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Neurolinguistics Programming (NLP) in the Teaching of Mathematics to Improve Teaching Quality

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Abstract: At the 37th session of the General Conference, the United Nations Educational, Scientific and Cultural Organization (UNESCO) gave nine medium-term strategic objectives to carry out from 2014 to 2021. In the first strategic objective it states, "Support the Member States in the development of educational systems that promote lifelong learning for all, high quality and inclusivity". In the second strategic objective it states, "Empower learners to be creative and responsible global citizens". During the 2014–2021 periods, UNESCO's will dedicate greater effort towards improving the quality of education, learning objectives and results in its education program. Taking into account the UNESCO objectives, we introduce in our mathematics didactics classes some strategies of Neurolinguistic Programming (NLP) in order to improve communication, especially non-verbal communication, in a classroom of many different learners. In doing so, we ask our students to identify with how they learn best, whether visually, auditorily, or through kinesthetics.

The 29th strategic objective states:

UNESCO will respond to the need to improve the quality of education and learning by focusing on the following essential areas: It will address the severe shortage of qualified teachers in many countries by supporting the professional development of teachers through capacity building, using teacher training facilities and the dissemination of innovative teaching practices that improve the effectiveness of teaching staff.

The 34th objective continues:

This will be achieved by helping Member States ensure that teaching content, environments, practices and processes foster the development of relevant skills required to respond to local and global challenges, such as critical reflection, creativity, understanding the ethical dimensions of human development, and being an active and responsible citizen.

Taking into account these considerations in our mathematics education classes, we introduce some ideas of Neurolinguistic Programming (NLP) to improve communication, especially non-verbal communication, and we ask our students about how they learn best, as either visual, auditory, or kinesthetic learners. We give them an assessment to determine their learning type, and from their results we incorporate strategies and resources that could be used to improve our teaching in our math classes. We incorporate NLP by introducing Group Dynamics in a different way.

Recreational math is also a fundamental piece, first the teacher shows the students what is intended by the assignment. Then the students, throughout the course, develop a mathematical activity which the rest of the class

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must participate in. This encourages positive emotions toward mathematics through laughter, surprise, and fun. Studies in the field of Neuroscience show that, "The brain stores any learning that has an emotional component better which then allows it to be used more effectively" (Bueno D., 2017)

With this experience we intend for our students to gain mathematical competence and communication skills which improve their own teaching abilities.

Key words: neurolinguistic programming (NLP), mathematical didactics, group dynamics, UNESCO

1. Introduction

The National Council of Teachers of Mathematics (NCTM, 2000) proposes the resolution of problems as the main focus of mathematics in schools and this is the main objective that we propose in teaching of mathematics to future teachers. We want them to be competent in the field, that is, to become competent in several concepts, methods, attitudes, and values. Developing these understanding involves applying methodologies and fostering discovery and self-criticism. Some of my students already have an acceptable level of understanding of mathematics, but others do not. Often times, students foster negative emotions toward mathematics because of a previous bad experience in learning this subject. Neuroscience confirms that emotions can shape learning and therefore I try to make my classes emotionally positive.

My research to improve the teaching of mathematics has led me to focus on emotions, emphasizing the most interactive parts of the subject, students' self-esteem, group dynamics, and NLP (Neurolinguistic Programming) strategies to improve verbal and non-verbal communication in the classroom in order to make the most use of our minds.

2. Goals and Objectives

L'OCDE / PISA (2006) defines mathematical understanding as the aptitude of an individual to identify and understand the role played by mathematics in the world; to obtain well-founded reasoning and to use and participate in mathematics according to the needs of his life as a constructive, committed and reflective citizen. Niss (1999) states that the selection of adequate techniques is necessary to calculate, represent and interpret the available information as well as develop problem solving strategies. To achieve teaching excellence, the research-action method is useful. We realize that our students have to develop skills through individual mental processes of critical and creative reflection in order to enhance and develop their personal logical-mathematical thinking (Callis & Mallart, 2011).

