Revista Internacional de Educação Superior
International Journal of Higher Education

Inquiry Teaching in Didactic Classes for the Chemistry Pre-Service Teacher Education[1]

Ana Paula Gutmann[1] https://orcid.org/0000-0001-9647-1699
Zenaide de Fátima Dante Correia Rocha[2] https://orcid.org/0000-0002-1489-6245
João Paulo Camargo de Lima[3] https://orcid.org/0000-0001-6847-8076

[1,2,3] Universidade Tecnológica Federal do Paraná

ABSTRACT

The present research aimed to analyze the effects of an inquiry-based class (investigative class) in a Chemistry Degree class during the discipline of General Didactics. Two investigative classes were developed, one in the experimental methodology and the other in the design thinking project methodology. And at the end of the two classes, the students answered two guiding questions: "What does this class allow you to compose the lesson plans and your own practices as future teachers?" and "What do this knowledge collaborate for your education?" The results demonstrate that the proposed activities contributed in a promising way to the process of understanding graduates on how to develop a teaching lesson plan, besides enabling the use of a teaching methodology by investigation for the development of their future teaching practices.

KEYWORDS

Initial teacher education. Teacher training. Inquiry teaching. Chemistry pre-service teacher.

Corresponding to Author
[1] Ana Paula Gutmann
E-mail: ana.paula.gutmann@hotmail.com
Universidade Tecnológica do Paraná
Curitiba, PR, Brasil
CV Lattes
http://lattes.cnpq.br/5961875530733578

Submmited: 02 Nov 2020
Accepted: 30 Jan 2022
Published: 24 Mar 2022

doi 10.20396/riesup.v9i0.8661880
e-location: e023006
ISSN 2446-9424

Antiplagiarism Check
turnitin

[1] Translate: Thiago Tomasin Biazin. Chief Operations Officer of the Brazil Barnabas Fund, where he is responsible for the translation from English into Portuguese of all publications made by the organization, whether in online or printed media. He did the translation into English of the book: Brazil - Land, Life & Jungle by R.R. Rufino. E-mail:thiago52@hotmail.com

Ensino por Investigação em Aulas de Didática Para a Formação Inicial de Professores de Química

RESUMO

A presente pesquisa teve como objetivo analisar os efeitos de uma aula investigativa em uma turma de Licenciatura em Química, durante a disciplina de Didática Geral. Foram desenvolvidas duas aulas investigativas, uma na metodologia experimental e outra na metodologia de projetos por design thinking. E, ao final das duas aulas, os estudantes responderam a duas perguntas norteadoras: “O que essa aula permite de aprendizagem para vocês comporem os planos de aula e suas próprias práticas como futuros docentes?” e “Em que esses conhecimentos colaboram para a formação de vocês?”. Os resultados demonstram que as atividades propostas contribuíram de maneira promissora para o processo de compreensão dos licenciandos sobre como elaborar um plano de aula docente, além de possibilitar a utilização de uma metodologia de ensino por investigação para o desenvolvimento de suas futuras práticas docentes.

PALAVRAS-CHAVE

Formação inicial docente. Formação de professor. Ensino por investigação. Licenciatura em Química.

Enseñanza Inquisitiva en las Clases Didácticas para la Formación Inicial del Profesorado de Química

RESUMEN

La presente investigación tuvo como objetivo analizar los efectos de una clase basada en la indagación (clase de investigación) en una clase de Licenciatura en Química durante la disciplina de Didáctica General. Se desarrollaron dos clases de investigación, una en la metodología experimental y la otra en la metodología de proyectos de pensamiento de diseño. Y al final de las dos clases, los estudiantes respondieron dos preguntas orientadoras: "¿Qué les permite esta clase para redactar los planes de lecciones y sus propias prácticas como futuros profesores?" y "¿En qué colabora este conocimiento para su educación?" Los resultados demuestran que las actividades propuestas contribuyeron de manera promisoria al proceso de comprensión de los egresados sobre cómo desarrollar un plan de lecciones de enseñanza, además de posibilitar el uso de una metodología de enseñanza por investigación para el desarrollo de sus futuras prácticas docentes.

