EDUCACION

Creencias sobre la resolución de problemas matemáticos: una investigación con profesores de primaria

Beliefs about mathematics problem-solving: An investigation with elementary school teachers

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Resumen: Esta investigación ha analizado las creencias sobre la resolución de problemas matemáticos. Se trata de una investigación cuantitativa basada en un diseño "Ex Post Facto" en el que se proporcionó una escala de dominio afectivo (creencias, actitudes y emociones) a 118 mujeres y hombres, profesores de primaria de la Costa Caribe nicaragüense. Los análisis sugieren que los docentes tienen creencias positivas que se manifiestan en factores como la confianza, la seguridad, la perseverancia, la satisfacción, la curiosidad, el gusto, la motivación y la utilidad para funcionar con éxito en la resolución de problemas matemáticos. Además, que las creencias sobre la resolución de problemas no difieren según la edad, el género, la etnia, los años de experiencia y el tipo de escuela (urbana y rural). Se concluye que es necesario seguir avanzando en los procesos de formación y capacitación de los docentes de educación primaria con un mayor énfasis en los procesos de resignificación de experiencias y prácticas matemáticas contextualizadas a las comunidades.

Palabras clave: creencias, resolución de problemas, enseñanza, aprendizaje.

Abstract: This research has analyzed beliefs about solving mathematical problems. This is quantitative research based on an "Ex Post Facto" design where a scale of affective domain (beliefs, attitudes, and emotions) was provided to 118 women and men, primary school teachers from the Nicaraguan Caribbean Coast. The analyses suggest that teachers have positive beliefs that are manifested in factors such as confidence, security, perseverance, satisfaction, curiosity, liking, motivation, and usefulness to function successfully in solving mathematical problems. In addition, that beliefs about problem-solving do not differ according to age, gender, ethnicity, years of experience, and type of school (urban and rural). It is concluded that it is necessary to continue advancing in the processes of education and training of primary education teachers with a greater emphasis on the processes of resignification of experiences and mathematical practices contextualized to the communities.

Keywords: beliefs, problem-solving, teaching, learning.

I. Introduction

Before the COVID-19 pandemic, a learning crisis was reported in relation to mathematical competences, due to the fact that the learning outcomes were unsatisfactory due to low levels of understanding and high social inequalities (World Bank, 2018), in addition, that digital technologies in the mathematics classroom were inconsistent in quality, quantity and effectiveness (Organization for Economic Cooperation and Development [OECD], 2016). The educational crisis caused by COVID-19 forced teachers to teach problem solving in virtual mode, regardless of their beliefs and attitudes towards mathematics. Although, this change is an opportunity for mathematics educators to use technologies in teaching problem-solving (Attard & Holmes, 2020).

The literature shows that the beliefs and attitudes towards mathematics of elementary school teachers can disrupt the learning of their future students. For example, in the study by Vale et al. (2020) it is said that most of the teachers initially had instrumental beliefs about the mathematical discipline and its teaching and learning, but advancing in the intervention they presented evidence of some changes when including approaches focused on problem-solving. In addition, elementary school teachers routinely face the challenge of having to teach subjects they may not like because they teach most of the subjects their students learn (Heather et al., 2020) which turn into conflicts cognitive processes in problem-solving processes that impact the mathematical beliefs, attitudes, emotions, anxiety and performance of their students (Flores & Auzmendi, 2018).

In this article, we analyze the beliefs of primary school teachers about problem-solving based on a study with Nicaraguan teachers, carried out in the context of the COVID-19 pandemic. The data that inform this article come from the online application of an affective domain questionnaire (Caballero-Carrasco & Guerrero-Barona, 2015) to 118 primary school teachers. The results of the study indicated points in common that are interesting in the beliefs about the nature of mathematical problems and their teaching-learning; beliefs about oneself as a mathematical problem solver; attitudes and emotional reactions towards problem-solving; and assessment of the training received in teacher education in relation to problem-solving.

II. Literature review

Beliefs are defined as a subjective and not always shared knowledge system that is modified as a consequence of the interactions of the environment (Diego-Mantecón & Córdoba-Gómez, 2019). Beliefs are used to describe individual mental constructions that are subjectively true for the teachers in question, that have a certain degree of conviction and are not consensual (Skott, 2015). In this work it is considered that the term of beliefs such as knowledge, feelings and cultural values of women and men "that arise as a result of experiences, living things and practices in the construction of their own knowledge to solve problems" (Flores, 2019, p. 115), in addition, to be associated with affective aspects such as attitudes and emotions.