By carrying out a positive learning experience in our classrooms, we aim to improve mathematical and personal understanding. We do this by encouraging a positive attitude towards mathematics and creating an enjoyable learning and teaching experience of mathematics. As teachers, we intend to change the attitude toward mathematics.

We also intend to:

- Have fun with mathematical riddles;
- Learn recreational math activities;
- Encourage laughter while doing mathematical activities;
- Seek to answer mathematical questions;
- Create positive emotions toward mathematics;

- Know how to solve mathematical problems in daily life;
- Incorporate funny anecdotes into classroom learning;
- See the fun side of mathematics.

3. Activities That We Carry Out

Once we define the goals that we intend to achieve and the objectives we want to develop, on the first day of class we present our students with a math problem that they should try to solve first individually, and if they do not reach the solution, in the form of a small group.

To achieve the proposed objectives, we work with content and concepts, procedures, and attitudes. We start by working with attitudes, then procedures, especially through mathematical reasoning, and finally with the conceptual content. Students define mathematical concepts based on experience and observation of facts. The National Council of Teachers of Mathematics (NCTM) states that the curriculum should provide students with the opportunity to formulate interesting problems based on a wide variety of situations, in and out of mathematics (NCTM, 2000). According to the NCTM, students should combine complex mathematical activities, problem-solving, creative thinking, reflection and persistence. Ellerton (2013) found that the ability to propose problems and solve them is related.

For example, a question could be to present two “friendly” numbers. In order to find what the two numbers are, students must use their technological resources to find out when we say that two numbers are friends.

I also propose to them to look for the etymology of the word “mathematics” and the word “calculus”, it is interesting that the word mathematics means, “That which can be learned”. Plato believed that no one could be considered educated if they had no knowledge of mathematics. Nowadays we all have to have a basic knowledge of mathematics because, as I tell my students, “Mathematics makes life easier”. The word calculus means “stone,” stone being the first calculator used by our ancestors in the Paleolithic period. For example, when hunting, individuals each left a stone to mark their spot before leaving. When they returned, the stones served as a way of knowing who had returned and who had not by counting the stones that remained. If someone had not yet arrived, group members would seek out the companion who had not yet returned. This is one of the many examples of how the stone was used as the first calculator in history.

Highlighting didactics as a fundamental part of teaching of mathematics, methods are the didactic when taught in school. Didactics, as an instrument, is the most relative, most contingent element, therefore it is the most changing and adaptable element. It is necessarily mutable, renewable and progressive. Didactic progress is not an option, it is a necessity, and therefore it will require more sensitivity, imagination, realism and courage, which will require constant updating and permanent recycling. Didactics is an art. Didactics is what makes a school interesting or boring and a boring school is an inefficient school. Today we must compete with social media for our students’ attention. To be effective, education must be attractive. Education is attractive by the quality of its teaching.

When introducing the concept of didactics of mathematics as an art, and therefore implying creativity, we must bear in mind that in his lecture “Creativity”, Guilford (1950) points out the fluidity, flexibility, originality, analysis and synthesis as basic principles of creativity. Pásztor, Molnár i Csapó (2015) also insists that creativity plays an important role in solving problems.

NLP helps us understand this definition of creativity. We talk about how to communicate by better

understanding the message we are trying to convey. Our words occupy 10% of the message students remember; our tone of voice represents 40% of what is remembered; and the gestures that accompany our message represent 50% of what they will remember. Another factor is the coherence between what we say and what our body expresses. We reinforce our message if there is coherence between our body gestures and our words.

Taking into account all of the ways we receive information, we determine if students learn better in a visual, auditory or kinesthetic way. About 50% of students learn better and remember what they have learned by pictures, as they are more visual learners. About 30% learn best in an auditory way, with words and sounds. Around 20% learn better in a kinesthetic way, through emotions and by hands-on experience.

I encourage students to make an effort to identify themselves as one of these three learners by telling them that there is always one category that dominates over the other two.

Once the base of the three groups is established, we started a group dynamics workshop where first all students must individually complete a table where I asked them what strategies and resources they would use to teach mathematics to each group of students.

Table 1 Strategies and Resources to Use in Math's Class.