PALABRAS CLAVE

Formación docente inicial. Formación de profesores. Enseñanza de la investigación. Profesora en prácticas de Química.

Introduction

Over the past few decades it has been perceived that the schools and, consequently, the teachers, are being faced with new challenges such as a multicultural society, the technological development providing an out-of-school learning, different educational models, among others (FLORES, 2004), making the teaching a very demanding activity.

According to Nóvoa (1992b), the teacher education needs to occur during the process of change, being produced by the effort of innovation and the demand for better methodologies for the transformation of the school. Therefore, teacher education should be conceived as one of the components of change.

Based on this change Carvalho (2013) highlights inquiry-based teaching as a methodology that can instigate the creativity of the teacher and of the student and create an environment conducive where students can build their own knowledge.

Foundation on the need for teacher training and through the potential of the inquiry-based teaching methodology, the objective of this research is to analyze the effects of an investigative class in a Chemistry Degree class during the General Didactic course.

The initial Science Teacher Education

Undergraduate courses do not normally present a specific training for teaching, but when graduated, this new professional teaches, professionalizing through an experience training-built experience in student experience (SANTOS e MARTINS, 2016).

In this context, Flores (2010) describes that student teachers already have internalized ideas and beliefs about what it is to be a teacher and about teaching because of their student trajectory. That is because, when they enter college, those students already know the environment in which they will exercise their professional activity: the school and the classroom.

Teacher education then becomes a complex and very important problem for education. Perhaps a qualified teacher training could modify some aspects of the current scenario, such as the fact of many teachers enter the classroom right after their graduation and not being prepared for the challenges that happens within it (CORREIA, 2008).

Based on this fact, Flores (2004) states that teachers receive increasingly complex demands and responsibilities, as they need to know how to deal with a social and cultural diversity of students with different levels of development of learning and stimulating situations that meet diverse needs and motivations, besides having pedagogical and didactic knowledge so that it can develop strategies that meet the heterogeneity of a classroom.

Therefore, it is essential to create spaces in the initial teacher education where one clarify the beliefs and ideas that they bring from what it is to teach to enhance a reflection and reasoned questions about the process of becoming a teacher (FLORES, 2010), since these teachers expect them to teach them how to teach.

Nóvoa (1992a) argues that training is built through the work of critical reflexivity of its practice and the permanent construction of a personal identity, and not through the accumulation of courses and knowledge. He also points out that it is very important to invest on the person and give the status to the knowledge of the experience.

Flores (2015) points out the teacher identity is a process that is constantly modified, being negotiable and open, because it is mediates by the experiences that the teacher acquires in schools and outside it and also by the very beliefs and values that this person has about what it is to be a teacher and the type of teacher that she wants to be. As Nóvoa (1992a, p.16) highlights, this professional identity is not stable or fixed, not even a product, it is "a place of struggles and conflicts", besides being also, "a space for building ways of being and being in the profession."

The initial Science teacher education is no different, it consists of a sum of courses on scientific content and on education disconnected from each other, and many are based on technical rationality, which is limited to only one training (BORGES, 2010).

Often teachers have little familiarity with research contributions and didactic innovation, believing that teaching is something simple, that a good knowledge of the content, some psycho-pedagogical practices and complements are sufficient (CARVALHO e GIL-PÉREZ, 2011). Those authors also point out that teacher training is conceived as a transmission of knowledge and dexterities, demonstrating their insufficiency both in the preparation of students and that of teachers themselves.

According to Borges (2010), permanent professional development needs to include an articulation between initial teacher education and continuing teacher education. In this sense, the author describes that this broad training will characterize professional development so that teachers acquire knowledge, dexterities and attitudes necessary for the construction of a quality teaching.

