs
   a) Reasons because not all the students learn mathematics.
   b) Moods that may present students towards mathematics (favorable/unfavorable, innate/learned)
   c) Mathematics: difficulty learn or really are.

3. Didactical Beliefs
   Importance of the role of teacher for learning mathematics

4. Socio-cultural Beliefs
   Roles from individuals surrounding the student of mathematics (friends, colleagues, neighbors, family, community, educational institution and government) that help or hinder their learning.

5. Emotions
   Importance from vocations, emotional aspect, sensitivity and their importance for the student can learn mathematics.
   Possibility for educate or cultivate vocations in students.
   Degree of consciousness /control to have about this. (By the student /teacher)

6. Attitudes
   Behaviors or habitual ways of proceeding from students towards mathematics.

7. Attributions
   Importance from the environment in which the student live and develops to learn mathematics.

8. Ethics and moral values
   Importance from the honesty of the individual in recognition of the level of understanding of the mathematical concept that is being learned (facilitating it/hindering it). The impact that honesty has at all levels (family, social, political), and especially its impact on learning of mathematics.