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WORKSHOP ON HYDROPONIC GARDEN WITH TEACHERS FROM A PUBLIC SCHOOL IN THE STATE OF SÃO PAULO

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ABSTRACT

The workshops are important practices, because, in a school contemporaneity, teachers are required to adopt differentiated strategies that provide the engagement of students in their learning. Continuing education workshops can be a counterpoint to help teachers improve discussions on how to innovate and articulate their pedagogical practices. Thus, in this work, we present a descriptive case study on a hydroponic garden workshop. The participants were 15 teachers from a public school in the interior of the state of São Paulo. The workshop took place in the Collective Pedagogical Work Classes, an important space to discuss pedagogical strategies and practices, as they enable discussions on transversal and interdisciplinary issues, such as Environmental Education, in the continuing education of teachers. The results showed that the workshop on the hydroponic garden provided moments of discussion and learning about hydroponic cultivation, in addition to reflection on the importance of continuing education in the school environment, by privileging dialogue between peers.

Keywords: Environmental Education, Continuing Education, Transversal, Interdisciplinary.

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INTRODUCTION

In a school contemporaneity, teachers are required to adopt differentiated strategies that provide the engagement of students in their learning. And with the considerable increase in discourses that highlight the importance of continuing education of teachers, the spaces that teachers can use for this discussion on issues that help them in their classroom practices are increasingly scarce.

Part of this is due to the excessive number of classes and bureaucratic activities that do not provide adequate planning for teachers to think about their own training. Thus, spaces such as the Collective Pedagogical Work Classes (ATPC) should be better explored by the school team to provide subsidies to teachers, especially on practices that can be used as a study laboratory, such as the hydroponic garden. For Cabral and Barreto (2024), experiences with a vegetable garden at school help children to formulate hypotheses by providing active learning.

However, the hydroponic garden was used for a long time as a technique to experimentally study plant nutrition in laboratories. Around 1940, William F. Gericke of the University of California improved the technique and named it hydroponics. The word comes from the Greek, which means hydro - water and ponos - work, that is, work in water.

Currently, we have several types of cultivation in which hydroponics are used. However, we hardly have this practice in the school environment, which can be a counterpoint to geoponics and a way of working on Environmental Education at school, which is a transversal and interdisciplinary theme. Thus, in this work, we present a workshop on hydroponic garden in ATPC, in a school in the interior of São Paulo. 15 teachers from different areas of knowledge participated in this workshop. The qualitative research, characterized by a descriptive case study.

CONTINUING EDUCATION IN ATPC THROUGH WORKSHOPS

The school is a democratic space that can provide the continuing education of teachers, being pointed out by Oliveira and Amaral (2024a) as the ideal *locus* for this, as it opens the possibility of recovering the initial training of teachers in the Collective Pedagogical Work Classes.

This aspect is corroborated by Dal-Farra and Valduga (2012, p. 410), because "at the same time that it meets the wishes of teachers, continuing education can fill the

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possible gaps that exist in the conceptual scope in a dialogical way with the eyes of the educators."

For Oliveira and Amaral (2024):

> [...] the Collective Pedagogical Work Classes are spaces that can help the continuing education of teachers, for example, in active teaching methodologies, in how students learn, and also in technologies. However, in this formative space, it is necessary to privilege transversal themes, especially on Environmental Education, and that it is fundamentally discussed by the various areas of knowledge. (Oliveira; Amaral, 2024a, p. 407)

However, the ATPC are spaces that can hardly be used nowadays by continuing education other than those planned by Seduc (Department of Education) and the school. Thus, to participate in a continuing education course, the teacher has to circumvent obstacles, such as the difficulty of schedules, the lack of a specific space to debate ideas and projects, in addition to the workload and low salaries resulting from the proletarianization of the profession. These obstacles are obstacles to continuing education and discourage teachers.

For Oliveira (2022); Oliveira and Amaral (2021), one of the obstacles that hinders continuing education is in the articulation between theory and practice. For the authors, there is a distance between thinking and doing, because, by developing differentiated strategies, teachers are able to overcome these barriers that hinder the teaching work. One of the strategies to help break down these barriers is workshops.

The word "workshop", according to Ribeiro and Preve (2018, p. 37), "derives from the Latin word *opificis* (craftsman), from the junction between *opus* (means to power, ability) and *facere* (to do, to perform, to operate, to work), keeping in itself a way of doing, a way."

