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Recontextualization of the teacher's formation in the learning of mathematic students

Recontextualização da formação de professores à aprendizagem dos estudantes em matemática

Recontextualización de la formación docente para el aprendizaje de los estudiantes en matemáticas

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Abstract: Continuing education is an essential part of teaching practice because the movements and advances in society change the ways of living, coexisting and acting, making it necessary for the teacher's practice to be congruent with the changes resulting from these movements. This article aims at self-regulating the training of teachers who teach mathematics based on students' learning, through teachers' reflection-action. Teachers who participated in the training studied, planned and applied the knowledge learned in the training with their students, and then discussed in the group how to self-regulate their training. The quantitative methodology was based on the analysis of pre- and post-tests that included numbers and algebra as thematic units applied to the students of the teachers in training. The analyses show that the students had better results in the post-test, allowing the teachers to reflect on the relationship between participation in the training, as well as openness to new ways of teaching, with the students' learning.

Palavras-chave: Teacher training. Professional development. Learning. Mathematics.

Resumo: A formação continuada é parte essencial ao exercício docente, pois os movimentos e avanços na sociedade mudam as formas de viver, conviver e agir, tornando necessária a congruência da prática do professor com as mudanças advindas desses movimentos. Este artigo tem por objetivo: autorregular a formação de professores que ensinam matemática a partir da aprendizagem dos estudantes, por meio da reflexão-ação dos docentes. Os professores participantes da formação continuada estudaram, planejaram e aplicaram os conhecimentos aprendidos na formação com os seus estudantes e após discutiram para autorregular sua formação no âmago do grupo. A metodologia quantitativa foi pautada na análise de pré e pós testes que envolveram números e álgebra como unidades temáticas aplicadas nos estudantes dos professores em formação. As análises mostram que os estudantes tiveram melhores resultados no pós teste, permitindo que os professores refletissem sobre a relação entre a participação na formação, bem como a abertura à novas formas de ensinar, com as aprendizagens dos estudantes.

Keywords: Formação de professores. Formação continuada. Aprendizagem. Matemática.

Resumo: La formación continua es parte esencial de la práctica docente, ya que los movimientos y avances de la sociedad modifican las formas de vivir, convivir y actuar, siendo necesario que la práctica docente sea consecuente con los cambios derivados de estos movimientos. Este artículo tiene como objetivo: autorregular la formación de los docentes que enseñan matemáticas a partir del aprendizaje de los estudiantes, a través de la reflexión-acción por parte de los docentes. Los docentes que participaban en la formación continua estudiaban, planificaban y aplicaban los conocimientos aprendidos en la formación con sus alumnos y luego discutían para autorregular su formación dentro del grupo. La metodología cuantitativa se basó en el análisis de pre y post pruebas que involucraron los números y el álgebra como unidades temáticas aplicadas a estudiantes de maestros en formación. Los análisis muestran que los estudiantes obtuvieron mejores resultados en la prueba posterior, lo que permitió a los profesores reflexionar sobre la relación entre la participación en la formación, así como la apertura a nuevas formas de enseñanza, con el aprendizaje de los estudiantes.

Palabras clave: Formación de profesores. Formación continua. Aprendizage. Matemáticas.

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INTRODUCTION

The current moment is characterized by rapid and constant changes such as never before in our history. Santos (2004) highlights the tensions experienced by society in relation to technological possibilities, scientific considerations and ecological disasters and/or nuclear war. In the year 2020, humanity has been alarmed by the pandemic caused by the COVID-19 virus, leading to different ways of living, coexisting and acting in order to comply with the recommendations of the World Health Organization (WHO).

Educational research, in this scenario of resignification of sciences and development of Digital Technologies (DT), is characterized by the rupture of paradigms in order to consider socio-technical and cultural phenomena with multi-referentiality, complexity and creativity. We are mediated by hybrid perspectives, elements are explained in relation to other elements; ubiquitous contexts, in which there is omnipresence; and diverse, in the porosity of borders differences emerge. Thus, expanding our understanding of the processes of teaching and learning from the perspective of overcoming the fragmentation and linearity of knowledge, the research project "Recontextualizing science and storytelling for teaching and learning processes from basic education to teacher training at the international level" emerged, to include teachers and students enrolled in the 3rd year of primary school, from schools in the Municipal Education Network.

