

Lesson Study methodology with elementary school teachers: inclusion of experimental and technological practices

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ABSTRACT

This article presents reflections from pre-school and early years teachers. The objective was to investigate the potential of the Lesson Study methodology in professional development. The intervention took place during the training meetings, using the methodology to improve pedagogical practices and insert technological and experimental resources. Four cycles were developed, which involved planning; application and observation; evaluation and replanning; and final evaluation of activities. For data collection, recordings of the meetings and one of the researcher's field diary were used. It is noteworthy that the teachers evaluated the methodology as productive for the improvement of pedagogical practices. The research showed that the training helped in the conceptual gaps of the teachers, being promising for their professional development, as it instigates investigative and collaborative postures, encourages reflection and research in class and student learning.

KEYWORDS

Lesson Study; pre-school and early years; technological resources; experimental activities.

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METODOLOGIA DE ESTUDOS DE AULA COM PROFESSORAS DOS ANOS INICIAIS: INSERÇÃO DE PRÁTICAS EXPERIMENTAIS E TECNOLÓGICAS

RESUMO

Este artigo apresenta reflexões de professoras da pré-escola e dos anos iniciais. O objetivo foi investigar potencialidades da metodologia de Estudos de Aula no desenvolvimento profissional. A intervenção ocorreu durante os encontros de formação, utilizando-se a metodologia para aprimorar as práticas pedagógicas e inserir recursos tecnológicos e experimentais. Foram desenvolvidos quatro ciclos, que envolveram planejamento; aplicação e observação; avaliação e replanejamento; e avaliação final das atividades. Para coleta de dados, utilizaram-se as gravações dos encontros e o diário de campo de uma das pesquisadoras. Destaca-se que as professoras avaliaram a metodologia como produtiva para o aperfeiçoamento das práticas pedagógicas. A pesquisa evidenciou que a formação auxilia nas defasagens conceituais de docentes, sendo promissora para o seu desenvolvimento profissional, pois instiga posturas investigativas e colaborativas e incentiva a reflexão e a pesquisa em aula e a aprendizagem dos alunos.

PALAVRAS-CHAVE

Estudos de Aula; pré-escola e anos iniciais; recursos tecnológicos; atividades experimentais.

METODOLOGÍA DE ESTUDIOS DE CLASE CON DOCENTES EN LOS PRIMEROS AÑOS: INSERCIÓN DE PRÁCTICAS EXPERIMENTALES Y TECNOLÓGICAS

RESUMEN

Este artículo presenta reflexiones de docentes de preescolar y primera infancia. El objetivo fue investigar el potencial de la metodología Estudios de Clase en el desarrollo profesional. La intervención se llevó a cabo durante los encuentros de capacitación, utilizando la metodología para mejorar las prácticas pedagógicas e insertar recursos tecnológicos y experimentales. Se desarrollaron cuatro ciclos, que involucraron planificación, aplicación y observación, evaluación y replanificación y evaluación final de actividades. Para la recolección de datos se utilizaron las grabaciones de los encuentros y el diario de campo de un de las investigadoras. Se destaca que los docentes evaluaron la metodología como productiva para la mejora de las prácticas pedagógicas. La investigación mostró que la formación ayudó en los vacíos conceptuales de los docentes, siendo prometedora para su desarrollo profesional, ya que incita a adoptar posturas investigativas y colaborativas, incentiva la reflexión e investigación en clase y el aprendizaje de los estudiantes.

PALABRAS CLAVE

Estudios de Aula; preescolar y primeros años; recursos tecnológicos; actividades experimentales.

INTRODUCTION

According to Paulo Freire (1991, p. 58, our translation), “No one becomes an educator on a certain Tuesday at four o’clock in the afternoon. No one is born an educator or is destined to be an educator. We make ourselves educators, we continuously train as educators during practice and by reflecting on the practice.” This idea makes even more sense when we think about the professional development of teachers, as this process permeates theoretical studies, observation, reflection, evaluation, and improvement of teacher practice. With collaborative groups mediated by Lesson Study, we can improve teaching and learning processes, particularly in Sciences and Mathematics.

This article results from doctoral research and aims to investigate the potential of the Lesson Study methodology in the professional development of a group of pre-school and elementary school teachers. To this end, a collaborative team of four teachers — two from pre-school and two from elementary school — was organized to use the Lesson Study methodology. These groups had moments of discussion, theoretical deepening, planning, execution, observation, evaluation, and analysis of the lessons taught using technological resources and experimental activities to explore Mathematics and Sciences contents. After these actions, when necessary, the activity was replanned and carried out again.

To understand the organization of this article, we present next the theoretical basis of the Lesson Study methodology that grounds the research, highlighting the benefits and importance of continuing education in the school context. Besides the research methodology used, the following section, which had a qualitative design, describes the research context, the participants investigated, the development of Lesson Study cycles, the data collection instruments, and how the data were analyzed. The penultimate section presents the descriptive and chronological data analysis, discussing elements that emerged during the development of the Lesson Study cycles. Lastly, the final considerations present the results, trying to relate them to the proposed objective and to the theoretical framework that supported the development of this research.

