Available online at www.jlls.org
JOURNAL OF LANGUAGE AND LINGUISTIC STUDIES
ISSN: 1305-578X
Journal of Language and Linguistic Studies, 18(4), 674-684; 2022

Non-Routine Problems For Sixth Grade Activities That Improve Learning Of School Mathematics

Jorge Rincón Castillo [a], Orlando García Hurtado [b], Edinson Caicedo Parra [c]

[a] "Universidad Antonio Nariño", Bogotá Colombia **jorgrincon@uan.edu.co**
ORCID: https://orcid.org/0000-00002-7128-6291
[b] "Universidad Distrital Francisco José de Caldas", Bogotá Colombia ogarciah@udistrital.edu.co
ORCID: https://orcid.org/0000-0002-7128-6291
[c],"Universidad Antonio Narino", Bogota Colombia,edicaicedo@uan.edu.co
ORCID: https://orcid.org/0000-0001-7625-6924

APA Citation:

Castillo, J.R., Hurtado, O.G., Parra, E.C., (2022). Non-Routine Problems For Sixth Grade Activities That Improve Learning Of School Mathematics. Journal of Language and Linguistic Studies, 18(4), 674-684.
Submission Date: 20/09/2022

Acceptance Date: 19/11/2022

Abstract

This article aims to show some activities based on non-routine problems with ifferent levels of difficulty and from different classes that are integrated into the curriculum, additionally two spaces were opened for students to interact with recreational mathematics activities with the purpose of providing opportunities to all students access the robust construction of the concepts involved. These activities showed significant improvements in the learning of some mathematical concepts such as: operations with fractions, order in fractions, part of a number, ratios and proportions, percentages. In addition, there was evidence of an increase in the opportunities that students found to participate and favor the autonomy of mathematical thinking.

This research was carried out in a public school in the city of Bogotá Colombia of low strata in the sixth grade of basic education, the activities designed in order to strengthen the robust concepts of fractions and decimals through different challenging problems will be shown, also called non-routine problems.

Keywords: non-routine problems, problems with fractions

Email : **jorgrincon@uan.edu.co**

Introduction

This research was carried out in a public school in the city of Bogotá Colombia of low strata in the sixth grade of basic education, the activities designed in order to strengthen the robust concepts of fractions and decimals through different challenging problems will be shown, also called non-routine problems.
ICMI 16 refers to the importance of recreational mathematics in the classroom, since it says that in these you can find a place to learn, but it should be clarified that it is not the only place where you can acquire information and knowledge. by the student, since the acquisition of knowledge is found in many places and in various forms, such as in the printed media, on the radio, on television and on the internet, these being some of the sources of information that When used correctly, they are an important complement to what is learned in school.
Also Singmaster (2000),considers recreational mathematics to be fun mathematics and lends itself to being used pedagogically as an alternative to formal mathematics or as a way to make formal mathematics understandable or enjoyable for all. Recreational mathematics makes mathematics a fun science, it also offers a way to communicate mathematical ideas to the general public, not forgetting that it has contributed as an important source of mathematical models.

Continuing with the desirability of including recreational mathematics in school, Zazkis (2013) also support its potential contribution and see in it a high-impact phenomenon that has been active since ancient times, being present in the development and discovery of formal mathematics. . For this reason, many of the most important mathematicians in the history of mankind have had contact with puzzles and games, developing strategies that later became rules or theorems for formal mathematics.

1. Methodology

For the implementation of the activities, a mixed methodology was used, which implies the design and validation of instruments on a Likert scale whose objective is to analyze the relationships between the inclusion factors in basic education.
At the beginning of this unit, the material (complete unit) was given to each student. The concept of fraction was introduced through the analysis and visualization of a figure (square). This activity consists of 8 questions that are designed based on the figure. The activity was carried out individually and the teacher permanently accompanied its implementation.
During this time, the teacher was permanently monitoring the progress made by each student in order to see their ways and face the new concept. Additionally, the material was collected and then socialized and a space of time was allocated for each student to present their procedure with the purpose of arguing their solution strategies.

