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CONTINUING TRAINING IN NON-FORMAL SPACE APPLIED TO TEACHERS TO DEVELOP SCIENTIFIC SKILLS IN ELEMENTARY EDUCATION

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Abstract: Science education involves implementing science skills throughout the entire teaching-learning process. In this sense, the teacher needs to carry out continuous training that allows this to happen. This work demonstrates how teachers from the municipal network of São Vicente (SEDUC-SV) carried out in-service training from 2017 to 2019 accompanying their students in carrying out investigative activities aimed at specifically working on scientific skills in partnership with the Center for Training and Research in Environment (CEPEMA) of ``Universidade de São Paulo`` (USP) located in Cubatão (SP). Subsequently, these activities were carried out with 4th and 6th grade students from 17 municipal schools in São Vicente during their visits to CAP. At each visit, the students, accompanied by their teachers, participated in investigative and diversified activities on curricular subjects of science and geography, contemplating skills such as observing, interpreting, identifying, comparing, analyzing, relating, among others. The impressions of the accompanying teachers were also recorded through questionnaires. For the professors, this was an opportunity to broaden their vision of how to work in a practical way with their students and evaluate in a different way.

Keywords: Teachers, Training, Skills, Research.

INTRODUCTION

For Science teachers, teaching scientific skills involving theoretical and practical concepts has been a great challenge. In this sense, Cachapuz et al (2005) argue that science education needs to start from the principle that its development must collaborate for the formation of citizens in an integral way. In this context, the study of science education by investigation integrates conceptual, procedural and values aspects.

Continuing Education is necessary for the professional improvement of teachers. The student needs to leave the passive position of learning science and build knowledge through curiosity, supposition, proposition, inquiry, questioning and other skills that can be developed when he becomes an active learning agent, as reinforced by Cachapuz et al (2005). Souza et al (2006) mention that, in many academic researches, the need to invest in continuing education in the search for a meaningful teaching-learning process for the student is evident.

According to Jacobucci (2008), there is still much discussion about the definition of formal, non-formal and informal space, but if the school can be considered a formal institutional space, every space where educational action can take place, different from the school, becomes a non-formal space and to understand what defines non-formal spaces, the author suggests categorizing these spaces into institutional places, such as museums, ecological parks, zoos, science centers, planetariums, botanical gardens, etc., and non-institutional. These spaces are regulated and have a technical team responsible for the activities carried out. Non-institutional places, on the other hand, include a park, house, street, river, cave, beach, soccer field, among other spaces that can develop educational activities.

The CAP/CEPEMA-USP (Researcher Apprentice Center of the Center for Training and Research in the Environment of ``Universidade de São Paulo``), according to Jacobucci (2008), can be inserted in the category of non-formal institutional space, as it is a research center and have an interactive space where students from public and private schools can carry out experiments and develop scientific skills, as described by Costa et al (2014). Teaching strategies that use formal or non-formal spaces can be learning

tools that bring students closer to the world of science, arousing curiosity, enchantment and motivation for what they are learning.

The National Curriculum Parameters (BRASIL, 1998 to 2000), suggest carrying out activities outside the school space, such as studying the environment, which further reinforces the use of these spaces that go beyond the school walls. The purpose of using a non-formal space such as CAP/CEPEMA is to develop scientific skills adapted to the São Vicente Curriculum to address the contents taught in the classroom. These activities seek to reach conceptual, procedural and attitudinal contents of the Natural Sciences, bound by the National Curriculum Parameters and collaborating with other areas of knowledge such as Mathematics, Geography and Art for example.

According to Trein (2005, apud LOPES et al 2011, p.517) "Education can act as a transforming instrument of individual and collective practices, promoting environmental education as a pedagogical practice that considers all factors, be they: economic, social, political and cultural aspects of the society in which it operates". Therefore, the study of science cannot be fragmented, the curricular components need to present common objectives, which does not mean that it is a simple exercise to carry out.

