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# **Tools to Stimulate Mathematical Performance in Students from 6 to 9 Years of the Manabí Educational Unit**

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**Abstract---**The research was based on the need to improve mathematical learning in the elementary basic educational stage, the results of the research carried out using a Kendall matrix and its interpretation are shown., the problem of academic performance lies in the resistance and apathy during the learning process, the variables found were classified for their subsequent weighting, and the objective was to identify the most efficient tools to stimulate mathematical performance in students from 6 to 9 years of Manabí Educational Unit. The research has a documentary and exploratory orientation, the application of a structured survey based on the Likert scale was applied to the students, interviews with the teachers and administrators of the institution, and analytical methods were used, including a Kendall matrix that weighs the results obtained from the expert criteria technique made up of professionals from public and private institutions and the rector of a school, this allowed the identification of the variables, their effectiveness and behaviour, the identification of the 7 most important tools was obtained as a result. incidents, these being the development of games and recreational activities, experimentation strategies, mathematical applications, correlation of a strategic intervention plan with the identified tools. **Keywords---**Learning tool, mathematical performance, mathematical methods, recreational activities.

# Introduction

The development of great nations has been intrinsically linked to their human talent, the ability to adapt and the interpretation of variables, all these elements contribute to the evolutionary process of societies, the strengthening of these areas shows unequivocal results today and we evidence it in those countries that today we call developed, however, modern society not only requires adapting to its demands, today it seeks to be competitive and have comparative advantages that ensure the quality of life, but these demands for their part they require processes to be systematized and risks to be reduced, in this context the exact sciences appear, those that ensure results and correct forecasts based on analysis, in all that is expressed the science that stands out the most for its link to all areas also is mathematics, present since time immemorial, have helped to understand the greatest mysteries and have contributed ted to the process of growth of man and communities (Moghavyemi et al., 2018; Perry, 2015).

Mathematical learning has been a challenge for many people throughout their student life, this science is characterized by being exact and not accepting subjectivities, the processes show whether a result is positive or negative, and the analysis of variables can help solve problems every day or even decipher highly complex astronomical codes, without a doubt, mathematics has helped us understand how things work throughout our existence.

Knowledge of the subject is achieved through the assimilation of its components, however, apathy towards this subject is evident, and resistance to procedures makes it difficult to assimilate its properties (Cerda et al., 2017) in their study on the influence of cognitive and motivational variables on academic performance in mathematics, they identify the importance of the predisposition towards mathematics for their good performance, they also suggest viable alternatives to improve the relationship with this science, in this context. the (Cervantes Virtual Center, 2009), defines the cognitive variable on the one hand as rational capacities such as intelligence or memory and mental processes such as analysis, synthesis, induction, or deduction.

Bazán et al. (2002), point out 4 fundamental aspects in mathematical performance, these being: "the perceived difficulty in learning Mathematics, the student's fear of participating in class, the taste for the subject in question, and the perceived level of understanding of their teacher's explanations" (...) additionally, they highlight the relationship between performance and attitude, based on what these authors expressed, it can be shown that emotional detachment with science generates mental blocks thus preventing good performance, phrases like "I'm not good at math" are frequent in students, (Molera Botella, 2012) on the other hand, points out that affective factors (emotions, beliefs and attitudes) are closely related to in mathematical performance and that working on these variables would ensure a better learning process, on the other hand, (Barrero Borrallo et al., 2015) suggest applying neuropsychology in the area educational tool to prevent learning difficulties in mathematics and promote school performance, based on the identification of patterns of movement and learning in children aged 4 and 5 years.

The identification of difficulties in the learning process, behaviour patterns and resistance to mathematical discipline, leads us to look for efficient alternatives to stimulate mathematical performance, in this context, (Chávez Arias, 2018), in his research on learning strategies. and academic performance identifies nineteen most used strategies, of which four have a significant impact on academic performance, also shows that low-performing students do not apply planning as a strategy, (Araya et al., 2019) point out the influence of creative mathematical thinking and the importance of its development in the school stage.

The approach of these hypotheses leads to the identification of the tools to stimulate mathematical performance in students from 6 to 9 years of age, for the development of this investigation, we will analyze habitual cases in the Manabí Educational Unit of the Chone canton, this study part of the documentary analysis, its development uses methods of an exploratory nature, given the circumstances of being a little studied case in the locality, teachers and the rector of the institution are consulted about the previously identified variables and students about their relationship with the subject, finally, the tools found are listed and weighted concerning their degree of efficiency (Aunio & Niemivirta, 2010; Vukovic et al., 2013; Nogues & Dorneles, 2021).

