Educação em Perspectiva / *Education in Perspective*
DOI: 10.22294/eduper/ppge/ufv.v11i.8028

EXPERIENCE REPORT

Science club in chemistry preservice teacher training

Clube de ciências na formação inicial de professores de química

Clube de ciencias en la formación inicial de profesores de química

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Abstract: This report aimed to analyze how the participation of pre-service Chemistry teachers in activities of a Science Club can contribute to their initial training. The focus was based on the written reports of pre-service Chemistry teachers on how the design and application of teaching activity contributed to their own teacher training. The undergraduates participated in the elaboration and application of teaching activities in 16 meetings of a Science Club of a public school located in São José do Rio Preto, in the interior of São Paulo. From a sociocultural perspective, excerpts from the reports show that positive emotional aspects resulting from the participation of the undergraduates in the activities of the Science Club are fundamental for the initial formation. In addition, the undergraduates also pointed out qualitative aspects differentiated in the interaction with the students of basic education like central element for its formation, and also how they could make better use of the experimental activities. It is evident that the activities in Science Clubs make possible unique experiences that also make possible the initial formation of professors of Chemistry.

Keywords: Science clubs. Preservice teacher training. Chemistry education.

Resumo: *Este relato teve por objetivo analisar como a participação de alunos de licenciatura em Química em atividades de um Clube de Ciências contribuiu para sua formação inicial. Focaram-se os relatos escritos dos estudantes de licenciatura em Química sobre como a elaboração e a aplicação de atividades de ensino agregaram para sua própria formação docente. Os licenciandos participaram da elaboração e aplicação de atividades de ensino em 16 reuniões de um Clube de Ciências de uma escola pública localizada em São José do Rio Preto, interior de São Paulo. A partir de uma perspectiva sociocultural, os excertos dos relatos evidenciam que aspectos emocionais positivos resultantes da participação dos licenciandos nas atividades no Clube de Ciências são fundamentais para a formação inicial. Além disso, os licenciandos também apontaram aspectos qualitativos diferenciados na interação com os estudantes de ensino básico como elemento central para sua formação e também como poderiam utilizar melhor as atividades de experimentação. Evidencia-se que as atividades em Clubes de Ciências possibilitam vivências singulares que também viabilizam a formação inicial de professores de Química.*

Palavras-chave: *Clubes de ciências. Formação inicial de professores. Educação em química.*

Resumen: *Este relato tuvo por objetivo analizar cómo la participación de alumnos de licenciatura en Química en actividades de un Club de Ciencias puede contribuir a su formación inicial. El enfoque se basó en los relatos escritos de los estudiantes de licenciatura en Química sobre cómo la elaboración y aplicación de actividades de enseñanza contribuyó a su propia formación docente. Los licenciandos participaron en la elaboración y aplicación de actividades de enseñanza en 16 reuniones de un Club de Ciencias de una escuela pública ubicada en São José do Rio Preto, interior de São Paulo. A partir de una perspectiva sociocultural, los extractos de los relatos evidencian que aspectos emocionales positivos resultantes de la participación de los licenciandos en las actividades en el Club de Ciencias son fundamentales para la formación inicial. Además, los licenciandos también apuntaron aspectos cualitativos diferenciados en la interacción con los estudiantes de enseñanza básica como elemento central para su formación, y también cómo podrían utilizar mejor las actividades de*

[1] **Submitted:** 18 Feb. 2019 - **Accepted:** 30 June 2019 - **Published:** 31 May 2020
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experimentación. Se evidencia que las actividades en Clubes de Ciencias posibilitan vivencias singulares que también viabilizan la formación inicial de profesores de Química.

Palabras clave: *Club de ciencias. Formación inicial de profesores. Educación en química.*

Introduction

The specific knowledge of the teaching profession stands out among several themes linked to preservice teacher training, which includes the knowledge itself, competences, skills and attitudes (TARDIF, 2002). This way, the integration between the many dimensions that contribute to the construction of this knowledge, such as the social, the affective and the cognitive ones, must be a goal in the preservice teacher training process (GATTI, 2016). Studies about the chemistry preservice training have aimed to contribute to critic reflexion on these formative processes. Researches have shown that the early formation in chemistry teaching courses might be considered an important focus of investigation (SILVA; QUEIROZ, 2017).