THEORETICAL BASIS

The theoretical basis of this research is the Lesson Study methodology, which is used for the professional development of teachers and considered a way to encourage reflection and collaboration among peers. Curi (2018, p. 19, our translation) states that Lesson Study “[...] is a process of professional development for teachers, organized into collaborative groups, mediated by researchers, and based on the thematization of classroom practice!”. It is a methodology that investigates the lesson, student learning, and teaching practice. Still according to Curi (2018, p. 19, our translation), “It is an interactive process of lesson planning, observation, and review, in which teachers and researchers work collaboratively to improve the students’ learning.”. Merichelli and Curi (2016, p. 17, our translation) corroborate these ideas by affirming that, in different countries, the methodology

[...] has been regarded as able to encourage reflection and collaboration among teachers and promote student learning, professional development, and improvement of lesson plans. In addition, its evidence-based nature favors the methodology, as teachers evaluate the teaching methods they are attempting to develop and use students' voices to analyze the teaching quality.

Merichelli and Souza (2016) also indicate the Lesson Study methodology as an effective proposal for teacher training in a continuing education program. According to them, this methodology can produce investigative and collaborative postures, promoting professional development and improving the lesson plans of the teachers involved. In turn, Blanco-Álvarez and Castellanos (2017, p. 8, our translation) point out that it aims at a training grounded in reflective and critical work about teacher practice: "Lesson study allows opening the classroom to the critical view of colleagues, enabling a mutual enrichment based on the experiences and specialties of each person, considered an improvement process." The observation stage lets the participants analyze the elaborated plans and change conceptions after reflecting on them. The authors also emphasize that "[...] the teacher must be willing to return to their practice and analyze it to give meaning to conceptions and knowledge, leading them to understand or improve it [...]" (*ibidem*, p. 8).

Utamura and Curi (2016) summarized the Lesson Study methodology in three stages: planning the lesson collectively; one teacher giving the lesson planned while the others observe; and reflecting on the strengths of the lesson taught and the aspects to improve. In certain contexts, as well as in this research, the stages of the Lesson Study methodology may vary. Thus, this section presents the effective adaptation for the development of Lesson Study cycles that mark this research:

1. Lesson planning: the group of teachers chose a theme — Mathematics or Sciences content that needed to be developed — and planned a pedagogical proposal, considering the difficulties reported by the participants regarding the use of technological resources and experimental activities;
2. Lesson teaching: a teacher was responsible for carrying out the activities, while some observed and recorded the lesson to discuss the proposed planning;
3. Lesson analysis: gathered in groups, the teachers watched the recording, discussed the activities performed, and analyzed the work done; and
4. Reformulation and reteaching: when necessary, the activity was reformulated and taught again by another teacher in a different class.

As Bezerra (2017, p. 24, our translation) point out, the main idea of this methodology is the "[...] reflection cycles, in which lessons are widely discussed before and after they are taught, always seeking its improvement, starting from practice, going through theory, and returning to practice." Also, according to the authors, professional development is covered when the training focuses on the teachers' professional practice so that they not only share their knowledge but

learn from colleagues and students, contributing to improving the teaching and learning processes.

In the Lesson Study process, teachers have the opportunity to review and reformulate the methodological structure they use in their lessons, the contents they teach, and the student's learning, as well as improve their professional and practical knowledge as a consequence of the regular, systematic, cooperative, and critical study they are doing. (Bezerra, 2017, p. 56)

In short, Lesson Study has a characteristic that is usually not identified in other methodologies used in continuing education programs; it starts with teacher practice, moves to theory, and returns to practice, that is, practice is part of the whole training process. According to Quaresma *et al.* (2014, p. 2), "It is, therefore, a process very close to a small investigation about the professional practice itself, carried out in a collaborative context, and that is usually informed by curricular guidelines and the results of analysis related to a given topic of school programs."

Thus, the Lesson Study methodology has a reflective and collaborative nature; namely, it aims at the professional development of teachers based on reflection on their own practice with the help of colleagues and researchers. This process, which allows the teacher to identify and share their struggles and progress in a certain topic, can be a crucial step toward their professional growth. When they allow themselves to think and analyze their practice, they also realize the changes that need to be recommended.

RESEARCH DEVELOPMENT

This section presents the methodological basis that guided the research development. To achieve the study objectives, we chose to perform qualitative research, since this approach includes direct and prolonged contact of the researcher with the environment and the situation investigated (Lüdke and André, 2001). In addition, this type of study seeks to question subjects to understand how they live and interpret their experiences (Bogdan and Biklen, 1994).

The research was developed in a school from a municipality in the inland of Rio Grande do Sul, and the participants were two pre-school and two first-grade teachers.¹ Initially, a meeting was held to present the proposal and define the initial planning theme/focus, remembering that, previously, the inclusion of pedagogical practices that used technological resources and experimental activities was suggested as a way to help teaching and learning processes. Next, the group conducted theoretical studies, as well as planned and organized activities collaboratively. To develop the planned activities, the group chose the teacher who would later carry out the first activity in her class, with the others as observers.

¹ The teachers are represented as P1, P2, P3, and P4 to protect their anonymity.