### **Materials and Methods**

The methodology applied is of an exploratory type, starting from a documentary base, allowing the application of various techniques for the collection of information and the analysis of the perspective around the current learning system used and its interpretation by teachers, the approach of this article, allows considering options that yield punctual results and approve the identification of tools that stimulate mathematical performance in students from 6 to 9 years of age.

After the identification of parameters through the documentary search, a quantitative methodology is applied to the students through a structured survey based on the Likert scale to the entire population of 41 students and, in parallel, the development of interviews with the teachers and administrators of the institution around the results of the survey, the data obtained require in-depth analytical methods, for this purpose, we implemented the expert criteria technique made up of 10 professionals with more than 10 years of experience in teaching, 5 from public institutions, 4 private and the principal of a school, who will qualify the identified variables in a Kendall matrix, later, these results will establish an average that will allow classifying the tools based on scores, for further analysis and discussion establishing their effectiveness and behaviour in the use of the found tools.

## **Analysis and Discussion of Results**

Surveys were carried out on 41 fourth-grade students of basic education from the Manabí educational unit, the information collected was analyzed with the teachers of the institution, and the criteria of the rector of the campus were also used, who provided an analysis by the administrative approach, the results obtained to allow a better understanding of the students' thinking to mathematical learning, the approach that this research should have and the type of tools for stimulation that should be identified, the results are shown in the graph of figure 1.



Figure 1. The age range of surveyed students

The students who were surveyed have an age range between 7 and 9 years, the proportion having the results shown in percentages. The surveys were carried out inside their classrooms, and they were given absolute freedom to answer when they like mathematics, the results are shown in figure 2.



Figure 2. Affinity for mathematics

60% of the students indicate that they like mathematics a lot, 40% that they like it proportionally, these answers are encouraging, however, it should be considered that the subject as such is interesting for its diverse application, one reality is the perception of science and another of the teaching methodology with which it is taught, teachers suggest that the results go hand in hand with the application of dynamic methodologies that have had a place in recent years at the institution. It can also be evidenced that with the new methodologies, the majority of the students like the math classes, noticing that it is more than 80 percent of the students, stated that they like their math classes and the way they are taught, and teachers comment that thanks to the application of playful and dynamic methodologies, the students enjoy their classes, however, more than 10 years ago, the reality was different and classes were monotonous, the results at that time would have been far from the current one, the activities Playful activities are defined as "a set of strategies designed to create an environment of harmony in students who are immersed in the learning process (...)" (Mendoza, 2018).

Students express that they like the way their math teacher teaches the subject, allowing them to be at ease. The rector of the institution indicates that for 10 years the teachers of mathematical sciences have been new and use novel stimulation methodologies, this has generated high empowerment on the part of the students, in addition, the teachers point out that success and acceptance are due to to the application of modern methodologies for stimulation.

In this context, the students in their answers to the questions asked want to learn to apply mathematics in different professions, the teachers state that one of the best experiences with the students arises from the correlation between the subject and its application in different professional branches. and daily activities.

Based on the results obtained in the survey carried out with the students and its subsequent analysis carried out with the teachers, it is evident that the role played by the stimulation methods has a decisive influence on the perception of mathematics, the application of this method It also shows that the correlation of science and its application in different professions and daily activities have a great impact, the indicators show a high interest of students in learning science with this methodology (Tonazzini et al., 2019; Sadeghi et al., 2013; Lu et al., 2018).

For the identification of stimulation tools, it is required to contextualize the mathematical learning process, (Mora, 2003) in his research on strategies for learning and teaching mathematics, detail six fundamental phases for mathematical work and learning, these are: intra-mathematical and extra-mathematical context, organization of learning and teaching activities based on a given problem, identification of specific variables around problematic scenarios, the solution to particular problems through applicability, design of concepts and mathematical tools, the correlation between own knowledge of the students and the new methodologies learned, the process of strengthening and systematization of the new knowledge.

12 didactic strategies are identified that allow the application of stimuli to improve mathematical performance, these have their conceptualization and a set of tools, these being: Problem-solving, project development, mathematical applications, mathematical modelling, experimentation strategies, methods demonstrations, development of games and recreational activities, correlation with other subjects, relationship with history, knowledge of fundamental ideas, development of workstations and the study of Ethnomathematics (Melo et al., 2020; Santos et al., 2016).