A significant part of the chemistry preservice teacher training is to make possible the use of necessary tools to the full exercise of the teaching knowledge by the preservice chemistry teachers. Thus, the comprehension on how chemistry students learn how to exercise such knowledge in teaching strategies becomes more relevant. Many difficulties faced by beginner chemistry teachers are related to the use of teaching strategies used in classrooms (COLOMBO JUNIOR, 2009), once mistaken approach decisions made by the teacher may interfere the teaching and learning process (SANTOS; MORTIMER, 1999).

The importance of Science Clubs

The use of activities in the Science Club format is well known among the literature about scientific communication, for it helps the basic level student develop critic thoughts and skills to relate the scientific knowledge to its daily life. Most part of works on Science Clubs point to the necessity of this kind of activity, basing on the perspective of the gains of learning by basic level students.

Prá and Tomio (2014) go over the literature about the theme of Science Clubs in the science education field. The authors cover works published until the year of 2012 in the format of articles in scientific journals ("*Investigações em Ensino de Ciências*"; "*Ensaio*", "*Ciência e Educação*", "*Ciência e Ensino*", "*Revista Brasileira de Pesquisa em Ensino de Cências*", "*Revista Alexandria*" and "*Ensaio – Pesquisa em Educação em Ciências*"), articles in the Science Teaching and Research National Meetings (ENPEC) from 1997 to 2011 (the event only takes place every other year), thesis and dissertations available in the CAPES's[i] repository until 2012 and articles obtained on the Academic Google[ii] searching tool.

Prá and Tomio (2014) have analyzed the work under the perspective of chronological distribution, origin of the researches, modalities of investigation, investigated participants and the most quoted authors, among other topics. For our work, we have highlighted the results obtained on the "researched participants" category, which are shown in Figure 1. In this case, the authors point that in 53% of the cases (the sum of the occurrences of students on the early years of elementary school, on the late years of elementary school and high school students) the studies focus on students from the basic education and only 21% focus on students on higher education.

Table 1. Researched students in reviewed Science Clubs literature shown by Prá and Tomio (2014).

Subjects investigated on the research	Occurrences
Early Elementary School Students	18%
Late Elementary School Students	21%
High School Students	14%
Higher Education Students	21%
Teachers in Schools with Clubs	10%
Not-identified Participants	16%

Source: Prá and Tomio (2014).

As examples of works that focus on basic education students, we have the Ribeiro and Parente's (2006) one, in which they describe the experience of a Science Club linked to Federal University of Pará (UFPA) based on the point of view of narratives from 9 to 13-year-old students coming from public schools in neighbourhoods near the university. There is also Oliveira's (2010) work, which shows the process of scientific literacy by the note taking and interviews of 7 to 10-year-old students of a private school in *São Leopoldo - Rio Grande do Sul* (RS).

In a similar way, Schleich and contributors (2014) show a research based on textual productions of students from the 5th and 6th years of basic education in a private school in *Porto Alegre* (RS), using as theme the geotechnologies in environmental studies. Silva, Santos and Rôças (2016) investigate the possible reduction of the stereotype around scientific activities in a Science Club by applying questionnaires to students from the 7th to the 9th year of elementary school.

It is also important to mention the Parente and contributors' (2010) work that narrates the activities in a Science Club done in partnership with UFPA and Pará State's Education Ministry, in which showed a process of scientific investigation in students of the 1st and 2nd years of elementary school with the theme "erosion". On the other hand, Alves and contributors (2012) showed the subjective senses that affect the motivation of students in the late years of elementary and high school in order to participate in activities that take place in the Science Club.

There are also works on Science Club literatures that aim to analyze some teachers' conceptions in activities that happen in these places. On this category, there is the contribution of Longhi and Schroeder (2012) who analyze the conception of seven teaching

coordinators of activities in Science Clubs in *Blumenau/Santa Catarina* (SC) about the nature of the scientific knowledge and the reasons for the existence of Science Clubs. In a similar way, Buch and Schroeder (2013) show conceptions of five teachers about methodological approach and evaluation in Science Clubs.