According to Queiroz et al (2011), the recognition of the place to be visited, the strategies that will be used for the development of the class and prior planning in non-formal spaces, are important criteria for relevant learning. Thus, CAP/CEPEMA plays a fundamental role, as it has a methodological organization that reaches students and teachers simultaneously, in addition to providing opportunities for teachers to reflect on their educational practices.

For Souza and Gouvêa (2006), short-term activities have been shown to be effective and

better accepted by teaching groups, most of which have double or triple journeys. CAP/CEPEMA activities take place in short visits, where the time allocated to activities is very well used.

The assessment is one of the stages of the learning process that is as important as carrying out the activities and can be applied during or after the visit. It is necessary to take into consideration, creativity, socialization, criticality, proposing, problem solving, formulating hypotheses, observations and student participation in activities and student self-assessment. In addition, the assessment must not be based on memorization and repetition, that is, the assessment must involve the entire knowledge construction process, contemplating the multiple intelligences. Terzi and Rossi (2015) agree that the teacher must take advantage of the students' curiosity awakened in the non-formal space visited, stimulating the construction of knowledge within what is necessary for scientific literacy. Zanon and Althaus (2008) defend the need to use several evaluative instruments and not a single instrument to qualify the activities carried out by students.

This work aims to demonstrate how teachers from the São Vicente Municipal network (SEDUC-SV) carried out in-service training accompanying their students in carrying out practical investigative activities in partnership with CEPEMA-USP. Activities with professors and students took place during visits to the Researcher's Learning Center (CAP) with the aim of awakening interest in science, research and the development of science-specific skills, but of great use in other disciplines. The activities addressed various knowledge and different curricular components and can be applied in the classroom of schools. Among many, one of the objectives of the article is to be able to show the new visions that the teacher has of their own students and how evaluating

in a different way can influence them.

METHODOLOGY

After some meetings between SEDUC and CEPEMA, represented by pedagogical advisors from the Science area and the CAP Coordination, a partnership was formalized between the two institutions in 2017. of the Project and the activities proposed for their students in order to define an action plan with this focus in mind, they visited CAP, at CEPEMA's facilities, in Cubatão, carrying out a training experience experiencing the methodology before the students' visits exactly as if they were students of Elementary Education.

In each CAP/CEPEMA room, three or four activities are available that can take place simultaneously with groups of four students/teachers. Each activity is accompanied by a monitor. The monitors are university students from Baixada Santista, such as UNIFESP, UNIP, UNIBR, Universidade São Judas Tadeu (Campus Unimonte), most of them from areas related to Science. Most are students of Biology, Chemistry, Marine Sciences and Environment.

In 2018, 50 teachers/coordinators carried out various activities in initial training at CAP/CEPEMA and reflected on the application in the classroom, using the materials available at the school. Teachers at SEDUC defined that the best age group to develop scientific skills activities at CAP/CEPEMA and multiply what they learned at school would be sixth-year students, as they are at the beginning of the second cycle of Basic Education. In this context, four schools were defined that would be included in a pilot project in 2018. These schools were located in less favored neighborhoods, with the lowest IDEB in 2015, with two schools belonging to the insular area and two schools belonging to the continental area. In the insular area of São

Vicente, the participating schools were EMEF Lúcio Martins Rodrigues and EMEF Antônio Pacífico and in the mainland area were EMEF CAIC Ayrton Senna da Silva and EMEF Jorge Bierrenbach Senra.

The schools choose the students, who could be from the same class or from different classes. Each school carried out four visits, the last one with the aim of training students to participate as monitors and multipliers of the science fair at their schools as a culmination of the Project. All schools were monitored by a science pedagogical advisor from SEDUC/SV (Municipal Secretary of Education of São Vicente). CAP/CEPEMA carried out other actions in the municipality of São Vicente. One of them was the lecture "Innovation Practices" offered to 67 teachers of Youth and Adult Education (EJA) at SEDUC. This theme aimed to reflect on the strategies that could be used to carry out scientific research in the classroom.