Beliefs are considered to be "a judgment of truth or the falsity of a proposition to identify beliefs from the teachers' narratives" (Pajares, 1992, p. 18). From this perspective, beliefs about mathematics determine the way in which a problem is posed, the techniques that are to be used, and how much time and effort are to be invested in solving. "Beliefs are established within which heuristic resources and control

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operate" (Schoenfeld, 1985, p. 45). In addition, they are made up of cognitive, affective, evaluative and social elements that influence the way in which people approach mathematical knowledge, and how they behave with respect to it (Gómez-Chacón, 2000).

In fact, if a teacher perceived himself as having little ability to teach mathematics (belief), he would develop a dislike for that area of knowledge (attitude), and would even feel anxious when he had to teach it (anxiety), consequently, as far as possible avoid teaching math (behavior) (Pendergast et al., 2017).

Research on teachers' beliefs about mathematics are interesting due to their reflection, or possible influence on students (León-Mantero et al., 2020). Although, there are more abundant studies of teachers' beliefs about the concrete domain of mathematics with an instrumental perspective, specifically related to beliefs about problem-solving (Lera & Deulofeu, 2014;Andrews & Xenofontos, 2015; Sivunen & Pehkonen, 2009; Villa & Callejo, 2004). In this sense, this study focuses on the line of research on the relationship between beliefs and teaching practice (Hannula et al., 2016), because a series of factors that can influence the beliefs of teachers have been established, among them are: beliefs about the nature of mathematical problems and their teaching and learning; beliefs about oneself as a mathematical problem solver; attitudes and emotional reactions towards solving mathematical problems; and the assessment of the training received in teacher studies in relation to solving mathematical problems (Caballero-Carrasco & Guerrero-Barona, 2015).

III. Methods and materials

Research objectives

In solving a mathematical problem, an affective situation is associated with the involved subject, who puts into play not only operative and discursive practices to answer the problem, but also mobilizes beliefs, attitudes, emotions, and values that condition, to a greater or lesser degree and in a different sense, the required cognitive response (Godino, 2013). Based on this approach, this research's general objective is to analyze teachers' beliefs about solving mathematical problems in the context of COVID-19, taking into account the variables gender, ethnicity, age, teaching experience, and type of school. For these reasons, the following specific objectives are proposed:

- Identify the beliefs of primary school teachers about solving mathematical problems.
- Explain the relationships between the beliefs of primary school teachers about problem-solving.
- Check if the beliefs of primary school teachers about the resolution differ with the variables gender, age and ethnicity.
- Study if the beliefs of primary school teachers about the resolution differ with the variables teaching experience and type of school.

Method

It is a quantitative study that focuses on the treatment of data through the categorization and description of the properties, characteristics and profiles of the people, groups, communities, processes and objects that have been subjected to analysis (Hernández et al., 2014) which is based on an "Ex Post Facto" design because it is about discovering the phenomena that occur naturally by measuring various variables to analyze their possible effect (Bisquerra, 2012).

Participants characteristic

We worked with a sample of 118 primary school teachers belonging to communities of the Autonomous Regions of the Caribbean Coast of Nicaragua. In this research, as we can see in Table 1, women (61) constituted 51.70% of the sample, while men (57) constituted 48.30%. 50% of the sample were from the age group 20 to 29 years. 25.40% were young people (<20 years old), while around 24.60% (29) were personnel older than 30 years or more. The mean (SD) of the participants' experience was 7.20 (3.48) and approximately 11% of the participants have 10 years of experience or more. 55.90% of the participants are from rural areas while 44.10% are from urban areas. Regarding the ethnicity variable, 9.30% (11) are Miskito indigenous, 15.30% (18) Afro-descendant (Creole) and 75.40% (89) mestizo.