The literature about Science Clubs even introduces works with focus on preservice teacher training like Parente, Teixeira e Saboia's (2013) article, in which undergraduate chemistry students had accomplished investigative experimentation activities with basic education students in a Science Club. The authors analyse episodes in which occur planning and development of investigation in a collective way among basic education students (6th and 7th years) supported by the undergraduate students. The activities were part of these future teachers' formation process. The analyzed data were based on the transcription of the dialogs between the participants of the activities.

In Batista and contributors' (2014) work, students of Institutional Teaching Initiation Scholarship Program (PIBID) Chemistry in University of Brasília (UnB) who had already worked with Science Clubs had their conceptions analyzed. The authors observe that the responses of undergraduate students to the questionnaires show that PIBID had motivated these students to follow the teaching career, besides encouraging them to instigate innovative methodological experiences in their schools. The authors also highlight that the students who had participated in these activities have experiences that may not be provided by any supervised curricular internship due to the amount and quality of the accomplished activities.

It is also important to take as an example Adriano and Schroeder's (2015) work with biology graduate students who had accomplished activities in Science Clubs in municipal schools in *Blumenau* (SC). In this case, the authors have collected data in the form of questionnaires with the undergraduate students, who showed their comprehension of science and the contribution of the project to their professional qualification.

Generally, teachers show an exclusively empirical vision of sciences (BECKER, 2005), making the implementation of innovative educational practices more difficult. The Science Club can motivate undergraduate students to search for the enhancement of their qualification with the integration of theory and practice in science education, going also towards the critic-reflexive practice (NÓVOA, 1992). In this sense, the teacher must consider its practice in a crucial way and be willing to improve it for some problem-solving situations experienced in their day-to-day school (SILVA; SCHNETZLER, 2008).

The works about Science Clubs on the literature in Science Education point that activities accomplished based on these fundamentals also contribute in a relevant way to teaching and learning processes. It is also possible to assert that this theme is used as base to researches about teaching and learning processes in basic education students, in the preservice teachers training and even about the conceptions of natural sciences teachers. In this work we focus on the role of a Science Club on preservice chemistry teacher training. Hereafter, we show the theoretical referential which will be used as base for the data discussion.

Interaction

In this article, we have used theoretical elements from the contributions of James Wertsch (1998) in Science Education. The choice of this referential enables the understanding of the activities accomplished in Science Clubs in the point of view of **cultural tools** or meditational means present in there. In this theoretical referential all the participants (basic education students, undergraduate students or teachers) can be considered **agents-acting-with-cultural-tools** and it includes the **mediation** enabled by these tools. These elements permit the understanding of several types of action which occur in teaching activities in a sociocultural point of view in which knowledge must be seen as historically and socially composed, and not only individual (GIORDAN, 2008).

This theoretical referential enable to evidence a series of aspects that integrate interaction and use of the language in researches in Science Education. Silva and Chiaro (2018) observe the importance of dialogical interactions in which there is space for negotiation, meanings redevelopment and interaction. In contrast to this type of interaction, there is the univocal function of language, which results in a minimum voice contact. Besides spoken language, the writing and reading comprehension skills may also be understood within the presented referential, more specifically in case of chemistry undergraduate students (ROUAUX *et al.*, 2006).

From the social use of language, there are also studies about this academic referential that show the importance of the emotions triggered by social interactions. In this case, the teacher must be conscious of the emotional results from its social interactions with students as a way of improving the teaching resources mobilized in classroom (MONTEIRO; GASPAR, 2007).

Still within the possible contributions that Wertsch's (1998) thoughts bring to the Science Education area, the verbal interaction between teachers and students or between students themselves may reveal the interest in learning a specific theme. In this way we must appreciate and privilege questionings made by students, once the most influent factor in this case is the formulation of these questions by the student and not what kind of question has been made (GALLE; PAULETTI; RAMOS, 2016). Besides questionings, general teaching planning activities that are elaborated by the students themselves also cooperate with their learning process, once they show concern about the domain of the contents and knowledge of the involved phenomenon (LARA; DUARTE, 2018).

Boosting the interaction between the participants of teaching activities is relevant under a sociocultural perspective, in as far as it enables collaborative situations, especially in the higher education. These activities promote speech production moments, in an effort to notice the influence of the interlocutor's speech in the words of the subject in focus (DUARTE; REZENDE, 2008). In the case of students who get involved in problems resolution in small groups, their engagement in discussions and their collective work have

already been analyzed with this theoretical reference (REPICE *et al.*, 2016), even in the sense of scanning dialogical or authority forms in the speech (AMARAL; MORTIMER, 2004).