Students	Strategies and Resources to Use in Math Class
Visual Learners	
Auditory Learners	
Kinesthetic Learners	

Source: author's creation.

Once each student has filled in their table, they form groups of two in order to create additional strategies and resources without repeating any already mentioned; the students must reach a consensus. Afterwards, the students form groups of four and fill in another table with proposals for each of the three categories. Although there are four students, they must reach a consensus. Once completed, I put them in groups of eight in order to fill out a final table. By the end of the activity, students learn that there are many possibilities for each category than they initially realize. By reaching a consensus, the students learn that although each individual has many ideas, reaching a shared decision is often more powerful. In this way, we point out the importance of teamwork.

Through this activity we achieve two objectives: developing mathematical strategies and learning the importance of teamwork. The importance of positive group dynamics are constantly emphasized in my math classes. Teamwork favors group cohesion and gives more confidence to the students' abilities to work together, making it an effective method for decision making that I call the "Incident Process".

Once the activity was completed, I used the sheet they filled out together to make a final summary of all the groups in a single document that I share with every student. In the end, these strategies and resources appeared to work with visual, auditory and kinesthetic students, taking into account that there are resources and strategies that serve all types of students in learning mathematics.

These resources are what students put into practice when they perform and present their work in the classroom since we use different models such as POL (Project oriented learning), PBL (Problem-based learning), ApS (Service Learning) and Flipped classroom. Another group activity we perform in the classroom is the technique called "Symposium" where between all of us, we complete the task, but no single person does all of the work.

Table 2 Examples of Strategies and Resources to Use in Math's Class

VISUAL	• BitsDigital Support: Youtube, PowerPoint, Prezi, videos, Internet tutorials • BaFi (instructional material) • Posters (with velcro) • Textbooks • The chalkboard • Abacus • Sudokus • Imagination problems • Noticing the surrounding area • Tangram • Strategy games: ex: tic-tac-toe, chess... • Non verbal communication: body gestures and facial expressions • Magic mathematics • Graphs and images • Drawings and sketches • Computer games • Board games
AUDITORY	• Explanation from the professor and from students (examples) • Videos • Mathematics debates • Music • Word games (rhymes) • Mental math • Oral problems • Voice characteristics: tone, intonation, speed, volume, vocalization • Clear and emphasized vocabulary • Repetition of concepts • Riddles • Stories
KINESTHETICS	• Tangible elements: BaFi, tangram, puzzles, plastic material, clay, money... • Body usage • Practice exercises • Strategy games • Chalkboard activities • Tablets, computers • Lego-robotics • Flipped classrooms • Mathematics laboratory • Mathematics debate • **Visit mathematics museums.** • Teaching children • Mathematical theatre • Drawing material: compass, cartabon...

Source: Author's creation.

Achieving mathematical competence involves:

- Thinking mathematically;
- Reasoning mathematically;
- Proposing and solving mathematical problems;
- Obtaining, interpreting and generating information with mathematical content;
- Using basic mathematical techniques;
-Interpreting and representing (through words, graphics, symbols, names and materials) expressions, processes and mathematical results;

-Communicating the work and discoveries made both orally and with short writing assignments, using a mathematical language.

These seven aspects are worked on in seven groups, so that each group must think and plan two activities to achieve each goal. The planned activities should place them in a specific cycle of primary education: 6 - 8 years in the initial cycle, 8–10 years in the middle cycle and 10–12 years in the upper cycle of primary education. They must also specify in which of these five categories they situate their activities: (1) numbering and calculation; (2) relationships and change; (3) space and form; (4) measures and (5) statistics and chance. Students must choose one methodology that will be used in their activity, specify what is intended for students to learn from the activity, and develop criteria for evaluation to assess the degree of achievement of the objective. To carry out this activity as a team, they must utilize the document of the New Curriculum of the Generalitat de Catalunya that appeared on June 23, 2015.

It is an activity that students complete in the classroom forming groups of five people. Once finished in their groups, each group shares their activity with the rest of their classmates. The other teams must take notes on each activity so that at the end of the session everyone has the material of the seven groups. In the end, we all share what we gained from this learning experience. Group dynamics greatly favor teamwork and help all students have an active role, as we begin with individual goals that we achieve as a group.