2. Implementation and Results

Activity No. 1 (Fraction)

Below is a figure (square) divided into several regions of different colors:

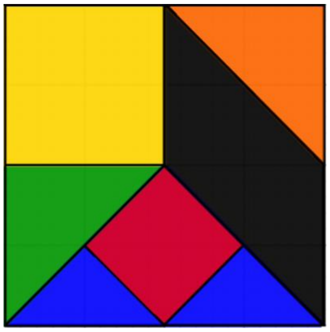


Figure 1. Rincón (2020)

Answer the following questions based on the graph above:

What fraction(part) of the large square does the yellow square represent? What fraction(part) of the large square does the green triangle represent? What fraction(part) of the large square does the red square represent? What fraction(part) of the large square does the orange triangle represent? What fraction(part) of the large square does the black parallelogram represent? What fraction(part) of the large square do the two blue triangles represent? What fraction(part) of the large square do the two squares (yellow and red) represent?

Here is the solution made by a student:

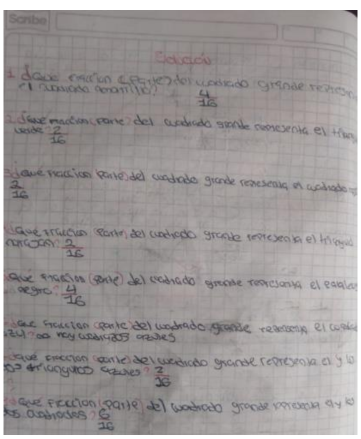


Figure 2. Rincón (2020)

It can be seen that the student divides the square (Tangram) into 16 equal parts and gives their answers in fractions with a denominator of 16. It should be noted that in this activity 18 students found the correct solution and 4 students found a partial solution.

Activity Nº 2 (Addition and Subtraction of Fractions)

This activity will begin by forming groups of three students freely. Then the concept of addition and subtraction of fractions will be introduced by the teacher through the formulation of 3 problems and 1 exercise based on the book MATH CONNECTIONS Editorial Mc Graw Hill. It is intended that with these problems students can begin to build the foundations of a graphic model for the addition and subtraction of fractions. It is expected that in the development of this activity, all the questions that may arise based on the problem will be investigated and socialized. During this time the teacher will be permanently monitoring the progress made by each student in order to see their ways of dealing with the new concept and solving a problem, additionally the material will be collected and then socialized.

Example: Add 1/3 and 1/6

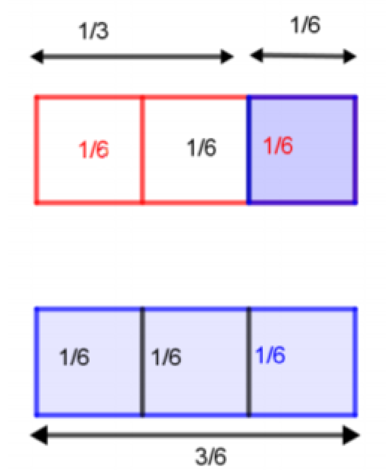
Escribe el problema		**Convierte usando el MCD[1]**		**Suma las fracciones homogéneas**	
$\frac{1}{3}$	→	$\frac{1x2}{3x2} = \frac{2}{6}$	→	$\frac{2}{6}$	
$+\frac{1}{6}$	→	$+\frac{1x1}{6x1} = \frac{1}{6}$	→	$+\frac{1}{6}$ $\frac{3}{6}$ ó $\frac{1}{2}$	

Figure 3. Rincón (2020)

Now the student must perform: $\frac{3}{4} - \frac{2}{3}$

Solution given by a student:

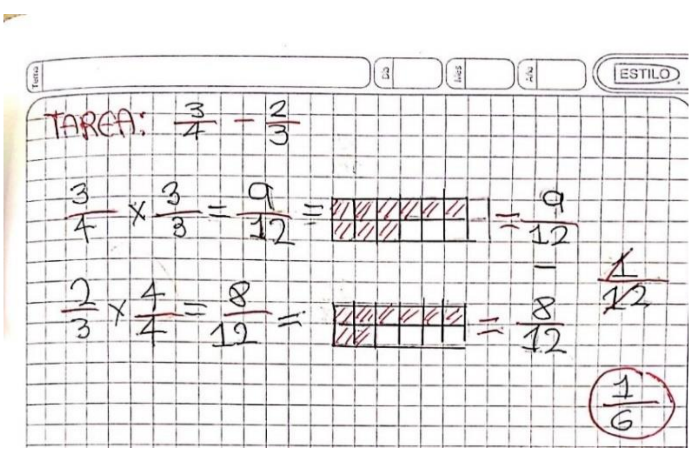


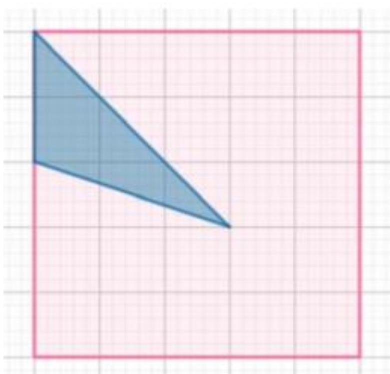
Figure 4. Rincón (2020)

It can be seen that the student applied the model correctly, but when simplifying the answer he had a worrying error, since it reveals a lack of conceptual understanding. In this activity, 8 correct solutions were found, 12 partial solutions and only two students did not find the solution.