Considering the teaching processes that occur in the Science Club, there is a maximization of verbal and non-verbal interactions between basic education students, undergraduate students and teachers. In this scenario it is possible to appreciate questions made by students as a way of participation and affective and cognitive involvement with the theme. The engagement of those involved in the problems resolution activities by the use of language may be even more maximized with the proper choice of cultural tools, which we will describe hereafter.

Cultural Tool

The idea of **Cultural Tool** is also very important in Science Education in several works which has already been published based on the theoretical referential of James Wertsch. For example, the speech stands out as a central macro-cultural tool for the teaching, since it's by means of the speech that the teacher establishes the interlocution with the students and aims to execute great part of the teaching activities in classroom (GIORDAN, 2008).

To Pinheiro (2012), it is very important the use of different teaching activities as cultural tools in chemistry undergraduate students' planning, for preservice teacher training as well as the basic education ones who will carry out such activities. In this case, the conceptions of Wertsch (1998) allow us to understand this process in pre-defined sociocultural scenarios, which promotes the internalization of the knowledge (PINHEIRO, 2012).

Giordan, Silva-Neto and Aizawa (2015) base themselves in this referential to comprehend the chemistry undergraduate students' apprenticeship considering the chemical representations and the gestures used by students in the conceptual apprenticeship. Vilas Boas and Barbosa (2011) investigate how speeches are produced by students by means of materials manipulation and they notice that the means and the mediation are deeply overlapped.

Trazzi and Oliveira (2016) quote books, experiments and speech genres as examples of cultural tools, and they notice that several contexts may influence or even determine the construction of concepts. With this, technical cultural tools as well as manipulated artefacts and experimental activities, besides the speeches presented by the teacher may be considered cultural tools. Other examples of cultural tools that are shown in the Science Education literature include digital platforms (MASSI; GIORDAN, 2014) or even interactive computer programs (DUARTE; REZENDE 2008).

In this work our objective is to report how chemistry undergraduate students describe the contributions that the participation in a science club have provided to their early formation, especially considering the used cultural tools and the enabled interactions.

DOI: 10.22294/eduper/ppge/ufv.v11i.8028

Methodology

The presented data in this work is discussed based on a qualitative delimitation, in which we aim to understand relations between the subject and the world that cannot be described by numbers (ALVES-MAZZOTI; GEWANDSZNAJDER, 1999).

Context of the research

The presented report relates to the teaching and learning activities that took place in a science club of a public school in *São José do Rio Preto, São Paulo*. The science club's activities happened every fifteen days from May to December 2017, in 16 meetings altogether. The participants of the science club's activities were a group of chemistry undergraduate students of a public university, a group of high school students from that school and the teacher responsible for the chemistry subject in that school. The partner school's students were between 16 and 18 years old and around 20 students participated in each science club meeting.

The participation of the undergraduate students in the science club's activities were centered in two aspects. The first one was the preparation of support materials to the experiments done in the school's laboratory. The second one was the experimental activities' follow up performed by the high school students by questionings and discussions with scientific content and the relations with society, technologies and the environment. The addressed topics in the science club meetings were electrochemistry; non-Newtonian fluids, polymers, moistures and solubility, and the activities were after the high school students' classes.

Research subjects

The subjects of this research were 3 chemistry undergraduate students of a public university in São Paulo state. The course is taught full-time and it offers bachelor degrees in chemistry with a single entry to all the entrants and it has the minimum duration of four years in each of the modalities. The enrolled students choose between one of the modalities on the second year of the course. The research subjects were on the last year of the preservice teacher modality.

In this modality the foundation of education modules are given in the beginning of the second year of the course and the specific Education in Chemistry subjects are given in from the third year. By the end of the science club activities, the chemistry undergraduate students were between 23 and 24 years old. Their names were omitted in this work due to ethical matters, in a way that it is possible to identify them only by the letters (A, B and C). The data

gathering was performed after the research explanation, reading and signing a consent term by the undergraduate students.