#### The solution to problems

It raises the performance of exercises based on everyday problems and these are solved mathematically, the objective is to promote a culture that proposes the mathematical solution to the various eventualities, and the army develops exercises based on this methodology.

#### Development of projects

The methodology seeks to propose projects where the use of mathematics for its achievement is evidenced, and the realization of budgets or economic projections arise as alternatives, in the case of schools these projects must be adapted to the corresponding ages.

# Mathematical applications

Refers to the use of digital applications for the development of mathematical skills, before the appearance of the technological era, all kinds of challenges were used seeking the use of mathematical operations, these ranged from board games to highly complex puzzles.

## Mathematical modelling

Exercises that seek to give a mathematical explanation to the events that have occurred in any area, for example, why the flash of lightning is seen before the sound, wind speed, and temperature, among others. (Brito-Ballina et al., 2011) define it as the "Attempt to describe some part of the real world in mathematical terms.

Mathematical models are built in all the physical, biological, and social sciences. The elements that compose it are taken from calculus, algebra, geometry, and other related fields (...)"(Brito-Ballina et al., 2011).

#### Experimentation strategies

Development of experiments that allow the collection of mathematical data, for example, the boiling point of water, which is a physics experiment, but which provides numerical data and allows generating an antecedent and even a forecast.

# Demonstrative methods

Application of methods that demonstrate or mathematically explain a fact, event or reaction, is the basic principle of the descriptive method, for example, the decomposition time of an apple in different environments, in this mathematics would explain why the selected product breaks down slower when exposed to low temperatures.

#### Development of games and recreational activities

Set of practical activities that range from games to dynamics designed to promote mathematical learning, previously board games were used to calculate statistics and probabilities such as chess or cards, more sophisticated tools of Hand in hand with technology, these activities are based on the concept that human beings learn better when they feel motivated or find an activity fun.

# Correlation with other subjects

The linking of mathematics with other sciences and how they contribute to their actions, for example, in the medical area the use of indicators allows establishing diagnoses, these data can be; temperature, blood pressure, test results, and family history, among others, this information allows the doctor to identify pathologies and prescribe a patient, in this case, mathematics helps to record history and predict possible futures based on existing information.

#### Relation with history

Methods of illustration where it is evident how mathematics has contributed in history, an example may be the Punic Wars and their repercussion on world trade of that time at present, you can see what is happening in the product gross domestic of the countries and the behaviour of the currencies, the gold and the currency.

# Knowledge of the fundamental ideas

Explanation of the mathematical bases, the use of numbers, geometric figures, sets, and functions, in this segment we seek to relate the mathematical foundations in all possible areas, be they medical, social, construction, environment and all the environment, for example, the importance of the shape of a vehicle to counteract the force of the wind and that it is aerodynamic.

# Development of workstations

It consists of the search for suitable spaces for mathematical learning, especially at an early age where the aim is to stimulate the student, these spaces are complemented with articles that contribute to the process, in schools' abacuses are common, billboards with exercises, mathematical games table, technological equipment, blackboard and all the elements corresponding to the ages of the students.

# Study of ethnomathematics

This strategy seeks to explain how communities and peoples have forged their activities, the objective is to demonstrate mathematically how the events and decisions made marked the course of their destinies, this type of research is ideal for the making of historical and political documentaries of cities, countries and even empires (Peña-Rincón et al., 2015), indicate that Ethnomathematics "Studies how knowledge is produced in the practices of communities and groups that respond to various forms of life and that develop from the need to survive and transcend, both in time and in space (...)".

Based on the results of the surveys where the need to use simulation tools and the analysis of documentary information from various authors is evident, 10 experts, mathematics teachers with more than 10 years of experience, and 5 from public institutions, were consulted. 4 private and the rector of the Manabí Educational Unit, the results allow identifying the most efficient tools to stimulate mathematical performance in students aged between 6 and 9 years (Loor-Mera & Yánez-Balarezo, 2022).

The application of the tool according to expert criteria and the Kendall matrix allows to identify the variables with the greatest incidence in the stimulation process for mathematical performance, during the development of the exercise the 7 most efficient tools were identified, these being; The solution of problems, the development of projects, the mathematical applications, the experimentation strategies, the demonstrative methods, the development

of games and playful activities and the correlation with other subjects, each of these tools exceeded the average established based on the rating given by the experts, see table 1.