Activity No. 3 (Challenging problems).

This activity is made up of 4 challenging problems, one of them taken from the Mathematical Kangaroo competition. The activity will be carried out in groups of three students formed by the teacher by lottery. It is expected that during the development of this activity there will be an exchange of ideas by the students. In the event that a group asks the teacher for help, the teacher will do so in a very subtle way by asking guiding questions to direct the group towards solving the problem. Once the activity is over, the material produced will be collected and, if the group does not finish the activity, they can take it home to continue working in such a way that time is not a pressure factor and that each student can think freely about the solutions of the problems. Later, when all the groups have finished the activity, a presentation will be made where each group will argue its procedures. These arguments will be the instrument that will allow the student to build a robust meaning of addition and subtraction of fractions.

NOW THINK ABOUT THE FOLLOWING PROBLEMS: 1. In the diagram drawn on the grid. What fraction of the square does the shaded area represent?



a. $\frac{2}{15}$

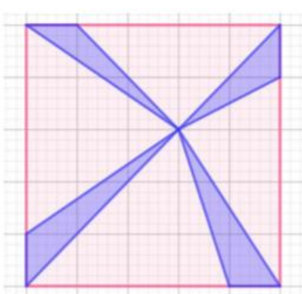
b. $\frac{5}{12}$

c. $\frac{3}{25}$

d. $\frac{4}{25}$

Figure 5. Rincón (2020)

2. In the next square. What fraction does the shaded area represent?



a. $\frac{1}{4}$

b. $\frac{1}{5}$

c. $\frac{1}{6}$

d. $\frac{2}{5}$

e. $\frac{2}{7}$

Tomado del Canguro Matemático, Nivel Benjamín 2004.

Figure 6. Rincón (2020)

Now the solution given by a student is shown:

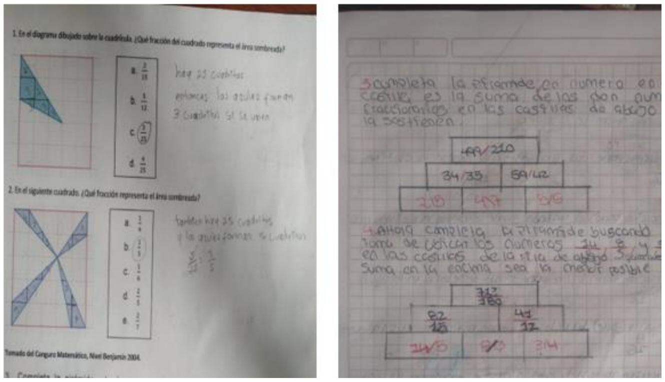


Figure 7. Rincón (2020)

In the problems in the first image you were looking to find the shaded fraction. It can be seen that the student formed complete squares with the blue shaded regions, finding the correct fractions. Now in point N°3 it was intended to complete the pyramid by addition and in point N°4 it was also sought to complete the pyramid, but optimizing the result. It can be seen that at point No. 3 the student added the fractions correctly, but at point No. 4 he made a mistake in the addition and did not take into account that the sum should be the smallest possible. In this activity, 3 correct solutions, 16 partial solutions and 3 without solutions were obtained.

Activity No. 4 (Part of a number)

This activity will be developed individually. Then the concept of part of a number will be introduced by the teacher through the formulation of 3 problems and 1 exercise based on the book MATH CONNECTIONS Editorial Mc Graw Hill. It is intended that with these problems students can begin to build the foundations of a graphic model to determine the part of a number.

It is expected that in the development of this activity, all the questions that may arise based on the problem will be investigated and socialized.

During this time, the teacher will be permanently monitoring the progress made by each student in order to see their ways of dealing with the new concept and solving a problem. Additionally, the material will be collected and then socialized.

PART OF A NUMBER. Skee ball. Iris is playing skee ball at a game center and scored 20 points or more two-thirds of the time she played. If she threw a total of 15 balls, how many times did she score 20 or more points?

Actividad:

1. ¿Qué tienes que encontrar? Cuántas veces Iris obtuvo 20 puntos o más.