Table 1: Teachers' background information

TABLE 1
Teachers' background information

Characteristic	Percentage (%, n) or mean SD
Age in year (n=118)	
< 20	25.40 (30)

TABLE 1
Teachers' background information

Characteristic	Percentage (%, n) or mean SD
20-29	50.00 (59)
30	24.60 (29)
Mean (SD)	24.81 (4.72)
Gender (n=118)	
Male	48.30 (57)
Female	51.70 (61)
Ethnicity (n=118)	
Mestizo	75.40 (89)
Afro descendant (Creole)	15.30 (18)
Miskito (Indigenous)	9.30 (11)
Teaching experience (years) (n=118)	
< 5	40.70 (48)
5-9	48.30 (57)
10	11.00 (13)
Mean (SD)	7.20 (3.48)
School type (n=118)	
Urban	44.10 (52)
Rural	55.90 (66)

Instruments

The affective domain instrument was used in solving mathematical problems (Caballero-Carrasco & Guerrero-Barona, 2015). The instrument is made up of 21 items grouped into four categories:

- Beliefs about the nature of mathematical problems and their teaching and learning. It aims to analyze and seek a greater understanding of teachers' role and value in problem-solving and their learning. Consisting of 5 items. The score for this category is obtained by adding items from 1 to
- Beliefs about oneself as a mathematical problem solver. It is about exploring the self-image of the teacher in initial training with respect to his abilities and capacities as a solver of mathematical problems. Made up of 6 items. The score for this category is achieved by adding items from 6 to 11.
- Attitudes and emotional reactions towards solving mathematical problems. It is about knowing and analyzing the attitudes and emotional reactions that teachers manifest in problem-solving. Made up of 8 items. The score for this category is achieved by adding items from 12 to 20
- Assessment of the training received in teaching studies in relation to solving mathematical problems. It is about analyzing the teacher's assessment of the changes that his/her training has produced in her coping with problem-solving. This category is configured with item 21

In all the items, the possible answers range from 1 to 4, Likert scale. These alternative answers are: 1 = Strongly disagree; 2 = Disagree; 3 = Agree; and 4 = Strongly agree. The instrument on affective dominance in solving mathematical problems allows obtaining, in addition to a global score on beliefs, four more scores referring to each of the categories that are evaluated

Reliability and validity

To guarantee the quality of the measurement, a psychometric study was applied to the instrument, to check its validity and reliability values. The internal consistency value of the instrument items was calculated, obtaining a Cronbach's alpha value of 96% reliability. Regarding validity, a principal component analysis (PCA) was carried out, in this sense, the Kaiser-Meyer-Olkin measure of sampling adequacy shows a value of 0.777. On another hand, the Bartlett sphericity test offered results that indicated that the analysis is relevant (Chi-square = 774.585; gl = 210; sig. 0.000). In addition, the value of the determinant matrix was calculated, which is equivalent to 0.001, this value is different from 1. Ultimately, the principal components analysis shows an adequate model.

Administration procedure and ethical approach

The administration of the instrument was carried out by the author during the 2021 academic year using Google Forms. Before the administration of the instrument, the objectives of the study were informed, emphasizing the right not to participate and the confidentiality of the process. Participants were asked not to reveal their identity to ensure that the completion of this instrument was for academic purposes only. Prior to data collection, the prior, free and informed consent of the primary education teachers was obtained, as well as the authorization of the educational institutions of the Caribbean Coast of Nicaragua.

Data analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS), version 25. Frequencies, percentages, means, and standard deviation were used to summarize the data. An internal consistency analysis of the instrument, a principal component analysis to determine the quality and validity of the measure and parametric tests were applied.

IV. Results

Beliefs about the nature of mathematical problems and their teaching and learning

In Table 2, it can be seen that most of the participants (81.30%; M = 3.16; SD = 0.94) reported strongly agree / agree in believing that the problems are solved if the formula, rule or procedures are known, accepting that the result is more important than the process followed (75.40%; M = 3.04; SD = 0.97), also, they believe that they can solve problems after a teaching process in the classroom (76.30%; M = 3.10; SD = 0.97), although the capacities o skills used in math classes to solve problems have nothing to do with those used to solve problems in everyday life (86% .40; M = 3.42; SD = 0.89), therefore, teachers look for different ways and methods to solve problems (78%; M = 3.17; SD = 0.89). The total score of the five items of beliefs about the nature of mathematical problems and their teaching and learning has a mean of 15.89 (SD = 3.08; S =

9.54), reaching 79% in the maximum score of 20 points, which indicates a positive belief of the participants regarding the teaching and learning of problem-solving.