After exploring the activity, they took a moment to produce a practice report, in which the lesson instructor reported her perceptions, and the observers highlighted their notes on the activity developed. Some excerpts of the practice were recorded and watched to deepen the discussion in the respective group. In the following stage, they made the necessary changes in the first planning, based on the observation notes, and organized a new performance of the activity. Each Lesson Study cycle had five meetings, which, succinctly, can be described as:

1. initial planning;
2. teaching and observation;
3. evaluation and replanning;
4. reteaching; and
5. final evaluation.

We underline that four of these cycles were developed during the research; two employed technological resources, while the others had two experimental activities.

Data were collected from audio recordings of Lesson Study meetings, filming of the teaching of planned practices, in addition to one of the researcher's field diary. Regarding qualitative data analysis, we used the descriptive analysis by Bogdan and Biklen (1994), with a chronological description of the actions developed at each stage of the research intervention. According to the authors, this type of analysis aims to improve their own understanding of the materials and present what they find to others. Thus, the results of the intervention process were analyzed using the Lesson Study methodology as a way to contribute to the professional development of this group of teachers, participants, and research collaborators.

RESULTS

This section discusses and analyzes data from the four cycles of the Lesson Study methodology developed during the training to help the process of professional improvement of the participating teachers.

FIRST CYCLE OF THE GROUP

At the beginning of the first Lesson Study cycle, we talked about how the meetings would happen and listened to the group's teachers, identifying difficulties and expectations for the training process. At that moment, the subject to be used in the first stage was defined, that is, in the planning. According to Ponte *et al.* (2016, p. 869, our translation), this stage "[...] starts with the teachers identifying a relevant problem in student learning." Thus, the teachers reported what they were working on in the classroom.

I started a project called "Me, my hands, and my body". In it, I am working on large motor skills. (P4)

I'm thinking of a project with manual skills. I thought of putting together pattern blocks to work with Mathematics: constructing the number, seeing shapes, feeling the differences. And, within this scope, working on visual-motor coordination, something like this. Cuttings, paintings, defined shapes in the drawing. (P1)

Initially, we noted that P4 and P1 could not point out the difficulties of their students, only mentioning what they were working on or thought about developing in their class, a situation similar to that reported by Cyrino and Jesus (2014, p. 760, our translation): "In the first discussions of the study group, we noticed that the teachers were not used to 'thinking' about the activities they develop in their classes.". Reflecting on pedagogical practices is not customary among teachers; however, they need to get used to this methodology.

While planning the first cycle, the teachers decided to organize an experimental activity for pre-school classes. Thus, they chose the quicksand activity, planning to explore it first in the pre-school B class and later reteach it in pre-school A. Regarding the planning of experimental activities, from the beginning, this teaching group was concerned with fully detailing each stage, as can be observed in some statements and even questions during the first meeting held.

We can do it with aniline later. (P4)

I think if we dilute it a little more, they can pick it up with their hands and paint, not only on paper. (P3)

We could do something else with colors, but what would that be? With numbers, counting. (P4)

But then we would do it down there with the children. (P1)

Making a drawing in high-relief and then painting it. Or making it colorful. (P2)

Okay, let's make a competition. But first, we should present, explain the activity. (P1)

That it'll be a game, play. With 4 teams. 4 buckets. (P3)

It has to be something not so big, a marble, right. (P4)

We could even put the amount corresponding to the number of children in each bucket. (P1)

I was thinking more about drawing on kraft paper or cardboard... (P4)

As if it were playdough. (P2)

Making little cardboard squares for them. (P1)

They can't let it run out of the cardboard. (P4)

I was going to put aniline and do it like my class did last year. (P2)

In fact, the four teachers were actively involved in developing the experimental practice, which promoted an exchange of ideas, discussions, clarification of doubts, adjustments of details in the preparation and organization of the lesson. According to Castellanos Sánchez and Blanco Álvarez (2019, p. 4, our translation), at this stage, teachers need to discuss the activity objective, classroom organization, “[...] instructions for the students, children organization — individually or in groups —, materials for developing the activity, the time considered necessary.” and, mainly, the student’s learning.

This first planning revealed the concern of teacher P1 (who would teach) to write down all details, as shown in the following excerpt:

I'll write it down; first, we'll explain what will happen in a talking circle, the game rules; organize them into 4 teams; and the team that first picks up all marbles inside the bucket will play. Then we sit in a circle again, in a ring, and give each one a cardboard, giving the same amount to each of them [...]. (P1)

In this first planning, which involved experimental activities performed in pre-school classes, the teachers were concerned with detailing the tasks, particularly the organization of the physical space and the materials necessary to carry out the activities. This finding is highlighted by Utimura, Borelli, and Curi (2020, p. 7, our translation), that is, teachers, “[...] while planning the lesson, list some aspects such as its purpose based on the theme; choose the learning process that will be developed; bring evaluation indicators; provide copies of lesson materials.”. However, we noted a lack of discussions as to the physical and chemical knowledge associated with the experiment.

The group also defined the date of the lesson and observation by the other participants. Thus, P1 taught the lesson to the pre-school B class, and the others (P2, P3, and P4) observed the development of the pedagogical practice. During teaching and observation moments, the lesson instructor was a little apprehensive about the students’ collaboration and involvement with the activity. Both the teacher and the observers were willing to assist the students in developing the experimental practice.