Paso 1: Dibuje un diagrama que represente el número de bolas que ella lanzó. Luego divida la barra en 3 secciones iguales, ya que el denominador es 3.

Paso 2: Determine el número que va en cada sección.
Piensa: 15 ÷3= 5.

Paso 3: Determinar los 2/3 de 15.
Dos tercios de 15 *es* 2x5 *o* 10.

Entonces, Iris lanzó 10 bolas que lograron 20 puntos o más.

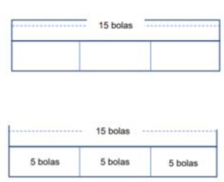
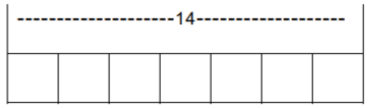


Figure 8. Rincón (2020)

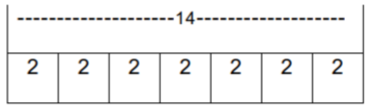
Encuentra los 5/7 de 14.

Paso 1. Dibuje un diagrama que represente "14". Divida la barra en siete secciones iguales, ya que el denominador es 7.



Paso 2. Determine el número que va en cada sección.
Piensa: $14 \div 7 = 2$

Paso 3. Encuentra los 5/7 de 14.
Cinco séptimos de 14 es 5x2 o 10



Entonces, 5/7 de 14 es 10.

Encuentra cada parte. Usa un diagrama de barras.

1. $\frac{1}{2}$ *de* 10 2. $\frac{2}{3}$ *de* 18 3. $\frac{1}{4}$ *de* 16

Figure 9. Rincón (2020)

Now a solution made by a student is shown:

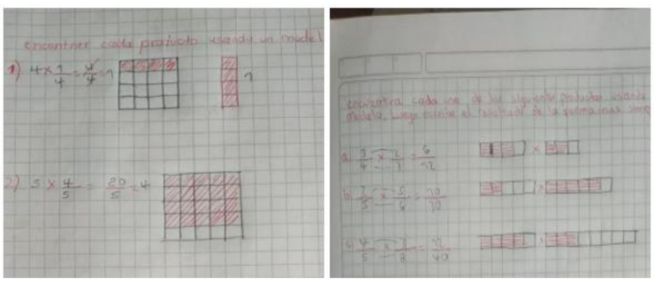


Figure 10. Rincón (2020)

In this case, the student performed the first exercise correctly, but in the following exercises he did not find the result using the graphic model. In this activity, 2 correct solutions were found, 18 partial solutions and 2 students did not find the solutions.

Activity Nº5 (Division by fractions)

In this activity, the concept of division by fractions was introduced by the teacher through the formulation of three problems and an exercise based on the book MATH CONNECTIONS Editorial Mc Graw Hill. It is intended that with these problems students can begin to build a model to divide fractions. This moment will be carried out in groups of three students formed by the teacher through a draw.

During this time, the teacher was constantly monitoring the progress made by each group in order to see their ways of dealing with the new concept and solving a problem. Additionally, the material was collected and then socialized.

Encuentra cada cociente. Usa un modelo.

1. $3 \div \frac{1}{3}$ 2. $6 \div \frac{1}{4}$ 3. $5 \div \frac{2}{3}$ 4. $8 \div \frac{1}{2}$

The solution given by a random group is:

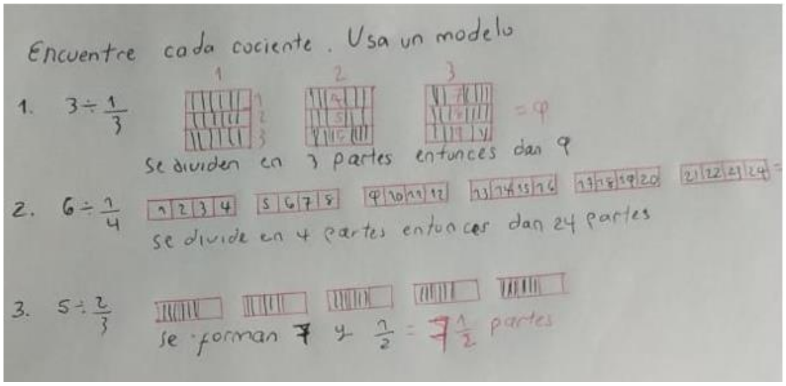


Figure 11**.** Rincón (2020)

In this case, the student correctly built the model and found the correct result by counting the parts in each exercise; In addition, it can be seen that in point No. 3 he used a mixed number to give the answer. It should be noted that in this activity 8 correct solutions, 11 partial solutions and 3 without a solution were found.