Table 2: Beliefs about the nature of mathematical problems and their teaching and learning

TABLE 2
Beliefs about the nature of mathematical problems and their teaching and learning

Statement	Response %				Scores
	Strongly disagree	In disagreement	Agree	Strongly agree	mean (SD)
1. Most math problems are usually solved in a few minutes, if you know the formula, rule, or procedure that the teacher explained or that is in the textbook.	8.50	10.20	38.10	43.20	3.16 (0.94)
2. When trying to solve a problem, the result is more important than the process followed.	10.20	14.40	36.40	39.00	3.04 (0.97)
3. Knowing how to solve the problems that the teacher proposes in class, it is possible to solve others of the same type if only the data has changed.	9.30	14.40	33.10	43.20	3.10 (0.97)
4. The skills or abilities used in math classes to solve problems have nothing to do with those used to solve problems in everyday life.	6.80	6.80	23.70	62.70	3.42 (0.89)
5. Find different ways and methods to solve problems.	5.10	16.90	33.90	44.10	3.17 (0.89)
Total score[a]					
Median (range)	15 (5–20)				

TABLE 2
Beliefs about the nature of mathematical problems and their teaching and learning

Median (SD)	15.89 (3.08)
Variance	9.54
Total score/full score %	79%

[a]Maximum score = 20

Beliefs about oneself as a mathematical problem solver

In Table 3, shows that most teachers (70.30%; M = 2.97; SD = 0.96) reported strongly agree / agree that when more study time is dedicated to mathematics, better results are obtained in problem-solving, but when they solve a problem usually doubt if the result is correct (79.60%; M = 3.16; SD = 0.90), although they are confident when faced with mathematical problems (87.30%; M = 3.41; SD = 0.86) because they are calm (88.10% ; M = 3.36; SD = 0.84), because they believe that if they give their best effort they will have a correct result (76.70%; M = 3.15; SD = 0.86), however, they have the belief that luck influences when solving successfully a math problem (84.80%; M = 3.30; SD = 0.89). The total score of the six items of beliefs about oneself as a mathematical problem solver obtained a mean of 19.33 (SD = 3.33; S = 11.14), obtaining 80% in the maximum score of 24 points that indicates a positive belief of teachers regarding their problem-solving competencies

Table 3: Beliefs about oneself as a mathematical problem solver

TABLE 3
Beliefs about oneself as a mathematical problem solver

Statement	Response %				Scores
	Strongly disagree	In disagreement	Agree	Strongly agree	mean (SD)
6. When more study time is devoted to mathematics, better results are obtained in solving problems.	9.30	20.30	34.70	35.60	2.97 (0.96)
7. When I solve a problem, I often doubt whether the result is correct.	6.80	13.60	36.40	43.20	3.16 (0.90)
8. I am confident in myself when faced with math problems.	5.90	6.80	28.00	59.30	3.41 (0.86)
9. I am calm and collected when solving math problems.	5.90	5.90	34.70	53.40	3.36 (0.84)
10. When I try to solve a problem, I usually find the correct result.	5.1	15.30	39.00	40.70	3.15 (0.86)
11. Luck influences the successful solving of a math problem.	6.80	8.50	33.10	51.70	3.30 (0.89)
Total score[a]					
Median (range)	16 (8–24)				
Median (SD)	19.33 (3.33)				
Variance	11.14				
Total score/full score %	80%				

[a]Maximum score = 24

Attitudes and emotional reactions towards solving mathematical problems

It can be seen in Table 4, that almost all teachers (82.20%; M = 3.13; SD = 0.92) showed that they strongly disagree/disagree that when faced with a complicated problem, they tend to give up easily because they feel anguish and fear when solving the problem (76.20%; M = 1.96; SD = 1.03), likewise, they indicate that they get stuck, block and manifest feelings of insecurity, despair and nervousness (82.20%; M = 1.84; SD = 0.91), also, if they do not find the solution to the problem they have the feeling of having failed and of having wasted time (85.60%; M = 1.65; SD = 0.92). On the other hand, the teachers revealed to strongly agree / agree (79.70%; M = 3.19; SD = 0.98) that when they solve problems in groups they have more self-confidence, causing great satisfaction to successfully solve a mathematical problem (84.70%; M = 3.25; SD = 0.87), although, when their attempts to solve a problem fail, they try again (72.90%; M = 2.92; SD = 0.98), because they are very curious to know the solution (76.30 %; M = 3.15; SD = 0.95) since solving a problem requires effort, perseverance and patience (90.60%; M = 3.40; SD = 0.79). The total score of the nine items on emotional attitudes and reactions towards solving mathematical problems obtained a mean of 24.48 (SD = 2.58; S = 6.66), achieving 66% in the maximum score of 36 points that indicates attitudes and emotional reactions positive in problem-solving processes (understanding that the higher the score, the lower the negative emotional reactions and attitudes).