The research project is funded by the Foundation for Research Support of the State of Rio Grande do Sul - FAPERGS, through the FAPERGS SEBRAE/RS 03/2021 - Program of Support for Research and Innovation Projects in the Area of Basic Education - PROEdu. In the development of the research, the participating teachers follow and/or build the flow in a complex way, configuring ways of living, coexisting and acting, of being and being in the world. All the segments that make up contemporary reality are articulated and related in a recursive way, like a large network, according to Backes (2011). Therefore, we cannot discuss education without considering politics, economics, religion, culture, and many other aspects that are part of the reality built throughout history.

In this article we highlight mathematical knowledge through new ways of learning that involve acting, interacting, speaking, creating and remembering, what Alves (2008) calls practice-practice. Thus, considering the flow, the complexity, the network, among other aspects that can be highlighted, we can understand the paths of knowledge that "[...] can only begin to be explained if we dedicate ourselves to perceiving the intricate networks in which they are truly entangled" (Alves, 2008, p. 16). We aim in this article: To self-regulate the training of teachers who teach mathematics from the learning of students, through the reflection-action of teachers. This objective uses quantitative analysis in the treatment of the responses given to the activities proposed to the students, in order to better identify evidence of the results of the training offered to teachers and to self-regulate the training process. This is justified because quantitative results can better signal the next steps to be taken regarding the teaching and learning processes, whether in the design of the training or with those involved in the project, teachers and students.

WHY CONTINUOUS TRAINING?

Our experience as teachers in the pedagogy course, in disciplines focused on the teaching of mathematics in the early years, allowed us to identify revealing evidence about the teaching of mathematics to children. We noticed that such disciplines are fundamental to the pedagogy course, but not enough to prepare the future teacher for the teaching of mathematical content. This could not be otherwise, since the complexity of teaching mathematics lies not only in the pedagogical knowledge for the practices developed by the teachers, but also in the understanding of the content itself, since the Pedagogy course does not aim to train mathematics teachers, for that we have the degrees in Mathematics. Pinho and Garcia (2014, pp. 61-62) confirm this:

> We also know that many of the contents that should be part of the initial training (technical or academic) are not addressed or deepened in the preparation of professionals to work in the school environment, which reflects the complexity of cultural and social diversity. In view of this, there is a need for continued (or permanent) training for education professionals.

Thus, our concern lies in the fact that this future teacher develops mathematics lessons in the early years of elementary school, based on the way they learned mathematics in basic education. For Tardif (2012), the future teacher has in his or her training the internalization of various knowledge, beliefs, competencies, and values that he or she has built up throughout his or her school and personal life and that are "updated and reused, in an unreflective way, but with great conviction, in the practice of his or her craft". (p. 72). Therefore, much of what and how they learned mathematics is inherited from the school history of the future teachers who will teach not only mathematics in the early years. One way to contribute to reflection is through continuing education, since the way they have learned or what they have learned is not always in congruence with the demands contained in the Common National Curricular Base (CNCB), as well as the demands of society. In addition to the oxygenation of content, strategies and practices in the school and classroom context, in-service training provides teachers with peer exchange, reflection, empathy, respect, support and consolidation of a professionalism that goes far beyond knowledge and skills in a particular curricular component and its objects of knowledge and/or content.

In continuing education are included behaviors, attitudes and values that constitute the particularities of continuing in the profession and consolidate being a teacher, since being a teacher "[...] is to be open to learning as a whole, is to be an investigator in the whole of teaching work, is to know how to tune the contents of their discipline to the needs of students [ ]" (Felicetti, 2011, p. 04). For the aforementioned author, teacher training takes place under the perspectives of deconstruction, reconstruction and construction of teaching knowledge, whether they are on the list of professional skills or interpersonal relationships. These perspectives are offered in a training based on "spaces for reflection, sharing experiences, mediating conflicts and planning pedagogical strategies to qualify the teaching and learning process. (Pinho & Garcia, 2014, p.62)

Formation is related to the creation of conditions in which the human being can grow in self-respect and respect for others, considering individualities, identities and

ontogeny, in order to establish cooperative relationships, to configure spaces for action, for doing in reflection (Maturana & Rezepka, 2008). In formation is the foundation of the entire educational process, and training is the action we plan to accomplish the educational task.

During formation, the critical reflection of the participants on the teaching and learning processes must include the pedagogical practices developed by them. However, what we usually see is a transposition of practices that are already consolidated and considered "efficient" or effective models, as developed in teacher education.

The training developed as part of this article had the intention of:

1) Work the pedagogical practice in the training, articulated to the knowledge to be built or reconstructed by the teachers about numbers and algebra as thematic units contained in the BNCC as;

2) Work on the pedagogical practice with teachers in the same way as it will be worked with students in basic education. Revise what you already know in order to extend it to what you don't know.