In 2019, the CEPEMA/SEDUC-SV partnership expanded the number of participating schools, including schools in the Final Years, as well as in the Early Years.

This allowed teachers in the early years to also visit CAP and accompany their students during activities. The Early Years schools served were EMEIF Mauro Aparecido de Godoy, EMEF Luiz Beneditino Ferreira, Leonor G. O Stoffel and EMEIF Prof. Jose Meireles. In the Early Years, the chosen classes were from the fourth year, since the fifth year classes were involved with the studies of the SAEB (Basic Education Assessment System). There were five final year schools served by the Project, two in the continental area (EMEF Raul Rocha do Amaral and EMEIEF Saulo Tarso Marques de Mello) and three in the insular area (EMEF Vera Lúcia M Massis, EMEF Lions Clube and EMEF Matteo Bei). The classes chosen for the final years were sixth grade, following the same proposal as in 2018.

The criteria used by SEDUC of São Vicente in choosing the schools that would participate in the project were non-participation in the previous year and the minimum conditions to offer differentiated activities to its community. In 2018, 16 teachers/coordinators participated in visits to CAP/CEPEMA and the Science Fair and in 2019 there were 20 teachers/coordinators. Some CAP activities were adapted and new ones were developed in accordance with the curricular proposals for the fourth and sixth years. At the end of each visit, students and teachers performed a self-assessment as part of the learning process.

To finalize the Project in each school year, each participating school held the Science Fair at the school unit. Therefore, students participating in visits to CAP/CEPEMA were invited to be student-monitors, multiplying what they learned in CAP, in their home school. These students chose which activity they would like to present and received training from CAP/CEPEMA monitors to present to school colleagues who did not have the opportunity to meet. The school adapted the space where the Fair would be held, as well as the public and organization of the students who would attend. CAP provided and took the materials for the activities to the schools and CAP monitors accompanied the students in the development of activities and SEDUC followed up the entire process through the pedagogical advisor.

In 2018, 61 students/monitors participated in the fair, presenting the following activities in schools: fossils, color magic, shells and stars, laboratory materials, taxidermied animals, classification, map, rocks and minerals, recycling and insects. In these two days of the Science Fair in 2018, a total of 466 students participated in the activities presented. In 2019, 51 students/monitors participated in the fair. These students presented the activities of fossils, color magic, shells and stars, laboratory

materials, taxidermied animals, substances and mixtures, rocks and minerals, recycling and insects. The Science Fair was evaluated through interviews with students/monitors, visitors to the fair, teachers and pedagogical coordinators, by team members and by the local newspaper ``TV Primeira``.

RESULTS AND DISCUSSION

ABOUT THE OPINION OF THE TEACHERS REGARDING THE TRAINING

All of the teachers interviewed had received some training related to investigative skills, with 30% at CAP/CEPEMA or 30% taking the LSS (Learning Skill for Science) course in São Vicente, 30% taking both courses and 10% taking part in other institutions.

- The teachers as a whole managed to experience some CAP/CEPEMA activities as a student and were able to carry out similar activities with their students at school.
- All teachers were able to carry out more than one activity on investigative science skills.
- Teachers were able to improve their classroom practice: improve content, change their planning and incorporate new methodologies. The results organized according to these criteria are shown in Figure 1:

Figure 1: Teachers' opinions about their training experience

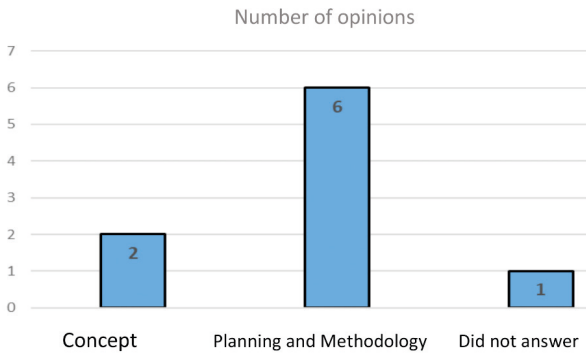


Figure 1: Teachers' opinions about their training experience

Source: The authors

- The applied perception questionnaire also made it possible to observe results on the changes that took place in the professional field. Table 1 below shows the results obtained:

Question	A lot	A little	Nothing
Has your look on how to investigate with my student improved?	100%	0	0
Was my vision of how my students work in groups possible?	100%	0	0
Has my view of how my students experience skills improved?	100%	0	0
Has my way of planning lessons changed?	89%	11%	0
Has my way of assessing students changed?	89%	11%	0

Table 1: Teachers' answers about their professional changes

Source: The authors

The results of the questionnaires applied to teachers evaluating the students' visit to CAP- CEPEMA in 2018 and 2019 briefly demonstrated that:

On student participation and conduct:

- Leaving the schools was educationally productive in all cases, considering that in the visits to CAP the students worked in order and discipline, that the climate during the visit was different from the school climate, that they managed to

work well in groups, they paid attention and that they respected institutional rules at all times.

- According to the results presented, the teachers also found that their students handled materials that they did not have at school, that the students' interest in learning was greater, that they were able to locate information, identify purposes and establish causes and consequences.

- Some data can be seen in Figures 2 and 3

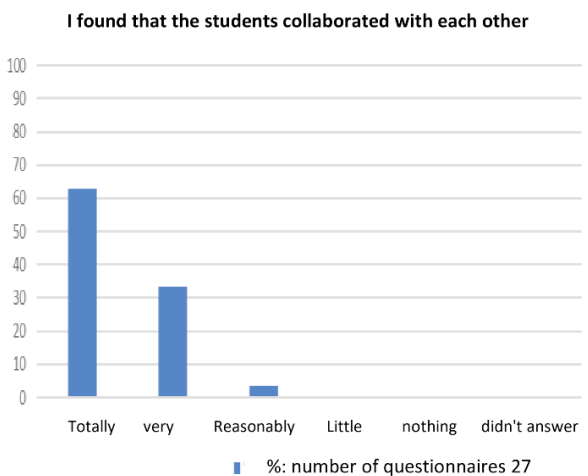
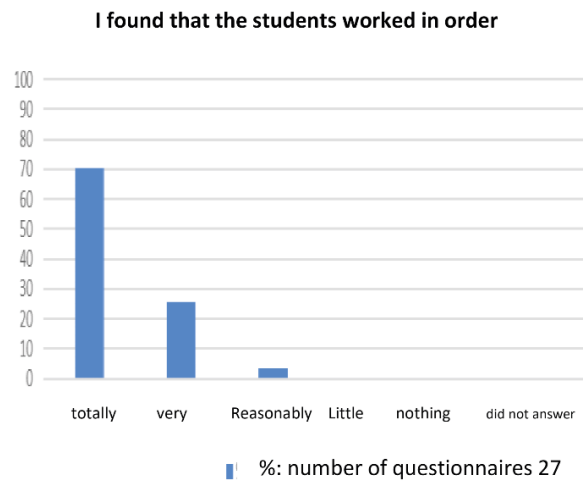


Figure 2 and Figure 3: How did they observe their students?

Source: The authors

ABOUT HOW THE VISIT TO CAP – CEPEMA CAN HELP THE PEDAGOGICAL WORK

The teachers recognized that the skills worked on in the CAP would be useful in their classes, that the students could feel that they were in a learning environment, that the activities favor interdisciplinary work, that the students showed work autonomy, that the students used skills that were not always used in the classroom and that it is possible to apply CAP activities at school. The results can be viewed in figure 4.