In these two moments (teaching and observation), the teachers received a script with some important items to which they should pay attention, such as positive and negative planning aspects, student questions, and points to change. They also debated aspects related to the progress of the lesson and possible questions from the children. The observations were discussed and reintroduced in the activity analysis and reformulation stage. At the end of the first teaching moment, they were prompted to reflect on the developed practice; accordingly, they evaluated the positive and negative elements of the planning organized collaboratively by the group. In this scenario, Castellanos Sánchez and Blanco Álvarez (2019, p. 3, our translation) affirm that “[...] the teacher must be willing to return to their practice and analyze it to

give meaning to conceptions and knowledge, leading them to understand or improve it [...]”.

Regarding the quicksand practice, next, we have the reports of teachers P1 and P4, who confirm the students’ excitement, involvement, and interaction.

As a positive aspect: everyone participated in the cardboard part; they held the bucket with one hand, which allowed them to search inside, and they did not give up. There’re some children who, when they don’t find it, give up, right. (P1)

I think it was a learning experience; they’ll remember it. (P4)

I think experiences are always welcome. (P1)

While P4 emphasized the learning part, P1 highlighted the development of experimental activities during the pedagogical practice. After corroborating the use of experimental activities as motivational tools in the classroom, Soares *et al.* (2013, p. 3, our translation) inferred that,

[...] in the Science Teaching field, we underline experimental activities as an important educational tool. They allow the active participation of students in the knowledge construction process, which can work as a motivating agent for them.

At that time, the group was asked if the predicted objectives for the activities developed had been achieved. Teacher P1 immediately replied: “Yes, because most students were gradually looking for the marble, which was the goal.”.

Regarding the experimental activities, the negative aspects indicated by the teachers initially related to material and space organization.

It took time, and they weren’t used to competition; they didn’t care. And it was also a mess. But this isn’t a negative aspect, just an observation. (P1)

There were some who, when it was their turn, skipped. (P4)

And some had difficulty in really searching, while others went right ahead. I listed holding the bucket as a negative aspect. One student put both hands. (P2)

As the excerpts show, P1 pointed out the commotion in the room, which also interfered with the organization of queues, as P4 noted, since some students did not wait their turn in the game. According to P2, the instruction to hold the bucket with one hand was lacking, as some put both (hands) in and then could not pull them out.

We reiterate that, in this first experimental activity, the teachers were not concerned with exploring physical and chemical concepts that could be discussed. In addition, the lesson instructor did not notice the questioning of a student about such concepts during the practice, as the statements of P1 and P4 show. Therefore, the group was asked about the conceptual approach to the activity in an attempt to

prompt them to think about its importance in experimental practice. The following excerpt was extracted from the diary of one of the researchers:

When planning the activity, we did not consider the physical concepts involved. And the students realized it when they were handling the paper; they understood that they had to put more force for it to become solid. In fact, that is the physics part. You put force to change the physical state of the matter. During planning, we did not reflect on which question to ask so that they would think about it. He said: "Look, if I hit it!" Then everyone started hitting it as well. It happened by accident. When we teach this lesson again, I think we should find something for them to hit during the activity. (Researcher)

The excerpt above shows that the teachers did not focus on students' questions during the activity. Merichelli (2018, p. 24) identified something similar in his research. According to the author, teachers should reflect "[...] on the need for and importance of identifying and anticipating possible doubts that students may have when developing the activity."

Therefore, the group was encouraged to rethink and consider what they could change in the initial planning for the new teaching. Next, we present some modifications cited by the teachers for issues related to organization, space, and time.

Performing the activity on the street (the courtyard) instead of inside. There's also the matter of time. (P1)

I'd organize the queues by color. Because later, we didn't know who was who. With a line they can't cross. I mentioned that, in the end, I'd take the pots to distribute into little pots without putting them on the cardboard. With the pot, they can play longer and take it home. (P4)

Really. I think the queues didn't work; there were students in different queues. We had 4 queues and 4 buckets. The first in line should always go, and in the end, it was all mixed up because it took time, and they became impatient. A different way of organizing it, maybe, would be to make a circle, 4 little circles, with the bucket in the middle, because then they won't stand up; they will see their friend there in the middle. (P3)

The reports from P1, P4, and P3 show that, initially, the group was interested in changing the issues related to physical spaces and class organization. Next, P4, who would reteach the activity, asked her colleagues how she could motivate the students if none of them asked about the force that should be applied.

How can I guide the activity, so students realize they have to hit it? At some point, I think I should tell them to hit the sand and see what happens. (P4)

I think if no one realizes they have to hit it, you can tell them to do it. But it'd be cooler if someone realizes it by themselves. (P2)

I also think it'd be cool to ask them if they've seen something similar and where. (P3)

Nice, we could also make comparisons, where else can we see it, at sea what happens...? They might have seen it in movies and cartoons... Something you can ask them later. (P4)

As the dialog between P4 and P2 indicates, the group reflected on how to approach the force issue during planning, and P3 suggested keeping stimulating the students about the experimental activity. Thus, she reorganized the planning, including some questions posed to the class during the practical activity. The teacher must question and also consider the doubts of students to increase their participation, as usually, when students share their discoveries in the classroom, they indirectly challenge each other, becoming more motivated to participate. Ponte *et al.* (2012) emphasize that, rather than just commenting on the right answers of students to understand how they developed their reasoning and reached a certain result, the teacher should question them during and after a lesson, thus helping them advance their learning.