These opportunities have the perspective of developing the habits of a reflective teacher. This seems simple, according to Cornish (2015, p. 50), "[ ] after all, what teacher does not think constantly about lessons, those already taught and those to be planned, and about student learning?" However, in addition to thinking about the practices developed in the school context and lessons, teachers need to think critically about these practices. To this end, the sharing of experiences among peers allows not only critical reflection, but also the reconstruction and construction of actions capable of improving teaching and learning processes. And this is what the training proposed in the Recontextualize project was dedicated to. By reflecting on our daily life and coexistence, we understand how our actions are processed and based on these reflections, we construct new concepts that systematize coexistence and design the actions of future generations that, through their reflective and conscious actions, can build new systematizations that expand knowledge even more. In this scenario of

continuing education, it has been possible to develop training: "Who tells a story, adds a point?"

HE WHO TELLS A TALE, ADDS A POINT? REFLECTIVE EDUCATION

Beyond the challenge of developing teacher education on two levels, we need to think about teacher education, through analog and digital artifacts, in congruence with contemporaneity. Thus, by reflecting on daily life and coexistence, we understand how our actions are processed and, based on these reflections, we build new concepts that systematize coexistence and design the actions of future generations who, through their reflective and conscious actions, can build new systematizations that expand knowledge even more. We understand teacher training as being based on the learning experiences of teachers, on theoretical studies, on planning (creating), on applying in the classroom, on discussing among peers, and on continuing the process. In this dialectical movement we see the possibility of reconstructing pedagogical practices.

The training was developed in the extension course: Who tells a story, adds a point? Recontextualizing the Sciences through Stories, for teachers of the 3rd grade of the Municipal Education Network, with the aim of "developing pedagogical practices that recontextualize the sciences, the Portuguese language and mathematics in basic education, mediated through technological artifacts (analog and digital) in the 3rd grade of primary school". Soon 3 stages were organized: Reading and writing - Let's tell a story? The four operations - Who wants to make a point? Problem Situations - Building Stories, organized on the basis of the skills and competencies defined in the BNCC and in the learning milestones established by the Municipal Secretariat of Education. In addition to the above steps, the researchers carried out observations in the classes of the teachers participating in the training.

In this article we will focus on the stage: The four operations - Who wants to raise a point? aimed at the thematic units numbers and algebra contained in the BNCC. To develop the specific objective: Understand mathematical concepts to propose pedagogical practices that contribute to the construction of the four operations for 3rd

grade students, 5 meetings were promoted, totaling 15 hours of synchronous activities, plus 15 hours of face-to-face study activities, planning and practical activities.

This professional development dynamic has enabled peer-to-peer exchanges within the teaching network itself, leading to changes in the learning of students in the participating schools. The training sessions are based on the research conducted by Silva (2021) in the same network, which showed significant impacts on the mathematical learning of students whose teachers participated in the meetings.

We understand that by accepting the invitation to reflect, we are also accepting the invitation to create, to create not only new things, but innovations in relation to everything that has been created, attributing other meanings, identifying other functionalities, developing other processes. For Hugon (2011), this is the great question of innovation, to reverse the way it is understood. A new technical object simply has no value until the critical mass of users has not explored it, in order to legitimize the object in the group that explores it. To do this, one must construct reality, deconstruct it through disturbances initiated in plurality, and then reconstruct it in the collective action of the group.

Therefore, in their life and coexistence, each participant gives meaning to what he does (in relation to himself) and to what the other does (in relation to the social). Only in this way can we think of the autonomous human being, who recognizes the different possibilities in the group to which he belongs, and who is the author of the world in which he lives with the other, aware of his choices and actions. Besides all this, living and coexisting also implies acting cooperatively, exploring, experimenting, relating, being provoked by the environment, making approaches and distances necessary for meaning.

METHODOLOGY

This article deals with the analysis of a pre- and post test in the field of mathematics, consisting of nine questions covering the thematic units: numbers and algebra. Both tests were part of the in-service training carried out as part of the project

"Recontextualizing Science and Storytelling for Teaching and Learning Processes from Basic Education to Teacher Training at the International Level". The pre-test, carried out before the teacher training, included 594 students of the 3rd grade of primary school in the municipal network of a city in the metropolitan area of Porto Alegre in the year 2022, corresponding to 27 classes of 12 schools.

The post test, conducted after the teacher training, included 363 students in 21 classes and 10 schools. The decrease in the number of students and consequently in the number of classes and schools was due to the fact that three teachers decided not to participate in the training. They signed up but were unable to attend, each with their own personal reasons. The pre- and post tests covered numbers and algebra as thematic units. The same thematic units were covered in the teacher training step: The Four Operations - Who Wants to Make a Point?