TOOL WEIGHTING														
VARIABLE		E 1	E 2	E 3	E 4	E 5	E 6	<b>E</b> 7	E 8	E 9	E 10	Т	$\frac{N}{n}$	%
1	Troubleshooting	5	4	5	4	4	5	4	4	4	4	43	>42.3	1.57
2	Project development	5	4	4	4	4	4	-5	-5	4	4	43	>42.3	1.57
3	Mathematical applications	5	5	-5	4	5	4	4	5	4	4	45	>42.3	6.30
4	Mathematical modeling	5	4	4	3	4	4	4	4	4	4	40	<42.3	-5.51
5	Experimentation strategies	5	5	4	5	5	4	4	5	4	5	46	>42.3	8.66
6	Demonstrative methods	5	4	4	4	5	4	4	4	4	5	43	>42, 3	1.57
7	Development of games and recreational activities	5	5	4	5	5	4	5	5	5	5	48	>42.3	13.39
8	Correlation with other subjects	5	4	4	4	5	4	4	4	5	5	44	>42.3	3.94
9	Relationship with history	5	4	4	3	4	4	3	4	4	4	39	<42.3	-7.87
10	Knowledge of fundamental ideas	4	4	4	3	4	4	3	4	4	5	39	≪42.3	-7.87
11	Development of stations of work	5	4	4	4	4	4	3	4	4	4	40	<42.3	-5.51
12	Study of Ethnomathematics	4	4	3	4	4	4	3	4	4	4	38	<42.3	-10.24
-									TOTAL		508			
					   					Σ		42.3		

Table 1		
Application of the expert criteria tool and	Kendall	matrix

The Tool weighting results allow identification of variables more incidents and those that precede it, resulting in the development of games and recreational activities as the highest score, exceeding the base by 13.39%, this is based on the score obtained of 48 points over the average of 42.3 established in the Kendall matrix, see figure 3.



Figure 3. Weighting and identification of most incident variables.

The determining variable identified was the development of games and recreational activities, obtaining a rating of 96%, achieving a difference of 4% over the immediate lower variable, which is the experimentation strategies, with these results it can be determined that the most efficient tools for stimulating mathematical performance are those that include dynamic activities and ensure student participation in a fun and active way, see figure 4.



The development of games and playful activities emerges as the determining variable and the most incidental tools for the stimulation of mathematical performance in students from 6 to 9 years of age, (Colmenares, 2009) points out that the use of playful methodology allows the creation of bonds of trust between the teachers of the area of mathematics with the students, this allows to obtain a greater predisposition on the part of the students for the learning of science, on the other hand, (Solórzano & Tariguano, 2010) in their research on the playful activities to improve the learning of mathematics define the game as an activity used for fun and enjoyment of the participants, often implemented as an educational resource, in addition, they classify playful activities as free and directed, referring to the first as actions that do not follow a format or context, are of free choice and are carried out mostly in this open spaces, on the other hand, the directed ones are previously structured and respond to an established pattern in search of previewed results, instructions are generally followed and their context is more academic.

In the entertainment segment, 16 types of games are identified, according to their classification, these are; roleplaying games (captain commands), skill or dexterity (marbles or spinning top), strategy (chess), chance (dice or bingo), adventure (find the treasure), action (Russian roulette), educational (trivia ), hands (wrestling or thumb wrestling), words (tongue twisters), affirmation (dramatization of characters or trades), cooperation (skills for group work), communication (guess the character), conflict resolution (riddles), intercultural (representation of different customs), presentation (dynamic personal presentation with the representation of animals or objects), intelligent (Sudoku or mental ability).

The second highest scoring tool was the experimentation strategies, this tool has an academic approach, the methodology suggests carrying out experiments and finding explanations through mathematical formulation, with these actions it is sought to promote the experimental and descriptive method, at the same time that uses observation and measurement methods, (Pérez González et al., 2019) in their research on mathematical experiments to teach magnitudes in the first cycle of primary education, they conclude that;

Mathematical experiments are considered as types of tasks that can be used to encourage the elaboration of conjectures and their verification based on the analysis of situations of practical life that require the student to investigate and develop ways of working and thinking mathematically (Pérez González et al., 2019).

In addition, they suggest experiments such as calculating the weight of articles or common and domestic goods, calculating distances such as the distance from home to school, and the speed that a pet reaches, among other tests that are easy to carry out, in this context, the There are thousands of possibilities for experimentation, everything depends on the creativity of the teacher when teaching the subject.