The workshops are part of a whole, as they are places where artifacts, raw materials and tools are manipulated to provide the debate of constructive and collaborative ideas. In them, the rules, the codes, the relationships that identify those who make the workshop work, are instituted. Holding a workshop with teachers recreates an identity with the materials, with the tools they handle and with the processes with which they interact (Neto, 2005).

In addition, the author argues that the workshop reestablishes a professional identity of teachers in the environment, by allowing, based on the practices and knowledge, to situate themselves within societies, to understand the roles they play, while helping to understand the historical moment of their social relations.

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However, in order to be successful, the workshops require that teachers be in constant continuous training and that schools guarantee conditions and spaces for integrated work to be carried out with their peers (Paviani; Fontana, 2009) (Oliveira; Adam; Amaral, 2023).

From this perspective, Anastasiou and Alves (2015) argue that workshops can provide practical experiences, research, text elaboration and the use of heuristic tools, such as concept and mental maps.

Thus, Candau (1999, p.10) adds that "the workshops are spaces for the collective construction of knowledge, for the analysis of reality, for confrontation and exchange of experiences". According to the author, the workshops provide, according to the type of activity developed, participation, socialization of the word, the experience of concrete situations through studies that include social dramas, events, reading and discussion of texts with debates.

In this way, when thinking about the workshops, space is opened for exchanges between teachers to take place in the school environment and for interdisciplinarity to actually happen. All these aspects enable the use of different materials, in addition to reflections on pedagogical practices.

For this way of doing, we think that planning is important and should provide a different and appropriate strategy for each specific stage, which respects the life experience of the teachers involved in the educational process (CANDAU, 1999).

METHODOLOGY

The research was developed with a qualitative nature, which, for Bogdan and Biklen (2010, p. 49), "requires that the world be examined with the idea that nothing is trivial, that everything has the potential to constitute a clue that allows us to establish a more enlightening understanding of our object of study".

In this research, the methodology adopted was a case study, which, according to Yin (2010), presents different forms of application: explanatory, descriptive and exploratory.

In this work, we chose to describe a workshop involving Environmental Education. The training included seven workshops that took place at the ATPC. However, in this work, we present the discussions that took place in the ATPC regarding the second workshop, which had four meetings on the themes: how to plant lettuce in water (hydroponics) and the

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construction of a prototype of a hydroponic garden. To maintain the anonymity of the teachers, we used the symbolic representations (P1, P2... P15) and Pe for the researcher.

15 teachers from the areas of Language Codes (Portuguese, English, Art and Physical Education), Natural Sciences (Science, Chemistry, Physics and Biology), Human Sciences (History, Geography, Philosophy and Sociology) and Mathematics participated in these workshops, in Elementary and High School in a state school in São Paulo.

It is worth mentioning that all participants signed the Informed Consent Form (ICF), in accordance with Resolution 466/2012 of the National Health Council (CNS). It is worth mentioning that all participants signed the Informed Consent Form (ICF), in accordance with Resolution 466/2012 of the National Health Council (CNS). In addition, the research presented here was approved by the Research Ethics Committee (CEP) of the University of Cruzeiro do Sul, approval registered in Opinion 3,422,890.

RESULTS AND DISCUSSION

In the workshop on the hydroponic garden, we began the meeting by asking if the teachers knew the operation and construction of a hydroponic garden. Most of the teachers answered no, and only two were aware of this form of cultivation. P13 argued:

> P13: I have a relative who has a relative in Ibiúna and who plants succulents. Your hydroponic garden is covered by plastic on top and around it has a screen that protects from excess light and pests.

Then, the teachers argued that the subject of vegetable garden is not "fashionable" at school. However, for the authors Lago, Miranda and Silva (2018), it is necessary for EE, through interdisciplinary practices, to be present in the teacher's daily life. We believe that the insertion of vegetable gardens in the school with diversified techniques can be a way to rescue environmental discussions, in addition to favoring the coexistence of teachers and students.

In order for the teachers to know what the hydroponic system is like, we used videos that were available on YouTube. Thus, this stage had the presentation and discussion of two videos: the first with the title "Planting Lettuce in Water: hydroponics"[3] and the second "Knowing Hydroponics".[4]

[3] Available at: https://www.youtube.com/watch?v=X6F4snMPrFI&t=4s. Accessed on: 27 jan. 2022.
[4] Available at: https://www.youtube.com/watch?v=ethwEJalX-U. Accessed on: 27 jan. 2022.