ABOUT THE SPECIFIC SKILLS DEVELOPED BY STUDENTS

Teachers found in students that some skills identified and listed below were fully, very or reasonably well performed. These identified skills were: understanding the problems posed, identifying what was proposed in the activity, whether students were able to raise hypotheses and observe, understand graphs and/or tables, analyze results, measure and use measurement units.

The teachers also gave their opinion on the positive and negative aspects of the visits made to the CAP and the Science Fair, they analyzed the positive and negative aspects:

On the positive aspects the comments were that:

- The Laboratory and staff were well prepared;
- The students themselves being monitors and explaining to their colleagues was an interesting novelty.
- All students could interact with physical objects and feel that they learned by playing; and this interaction aroused confidence
- The project turned out to be very dynamic and rich in materials that schools do not have;

- There was total socialization among all students;
- The students liked it and put in a lot of effort, they paid attention to the explanations and the student monitors knew a lot about the subjects;
- The experience encouraged the study of science, research and scientific investigation;
- The experience stimulated the students and allowed them to realize that science can be fun and that it is part of everyday life

On the negative aspects, the comments were:

According to the pedagogical point of view, there were no negative aspects, every school benefited, as there were exchanges of experiences and deep learning, unfortunately it did not cover all school units and must be open to all students.

ABOUT THE SCIENCE FAIR

In addition to promoting interaction between students and teachers, the fair also involved research, search for solutions, creativity and often students discovered their talents and skills. It can always be an opportunity to bring families into the school environment and strengthen partnerships.

They commented that the fair was well accepted by the student community and that it served as content for quarterly evaluation. They also commented that this approach to an experience with the concrete, which previously the students only saw through books, was an incentive for the students to be protagonists. Clearly, the possibility for students to monitor their own colleagues favored this protagonism and allowed them to clearly feel like teachers and scientists.