4. Conclusion

NLP (Neurolinguistic Programming) has been an excellent resource to incorporate as we make our class presentations and prepare our class sessions. The students have collected a number of activities and resources that will be useful for them in fulfilling their function as future teachers. The recreational mathematics introduced at the beginning of the classes, first by the teacher and then by the students themselves, is the way to achieve a change of attitude towards mathematics and thereby improve students' learning. Recreational mathematics makes students think, relate, reflect, and form relationships. When students manage to solve the presented challenge, the initial restlessness becomes satisfaction, and positive emotions are created through the effort they have put forth in their work.

Group dynamics is a resource that favors teamwork and with it we:

- Develop the feeling of teamwork;
- Teach students to think actively;
- Teach students to listen comprehensively;

-Develop capacities for cooperation, responsibility, autonomy, creativity, exchange of opinions, and collaboration;

-Overcome frustrations and false fears and create feelings of security;

-Create a positive attitude toward the problems of human relations and encourage a good environment for the socialization of the individual.

Group dynamics favors the development of the emotional competence that is necessary in our mathematics classes.

Students complete a survey of their mathematics classes rating their learning experience (two surveys each year, one per semester, with the scale of 1 through 5). The results of the student surveys are as follows: 4.53, -4.43, -4.85, -4.21, -4.77, -4.86, -4.73, and -4.11.

These favorable responses fill us with satisfaction and encourage us to continue encouraging emotional competence in mathematical training. My line of research is to achieve excellent teaching through all of the mechanisms that science provides us. Teaching is an art.

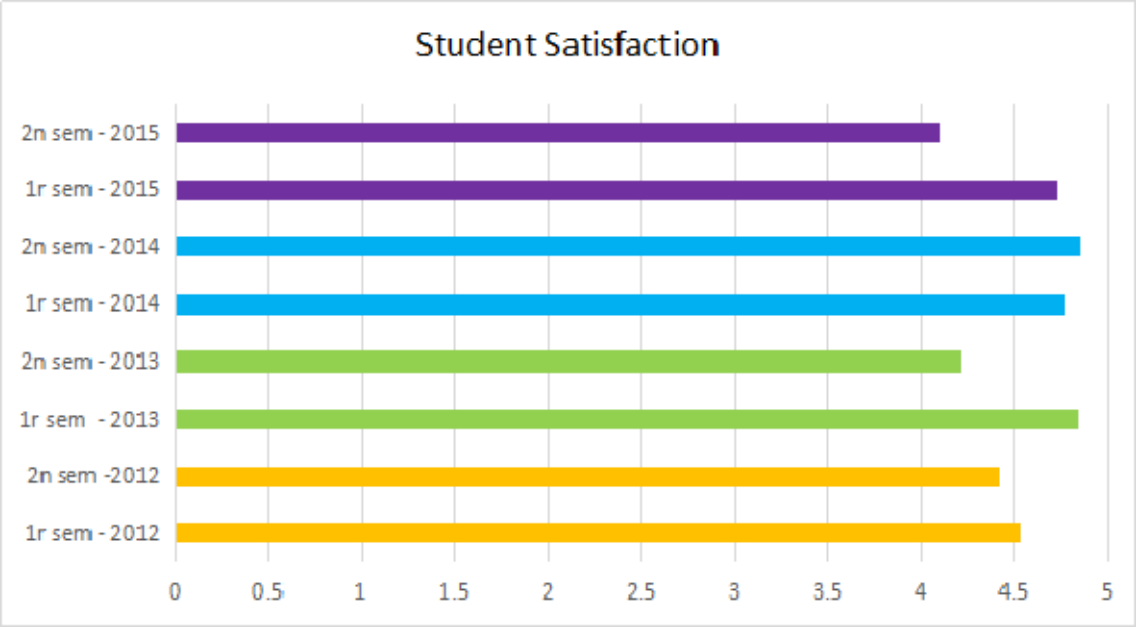

Figure 1 Student's Satisfaction from 2011 to 2015

Source: Author's creation

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