In this perspective, Nóvoa (1992a, p.16) points out:

> Training can stimulate the professional development of teachers, within the framework of a contextualized autonomy of the teaching profession. It is important to value training paradigms that promote the preparation of reflective teachers, who assume the responsibility of their own professional development and who participate as protagonists on the implementation of educational policies.

Thus, Carvalho and Gil-Pérez (2011) report that teaching work should not be an isolated task, and that no teacher should feel defeated by a set of knowledge, which often go beyond human possibilities, but it is important that it may have a collective work throughout

the entire teaching-learning process, from the class preparation to evaluation. In this sense, the NRC document entitled – Inquiry and the national science education standards: A guide for teaching and learning - makes the following statement,

> For students to understand inquiry and use it to learn science, their teachers need to be well-versed in inquiry and inquiry-based methods. Yet most teachers have not had opportunities to learn science through inquiry or to conduct scientific inquiries themselves. Nor do many teachers have the understanding and skills they need to use inquiry thoughtfully and appropriately in their classrooms. What do teachers need to know and be able to do to use inquiry effectively? What kinds of professional development can help prospective and practicing teachers both develop and use inquiry-based strategies? (NRC, 2000, p. 87).

Therefore, the teacher training should propose a commitment to investigate teaching and to teach themselves how to investigate, since the relationship between inquiry-based teaching in teacher training and research on teaching are of great importance for a progress either on the teaching as well as on the teaching education and encouraging all the participants to value the nature of their work more (FLORES, 2010).

The Importance of Inquiry-Based Science Teaching

A proposal to qualify the training of Science teachers is in the investigative approach, as it values the knowledge and the understanding of students and teachers trough interactions with curricular components.

Scientific education should be based on the development of skills based on familiarization with scientific procedures, on problem solving, the use of instruments and, finally, the application in real everyday situations, ensuring students the ability to participate and make informed decisions (SCHIEL e ORLANDI, 2009).

The document of the National Science Foundation - Inquiry: Thoughts, Views, and Strategies for the K-5 Classroom (NSF, 2005), which deals with investigation in elementary school, describes that students need to fully develop their skills to become real thinkers by coping with problems to understand various ways to find solutions, so that they can gather and weigh the evidence and that they can apply and test scientific ideas. These skills can enable these students to become qualified adults for the everyday world and work.

Azevedo (2004) reports that investigative activity is a fundamental strategy for Science teaching, being an indispensable component and that this methodology cam be oriented towards achieving different objectives. For the author, different activities should be carried on, which need to contain problematizing situations, questioning and dialogues, and which need to involve solving the problem in order to introduce new concepts and, consequently, the construction of knowledge.

Carvalho (2013) states that investigative activities provide students with condition to present their previous knowledge to then start the new ones, develop their own ideas and discuss them with the teacher and with their classmates, moving from the knowledge for the scientific and developing ability to understand the knowledge already structured by the previous generations.

Therefore, it is through research that students can acquire concepts in an authentic way and can therefore be aware of the level of conceptualization they have achieved (NSF, 2005). The same document justifies that

> When children learn science through research, they communicate their thoughts and ideas through practical action as well as through symbols (i.e., speech, writing, numbers, drawings). With various ways to communicate the same information, teachers can have direct access and accurate knowledge of the level of learning of each child's science. It also gives teachers direct knowledge of the child's ability to conduct research successfully. As a result, teachers are better able to help children improve knowledge of science, science research, and the nature of doing science. (NSF, 2005, p.12).

According to Azevedo (2004), the use of investigative activities is the starting point to develop the understanding of concepts, providing students with their participation in their own learning, leaving a passive posture and acting in the construction of their own knowledge, relating the concept to events and seeking the causes of this relationship. This process of thinking, which happens because of their participation, causes students to build their autonomy.

Didactics and Action Planning

Didactics is a specialty of pedagogical Science that has the purpose of aiding the construction of the student's knowledge, as well as allowing the development of the student's interpretation and organization of it (LIMA e PIMENTA, 2006). Pimenta *et al* (2013, p.144) comments that "didactics can be considered as the science of teaching, the art of teaching, a theory of instruction, a theory of training or even a technology to provide methodological support to curriculum subjects."