At the end of the analysis, reflection, and replanning meeting, the group was asked how the activity continued or ended with the students. Teacher P1 pointed out that, after the conclusion, she performed another activity with them: *“My students registered the activity with a drawing; I think it's important to have feedback. It was very cool, they even drew the observers, and then each student had to explain the drawing to their colleagues.”*

After these discussions, the planning of the activity to be retaught underwent some changes, mainly with respect to the physical organization and distribution of the class. In addition, other questions were added to motivate the students to think about the physical concepts involved. Silva and Curi (2018, p. 49, our translation) consider the replanning process

[...] a movement of reflecting on the action, in which the teacher needs to put into practice their professional knowledge to adjust educational processes. This movement is intrinsic in the Lesson Study process because it prompts reflections that help teachers rethink their own practice, seeking answers and new paths.

Thus, the reflective process and collaborative actions that became possible due to Lesson Study promoted the learning of all involved. The methodology creates opportunities for teachers to think and rethink their lessons and practices with their colleagues. Regarding this aspect, Silva and Curi (2018, p. 52, our translation) comment that

[...] identifying critical moments of their own performance in the classroom is not a simple and assertive movement. Often, the “eyes” of another, be it the professor, researcher, or co-worker, can help such action and indicate situations that go unnoticed by the teacher [...].

SECOND CYCLE OF THE GROUP

Planning the lesson of the group's second Lesson Study cycle involved using technological resources. The first-grade teachers stated that they wanted to explore activities related to counting to twenty.

I'm counting to 30 with them, but writing to 20. The students are having a lot of difficulties. (P3)

I pulled a clothesline and put two clips in it. Then I hid the others. Next, I asked how many clips I had hidden; there were 10. They started counting until they reached 8. [...] I'm working on options up to 10, but I'm there.... wishing. I couldn't structure the calculation. (P2)

In their reports, P3 and P2 claim that their students were having trouble counting numbers. For Ponte *et al.* (2016), in this planning stage, teachers must anticipate students' difficulties and possible questions that may arise in the classroom, develop tasks, formulate teaching strategies, and prepare instruments for observation. However, during planning, the participants focused on raising questions about their students' struggles, such as number sequence, counting beyond ten, and number identification (quantity and numerical representation).

In general, the group did not offer many suggestions for planning, a fact that can be justified by the trouble in finding a specific game for the theme. After some time researching, the teachers proposed, discussed, analyzed, and evaluated a few ideas.

Do we start with this one and then move to the puzzle one? (P4)

It's too many games [...]. (P2)

She takes one and goes through the levels. (P1)

I think they can do it all if I interact with them. (P3)

P4's report revealed an organization of the game sequence. However, P2, P1, and P3 showed concern about the number and length of the activities. After choosing digital applications, which actually took a long time, as the teachers could not find a resource that met their needs, the group organized the planning. The systematization of this planning, with activities involving digital resources in Mathematics, differed from the experimental activities because the teachers only wrote down the sequence of games or applications and discussed the number of activities they could use.

As one researcher pointed out in her field diary, "[...] *when it comes to resources, they do not put much on paper.*". After choosing the applications, the planning was organized quickly and succinctly, different from the development of the first activity, which had a detailed description. Therefore, we can infer that teachers need

detailed planning when developing experimental activities, contrary to when they use technological resources. We underline that, in this planning with technological resources, the group did not realize that, perhaps, they needed to plan an activity to continue the study.

The second cycle activity was carried out by the first-grade B teacher and observed by the others. According to the field diary of one of the researchers, who also participated in the lesson as an observer, the teachers were surprised by a failure in one of the games they had selected.

[...] they had the lesson in the laboratory, [...] one of the resources had a problem and did not open. But they had already added an extra [resource] to the planning. So, it was fine. They had selected three and commented that they thought they would not be able to use all three. (Researcher)

During observation, the group realized that students who could not perform some activities in the classroom developed something similar in the laboratory, as P3's comment demonstrates: *"In the classroom, he can't do it, and in the laboratory, he did them all."* P3's statement translates the teachers' surprise with the interaction of two students in the class. When analyzing the case, they raised the hypothesis that students focus more in front of the computer because they work and interact individually with this tool. In addition, the teacher found signs of learning, especially in the two students who were having trouble concentrating in the classroom and could not count to ten.

After this discussion, we addressed the issue of continuing the activity with the group. The idea proposed was to develop an exercise in the classroom similar to that performed in the application. Advancing in the analysis, the teachers also concluded that they should have better prepared their classes for the activity to be more productive, since, in addition to the students becoming excited during the trip to the computer laboratory, the calculation structure had not been fully understood by them. Additionally, they highlighted that the laboratory allowed for individualized support.