This paper presents the mean pre- and post test scores, the difference between them, the standard deviation and the chi-square (P) of all nine test questions, but is concerned with the more detailed analysis of three questions. Question 1C, Question 4 and Question 5.

Question 1 C) Fernando and Marcia have organized their crayons for school:

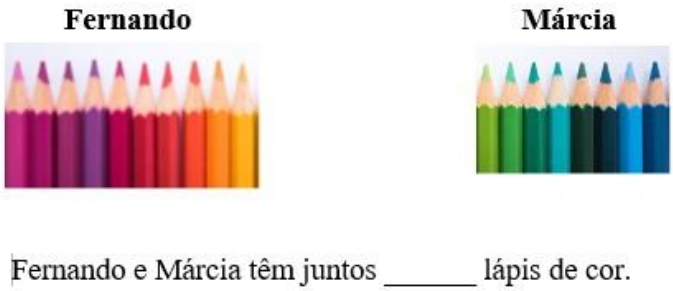

Figure 1. Question 1 C.

Source: The authors 2023.

As can be seen, this question contemplates the ability to solve an addition problem, involving numbers of up to two digits, with the meanings of joining, adding, with the support of images and/or manipulative material, using personal strategies and ways of recording. (BNCC, 2017)

Question 4) Complete the numerical sequence

4,8,12,	(1)

This question aimed to identify regularities in ordered sequences of natural numbers, resulting from making successive additions by the same number. (BNCC, 2017)

Question 5) Fernanda got 3 dolls for her birthday. She already had 13 dolls. how many dolls did Fernanda get?

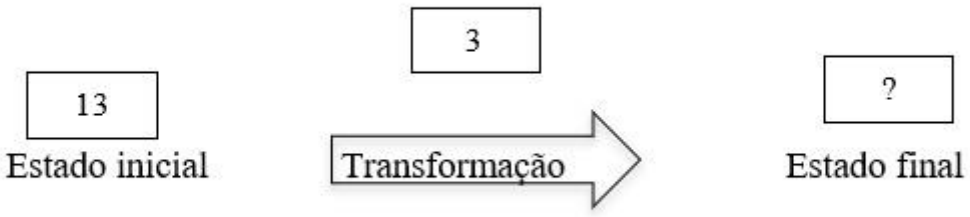

Figure 2. Unknown final stage.

Source: The authors 2023.

This question involves a prototype transformation type problem situation (Magina et al, 2008) with unknown final state. Transformation problem situations are characterized by the transformation of the number in the problem situation and by presenting ternary relations:

The skills to be developed in this problem situation correspond to building and using basic addition facts for mental or written calculation (BNCC, 2017).

The pre-test was applied by the 3rd grade teachers who signed up for the continuing education course before they started the course, which included the study and development of practices focused on building numbers and the four basic operations.

The post test was administered after the training, which consisted of nine sessions of 3 hours each, carried out within the framework of the project "Recontextualizing Science and Storytelling for the Teaching and Learning Processes of Basic Education to International Teacher Training", in which, at the end of the training, 15 teachers from 10 schools of the municipal network, named here from E1 to E10, participated.

The correction of the tests was based on and adapted to the correction criteria constructed by Silva and Felicetti (2021) and considered the following solution strategies: algorithm, mental calculation, pictography and associated algorithm, pictography, counting on the fingers, and no strategy for those who got the question right, and they were scored from 6 to 1, as shown in Table 1. For those who got the question wrong, the strategies considered were: Use of algorithm, Use of mental calculation (manifested on the test), Use of inverse operation, Misinterpretation, Use of pictogram and associated algorithm, Use of pictogram, Counting on fingers, No strategy, and Blank, valued from 0 to -8.

Table 1

Strategies considered in solving the pre- and post test activities.

	Strategy Used	Value
Correct Answers	Use of algorithm	6
	Use of mental calculation (manifested this on the test)	5
	Use of pictography and associated algorithm	4
	Use of pictograph	3

	Used counting on fingers (manifested this on test)	2
	Lack of strategy	1
Wrong Answers	Use of algorithm	0
	Use of mental calculation (manifest this on the test)	-1
	Use of inverse operation	-2
	Misinterpretation	-3
	Use of pictograph and associated algorithm	-4
	Use of pictograph	-5
	Finger counting	-6
	Lack of strategy	-7
	Blank	-8

Source: Recontextualize project data.