Planning of the Science Club activities

Besides operating in the partner school's science club activities, the undergraduate students also took part in meetings in the university every fifteen days, in order to discuss, plan and reflect on the activities performed at the school. The coordinator of this project, the three undergraduate students and another chemistry student who helped with the organization and preparation of the activities took part in the meetings.

The partner school's high school students also took part in the planning of the activities performed in the science club. The first meeting in the club was designed to a planning, in which it was settled how the divulgation would be done at the school (by its students themselves), the goals of the club (the students of the school preferred to perform a science fair in the end of the school year), suggestions of experiments and themes by the high school students, definition of the meeting dates and the days of the week for the activities. From the second meeting on, some investigative and problematizing experimentation activities were done.

Data production

The presented data in this work were obtained by means of reports of chemistry students who took part in the elaboration and application of the activities done in the science club. By the end of the school year, after the science club activities and the presentation in the partner school's fair, the chemistry undergraduate students presented oral and written reports about the developed activities.

The written ones were elaborated by the subjects of this research after presenting their oral reports in the form of seminaries in two distinct occasions: one for other chemistry undergraduate students and other for the public schools education network teachers. This path enables the subjects to organize their ideas when expressing their experiences in the form of narratives (LARROSA, 1996).

Analysis of the produced data

In the analysis of the data, the principles of the Content Analysis were used (BARDIN, 2011), which included pre-analysis, extensive material exploration and treatment of the results. In this work the presented data are separated in three categories, which are "Cultural tools" and "Impact on the undergraduate student's formation", *a priori* defined, and the emergent category "Basic education students".

The main cultural tool used in the science club activities was the **experimentation**, once the great part of the elaborated and accomplished activities was experimental. In the science club activities the typically scientific aspects of a cultural tool may be exercised by the basic education students and the aspects related to the teacher knowledge, on the other hand, may be exercised by undergraduate students when they plan and execute the activities. This way, the same cultural tool may be exercised on its scientific and didactic aspects, considering the basic education and the undergraduate students. In special, the problematizing (DELIZOICOV, 1983) and the investigative (HOFSTEIN *et al.*, 2005) experimentations were used.

Results and discussion

The undergraduate students, by participating in the planning of teaching activities that would be applied in the science club, have searched for the scientific knowledge contextualized with the students' daily routine. They have also showed themselves attentive to the basic education students' interests and difficulties and aimed to eliminate their doubts, even if in posterior encounters.

When the undergraduate students were in doubt about what to do in specific situations during the teaching activities, the coordinator and the responsible chemistry teacher were consulted and the theme was discussed in the meetings at the university. They searched for scientific information about the experiments and also the best way of dealing with the scientific knowledge, always searching for the central aspects of the conceptions in the experiments and the daily applications enabling connexions between them.

The undergraduate students have also aimed to use some of the basic education students' everyday expressions with the objective of making the environment informal. This has been made with the expectation of distinguishing this environment from the daily classroom activities, making them feel at ease. With this, there has been a concern by the undergraduate students in attempting to improve their interaction with the high school students. This experience may reflect in the classroom when the undergraduate student becomes a professional and starts working everyday in a school.

Next, the results classified in categories will be shown and discussed, as well as excerpts of reports that exemplify them.

Impact on the formation of the undergraduate student

The delimitation of these categories aims to show the intensity of the impact that the performed activities had on the formation of the undergraduate students by their own perspective. In fact, the undergraduate students were asked to write about which roles the

activities in the science club played in their formation. With this, the reports were hoped to contain this topic, as we see on Frame below:

Frame 1. Excerpts of the reports of undergraduate students classified in the category "Impact on the formation of the undergraduate student".

A: "The impact that the club had in my pedagogical practice was **intense** and interesting, not only for aiming to establish relations between practice and theory related to the content, but also for **instigating me**, as an educator, to search for practices aiming the investigative experimentation and problematizing".
B: "Taking part in science club activities as a training teacher has granted me **uncountable experiences** that will certainly contribute to my pedagogical practices as a professional".
C: "The participation in the science club is the opportunity to work and develop different methodologies and approaches".

Source: Prepared by the authors.

It is possible to notice some evidences of enthusiasm in the excerpts of the A and B students' reports when describing the role of the activities for their teaching formation according to some fonts added. In special, this was the first opportunity for student A to participate in science club activities. Student B has already been participating in this type of activities for the third year in a row.

