TECHNICAL REPORT OF THE OBSERVATIONAL MONITORING FOR THE IMPLEMENTATION OF THE TEACHING PROTOTYPE METROMATEMATICAS

Introduction:

The project Metromatemáticas (MM) has been invented by Nahum Correa, to implement a new model of teaching mathematics starting in middle school. The model is based on constructivist learning theory, which says that learning takes place when the student participates as a center of the discovery process and generate results from collaborative work.

The teaching and learning processes are enhanced by the application in student teams, of principles and procedures of scientific and mathematical cases and real problems. Constructivist orientation distinguishes two nested elements in the process: the individual element is the direct involvement of the student in the application and generating their own knowledge and skills, and the social element is the collaborative participation of student teams that have the accompanied by qualified instructors and trained tutors. The prototype of MM is operationalized through a combination of procedures and situations adapted problem-based learning (PBL for its acronym in English), object-oriented learning (OBL) and case-based learning (CBL).

The approach proposed in the Model Metromatematicas, seeks to overcome the limitations of traditional models of teaching where students assume roles of greater receptivity and less participation in classroom activities. The current implementation of MM in Sonora, combines theoretical and practical instructional design with laboratories equipped with state of the art technology, workstations organized in groups of up to 40 students (10 stations), and a sequence of activities following the official math current curriculum (SEP), they materialize learning practical applications and projects located in cases. The Metromatematicas model has the goal of helping improve student learning and reduce failure rates in mathematics at the middle school level.

Current trends in failure and dropout rates driven in part by poor knowledge of mathematics are a serious barrier to the progress of the state and the country. Through this model, Nahum Correa intends to make teaching a technical resource for deficit reduction capabilities and competitiveness in Sonora and Mexico. It is planned, as a result of this project, to have a validated pedagogical model prototype obtained through robust methodologies so that it can be released by Centro Metrologico de México in the state and the country. Metromatematicas proposes an educational model to move towards teaching mathematics in a very practical way. Position itself quickly in the first place of existing educational models, combining the science of metrology, the scientific method and mathematics all taught in a laboratory to practice solving problems in the real world, it is also an educational model to promote research, development and innovation.

Method.

Participants:

Centro Metrologico de México certified teachers with 120 hours of training and a 40 hour certification. The five teachers who will serve as the prototype monitors are employed by the Ministry of Education and Culture and develop their programs based on the prototype proposed by Metromatematicas. To carry out the evaluation study it is required to have five laboratories with five control groups which do not have equipment or prototype.

In addition to a pre and post test assessment of achievement in mathematics, the assessment process has observations of the educational activities, the opinion of students and teachers in both groups, with the purpose of making sure the groups were balanced against the set of uncontrolled variables that are expected in this context.

The monitoring program is part of the Program Evaluation System of Metromatematicas and it works as follows:

a) Observations of the teaching strategies in the control and experimental group the teacher is conducting during sessions with their students;
b) Interviews with students about the program's features and their attitudes and opinions regarding the regular program and the new Metromatematicas program;
c) Interviews with teachers about the strengths and weaknesses that are facing with the official program and with Metromatematicas.

The objective is through surveys, videos and photographs to describe the everyday teaching process of mathematics comparing the two groups of students. 132 students were interviewed from experimental schools and 147 from control schools observing 58 classes, 13 for the control group and 45 to the experimental group while teachers were interviewed regarding experimental and control groups totaling entirely 18. Three visits were carried out to different schools during the morning or evening shift to deploy the three actions in the hours from 7:30 to 1:30 or 1:30 to 7:00 pm. The data was placed in the first instance in a database designed in SPSS with the aim of observing frequencies for later conduct a qualitative analysis.

Results:

Table 1 shows some of the variables related to the views and attitudes of students in front of both programs and mathematics content. The mean maximum possible is 1 and the minimum possible is 0. We present only those questions in which it was possible to find substantive differences associated with the Metromatematicas program.