Activity Nº6 (FRACTIONS AS DECIMALS)

Birth order. The table shows responses to a survey about birth order.

¿Cuál es tu orden de nacimiento?	Respuesta
Hijo mayor	1/20
El del medio	1/2
Hijo menor	3/10
Hijo único	3/20

1. Escribe el decimal para $\frac{3}{10}$.
2. Escribe la fracción equivalente a $\frac{1}{2}$ con denominador 10.
3. Escribe el decimal para la fracción que encontraste en el Ejercicio 2.

Figure 12. Rincón (2020)

Fractions with denominators: 10, 100 or 1000 can be written as a decimal using place value. For fractions with denominators that are factors of 10, 100, or 1,000, you can write equivalent fractions with these denominators.

1) Escribe 2/5 como decimal.
Como 5 es un factor de 10, escribe una fracción equivalente con denominador 10.

$\frac{2 \times 2}{5 \times 2} = \frac{4}{10}$ Como $5 \times 2 = 10$, multiplica el numerador y el denominador por 2.

= 0.4. Lee 0.4 como cuatro décimas.

2) Escribe 9/12 como un decimal.
Como 12 no es un factor de 100, escribe una fracción equivalente con un denominador que sea factor de 100.

$\frac{9 \div 3}{12 \div 3} = \frac{3}{4}$ $\frac{3 \times 25}{4 \times 25} = \frac{75}{100} = 0.75$ Lee 0.75 como setenta y cinco centésimas.

Como 4 es factor de 100, convierte $\frac{9}{12}$ en $\frac{3}{4}$ dividiendo numerador y denominador por 3.

Figure 13**.** Rincón (2020)

Since 4 x 25=100, multiply the numerator and denominator by 25.

Write each of the following fractions as a decimal.

a. $\frac{3}{5}$ b. $\frac{14}{25}$ c. $\frac{102}{250}$

Solution made by a student:

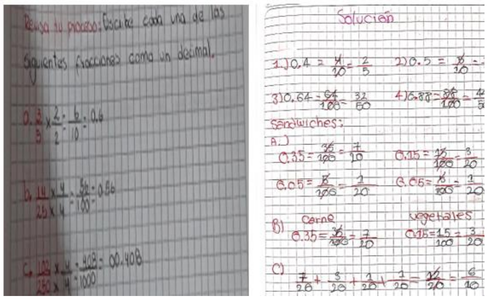


Figure 14. Rincón (2020)

As can be seen in the first image, the student correctly converted the fractions with a denominator into multiples of 10, it can be seen that in point c) the decimal is not written in the usual way. Now with regard to the next activity consisting ofwriting each decimal as a fraction or mixed number in its simplest form, it can be seen that the student correctly carried out the process of converting from decimal to fraction, although some exercises lacked simplification. In this activity, 3 correct solutions were found, 15 partial solutions and 4 students did not find the solutions.

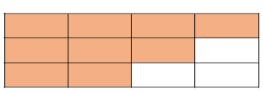
Activity No. 7.(Fractions as Percent and Percent as Fractions)

This moment will be carried out in groups of three students formed by the teacher through a draw. It is expected that in the development of this activity, all the questions that may arise based on the problems will be investigated and socialized.
During this time, the teacher was constantly monitoring the progress made by each group in order to see their ways of dealing with the new concept and solving a problem. Additionally, the material was collected and then socialized.

Escribe cada fracción como un porcentaje.

a. $\frac{3}{5}$ b. $\frac{9}{10}$ c. $\frac{17}{20}$

d. ¿Qué porcentaje del modelo no está sombreado?



Escribe cada fracción como un porcentaje:

a. $\frac{3}{10}$ b. $\frac{7}{20}$ c. $\frac{11}{25}$

Figure 15. Rincón (2020)

The following is the solution presented by a group of students:

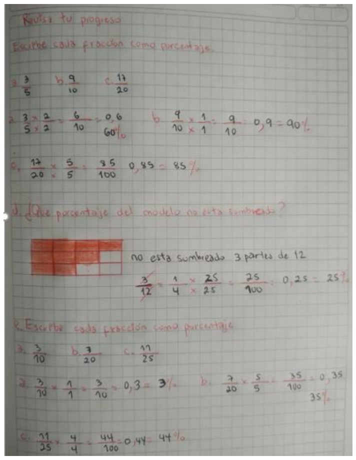


Figure 16. Rincón (2020)

The pie chart shows the fraction of each weather type during the month of September.

a. What percentage of the days were sunny?
b. What percentage of the days were rainy?