Student C, however, with a way more rational description, used to take part in projects involving specifically science club activities for the fourth year in a row. It is interesting to observe that the description of the intensity of the impact by these undergraduate students is inversely proportional to how long they have been participating in science club activities.

It is possible to deduce that the lowest intensity on Student C's description shows that the performed activities have already become common and ordinary. However, this fact does not reflect a lack of enthusiasm for the accomplishment of the activities for this student has worked in an exemplary manner.

If we consider that the impacts shown are relates to the emotional state of the undergraduate students, the reports classified in this category are in consonance with the ones obtained by Monteiro and Gaspar (2007), quoted in the introduction, in which are considered the emotional results of the students in the interaction with the teachers. In the case of the undergraduate students, which are students but perform some typical teaching activities in the science club, there are also positive emotional impacts in the future teachers. As students who had chosen a higher education course according to their interest in chemistry, they feel positively affected by developing and applying activities that are noticed to be beneficial to the basic education students. The outcomes obtained are also aligned with the works of Adriano and Schroeder (2015), in which undergraduate students report with enthusiasm the contribution of the project to their professional formation.

Basic Education students

In this category we show the undergraduate students' concept on why the science club activities are important to the basic education students on Frame below:

Frame 2. Excerpts from the undergraduate students' reports classified in the category "Basic Education Students".

A: "I believe the club has its importance for it brings outside the classroom an attempt to **bring the pupil closer to a more scientific knowledge** and also the possibility of **stimulating** their **autonomy** by trying to stimulate their **curiosity** from a critic point of view, in search of knowledge.
B: "Among them, the main relation is the teacher-student one that begins, because participating in the science club has helped me to establish a **closer relationship with the students** and how to establish it. That is because the activities in the club are very dynamic, **enabling many moments of dialogs and discussions** about the topics covered".
C: "Another difference is the relation of the students with this space because, one it is an extracurricular activity, the big majority of the students **demonstrates great interest by science**".

Source: Prepared by the authors.

On the excerpts classified in this category the undergraduate students assign a great value to the relationship between teachers and students. By writing about why the club was important to its students, they all pointed to factors related to the interaction between teachers and students. The undergraduate student A indicates the possibility of stimulating its students to some more scientific knowledge, besides autonomy and curiosity, which gets close to Freire's referenced direction of knowledge and it is aligned with the premises of the problematizing experimentation (DELIZOICOV, 1983).

Student B deals directly with establishing the closet relation with the students. Considering that this undergraduate student had already been developing activities in chemistry education programs for the past three years, it is possible to understand that in this teaching activity modality, the undergraduate student has felt more possibilities of establishing dialogs besides more fruitful discussions with the students.

On the other hand, undergraduate student C shows that students in science clubs show much interest in science. Considering that the activities in the science club were elective, it is possible to comprehend that only interested students have registered for the activities. In this case, it is evident that the biggest interest by the students is related to more fruitful relations between the participants.

The reports classified in this category are also aligned with the ones obtained in the literature, which show the importance of the dialogical interactions (ROUAUX *et al.*, 2006) as elements in the teaching activities. In the same way, the type of verbal interaction may reveal the interest in learning (GALLE; PAULETTI; RAMOS, 2016) especially when students elaborate questions (LARA; DUARTE, 2018). In a similar way, the collaborative

situations, which is the case of the experimental activities in the science club, play a leading role in the exercise of this cultural tool (DUARTE; REZENDE, 2008).

Cultural Tools

In this category, we have gathered the excerpts of the reports in which the undergraduate students have referred to the pedagogical knowledge, or cultural tools, that are necessary to elaborate and apply the experimentation activities in the science club.

Frame 3. Excerpts of the undergraduate students' reports classified in the category "Cultural Tools".

A: "I believe that, with the weekly activities, the possibility of proposing **problematizing or investigative** activities would have been **more successful**. The last point would be a necessity of trying to establish **connections between the contents in classroom**".
B: "In this way, me acting as a teacher in the club had to be in a frequent dialogue with the students and this drew me very close to them and I also **learned how to consider even more their opinions to prepare the activities**. Besides, my participation in the club **helped me to contextualize more the topics** that were studied and make them less segmented".
C: "Thus, the approach, the questions and doubts presented by the students **have provided us the opportunity to work with chemistry under a more scientific perspective** and, therefore, the students as well as ourselves have grown a lot during the process".