I should have prepared the class for the activity. They were not used to the structure of the calculation, but I also managed to explain it individually to each of them because the others were playing on their computer. [...] We need to think about doing something later, about continuing the activity. (P2)

Or write the number below in this one and not in the other. Writing the results without writing the addends. (P3)

In these reports, P2 and P3 confirm that they understood the importance of continuing the activity. Thus, they offered some suggestions to be used in their classes, including evaluating whether the students who surprised the teachers in the laboratory could do the task in the classroom. According to Silva (2014, p. 41, our translation), *"[...] the lesson becomes more interesting when the teacher explains the content using technologi-*

cal resources and tries to connect the subject taught with the daily life of the students.”.

Therefore, in the replanning, the group organized a sequence of exercises for the lesson instructor to develop with her class, thus continuing to use the resource. In addition, they decided that the same teacher could reteach the activities since the game had not worked in the first experience. This action was accepted because they considered the application important for the defined planning sequence. In the replanning, some activities were included to evaluate student learning, which P2 — the instructor — considered very good. Moreover, she commented that the tasks helped the process of understanding the content she was developing because some students in her class also solved activities in the laboratory that they could not do in the classroom.

Once they finished discussing the notes on the development of the second Lesson Study cycle, they concluded that the group exceeded expectations and found signs of progress during the teaching moment of the pedagogical practice. Lesson instructors and observers analyzed the students' reactions during the lesson, trying to identify and understand their progress and difficulties. Likewise, replanning was a significant cycle, as the teachers realized the importance of planning and organizing activities to continue the pedagogical practice.

Regarding the use of technological resources, with the increased demand for applications, the teachers began to understand the importance of analyzing and evaluating the resources before using them with the students. Castro (2001, p. 32, our translation) argues that using technological resources “[...] contributes to a more dynamic learning experience, when teachers schedule, plan, launch strategies in order to mediate the teaching-learning process.”.

Lastly, this stage marked the beginning of collaborative work, as teachers who worked at the same educational level started to relate more to each other. In her field diary, one of the researchers wrote:

They are organizing themselves in pairs, those in pre-school and those in first grade; one is giving pointers to the other's planning, suggesting ideas. [...] they are helping each other. I am realizing and feeling that I achieved something they did not have: collaboration in planning. (Researcher)

According to the researcher's statement, the participating teachers were rarely seen sharing activities or planning together. However, this attitude changed during the planning and replanning meetings, as well as at other times of daily work at school. Marmolejo Avénia, Blanco Álvarez, and Fernández Mosquera (2009, p. 14, our translation) underline that the Lesson Study methodology “[...] is a framework to consider in teacher training programs, as it evidences, among other aspects, the role that group work plays on the conception of classroom activities.”.

THIRD CYCLE OF THE GROUP

The third Lesson Study cycle involved using technological resources in pre-school classes to address the sequence of geometric shapes, number sequence, and the relationship between quantity and number. The group suggested some activities, but not experimental ones.

There's an activity in the laboratory, I think it is on the blog, which gives the shape, and they have to put them in order, as shown there... It starts very easy and then begins to have 4 in a square. For example: red, yellow, blue, and green. And they have to arrange them like in the image. And there're several; I think there're 4 on the top and 4 on the bottom. It's very cool; I just don't remember its name. (P1)

P1's account of an application she found on the school blog shows that she searched for games or applications to suggest. Her statement also shows that the group began to recognize the importance of analyzing the application or game to be used. One of the researchers commented on this realization in her field diary when she wrote that “[...] *the teachers were very focused on analyzing and evaluating whether the students could do the activity and whether it covered the goals they established for the activity.*”

According to Masetto (2006, p. 143, our translation), the technological resources used

[...] need to be chosen based on what students are intended to learn. As the learning process encompasses intellectual, affective, skill, and attitude development, we can assume that the technology used should be diverse and appropriate for these objectives. We cannot hope that one or two techniques, repeated to exhaustion, will be enough to encourage and guide all the expected learning.

The author also points out that the technology “[...] will only be important if it helps achieve the objectives efficiently. The techniques will not be justified by themselves, but by the objectives they intend to achieve, which in this case is learning.” (*ibidem*, p. 144). We emphasize that the process of analyzing and evaluating the digital applications used in planning the pedagogical practice started to make sense to teachers during the discussions. Nevertheless, according to the diary of one researcher, the teachers did not feel the need to do detailed planning of activities using applications but took the time to organize an activity to evaluate students, trying to identify learning signs: “[...] *the teachers did not detail much of the planning and organized a very similar activity for the classroom, in which students should complete a sequence of images.*” (Researcher).

The teachers praised the activity in the evaluation of teaching and observation moments. The instructor found it important because she could follow each student individually and even make notes regarding difficulties

some of them had counting to five, and others had to continue a number sequence.

I really liked it. I think I'm achieving my goal. Some were absent, and only a few couldn't do it. W, R, and P² struggled the most. Others were getting it. And a few were able to reach the last one. (P1)

I realized that the sequence game was easier for them when it had animals, while they couldn't do it with geometric shapes. Maybe because animals draw more attention. They have more differences. And the geometric shape is very abstract for them. (P4)

Thus, the laboratory activities were positive in P1's and P4's evaluations. P1 considered the activity performed in the classroom important because it proved that some students still had difficulties related to geometric shapes: "*They had trouble drawing geometric shapes in the classroom. They knew it, but they couldn't draw it.*". She commented that, after using the application, she conducted more activities related to the content studied.