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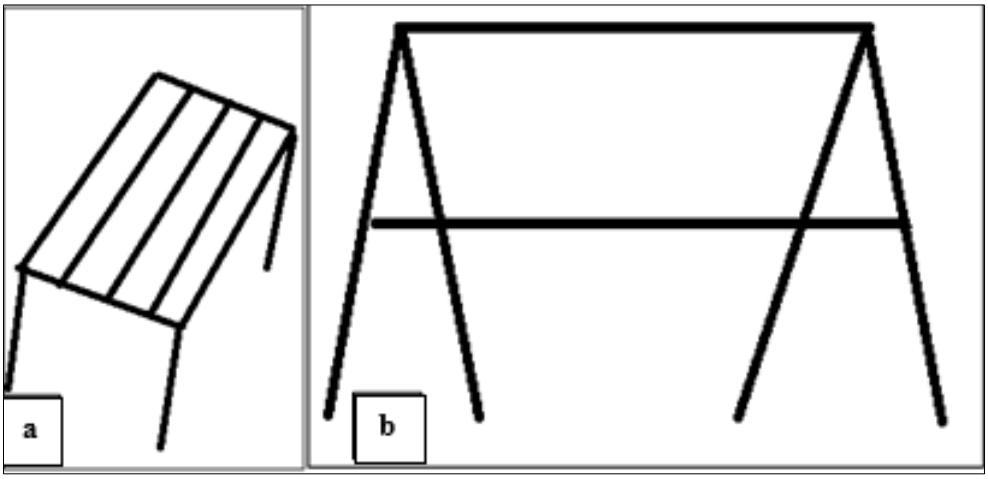
After showing the videos, we started a discussion on the subject and then the teachers began the construction of a prototype of a hydroponic garden. The professors outlined the best way to find a support for Polyvinyl chloride pipes, better known as PVC, with the available materials (wood and PVC pipes). The question was whether the construction of the support would be horizontal, like a bench (figure 1a), or whether it would be similar to an easel (figure 1b).

Figure 1 – Sketch of the supports for the construction of the prototype of the hydroponic garden



Source: Author's Collection

In the end, the chosen one was the easel model. After this definition, the teachers were divided into groups and each one chose a task to develop. P9 and P10, for example, sawed off the three-inch-diameter PVC pipe to assemble the prototype. The size chosen was approximately 1 m in length. Another group, led by P3 and P4, started the construction of the support for the pipes. While performing the tasks, the teachers commented on the knowledge they had about vegetable gardens using pipes. In this regard, P7 and P10 commented:

> Q7: I took a picture of my brother-in-law's vegetable garden; inside the pipes I verified that it was with soil.
>
> Q10: But in this case it is not a hydroponic garden; this type can even use *a PET bottle,* which has the same effect as pipes.

The teachers together demarcated the parts that should be drilled in the PVC pipe. At first, P10 and P13 volunteered to perform this step, but were soon helped by P12, who helped fix the barrel to the wallet so that it would not move.

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P10, in figure 2, drilled the holes using a drill, with a hole saw attached to it, which would facilitate the work. The openings made in the pipes were approximately 5 cm in diameter each. P7 and P9 sanded the openings so that, when handling, possible splinters would not injure their hands.

Figure 2 – Teachers preparing the pipes for the construction of the prototype of the hydroponic garden

Source: Author's Collection

While the steps were being carried out, the teachers discussed the cost of a large-scale hydroponic garden project. With the assembly, they became interested in the prototype, as the objective was to reproduce the garden in their homes.

The frequent discussion was about the total cost of the project, as shown by the dialogue between those involved:

> Q5: What is the total cost of this small project? In order for us to think about the construction on a larger scale, it would be an important project to work in an interdisciplinary and multidisciplinary way with students.
>
> Pe: I believe that around R$ 500.00, the biggest cost is the pump and the *timer*.
>
> Q9: Wood is also expensive, and has a great impact on the final cost.
>
> Q13: To lower the cost and take up less space, the pipe could be fixed to the wall with clamps.
>
> Q: Yes, there are several models of different shapes that can be assembled.

To close the side openings, we used perforated PVC plugs, in which the *Parallel Nipple* was introduced (figure 23a), which served as a hose connector (figure 3d). The circulation of nutrients inside the PVC pipes was done by a small 110V submersible pump (figure 3b). The nutrient solution was stored in a small 20 L bucket (Figure 3c).