Source: Prepared by the authors.

Student A observes that it would like to do the activities weekly instead of every fifteen days. It also notices that it would be better if there were greater consonance with the students' activities in classroom. In this sense, it is clear that it would be better that the themes in the science club could match those covered in the chemistry annual planning, instead of having elaborated another planning closer to the interests of the high school students. With this, this student realizes that the exercise of the "experimentation" cultural tool would be more effective if these two aspects were improved. The observations written by A show a perception of desire of the basic education students to exercise the "experimentation" cultural tool in a more intense way, but also articulated with the other teaching activities. This kind of observation shows a more mature pedagogical vision over the apprenticeship with the experimentation.

Student B writes that its interaction with the students helped him to take into consideration the previous knowledge when preparing the teaching activities. Besides, he observes that it managed to better contextualize and articulate the themes of the activities in science club. In this sense, it is clear that the use of the "experimentation" cultural tool is strengthened when basic education students' previous knowledge are acquainted. It is also clear for this undergraduate student that the activities in the science club motivated it to search greater connection between chemistry and the context of the basic education students, which would make the content less fragmented. With this, the themes worked in the science

club activities have a greater potential of being understood as a whole and are based in the basic education students' daily lives.

In another direction, undergraduate student C writes that he managed to work with the theme in a more scientific way in function of the best interaction with basic education students. The comprehension of the central scientific aspects for the school contents has been a challenge in Sciences Education (SILVA; QUEIROZ, 2017). The perception of these undergraduate students is that the cultural tool worked in the science club enables an interaction environment that facilitates a better content approach in a way that the scientific aspects are worked consistently.

Given the perceptions presented on the excerpts in Frame 3, it is possible to understand that these undergraduate students have exercised a didactic use of the "experimentation" cultural tool in the science club activities, which is aligned with the teaching knowledge that will contribute to dialogic interactions in which there is space for negotiation and re-elaboration of meanings.

Final considerations

It is possible to observe the formative importance of this experience for the undergraduate students that took part in the Science Club activities. The data show that these activities motivated these chemistry undergraduate students to reflect on their teaching practice and to improve it according to the observations obtained from the basic education students who participated in those activities. The presented analysis categories "Impacts on the undergraduate student's formation"; "Basic Education Students" and "Cultural Tools", helped to better describe the experience that the activities in the Science Club had for these chemistry undergraduate students' academic background.

First, we have described the perception of the undergraduate students of the positive impacts that the Science Club activities had in their early background. Adopting a sociocultural perspective, the impacts shown about the emotional states are important in the teachers' background, for they feel positively thrilled by elaborating and applying the Science Club activities.

Thereafter, we have shown how the undergraduate students noticed their interaction with the basic education ones. The data show that the undergraduate students indicate as elements in this relationship the possibility of motivating their students, the potential for autonomy and curiosity, the opportunity of establishing a closer relationship and better dialogues with their students, besides having more fruitful discussions with them. Furthermore, the undergraduate students have observed that the basic education students, during the Science Club activities, demonstrate much interest on the theme. In function of this type of collaborative situation, there is qualitative improvement in their verbal interaction.

It was also possible to observe that, in the undergraduate students' perspective, the exercise of the "experimentation" cultural tool it would be more effective if the Science Club activities were carried on more often during the week and more closely with the classroom activities. Besides, the "experimentation" is maximized when the students' previous knowledge is taken into consideration while teaching activities are being prepared, which motivates the undergraduate students to better contextualize the activities. There is also the perception by the undergraduate students that the exercise of this cultural tool in the Science Club enables a more scientific approach of the discussed topics.

In our work, we assumed that the Science Club activities are an example of how the specific teaching contexts influence the development of teaching knowledge in chemistry teachers' early formation. It is important to highlight that the appropriation of the "experimentation" cultural tool by the future chemistry teachers is absolutely central, once they are professionals who will teach the main knowledge that fundament the scientific practice to basic education students. In this sense, we recommend the use of teaching activities in a Science Club format as part of preservice chemistry teachers training, for they enable singular experiences in teaching and learning activities.

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Notes

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Acknowledgments

We thank PROEx/UNESP for the support.