Regarding the replanning, no instruction needed to be changed. The lesson instructor recalled that they were unable to perform all planned activities but commented that it would be interesting to keep them because they could be done in another class if they did the other activities faster. In general, after reteaching, the group concluded that the activity was significant and that the same learning aspects — such as the difficulty of some students in counting to five and completing sequences of shapes, especially when they were geometric — had been observed in the first teaching in another class.

We emphasize that, as indicated in the field diary of one of the researchers, the teachers showed engagement and commitment in these stages, not caring about criticism and accepting it as an opportunity to grow. This element deserves attention because, previously, this group had few moments of collaboration.

The two Pre-School teachers barely exchanged ideas or activities, [...] and now I often see them commenting: oh, I have it; do you want it as a suggestion? [...] They created a certain camaraderie; they saw that I can help you, and you can help me as well — that it is not shameful for me to ask you for something. (Researcher)

Therefore, at this point, the collaboration emerging between the participating teachers became clear. According to Castellanos Sánchez and Blanco Álvarez (2019, p. 8, our translation), "[...] collaborative group work enriches the program of activities with the experience of each one; the difficulties found are discussed, and solutions are sought. This allows thinking of teaching as a collective rather than individual work."

² Nomenclature used to protect the students' identity.

FOURTH CYCLE OF THE GROUP

In the fourth Lesson Study cycle, the teachers planned practical activities about the five senses, more specifically touch, to be carried out in first-grade classes. They shared several ideas in the planning meeting:

We'd have to work one sense at a time. We can make a mystery box, something related to touch, smells. (P2)

Regarding touch, we can make the mystery box or something involving physics; the foot one or the hot and cold one. With warm and cold water, and they put their hands in it to feel the temperature difference. (P3)

[...] those different paths. I think it's really cool; we should create one here at school. (P1)

[...] If we had some kind of basin or baking pan. We put tapioca pearls in one and jelly in the other. (P2)

Fusilli pasta, rice, beans [...] with a pizza box. (P4)

We'll focus on touch, then. We'll need two periods. Do the hot and cold one [...]. (P3)

What if they explored the textures in the pizza box with their feet and then the mystery box? We could make a record. (P2)

The statements above show that the teachers actively participated in planning the experimental activity, offering ideas and suggestions besides analyzing what they considered best for the planning. In this planning, the group was very interested in organizing the space and materials, raising questions involving physical concepts to explore in the practical activity with hot and cold water, and addressing hot and cold notions. Ponte *et al.* (2016, p. 870, our translation) indicated that

Participating in a lesson study is an opportunity for teachers to learn important factors regarding the content they teach, curriculum guidelines, reasoning processes, student struggles, and even classroom dynamics.

In this cycle, according to the field diary of one researcher, three activities were planned to achieve the intended objectives and address the physical concepts involved.

They planned 3 activities: one was a sensory box; then they worked on hot and cold sensations; and finally, they made a path with different materials for students to walk on and feel with their feet. (Researcher)

However, the planning of this activity was not described in as much detail as the other involving experimental activities. Since the content developed was more common for the teachers, they did not feel the need to detail the pedagogical practice. For Michel and Novo (2013, p. 100, our translation), planning,

[...] before meaning the organization of activities and content distributed throughout the school period, is a way of managing proposals to achieve goals in close relation to the role of the school, which determines, as a result, what it must offer and what should be learned when attending school.

The teachers wrote topics about the sequence that would be developed and the materials they would place in the mystery box and the sensory path. They also discussed the objectives of the activities and how to explore them. We highlight that the activity planning included the collective writing of a text to finish and conclude the experimental practice of the first day, in addition to the construction of a board with what each student felt when stepping on the different materials. According to Carvalho *et al.* (1998, p. 20, our translation), this type of activity reveals the “[...] student’s initiative because it creates an opportunity for them to defend their ideas safely and learn to respect their colleagues’ ideas. It also allows them to develop various types of actions — handling, observations, reflections, discussions, and writing.”

We underline that the objective of the Lesson Study methodology is not to evaluate the teacher’s pedagogical practice but to observe the effectiveness of the planning organized, identify and point out changes and adjustments necessary in replanning in order to achieve the intended goal. In this context, the teachers also commented on the observation moment:

I kept thinking: “If I were to do it like this, I don’t know if I would have figured it out”. (P3)

After you do it, you still realize a lot of other things. (P2)

That is the idea of exchange. (P14)

The dialog between P3, P2, and P14 denotes the importance of observing our colleagues and learning from the pedagogical practice they develop to improve our own. This idea corroborates what Castellanos Sánchez and Blanco Álvarez (2019, p. 5, our translation) state, that is, “[...] by observing the lesson, teachers are assimilating new ways of conceiving their actions, which allows them to adopt a systematic and informed perspective about it.” Thus, we can infer that the teachers learned by observing their colleagues develop the activities.