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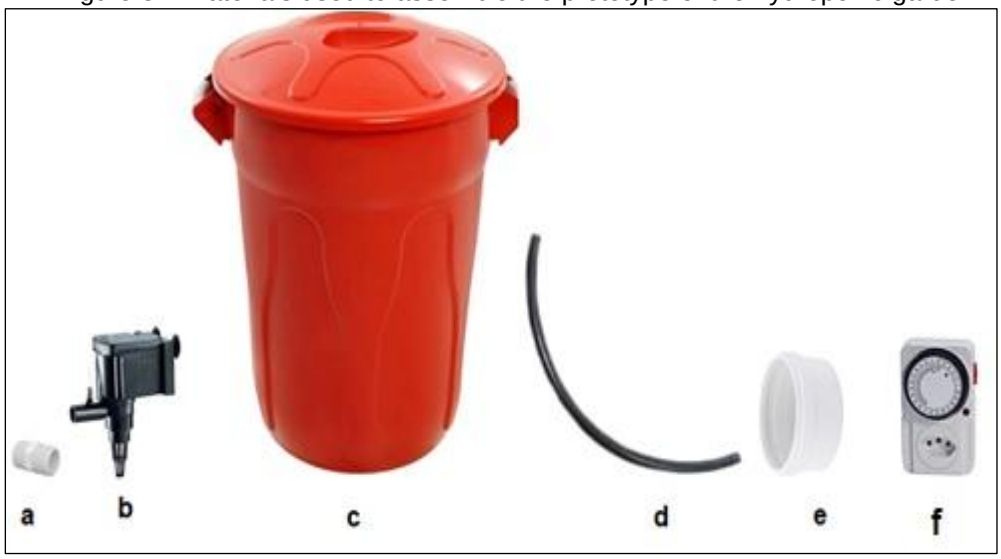
Figure 3 – Materials used to assemble the prototype of the hydroponic garden



Source: Author's Collection
Legend: a) *Parallel Nipple* ; b) Pump; c) Bucket; d) Mangueira; e) Buffer; f) *Analog timer* .

To control the system, we used an analog *timer* (timer), which was programmed to turn the pump on and off at an interval of 30 minutes. This pump, with a flow capacity of 300 L per hour, is mainly used in aquariums; it pumps the nutrient solution to a main inlet, circulating it through the PVC pipes and, at the end, returns to the container and begins the recirculation process.

The system used for the workshop was the NFT (Nutrient Film Technique), which has a continuous flow of nutrient solution that circulates through PVC pipes and is pumped from a reservoir, in our case, the bucket. The nutrient solution is in direct contact with part of the root, and the rest is free in contact with oxygen. This is the most used system in Brazil.

Workshops of this nature are important to encourage the teaching and management team to promote, in the school environment, discussions involving environmental issues, since they are little discussed, as shown by the research of Oliveira (2022), Martins and Schnetzler (2018) and Rodrigues and Saheb (2019).

The absence of these discussions, in general, is due to the fact that teachers have a solitary job in the classroom, and the ATPC are not planned according to their needs. This lack of discussion also causes the distancing from environmental activities in schools, which may be related to the lack of planning and its non-inclusion in the PPP. Projects involving environmental issues are fragmented and move through the school calendar to be

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documented by photos, videos and social networks, and then simply disappear (Sato, 2002) (Oliveira; Amaral, 2020).

However, it is necessary to overcome the barriers that are presented in the school environment and, thus, seek means for shared work with their peers, because only in this way will they be able to develop interdisciplinarity. Santos, Sabei and Moraes (2013) and Siqueira (2016) point out that the solution to develop interdisciplinary projects is to build a vegetable garden.

Figure 4 shows the prototype of the hydroponic garden assembled by the teachers, with approximately 30 lettuce plants.

Figure 4 – Prototype of the hydroponic garden assembled by the teachers

Source: Author's Collection

With the prototype in operation, the teachers used a pH meter, as seen in figure 5a, to measure the pH in conjunction with the conductivity meter (figure 5b). The teachers did not know the conductivity meter and asked what its function was in the hydroponic garden. We explained that the reading of the device would indicate when we should replace the nutrient solution. The measurement depends on the concentration of salts present in the solution. We explain that plants consume nutrients, so the value of electrical conductivity decreases as plants consume them.