The assigned score considered the level of complexity or abstraction in solving each problem. For example, the algorithm strategy was considered the most cognitively complex because, according to Silva (2021) and Vergnaud (2014), it requires the student to coordinate concepts that include understanding the positional value of the digit up to the operations to be used. The use of mental arithmetic also requires the coordination of different operational resources, which also requires some complexity. The related use of pictographs and algorithms requires that one strategy supports or underpins the other. According to Muniz, Santana, Magina and Freitas (2014) and Silva (2021), the use of pictography is a strategy that concretely helps in solving the question because it facilitates the visualization, which allows a better understanding and leads to the correct answer. Moreover, the pictorial records were understood as a representation of what the child knows about the objects and not only as part of the child's development (Fontana & Cruz, 1997). The use of the fingers, according to the aforementioned authors, is a process that, in the use of the body, has the symbolic basis in the development of counting. The absence of a strategy means only the placement of the result, without showing how this result was obtained, and there are still the empty questions. The strategies used that led to the error, in the

strategy of using the algorithm, bring to light possible "failures" in the process of performing the calculation itself, while the interpretation error or the choice of inverse operation may be associated with difficulties and/or not understanding why to use this or that operation.

THE ANALYSIS TO SAY IT AGAIN...

In order to identify the development of mathematical concepts, referring to the four operations, of 3rd grade students of teachers participating in the training, pre and post tests were performed, contemplating a total of 11 questions. In Table 2 it is possible to see the average performance of all students found in each question of the test applied in the pre and post tests performed in the Recontextualize project. Besides the averages, the difference between them, the standard deviation, and the chi-square are presented.

Table 2

Average of correct answers in the pre and post test, difference between them, standard deviation and chi-square (P)

Question	Pre	Post	Difference	P
Question_1-A	0,31±2,68	0,31±2,79	0,01±3,62	0,977
Question _1-B	-2,42±4,19	-1,25±4,01	1,17±5,63	<0,001
Question _1-C	-0,32±3,26	0,5±2,88	0,82±4,2	<0,001
Question _2	-4,12±3,95	-2,12±3,43	2±5,09	<0,001
Question _3	-1,48±3,73	-0,5±3,13	0,98±4,83	<0,001
Question _4	-3,93±4,04	-0,56±3,16	3,38±5,21	<0,001
Question _5	0,99±4,27	1,81±3,82	0,83±5,43	0,004
Question _6	-0,26±4,75	1,48±3,97	1,75±5,94	<0,001
Question _7	-1,13±4,75	0,67±4,35	1,8±6,02	<0,001
Question _8	-1,85±4,31	-0,54±4,21	1,31±5,95	<0,001
Question _9	-2,03±4,85	-0,35±4,55	1,69±6,58	<0,001

Source: The authors 2023

In the pre-test only questions 1A (with 0.31±2.68) and 5 (with 0.99±4.27) showed positive performance (better initial performance). Questions 2 (-4.12±3.95) and 4 (-

3.93±4.04) showed the worst performances. In the post test, all questions had positive average performance (better performance after teacher training). The difference between pre- and post- test was statistically significant for all questions except question 1. This question was designed to determine who had the most items simply by counting them, which may have influenced the results obtained.

Questions 4 (3.38±5.21) and 2 (2±5.09) were the two questions with the largest difference between the two ratings. These two questions dealt with mathematical sequences, a content developed during the professional development course in the thematic unit of algebra.

In Table 3 it is possible to analyze the average performance on Question 1C in the pre- and post test evaluations, performed after the education; the average difference between them in each school is also shown in Table 2.

Table 3

Mean performance on Question 1C in the pre- and post-training assessments and mean difference between them in each school.

School	Pre	Post	Difference	P (difference)
E1	0,63±2,3	1,29±1,49	0,67±2,7	0,9367
E2	0,34±3,81	-0,85±3,62	-1,2±5,27	0,147
E3	-0,23±3,07	0,49±2,18	0,72±3,93	0,1618
E4	-0,39±3,11	2,29±1,99	2,68±3,57	<0,001
E5	-1,05±3,66	-0,17±2,9	0,88±4,72	0,229
E6	-0,11±2,51	0,05±3,57	0,16±2,76	0,4391
E7	-0,62±3,55	-0,08±3,12	0,54±5,36	0,681
E8	-0,38±3,28	1,68±1,45	2,05±3,46	<0,001
E9	-0,88±3,68	0,12±3,4	1±4,77	0,162
E10	-0,18±3,04	0,21±2,45	0,39±3,76	0,562
p (between	0,581	<0,001	<0,001	

schools)

Source: The authors 2023

Although there are no significant differences between schools in the initial test, schools E1 (0.63±2.3) and E2 (0.34±3.81) stand out because they showed positive results in the initial assessment. The schools with the worst initial performance were E5 (-1.05±3.66) and E9 (-0.88±3.68). After further training, schools E4 (2.29±1.99) and E8 (1.68±1.45) showed the best performance, both with statistically significant differences between the tests. Only school E2 showed a statistically non-significant deterioration between the tests. Table 4 shows the distribution of students by the comparative performance of correct answers in question 1C before and after the teacher training in each school.