Finally, the report presented by CAP to SEDUC was discussed in order to be able

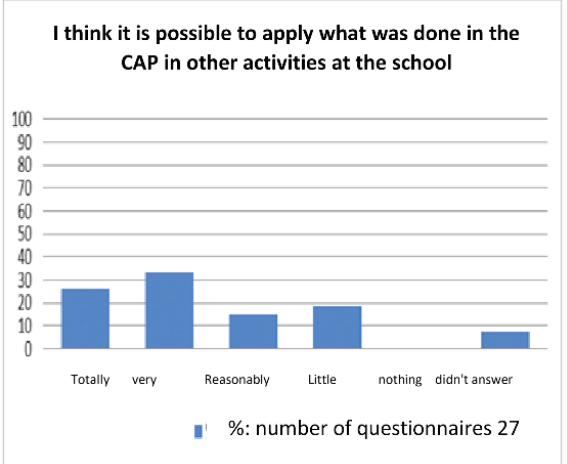
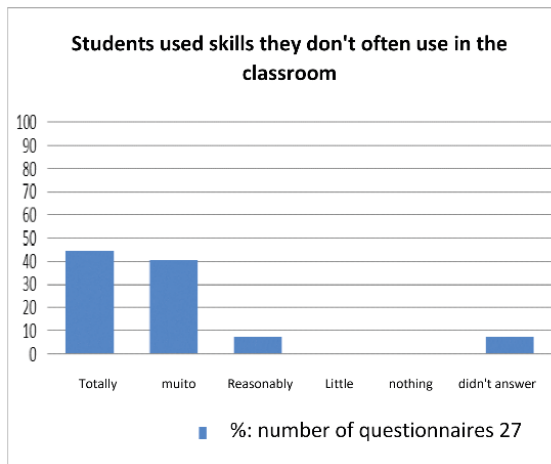
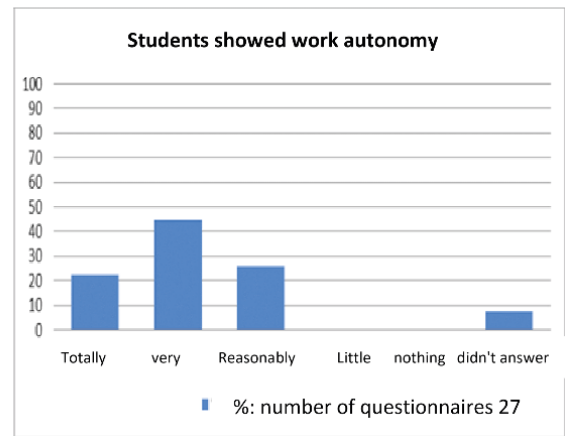
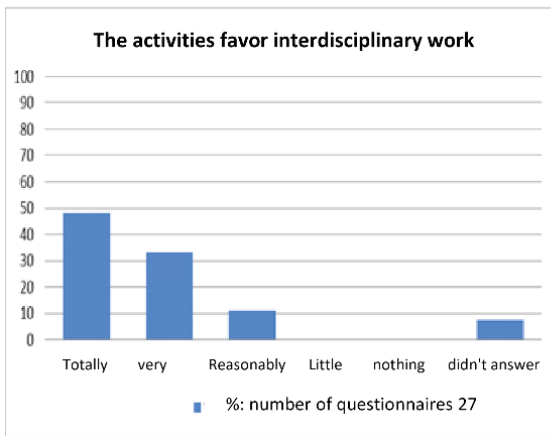
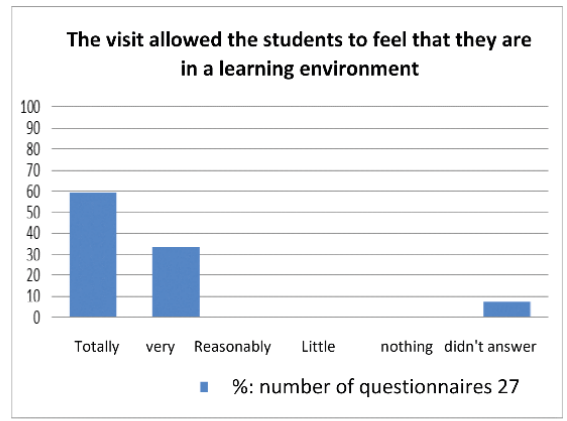
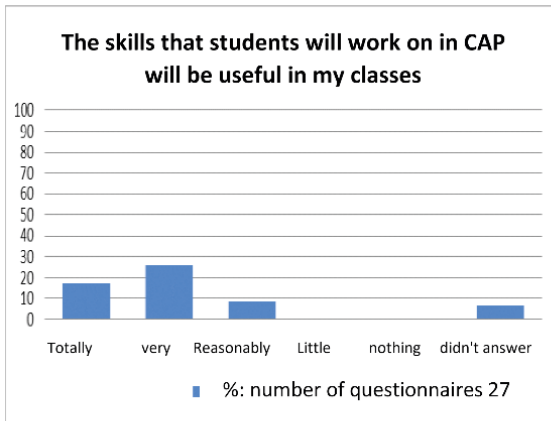


Figure 4: Teacher opinion on the applicability of training (%)

Source: The authors

to plan future partnership actions. Among the highlights of the aspects observed by the aforementioned teams, it is worth mentioning:

- The results of all perception surveys were satisfactory and the objectives sought in the project were achieved;
- The implementation of the project clearly favored the students' scientific knowledge and awakened in them the desire to investigate;
- Students developed skills that they are not always able to develop at school; For the teachers, it was a great novelty to be able to work with their students in an investigative environment outside the classroom and school.
- The project contributed to a behavioral change in students, making them more interested in participating in classes and multipliers of the teaching-learning process.
- The way of evaluating was new to them and favored the students' autonomy.
- Students who made 4 visits were able to deepen their knowledge and, fundamentally, skills in a very clear way and go through a remarkable formative experience in which self-esteem and autonomy were highly favored.
- Visits to CAP and science fairs allowed teachers to see their students in a different context, outside the classroom and think about different activities, having contact with science not only in theory, but also in practice.
- There was a lot of cooperation from the students at all times. Within the CAP, the students were very well-behaved and focused, demonstrating, in general, interest in all activities, surprising the teachers who accompanied them.