Table 4: Attitudes and emotional reactions towards solving mathematical problems

TABLE 4
Attitudes and emotional reactions towards solving mathematical problems

Statement	Response %				Scores
	Strongly disagree	In disagreement	Agree	Strongly agree	mean (SD)
12. In the face of a complicated problem, I often give up easily.	9.30	8.50	42.40	39.80	3.13 (0.92)
13. When faced with a problem, I am very curious to know the solution.	7.60	16.10	29.70	46.60	3.15 (0.95)
14. I am distressed and afraid when the teacher offers me "by surprise" to solve a problem.	34.70	41.50	10.20	13.60	1.96 (1.03)
15. When I solve problems in a group, I have more confidence in myself.	10.20	10.20	30.50	49.20	3.19 (0.98)
16. When I get stuck or block in solving a problem, I start to feel insecure, desperate, nervous.	39.80	42.40	9.30	8.50	1.84 (0.91)
17. If I can't find the solution to a problem, I have the feeling of having failed and wasting my time.	28.00	57.60	5.90	8.50	1.65 (0.92)
18. It gives me great satisfaction to be able to solve a mathematical problem successfully.	6.80	8.50	38.10	46.60	3.25 (0.87)

TABLE 4
Attitudes and emotional reactions towards solving mathematical problems

Statement	Response %				Scores
	Strongly disagree	In disagreement	Agree	Strongly agree	mean (SD)
19. When I failed in my attempts to solve a problem, he tried again.	12.70	14.40	40.7	32.20	2.92 (0.98)
20. Solving a problem requires effort, perseverance, and patience.	5.10	4.20	36.40	54.20	3.40 (0.79)
Total score[a]					
Median (range)	15 (15-30)				
Median (SD)	24.48 (2.58)				
Variance	6.66				
Total score/full score %	68%				

[a]Maximum score = 36

Assessment of the training received in teaching studies in relation to solving mathematical problems

The teachers state that they strongly agree / agree (82.20%; M = 3.13; SD = 0.92) that in the teaching profession they have discovered other ways of approaching mathematical problems, this can be seen in Table 5.

Table 5: Assessment of the training received in teaching studies in relation to solving mathematical problems

TABLE 5
Assessment of the training received in teaching studies in relation to solving mathematical problems

Statement	Response %				Scores
	Strongly disagree	In disagreement	Agree	Strongly agree	mean (SD)
21. In teaching, I have discovered other ways of approaching mathematical problems.	5.10	8.50	39.00	47.50	3.29 (0.82)
Total score[a]					
Median (range)	3 (1-4)				
Median (SD)	3.28 (0.82)				
Variance	0.68				
Total score/full score %	3 (1-4)				

[a]Maximum score = 4

Relationships between beliefs towards mathematics in problem solving.

Regarding the correlation of the different categories with each other, all the correlations were statistically significant at levels of 0.001, in Table 6, relevant associations are observed. The correlations between the various categories are statistically significant and of moderate or high intensity, so we believe that, although they constitute different aspects of beliefs, each of these aspects can influence the others. For example, beliefs about oneself as a mathematical problem solver are correlated with attitudes and emotional reactions towards solving mathematical problems (r = 0.617), that is, the levels of confidence and security in their abilities, capacities, and possibilities to succeed in solving a problem is due to the level of perseverance, satisfaction, curiosity, and security in problem-solving.

Table 6: Analysis of correlations between categories (r-Pearson)

TABLE 6
Analysis of correlations between categories rPearson

Categories'	Categoric 1	Categoric 2	Categoric 3	Categoric 4
Categoric 1: Beliefs about the nature of mathematical problems and their teaching and learning	1			
Categoric 2: Beliefs about oneself as a mathematical problem solver	0.471**	1		
Categoric 3: Attitudes and emotional reactions towards solving mathematical problems.	0.560**	0.617**	1	
Categoric 4: Assessment of the training received in teaching studies in relation to solving mathematical problems	0.503**	0.354**	0.468**	1