Table 4

Distribution of students in each school by comparative performance on Question 1C, before and after training.

School	Mistaken	Maintained	Improved	Total	P
E1	3 (12,5%)	19 (79,17%)	2 (8,33%)	24 (6,61%)	0,314
E2	7 (17,07%)	29 (70,73%)	5 (12,2%)	41 (11,29%)	
E3	3 (6,38%)	36 (76,6%)	8 (17,02%)	47 (12,95%)	
E4	1 (2,44%)	33 (80,49%)	7 (17,07%)	41 (11,29%)	
E5	7 (17,07%)	26 (63,41%)	8 (19,51%)	41 (11,29%)	
E6	2 (5,41%)	32 (86,49%)	3 (8,11%)	37 (10,19%)	
E7	2 (15,38%)	8 (61,54%)	3 (23,08%)	13 (3,58%)	
E8	0 (0%)	30 (81,08%)	7 (18,92%)	37 (10,19%)	
E9	6 (12,24%)	33 (67,35%)	10 (20,41%)	49 (13,5%)	
E10	3 (9,09%)	26 (78,79%)	4 (12,12%)	33 (9,09%)	
Total	34 (9,37%)	272 (74,93%)	57 (15,7%)	363 (100%)	

Source: The authors 2023

The percentage of students who got question 1C correct (Table 3) was higher in Schools E7 (23%) and E9 (20%). Both School E2 and School E5 had 7 students (17%) who got the question correct in the initial assessment and incorrect in the post-training assessment. There was no statistically significant relationship between the schools and the comparative performance in correct answers between the initial and final assessments of question 1C.

What we can conclude from question 1C, which dealt with the ability to solve an addition problem with numbers up to two digits, is that the percentage of students who got the question wrong in the pre-test and got it right in the post test was higher than 15%, which shows that in most schools, students made progress. We also note that although only two schools showed a statistically significant difference between the pretest and the posttest, there was improvement in the posttest in most schools.

Table 5 shows the mean performance of the students on the pre- and post test assessments and the mean difference between them in each school for question 4 of the test.

Table 5

Average performance on Question 4 in the pre- and post-training assessments and the average difference between them in each school.

School	Pre	Post	Difference	p (difference)
E1	-3,04±4,13	-0,5±3,56	2,54±5,53	0,027
E2	-3,95±4,29	-2,17±3,65	1,78±5,47	0,045
E3	-2,74±4,09	-0,6±3,15	2,15±4,75	0,005
E4	-4,02±4,08	0,46±3,83	4,49±5,87	<0,001
E5	-3,83±4,13	-0,32±2,9	3,51±4,52	<0,001
E6	-4,51±3,71	-1,24±2,87	3,27±4,86	<0,001

E7	-4,77±4,02	0,38±2,22	5,15±5,37	0,0015
E8	-3,65±4,33	-1,22±3,54	2,43±6,68	0,008
E9	-4,33±3,75	0,31±1,61	4,63±4,33	<0,001
E10	-5,03±3,77	-0,24±2,82	4,79±4,01	<0,001
P (between schools)	0,377	0,002	0,032	

Source: The authors 2023

All schools had negative performance on Question 4 (Table 5) at the initial assessment (pre), with non-significant differences between schools. The schools with the worst initial performance were: E10 (-5.03±3.77) and E7 (-4.77±4.02) and schools E3 (-2.74±4.09) and E1 (-3.04±4.13) with the best average. There was a significant difference (p=0.002) among the schools in the average performance of the scores in the assessment after the teacher training. Three schools had a positive performance in the second evaluation: E4 (0.46±3.83), E7 (0.38±2.22), and E9 (0.31±1.61). The schools with the worst performance in the second assessment of question 4 were E2 (-2.17±3.65), E6 (-1.24±2.87) and E8 (-1.22±3.5). All schools significantly improved their scores between the first and second evaluation of Question 4. The largest differences between pre- and post-assessment were observed in schools E8 (5.15±5.37) and E10 (4.79±4.01), and the smallest differences were observed in schools E2 (1.78±5.47) and E3 (2.15±4.75).