Mathematical applications emerge as the third best weighted tool, the use of digital tools represents a great challenge for teachers of advanced ages, many of them have adapted, however, the use of these options is more

frequent in young teachers who use technology to daily living, (Alcántara, 2021) on its website ANDRO4ALL suggests the use of 7 applications that can be operated from mobile phones, these being; Photomath, King of Mathematics, Microsoft Math, Graphing Calculator + Math, GeoGebra, Smartick, Free Formulas, Socratic and Fx Calculator, all of these are available from the Play Store, on the other hand the digital educational company (Education 3.0, 2020) suggests 20 applications free that have a more academic approach, some coincide with Alcántara and others are totally new, these options are; Bmath, Mathway, Math King, Equilibrians, Times Tables Game, IkMat×, Math Exercises, Numbers and Shapes, Math 1st ESO, Math Teacher, PhotoMath, Math, Tricky Maths, Practical Math, Fractions Calculator Free, Math Tricks, Board Games, Math vs Zombies, Mathlab Graphing Calculator and Free Formulas, all available in the Play Store and can be used in the classroom on a normal computer.

The fourth tool is the correlation of mathematics with other subjects, (Rodríguez, 2011) in his publication on mathematics and its relationship with science as a pedagogical resource, summarizes that to understand any phenomenon, mathematics is required because it is the language universal and allows the interpretation of all academic branches and professions, it also highlights its direct relationship with physics, computing, biology, medicine, social sciences, education and music, the methodology used by this author opens the gap for more research and relationships of mathematics with the other sciences.

Problem-solving emerges as the fifth most incident tool for mathematical stimulation, (Pozo et al., 1994) express that the success of a strategy is subject to its adaptation to the form of the task, such as the presence of rules, algorithms and specific operators, in short, the use of mathematical language allows easy adaptation to any process, this largely due to the facilities for establishing parameters, indicators, measurements and all calculation possibilities acquaintances.

The sixth tool identified is the development of projects, the object of this variable is learning through the development of plans and processes that allow the use of formulations and calculations, this model is completely experimental and turns out to be a pleasant and stimulating experience for students. (Aravena et al., 2008), their publication on mathematical models through projects highlights the importance and usefulness of this methodology, they also conclude that a remarkable cognitive, metacognitive and practical development is evidenced, as well as an application of intelligent mathematical concepts and processes, it is identified that the application of this method broadens the student's vision due to the comprehensive use of mathematical sciences, regardless of the type of project, learning is proportional to the number of problems or obstacles that must be solved, It is recommended the use of projects according to the ages of the students and that they present progressive difficulty.

The seventh most efficient tool is the demonstrative method, this methodology is widely applied in technical careers, in the school stage they are present in geometry, technical drawing, physics, chemistry and the sciences that mostly use mathematical verifications, however, despite its great use, most students and even teachers do not identify that they are applying a demonstrative method, this is because they are generally based on a text or syllabus already established by the institution or the ministry of education, (Ibañes, 2002) highlights the importance of differentiating between understanding and making demonstrations, the first situation invites to understand the statements to be able to differentiate it from other processes such as justifications, calculations or practice exercises, while the second invites demonstrative practice, this must make them coincide the practical results with the theoretical statement.

#### Conclusions

The 7 most efficient tools to stimulate mathematical performance in students from 6 to 9 years old are identified through the weighting system of the Kendall matrix, being these; The development of games and recreational activities, experimentation strategies, mathematical applications, mathematical correlation, problem-solving, project development and demonstrative methods. The best-weighted tool and determining variables are games and recreational activities, these enjoy great acceptance by students, achieving a greater predisposition for learning, additionally, it is verified that this methodology ensures better results due to the pleasant environment that is generated in the classroom.

Mathematical learning is subject to the predisposition on the part of the students during the teaching process, the little collaboration or participation of the students generates resistance to the subject and given the conditions of the progressive advance of this science, concentration is required in each one of its stages, put in context, we indicate that mathematical levels cannot be skipped and it is complex to use them when there are gaps during the process, we find, for example, that a child who has difficulties with multiplication will hardly learn to divide correctly.

The use of the tools indicated in this research allows to achieve the stimulation of mathematical performance, however, the most important thing is to know how to identify when to use them and which tool is best adapted to the situation we face, post-pandemic education has generated a greater dependence on digital media and electronic

devices, this opens a window of possibilities for mathematical applications, another variable to consider is the age of the students and what is expected of them in the classroom.

Finally, we conclude that no tool exceeds the experience and vocation of the teacher, it is for this reason that it is suggested to investigate more on this subject, especially in experimental areas, student-teacher relationship, the correlation between the application and non-application of the tools identified, design of new learning strategies and methodologies

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