- For the teachers, the importance of in-service continuing education was clear, as it favored expanding their knowledge related to scientific skills, allowing changes in pedagogical practice, carrying out workshops similar to the CAP within the classroom, such as: the use of laboratory materials, recycling, rocks and the application of evaluation, in addition to motivating a new Project model, such as the Science Fair.

- For most of the professors, planning and methodology were more important than content, which demonstrates the reflection of professors on the guidelines that must be considered before carrying out educational practice in order to obtain positive results.

- Finally, there was a change in the evaluation criteria, taking into consideration, the observation and participation of students in activities.

Perhaps leaving some examples of comments made by professors in applied research could be more illustrative and for this reason we have included several of them here.

P1: "The organization in the circuits helped me to put into practice some activities I learned at CEPEMA. The students learned the contents more easily and were able to assimilate them more clearly. These activities were so good that they became my practices in the classroom in all the schools I go to".

P2: "Very useful experience, because I noticed the enthusiasm and curiosity of the students as well as the spirit of participation".

P3: "I think that this way of teaching through investigation is necessary nowadays, because when the student becomes a protagonist, their involvement and results are surprisingly better, since they feel part of the process and co-author of all the work".

P4: “I would like more opportunities, such as the training we had at CEPEMA, as it ends up enriching our classroom practices”.

P5: “The opportunity to get to know CEPEMA and experience the many practices offered, give students enthusiasm and interest in learning, making them more participatory in the classroom. Regarding the teacher, it is a great opportunity to learn about new practices, enriched with ideas that can be applied in the classroom”.

The teacher has the opportunity to learn together with his students within CAP/CEPEMA, through the observations made in the different groups and later can use the same methodology or a similar one to be applied in the school, as happened in some schools that carried out the visits and consolidated with the Science Fair. These teachers, according to the evaluation, developed some specific activities that they found relevant or similar activities, motivated by what they learned in this non-formal space. Gil Perez (2003, apud SOUZA; GOUVÊA, 2006) reports that while the teacher is not faced with teaching problems through experience, it makes no sense to study it. The project had students from technical schools and universities in the region as monitors, which made it possible to develop their course completion work and scientific initiation projects.

FINAL CONSIDERATIONS

There are few opportunities in which in-service professors can innovate their practice accompanied by university teams and few opportunities in which two public institutions can show engagement, work collaboratively and complement each other's needs. This work allows showing a successful example between a research institution by nature and a service

institution, both focused on helping teachers to improve their educational practices in the classroom.

According to the results obtained, the Basic Education team of the Municipality of São Vicente after three years of collaborative work and evaluating the whole process from the point of view of the teachers, believes that this Project developed at CAP/CEPEMA and in the Vincentian schools is viable, important and essential for the consolidation of science teaching.

The possibility of meeting students in a different location allowed teachers to have a different look at their teaching-learning process

The two institutions concluded that the methodology and dynamics used in the project for visits to CAP/CEPEMA and in schools, allows for a full contribution to the implementation of the scientific skills required in the BNCC and in the curriculum of the municipality of São Vicente.

However, due to the Pandemic that hit Brazil and in accordance with the distance rules required by health agencies, the Project could not be carried out in person to continue in 2020. CAP/CEPEMA collaborated with SEDUC by reformatting its activities and creating new ones so that they could be used in the blog that the students used during the year (<https://educacaobasicasv.blogspot.com/p/e.html?m=1>). At the end of 2021, schools were finally able to continue the visits.

The different stages of training clearly allowed teachers from the municipal network of São Vicente to carry out in-service training that favored changes in professional practice, offering a space for discussion among peers and the possibility of immediate application in the classroom.

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