Table 6 shows the distribution of students in each school by the comparative performance of correct answers to question 4 in the pre- and post-intervention assessments.

Table 6

Distribution of students in each school by comparative performance on Question 4 in the pre- and post-training assessments.

School	Mistaken	Maintained	Improved	Total	P

E1	3 (12,5%)	12 (50%)	9 (37,5%)	24 (6,61%)	0,004
E2	7 (17,07%)	23 (56,1%)	11 (26,83%)	41 (11,29%)	
E3	4 (8,51%)	29 (61,7%)	14 (29,79%)	47 (12,95%)	
E4	6 (14,63%)	18 (43,9%)	17 (41,46%)	41 (11,29%)	
E5	2 (4,88%)	24 (58,54%)	15 (36,59%)	41 (11,29%)	
E6	6 (16,22%)	16 (43,24%)	15 (40,54%)	37 (10,19%)	
E7	1 (7,69%)	3 (23,08%)	9 (69,23%)	13 (3,58%)	
E8	9 (24,32%)	12 (32,43%)	16 (43,24%)	37 (10,19%)	
E9	4 (8,16%)	14 (28,57%)	31 (63,27%)	49 (13,5%)	
E10	0 (0%)	15 (45,45%)	18 (54,55%)	33 (9,09%)	
Total	42 (11,57%)	166 (45,73%)	155 (42,7%)	363 (100%)	

Source: The authors 2023

The distribution of students in each school (Table 6) by the comparative performance of correct answers in question 4 between the pre- and post-training assessment is shown in Table 4, which showed a significant relationship between the schools (p=0.004). Schools E7 (69%) and E9 (63%) had the highest percentages of improvement in correct answers, and schools E2 (27%) and E3 (30%) had the lowest percentages. Higher percentages of improving students (correct in the pre-intervention assessment and incorrect in the post-intervention assessment) were observed in schools E8 (24%) and E2 (17%).

We observed that in the content ordered sequences of natural numbers, addressed in this question 4, more than 42% of the students got it right in the post test. This performance could be related to the tutorial, since it included several activities related to this content, providing moments of discussion, both of the deepening of the content itself and of the pedagogical practices that recontextualize it.

Table 7 deals with the data related to question 5 of the test, where it is possible to observe the average performance in the tests before and after the training and the average difference between them in each school.

Table 7

Mean performance on Question 5 in the tests before and after training and mean difference between them in each school.

School	Pre	Post	Difference	p (difference)
E1	2,50±4,11	4,71±3,09	2,21±4,72	0,041
E2	1,37±4,80	-0,68±4,73	-2,05±6,32	0,054
E3	3,32±4,40	2,45±4,24	-0,87±6,07	0,329
E4	1,27±3,22	2,9±2,54	1,63±4,25	0,011
E5	-0,54±3,84	1,29±2,66	1,83±4,4	0,082
E6	1,78±3,18	2,51±4,53	0,73±4,55	0,125
E7	-1,08±4,68	2,15±2,19	3,23±4,64	0,090
E8	-0,51±4,16	3,46±3,99	3,97±6,22	<0,001
E9	0,78±4,45	0,51±2,8	-0,27±5,09	0,228
E10	-0,45±4,16	0,36±2,73	0,82±4,52	0,303
p (between schools)	<0,001	<0,001	<0,001	

Source: The authors 2023

It can be seen in Table 7 that most schools (6) showed positive performance in the mean scores of question 5 in the pre-training evaluation, with significant differences ($p<0.001$) between the schools, the same happened in the post-training test ($p<0.001$) and in the difference between the tests ($p<0.001$). The schools with the best initial performance were E3 (3.32±4.40) and E1 (2.50±4.11), and the worst were E5 (-0.54±3.84) and E8 (-0.54±3.84). The differences in performance between schools in the pre- and post-assessment were also significant ($p<0.001$). Schools E1 (4.71±3.09)

and E8 (3.46±3.99) had the highest mean test scores after training. The schools with the lowest post-training performance were E2 (-0.68±4.73, the only one with negative performance) and E10 (0.36±2.73).

The mean differences between the tests before and after the training were significantly greater than zero in schools E1 (2.21±4.72, p=0.041), E4 (1.63±4.25, p=0.011) and E8 (3.97±6.22, p<0.001), which is with the largest difference between the assessments. School E7 was the second school with the highest positive difference between assessments (3.23±4.64), although not statistically significant (p=0.090). Three schools showed worse means in the differences between the tests, characterized by negative means, but not significant: E2 (-2.05±6.32, p=0.054), E3 (-0.87±6.07, p=0.329) and E9 (-0.27±5.09, p=0.228).