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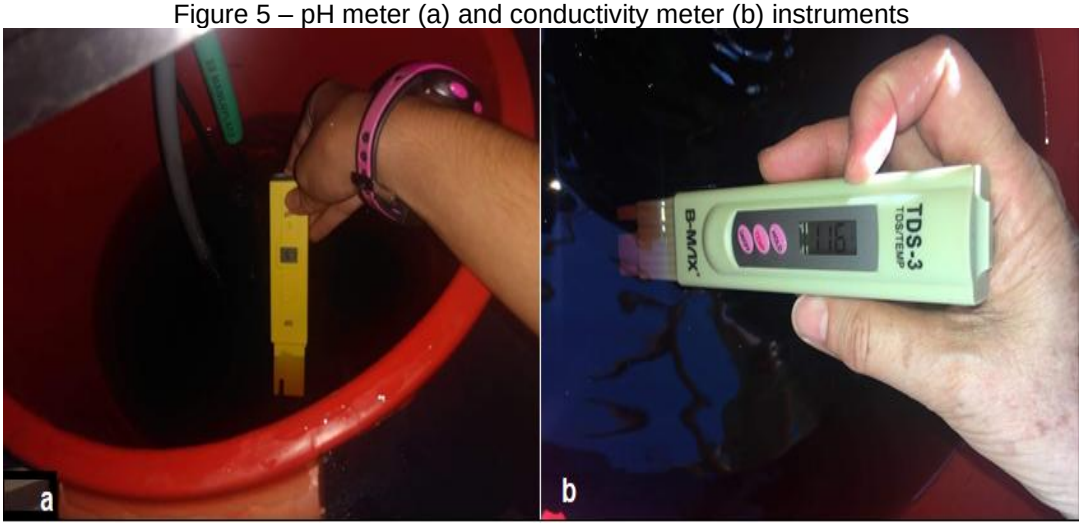
Figure 5 – pH meter (a) and conductivity meter (b) instruments



Source: Author's Collection

As the workshop ended, P8 commented:

> Q8: It is important to know it in practice, because this way it is much simpler to understand how it works. Many questions are answered, especially when in Geography we study about agriculture and how over the years this human activity has been changing and evolving, but with many question marks that we still cannot answer, such as transgenics.

P8's statement shows that, in general, teachers, when they participate in continuing education courses such as the one we offer, begin to reflect on their practice, to think about different ways to plan a class or even content. From this reflection, they take action, thinking about how to apply so much knowledge and information, that is, they think about how they will develop the knowledge acquired within their component, or even in an integrated work with their peers. As Freire (2018) and Oliveira and Amaral (2024b) say, the important thing is to create possibilities for the construction and production of knowledge in the school environment.

When evaluating the workshop, P1, P4, P9 and P14 commented that it provided moments of interaction and cooperation with co-workers, as shown in the comments:

> P1: In addition to debating healthy habits, the workshop provided the construction of the prototype of the hydroponic garden with collaborative interaction between colleagues[5].
>
> P4: The study and pedagogical practice in the construction of the garden was a sensational practice; the text expresses how important interdisciplinarity and cooperation between all those involved is.

[5] Emphasis added

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> P9: It was very important to discuss the food and the construction of the prototype, it was a very interesting moment of exchanges between the teachers.
>
> P14: It was wonderful to participate in the stages with my teaching colleagues; The step-by-step was very productive and enriching in our learning.

As we can see in the comments, the teachers also described the importance of discussion with their peers. The testimonies may indicate that moments like these in the ATPC and in the school environment are scarce.

By mentioning "collaborative interaction among colleagues", "cooperation among all those involved", "very interesting moment of exchanges between teachers" and "with teaching colleagues", they reinforced the considerations of Anastasiou and Alves (2015), Candau (1999) and Müstschele and Gonsales (1992) about the importance of the work developed in the workshops and the resignification of interaction with their peers.

An example of this is in P14's speech about the interaction with colleagues together with the learning provided by the moment in the workshop. In this aspect, Veiga (2008) says that it is necessary for the educational institution to provide situations of dialogue between peers, as it is essential in the school environment to break isolation and individualism, which are characteristic marks of the professional teaching environment.

Regarding the learning mentioned by P14, we believe that this is a reflection of the continuing education in the ATPC through the EE workshops, which provide the exchange of knowledge among the teachers, focusing on a constant process of reading, debates and production, whether in practice or in active methodologies.

The EE workshops at ATPC expressed a wealth of knowledge and constant exchanges among their participants. Thus, we agree with Ramos (1992), when he says that workshops are the best way to break the teacher's immobility in preconceived and planned practices from "top to bottom".