* * The correlation is significant with p 0001

** The correlation is significant with p <0.001

Similarly, beliefs about the nature of mathematical problems and their teaching and learning are related to attitudes and emotional reactions towards problem-solving (r = 0.560), this indicates that teachers who reported higher levels of utility, applicability, and importance to solve a mathematical problem had attitudes and emotional reactions of satisfaction, curiosity, and security towards problem-solving. On the other hand, beliefs about the nature of mathematical problems and their teaching and learning were positively correlated with the assessment of the training received in teacher studies in relation to the resolution of mathematical

problems (r = 0.503), which implies that the teacher's vision of how to learn to solve mathematical problems produces a change in the approach to solving due to teaching studies or training throughout their academic career. In addition, the training received in teacher education is correlated with attitudes and positive emotional reactions in problem-solving (r = 0.468), this indicates that attitudes such as liking, motivation, usefulness, and confidence towards problem-solving.

Another relevant aspect is that beliefs about the nature of mathematical problems and their teaching and learning correlate with beliefs about oneself as a mathematical problem solver (r = 0.471), this indicates that teachers try to analyze and understand mathematical problems with the help of your skills and abilities as a problem solver. And finally, it was found that the assessment of the training received in teaching studies is significantly related to beliefs about oneself as a solver of mathematical problems (r = 0.354), this indicates, in such a way that teachers receive a training increases their capacities and possibilities to function successfully in problem solving.

Analysis of categorical variables

The Kruskal-Wallis test was applied to try to explain, verify, study, and know if the variables age, gender, ethnicity, teaching experience, and what type of school influence beliefs towards mathematics in problem-solving this is shown in Table 7.

Table 7: Analysis of non-parametric tests

TABLE 7
Analysis of nonparametric tests

Categories	Age		Gender		Ethnicity		Teaching Experience		School Type	
	x2	p	x2	p	x2	p	x2	p	x2	p
Categoric 1: Beliefs about the nature of mathematical problems and their teaching and learning	2.33	0.313	0.005	0.939	5.07	0.079	6.68	0.035	0.150	0.698
Categoric 2: Beliefs about oneself as a mathematical problem solver	3.10	0.212	4.69	0.983	11.24	0.004	1.85	0.396	0.490	0.484
Categoric 3: Attitudes and emotional reactions towards solving mathematical problems.	3.72	0.156	0.477	0.490	4.03	0.134	2.26	0.323	0.020	0.885
Categoric 4: Assessment of the training received in teaching studies in relation to solving mathematical problems	5.33	0.070	0.064	0.800	1.65	0.439	0.99	0.608	0.003	0.953

It can be seen that the age variable does not influence beliefs towards mathematics in problem solving (Category 1: X2= 2.33; 0.313 <0.05; Category 2: X2= 3.10; 0.212 <0.05; Category 3: X2= 3.72; 0.156 <0.05; Category 4: X2= 5.33; 0.070 <0.05). Regarding gender, it was found that there are no statistically significant differences between women and men in relation to beliefs towards mathematics because the bilateral significance values are greater than 0.05 (Category 1: X2= 0.005; 0.939 <0.05; Category 2: X2= 4.69; 0.983 <0.05; Category 3: X2= 0.477; 0.490 <0.05; Category 4: X2= 0.064; 0.800 <0.05), this means that both women and men have similar belief systems. Also, it can be observed that being an urban or rural schoolteacher does not influence beliefs towards mathematics in problem-solving. (Category 1: X2 = 0.150; 0.698 <0.05; Category 2: X2= 0.49087; 0.484 <0.05; Category 3: X2= 0.020; 0.885 <0.05; Category 4: X2= 0.003; 0.953 <0.05).

On the other hand, when analyzing the ethnicity variable, it was found that there are no significant differences in some categories (Category 1: X2= 5.07; 0.079 <0.05; Category 3: X2= 4.03; 0.134 <0.05; Category 4: X2= 1.65; 0.439 <0.05). Although in category 2, regarding beliefs about oneself as a mathematical problem solver, differences are shown between teachers (Category 2: X2= 11.24; 0.004 <0.05) with a significant effect size (ε2 = 0.0961) in favor of the mestizo ethnic group, which can be corroborated with the results of the test of comparisons by pairs of Table 8. It was also found that the variable teaching experience does not influence some categories (Category 2: X2= 1.85; 0.396 < 0.05; Category 3: X2= 2.26; 0.323 <0.05; Category 4: X2= 0.99; 0.608 <0.05), but if the teaching experience influences beliefs about the nature of mathematical problems and their teaching and learning (ε2 = 0.0571).