Table 8 shows the distribution of students in each school by the comparative performance of hits on question 5 on the tests before and after training.

Table 8

Distribution of students in each school by comparative performance of hits on Question 5 in the before and after training tests.

School	To be improved	Maintained	Improved	Total	P
E1	2 (8,33%)	18 (75%)	4 (16,67%)	24 (6,61%)	0,277
E2	9 (21,95%)	27 (65,85%)	5 (12,2%)	41 (11,29%)	
E3	4 (8,51%)	37 (78,72%)	6 (12,77%)	47 (12,95%)	
E4	2 (4,88%)	31 (75,61%)	8 (19,51%)	41 (11,29%)	
E5	3 (7,32%)	28 (68,29%)	10 (24,39%)	41 (11,29%)	
E6	5 (13,51%)	29 (78,38%)	3 (8,11%)	37 (10,19%)	
E7	0 (0%)	9 (69,23%)	4 (30,77%)	13 (3,58%)	
E8	4 (10,81%)	24 (64,86%)	9 (24,32%)	37 (10,19%)	
E9	3 (6,12%)	34 (69,39%)	12 (24,49%)	49 (13,5%)	

E10	1 (3,03%)	25 (75,76%)	7 (21,21%)	33 (9,09%)
Total	33 (9,09%)	262 (72,18%)	68 (18,73%)	363 (100%)

Source: The authors 2023

The distribution of students in each school and the comparative performance of correct answers did not show a significant relationship (p=0.227). The highest percentages of improvement in correct answers were observed in schools E7 (31%) and with similar percentages (24%) in schools E9, E5 and E8. The percentage of students with improving performance in correct answers (they got it right in the first test but wrong in the second test) was higher in schools E2 (22%) and E6 (13%).

It should be noted that more than 18% of the students answered question 5 correctly in the post test. This question dealt with a problem situation of the prototype transformation type with an unknown final state. Different problem situations were worked on in the third stage of the training, which may have contributed to the fact that only two schools did not show a better performance in the evaluation carried out after the training.

THE REFLECTION ON EDUCATION

Reflection on teacher education, whether initial or continuing, always brings us back to learning as we learn or knowing as we know. The challenge to return to ourselves, to identify the difficulties and to try to overcome them in order to improve our action with others. This is the principle of continuing education, to improve our professional actions.

Thus, we set ourselves the challenge of reconstructing the post-pandemic reality by considering students who were in emergency remedial education in the first two years of basic education through teacher training. At the same time, we deconstruct the epistemological and methodological conceptions, through the disruptions

established in the plurality of learning experienced by each student in the period of social distance. Then, in the recontextualization of mathematical knowledge and content, the training sought to work on the pedagogical practice contextualized and articulated to the mathematical content to be developed with the children, allowing these contents to be constructed or reconstructed by the teachers in the common action of the group.

In the course "He who tells a tale, adds a point," we explored the recontextualization of mathematical knowledge and content in teacher training, considering the skills expected for the 3rd grade in the BNCC. Initially, the pre-test was applied, after the training was developed, and we finished with the post test, to identify the learning of their students developed by the teachers in training.

During the training, the teachers were participants in the practices developed, they were subjects of learning in those moments that gave them the opportunity to experience the teaching and learning processes under different possibilities. Teachers shared their practices, experienced new situations, expanded their theoretical knowledge about certain mathematical contents, reconstructed and applied their practices, and shared these experiences. In this interaction, reflection took place and teachers often (re)learned how to teach. During the training, observations were made by the researchers of the lessons developed by the teachers-in-training, where pedagogical practices recontextualizing the knowledge experienced during the training were identified.

In the development of the research, we identified that only one school did not show significant improvement in the learning of its students. We also highlight that there were students who got a question right in the pre-test and wrong in the post test. We know that the tests represent a differentiated situation in the educational process, which may cause surprise to the students. But we have also identified that some skills are under construction and, in these moments, teachers need to be aware of and contemplate these skills in their pedagogical practices.

In this sense, we understand that the proposed training can be self-regulated, starting from the expansion of the participation of researchers in the classroom, together with the teachers in training, to establish a dialogue for reflection, much more than pointing out the difficulties. Also, to develop the culture of interaction among peers, through study groups, based on the identification of their difficulties with the perspective of overcoming them. We are not talking about planning together, but about discussing the practices already carried out in the collective in order to extend the teaching action. According to Pérez Gómez (2001, p. 180), "the necessary transformation of the school and the increase in the quality of teaching are usually linked to the modification of the teaching function and the necessary enrichment of its professional development.

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