So we can see that from the perception of the student who was in the Metromatematicas classrooms the new structure and operation of the program strengthens learning, improving the use of information technology and communication, the use of measurements and conditions sorting and cleaning the classroom. As can be seen in Table 1, the averages are well above those obtained by students who do not have the Metromatematicas laboratory.

Table 1. Presents the opinión of the students over class activities of two Metromatematicas Groups – oficial program.

THE STUDENTS AND THEIR NEW LEARNING ACTIVITIES.		
	Metromatematicas	**Official**
	Media (varianza)	Media (varianza)
Strengthens learning	.52(.25)	.28 (.20)
Use of de Information Technologies	.43(.24)	.07(.06)
Use of measurements.	.64(.23)	.13(.11)
Learns playing.	.13(.11)	.05(.05)
Order and cleanliness.	.47(.25)	.08(.07)
THE STUDENT SAYS THAT LIKES TO TAKE CLASSES.		
Expresses liking for the program.	.98(.02)	.67(.22)
Now the class is interesting.	.61(.24)	.31(.21)
The group is committed.	.23(.17)	.08(.07)
Interested in school.	.08(.07)	.06(.05)

Regarding the joy for taking classes, you can see the sympathy for the program amount to .98 compared with .67 of the control group.

Table 2. Means and variances of teaching observations on the activities, attitudes and physical environment of metromatemáticas students and groups of with the official program.

TEACHING DEVELOPMENT		
	Metromatematicas	Official
Notes	.09(.08)	.85(.14)
Problem solving	.63(.23)	.38(.25)
PROMOTE CHILDREN TO PERFORM THE ACTIVITY		
	Mean (variance)	Mean (variance)
Individual	.18(.14)	.77(.19)
Teamwork	.82(.14)	.0
Students with no activities	.67(.22)	.46(.26)
Distracted with no activities	.33(.22)	.46(.16)
ATTITUDE OF STUDENTS IN CLASS		
They seem to enjoy much	.51(.25)	.38(.14)
They seem to enjoy little	.27(.20)	.38(.25)
MATERIALS USED IN CLASS		
Notebooks	.76(.26)	.92(.07)
Textbook	.60(.24)	.15(.14)
Teacher´s Notes	.04(00)	.77(.12)
Laboratory Technology	.87(.11)	00(.00)
PHYSICAL ENVIRONMENT IN THE CLASSROOM		
Posters	.07(.06)	.31(.13)
Announcements or photographs	.04(.04)	.31(.23)
Interactive Whiteboard	.40(.14)	.15(.14)
Television	.02(.00)	.62(.25)
Books	.13(.11)	.62(.25)

The following are indicators linked with observations of teaching. It is evident that the frequency of notes used in teaching in the classroom is almost a probability of 1 for the control group and tending to 0 for the Metromatematicas group and contrary to this the solution of exercises is on the .63 compared to the .68 of the control group.

It can be seen that the work in groups is highly encouraged in Metromatematicas laboratory and it is interesting to note that it seems the metromatemáticas professor finds it hard to control and monitor the total group as observations gives them a 67% of the time that a student or students are not working which is frequently seen in the control group.

During class Metromatematicas students seem to enjoy more half the time of the observations versus 38% in the control group. The 92% of the observations controls used notebooks. 77% of the time they used teacher´s notes while the Metromatematicas students in 87% of the time they used lab equipment, 76% books and 60% textbooks. In the physical environment of the classroom; the Metromatematicas laboratory has an interactive whiteboard in 40% of the observations and after that posters, photographs, TV and books are more frequent in the control group classes.

It remains to be carried out a comparative analysis that can show significant differences between the groups during follow-up. We can report from observational and students and teachers reports that traditional math class traditionalist with the teacher giving a conference and the student with a passive attitude. While in the Metromatematicas lab rather than be an interactive and constructivist classroom, teachers appear that these three months in which they conducted the Metromatemáticas exercise began to gestate a different environment that fails to have the total characteristics required in a constructivist classroom.