CLIMA DURANTE SEPTIEMBRE.

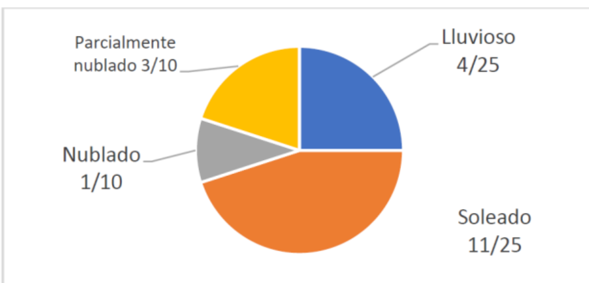


Figure 17. Rincón (2020)

Here is the solution presented by a group:

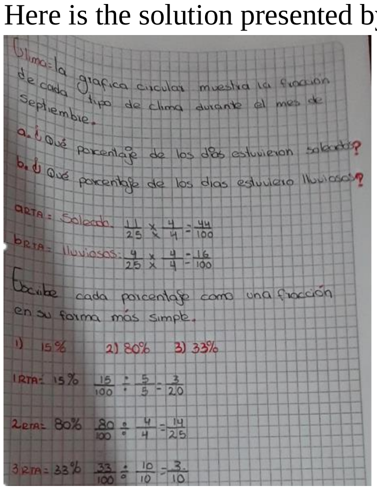
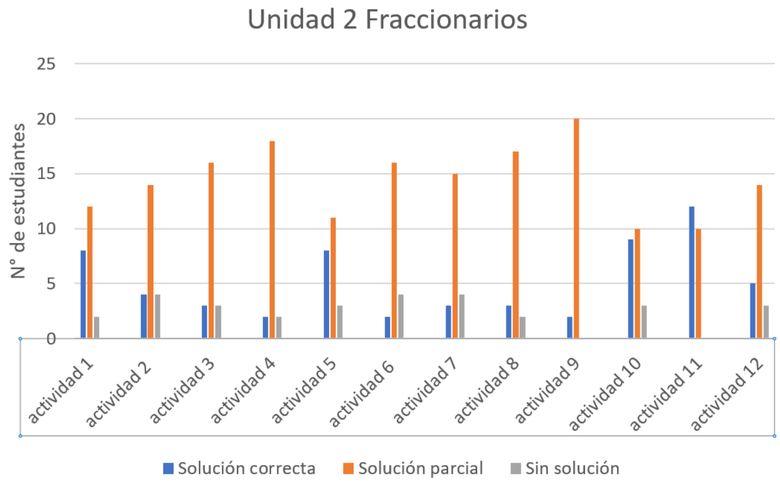


Figure 18. Rincón (2020)

Results
Below is a graph of the number of solutions corresponding to the Unit

Table 1. percentage of solution for the Rincón unit (2020)



3. Conclusions

These activities showed superlative results in terms of the participation and inclusion of students in each of the activities, there is also evidence of a great advance in autonomy when thinking mathematically, since the solutions given did not depend on methods used or designed. by others, but were devised by the students themselves in the face of novel situations.

An attempt was made to generate experiences in the field of recreational mathematics and problem solving aimed at students to promote opportunities for arguing their solution strategies and the possibility of sharing them with their classmates and teacher, in such a way that all their contributions were valued and appreciated for their own merit, guaranteeing active participation in spaces where the student can receive recognition or acceptance when expressing their ideas.

It is concluded that teachers must generate didactic and learning strategies that are adaptable and applicable to different scenarios in which students feel included and motivated despite the possible adversities that may arise.

References

1. McGraw-Hill, M. (2009). Math connects. Retrieved Sept. 18, 2009.
2. Rincon, J. (2021). Lrecreational mathematics as an inclusion factor in sixth and ninth grades. Doctoral degree thesis. Antonio Nariño University, Bogotá, Colombia.
3. Singmaster, D. (2000). The Utility of Recreational Mathematics. In The Lighter Side of Mathematics: Proceedings of the Eugène Strens Memorial Conference on Recreational Mathematics and Its History. Washington, DC: Mathematical Association of America.
4. Zazkis, R., Sinclair, N., & Liljedahl, P. (2013). Multiple Uses of Lesson Play. In Lesson Play in Mathematics Education: (pp. 271-274). Springer, New York, NY.