Regarding the statement that the school should be a place for discussion about healthy habits, P3, P6, P10, P12 and P15 argued that:

> P3: The text brought important information to be passed on to students, and the promotion of healthy eating habits should be a practice at school.
>
> P6: The workshop had a great value, it encouraged the faculty and the management team to mobilize to assist in the construction of a hydroponic garden, starting a healthy food culture in the school.
>
> Q10: This workshop was very constructive, I particularly participated a lot by drilling the pipes for the prototype and commenting on the power supply. I believe that the

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> vegetable garden will be an interesting and attractive option for students, whether hydroponic or traditional.
>
> Q12: The construction of the prototype of the hydroponic garden was a great learning experience for me. We have subsidies to teach healthy habits in a simple way; in a small space we can make a garden in different ways.
>
> P15: The workshop was important for us to think of an interdisciplinary project to arouse the student's interest in healthy foods; it can represent a source of income.

The teachers' comments show that the school has distanced itself from discussions on issues involving a balanced diet. Perhaps due to the fact that, most of the time, these discussions can generate questions in the attitudes of the management team (Oliveira; Amaral, 2024b). An example is the school canteen, which suffers little restriction and distances itself from subjects such as healthy habits, balanced eating and the culture of healthy eating.

Another example of this, as described by Trein (2012); Oliveira and Amaral (2018), it is the exaggerated concern with external evaluations that may be disfiguring the role of the school in our society, as the themes that involve life in society are being abandoned, or even treated in a superficial way.

Feeding as a healthy practice is hindered in modern agriculture due to residual amounts of pesticides. In this way, the plants that should provide well-being cause numerous diseases and serious risks to human health, in addition to environmental and social damage that is extremely harmful to the planet and to life in general (PENTEADO, 2010).

The construction of the hydroponic garden prototype, commented by P1, P4, P6, P9, P10, P12, was reinforced by P2, P8, P11 and P13:

> Q2: The workshop had the construction of a prototype of the garden, I didn't know how the NFT system worked.
>
> P8: The idea of building the hydroponic garden is excellent; through this workshop we observed that this action is possible in the school environment, as well as in our homes.
>
> Q11: The way the workshop and the whole project were developed made each of us feel the desire to produce our own traditional or hydroponic garden, such was the intensity of the explanation of the videos and the work of concrete realization, and the completion, which made us happy and fulfilled.
>
> Q13: The videos brought by the teacher made us understand and learn how a hydroponic garden works.

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As we can see in the teachers' statements, the discussion about the importance of healthy eating, which took place during the construction of the prototype of the hydroponic garden, provided the teachers with the interest in having their own garden.

The idea of building the prototype of the hydroponic garden in the workshop was "excellent" in P8's opinion. In P4's conception, it was "sensational". The workshops provided the study of the hydroponic garden, which is a great means of distraction for amateurs, however, for students, it is a learning about the life of plants, in addition to helping in the knowledge of scientific novelties (DOUGLAS, 2003).

P12, P13 and P14 commented on the moments that contributed to the learning of the subjects discussed. This context brings us back to Demo (2011), when he says that in order to do something for education, it is necessary to start with the teacher, caring for and assisting in their training.

For Imbernón (2010, p. 96), "training must take into account that, more than updating a teacher and teaching him, it creates the conditions, elaborates and provides environments for teachers to learn". This learning, for Ramos (1994, p. 16), "is not linked to the material itself, but to the way knowledge is treated through its didactic possibilities".

Thus, we agree with Müstschele and Gonsales (1994), when they say that the workshops offer concrete and somewhat consistent answers to the anguish of teachers, either by the space to talk to their peers, or to link their reality with their vision of teaching.

FINAL CONSIDERATIONS

The workshop on the hydroponic garden provided moments of discussion and learning about hydroponic cultivation, in addition to reflection on the importance of continuing education in the school environment, by privileging dialogue between peers. The ATPC are spaces that should be better used by the school team for the planning of school projects, with a focus on transversality and interdisciplinarity; as an example, we have Environmental Education.

The continuing education workshop on the hydroponic garden provided moments for the creation of a prototype, in addition to interaction in the planning and construction of the activities proposed to the teachers. Thus, it is moments of 'learning by doing' that modify the school "*modus operandi*", hence the importance of these formative spaces that involve, invigorate and dynamize pedagogical practices.

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