Table 8: Dwass-Steel-Critchlow-Fligner Pairwise Comparisons

TABLE 8
DwassSteelCritchlowFligner Pairwise Comparisons

Ethnicity	Mean (SD)	Pairwise comparisons	W	p
Mestizo	19.88 (3.04)	Mestizo - Creole	-4.56	0.004
Creole	16.72 (4.04)	Mestizo - Miskitus	-1.62	0.488
Miskitus	19.18 (2.35)	Creole - Miskitus	2.43	0.199
Teaching Experience	Mean (SD)	Pairwise comparisons	W	p
< 5	15.39 (3.20)	0 < 5 9	2.97	0.08
5-9	16.59 (2.71)	0 < 5 10	-0.90	0.799
10	14.69 (3.68)	5 < 10 +	-2.92	0.097

Teachers who have between five and nine years of experience have a broader vision of how to learn and teach how to solve mathematical problems (See Table 8).

V. Conclusion

The objective of the study was to analyze the beliefs of primary school teachers about problem-solving in the context of COVID-19, and their relationship with demographic variables such as gender, ethnicity, age,

teaching experience, and type of school. In this research, teachers' beliefs could propagate the idea of better achievement and improve the teaching and learning of mathematics (Tarmizi and Tarmizi, 2010). Therefore, it was identified that the beliefs of primary education teachers about solving mathematical problems are generally high (M = 67.11; SD = 9.95), coinciding with the study by Yavuz and Erbay (2015) in which they say that primary school teachers have positive perceptions of problem-solving.

Referring to the significant correlations between the categories evaluated, it can be indicated that the teachers' beliefs about solving mathematical problems become factors such as confidence, security, perseverance, satisfaction, curiosity, liking, motivation, and usefulness to function successfully in the resolution of mathematical problems, which implies the need to continue advancing in the training processes throughout their academic career, coinciding with what Flores-López and Auzmendi (2018) express that when solving mathematical problems beliefs are activated, emotions and attitudes in a positive way.

It was determined that teachers' beliefs about solving mathematical problems do not differ according to age, this means that young and adult teachers tend to have the same type of beliefs about problem-solving both in their learning processes and in their teaching shared with their future students. Also, it was found that the beliefs of teachers about solving mathematical problems do not influence according to gender (women and men), coinciding with the research of Sağlam and Dost (2014) and Yavuz and Erbay (2015) that states that the beliefs of teachers on problem-solving do not differ according to gender, although Bekirogullari et al. (2011) reported that the gender variable has a positive influence in favor of women. However, Arli et al. (2011) affirm that, if the beliefs of women and men differed or not according to gender, it could change according to the context of the research participants.

The teachers surveyed in this study belong to different ethnic groups (mestizo, Afro-descendant and indigenous), however, ethnicity is not a determining factor in beliefs about solving mathematical problems. Therefore, these findings suggest a greater investigation be carried out on various socio-cultural factors of these ethnic populations since it was found that beliefs about oneself as a solver of mathematical problems manifest significant differences in ethnic groups in favor of the mestizo, therefore, in the studies by Flores-López and Auzmendi (2015) suggested the powerful influence of the multicultural context on the beliefs and attitudes towards problem-solving of future teachers.

It was found that teachers 'beliefs about problem-solving do not differ according to their teaching experience, relating to the study by Yu (2009) that reported that the teaching experience does not influence the teachers' beliefs, likewise, they are consistent with the beliefs reported by Lebrija et al. (2010) from the perspective that the years of experiences do not seem to make a difference between their beliefs, but rather that they share similar beliefs, although, in the section beliefs about the nature of mathematical problems and their teaching and learning, few differences appear with regarding your teaching experience. Also, it was discovered that teachers' beliefs about solving mathematical problems do not differ according to their type of school (urban or rural). The reason for this situation may be the fact that the schools are in the same region, therefore, teachers develop a process of planning and evaluation of mathematical content in a collaborative and articulated way. Furthermore, the teachers' environments do not differ in general terms.

In light of these findings, it is necessary to advance in the education and training processes of primary education teachers with a greater emphasis on pedagogical and technological knowledge of the content, in the community construction of knowledge, wisdom, and practices, in teaching problem solving and beliefs, attitudes and emotions in solving mathematical problems. Taking as a reference that beliefs about mathematics are formed throughout life, it is also recommended that teachers develop the beliefs related to the mathematics of students from elementary school.

VI. Reference list

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