Regarding the planning changes, some adjustments were made, such as being more careful with the water temperature in the hot and cold activity because, initially, the children could not feel much difference between one and the other. Still, the planning was generally evaluated as very good and organized, meeting the teachers’ goals. The group considered the activities important and even decided to exhibit them at the school’s pedagogical fair along with the students’ reports. We also stress that, since the planning was developed together and the participants knew what to do in each activity, they did not feel the need to detail the process in writing.

Concluding the Lesson Study planning sequence, we clarify that the group did not always detail the plans because they did not see the need for it, as was the

case with the last planning, which involved experimental activities. However, this step was organized and elaborated together, with moments of discussion that led to the construction of a practice in which all participants knew what was happening. In addition, they took the time to think about the students' questions and attitudes in the face of challenges.

In the fourth Lesson Study cycle developed with the group, the first-grade A teacher observed the pedagogical practice her colleague used in first-grade B and reused it in her class, demonstrating its influence on her. According to Silva and Curi (2018, p. 100, our translation), the stages of "[...] Lesson Study allow the teacher to identify critical points and strengths of their performance, prompting valuable discussions in the group about the lesson methodological path, the effectiveness or weakness of the strategies [...]" used. This process contributes to the teacher's professional development. In this regard, one of the researchers reported the reflection of the observer teacher: "[...] *one learns from the other. I am glad it was the other way around, that I [P3] had the privilege of observing the first teaching; I learned many things I can do now in my turn.*" (Researcher).

At the end of this meeting, the training moments were evaluated in the form of Lesson Study cycles. According to the teachers, the methodology was valid because it provided moments of exchange, sharing, learning, and collaboration between co-workers. P1 stated: "*I found it very valid because the second time will always be different from the first. And we also stopped to talk, we thought together. What could be changed.*". P1 mentions collaboration, exchange between colleagues, and partnership as important points of this training methodology. For Curi and Martins (2018, p. 490), a group "[...] becomes collaborative as the members start to rely on each other, during training meetings, and in the friendships developed."

Also, some teachers declared that moments like these should happen more often in the school environment, suggesting that teacher meetings or gatherings should be available for this shared planning, aiming at knowledge exchange and, thus, thinking about the student's improvement and learning. For instance,

Meetings for this type of activity would be good, just to exchange ideas. Sometimes, we forget to do some activities, and when we are reminded, we do them. We remember other things. We even stop doing some activities because we forget. (P3)

In the classroom, even we need to plan the lesson and teach, and the result of this teaching makes you think. In the following days, if you go back to it, you'll do it differently based on what you planned before. So, this is crucial. (P2)

In their statements, P3 and P2 reiterate, in the evaluation, the exchange aspect to help planning. P2 also refers to the importance of replanning to analyze and evaluate the activity developed. The group work used in the meetings was productive for the teachers when it comes to collaborative work, autonomy, and

reflective processes. Following this line of argument, Curi and Martins (2018, p. 492, our translation) state that “[...] the collaborative actions of teachers and researchers significantly contributed to improve the organization of school planning and change the teacher practice based on the reflections made.”

FINAL CONSIDERATIONS

Based on these experiences and the proposed paths, we concluded that teacher professional development is a process that must be built from reflection, dialog, mutual trust, generosity, and, above all, the desire of each participant to be there, at that moment, sharing their ideas and demonstrating their weaknesses and anxieties. With respect to the proposed objective — to investigate the potential of the Lesson Study methodology in the professional development of a group of pre-school and elementary school teachers —, we emphasize that training based on this methodology contributed to the teachers’ professional development, given the rapport, involvement, and collaboration between them. All participated in the activities, analyzed, reflected, improved, and, at some points, criticized the pedagogical practice. This demonstrates trust among the members, which is essential for their professional development.

Regarding the Lesson Study methodology, the teachers highlighted the learning experienced during the activity and with the observation of their colleagues, the conceptual discussions in the meetings, the planning improvement, and their professional growth. In this context, the first planning cycles show that they were unclear about the objectives they wanted to achieve with the activities explored, but this changed throughout the process. Some difficulties noticed during the group’s initial planning stand out: lack of continuity of activities, as, at first, they were not integrated into the classroom context; the teachers offered few suggestions; and they were not concerned with the conceptual aspects involved. These aspects were addressed so they could be minimized in the development of Lesson Study cycles.

To conclude, we underline the strengths mentioned in the participants’ final evaluation and also noted by the researchers concerning the group’s professional development: positive changes in planning, that is, the teachers started to pay attention to the learning of their students; they recognized the importance of the observation process for the learning between colleagues; the participants gained confidence and, naturally, gave suggestions and criticized the work of their colleagues. Lastly, the collaboration began to be noticed in the school beyond the Lesson Study meetings because the teachers were gathering to exchange ideas and organize plans outside these meetings.

The research also evidenced that continuing education in the Lesson Study context has the potential to solve conceptual doubts of Mathematics and Sciences teachers in small children’s classes. In this scenario, the teachers began to realize the importance of the theoretical concepts involved. Moreover, during observation moments, the group began to talk and think about the theoretical involvement of each practice developed based on students’ questions. The study suggests that this methodology is promising for the professional development

of the participants since it prompts investigative and collaborative postures and encourages reflection and research on lessons, as well as students' learning and improvement of the teaching practice.

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