Table 3 presents the comparisons showing statistically significant differences on the observations of the educational activities in both experimental and control groups. This first of three tables refers to the observations of classroom activities. In general observation the teacher concluded with a single activity as homework, that was 81 percent. The only significant difference between all teachers is associated with the teachers in the experimental group three times ending with three to five activities while in 8 cases control groups finished with no extra homework.

Table 3. Significant results contrast U Mann-Whitney test for observational variables activity during class as a follow-up of the Metromatematicas Program.

Item	Treatment	Average	Significance

	Type	Range	bilateral
Activity Conclusion	Experimental Control	26.70 39.19	.012
Explains the Subject	Experimental Control	31.78 21.62	.005
Notes	Experimental Control	24.62 46.04	.000
Experiment Development	Experimental Control	31.38 23.00	.02
Copy and / or repetition exercises	Experimental Control	26.14 41.12	.000
Elaboration of Conclusions	Experimental Control	31.32 23.19	.05

N=Experimental: 45; Control: 13

In regards with the explanation given to class of the subject for that day, 11% of the experimental group did not explained the subject and 89 percent of the time they did. While 46% of the control groups did not explained and 53% did explained the subject before starting class. In students taking notes in class 89% of the time the students of experimental group teachers did not take notes compared with 15% of students in the control groups. 85% of control group students took notes compared with 11% of the experimental groups. In connection with the development of experiments, students in classes with experimental group teachers did in 30% of the time while with the control groups was nonexistent.

A significant difference in the frequency associated with the use of photo copies and repetition exercises was observed, in the experimental group was 3% of the time and the control group 12% of the time. The frequency with which teachers ask students to draw conclusions was 34% in experimental groups and 8% in control groups.

Table 4. Significant results contrast U Mann-Whitney test for observational variables on how students solve classroom activity during in the Metromatematicas Program.

Item	Treatment Type	Average Range	Significance bilateral
Individual, following teacher as they solve problems	Experimental Control	25.66 42.81	.001
Individual, working alone	Experimental Control	28.00 34.69	.001
Working in small groups or pairs	Experimental Control	34.84 11.00	.000

N=Experimental: 45; Control: 13

In Table 4 have significant differences related to the way in which students interact in class. Significant statistically differences are found when the student works individually with the instructions of the teacher, we found a rate of 18% of the students in experimental groups did it this way compared to 78% of control group students. At no time were students from experimental groups observed working individually and independently while 23% of the time this was observed

in control groups. Finally, the experimental group in 83% of the time the students worked in small groups while the control group was none.

Table 5 describes the observations were statistically significant differences were present in the materials used in class. First we have the materials used by the teacher, in the experimental group has a frequency of 5% compared with 77% in control groups. Using library books has zero frequency in the experimental group and 39% in the control group. The 74% of the students in the experimental group used calculator compared to 39% of control groups. Laboratory equipment for 87% of the students used it in experimental groups, while control groups was none.

Table 5. Significant results contrast U Mann-Whitney test for observational variables on the material used in class during the Metromatematicas Program implementation.

Item	Treatment Type	Average Range	Significance bilateral
Made by the teacher	Experimental Control	24.79 45.81	.000
Various Books	Experimental Control	28.50 32.96	.008
Library Books	Experimental Control	27.00 38.15	.000
Computers	Experimental Control	32.24 20.00	.005
Calculators	Experimental Control	31.77 21.65	.021
Lab Equipment	Experimental Control	35.13 10.00	.000
Materials or posters made by the teacher	Experimental Control	27.93 34.92	.020
Books	Experimental Control	26.37 40.35	.000
Calendar	Experimental Control	28.50 32.96	.008
Television	Experimental Control	25.64 42.85	.000

N=Experimental: 45; Control: 13

In the same table, observations on the physical environment of the classroom are listed. The presence of posters produced by the experimental classroom teacher was 7% of the time and 31% in the control groups. The 13% of the time the use of textbooks was observed in the experimental classrooms and 62% in control groups. The use of calendars was never observed in experimental classrooms compared to 16% of control groups. Finally, the use of television was observed in the 62% of the control groups and in 2% in the experimental classrooms.

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