According to Libâneo (2015), this pedagogical science is indispensable for teacher education because it investigates, through real teaching and learning practices, the conceptual and theoretical frameworks that underpin the professional knowledge that motivates the teaching practice, articulating theory and practice in teacher education. It is common to learn through observation, imitating the way teachers apply their lessons with their students and critically analyzing the work done. Lima and Pimenta (2006) report that this form of learning in school practice devalues the intellectual formation of the student, turning the teaching activity into a conservative of habits, ideas, values, and social and personal behavior. Therefore, the observation method is not suitable for teacher training.

Didactics, through teaching, analyzes the conditions, the ways, and the foundations of carrying out education. According to Libâneo (2017, p. 53)

> [...] Didactics investigates the conditions and forms that prevail in teaching and, at the same time, the real factors (social, political, cultural, psychosocial) that are conditioning the relationships between teaching and learning. In other words, highlighting instruction and teaching as the primary elements of the school pedagogical process, it translates social and political objectives into teaching objectives, selects and organizes content and methods, and, by establishing the connections between teaching and learning, indicates principles and guidelines that will regulate the didactic action (LIBÂNEO, 2017, p. 53).

Therefore, the subject of General Didactics in teacher education has a very important role in the development of these students, so that they can build a teaching education through critical analysis coherent with the social reality in which teaching takes place. Libâneo (2017), mentions that didactics has the function of guiding the teaching action starting from the concrete situations in which the teaching process occurs, having as support the pedagogical and scientific-technical knowledge.

From this perspective, undergraduate students in teacher training learn, in didactics classes, not only how to teach pedagogically, but how to organize scientific-technical knowledge to pedagogical and methodological knowledge, learning to develop lesson plans for different contents and apply them in the social context in which they will be inserted..

Klosouski and Reali (2008) describe planning as an anticipation of an action that will be developed and a way to think of the best methods to be applied to reach the proposed objectives. The authors comment that it is the teaching planning that will guide the activities developed by the teacher. Therefore, planning is concerned with education, ensuring a coherence between learning and the activities to be carried out with the students.

> To be considered adequate, a plan must follow some principles, such as: Coherence and unity; Continuity and sequence; Flexibility; Objectivity and functionality; and Precision. As planning requires thinking about the future. It is also formed by the basic components of educational planning, where the objective is the clear description of what we intend to achieve as a result of our activity, they are born from the very situation of the community, the family, the school, the discipline, the teacher and especially the student. The goals, therefore, are always of the student and for the student (CONCEIÇÃO *et al*, 2008, p. 8).

By doing planning while still in training, students understand the real purpose of the plans, improving their way of teaching and, consequently, improving the students' learning when they apply their plans. Klosouski and Reali (2008) report that it is necessary to constantly think about who this planning is for, what is being planned, what your actions will be, and what goals you want to achieve.

Methodological Procedures of the Research

This research is foundation on the qualitative approach where it is based on the observation of the reality and also because it is more concerned with the process than with the product (LÜDKE e ANDRÉ, 1986; BOGDAN e BIKLEN, 1994). The application of this research occurred during the discipline of General Didactics of a Chemistry Degree course, at a Public University in northern Paraná, with sixteen students enrolled in this discipline in the first semester of 2019.

The data collection instruments were: the recording on video of the classes, records written by the students in their groups, the audios with the discussion of each group and, in particular, two questions that guided this research, in view of the teacher training: "What the today's lesson allow you to compose lesson plans and their own practices as future teachers?" and "What do this knowledge collaborate for your education?" Data analysis occurred descriptively from the statements and discussions during the activities and the material written by the students[2].

The research began with an explanation of the steps described by Carvalho (2013), for inquiry teaching, which the author defined in stages, according with Frame 1.

Frame 1. Stages of inquiry teaching and its teaching-learning dynamics

Stages of Inquiry Teaching	Teaching-Learning Dynamics
1ª) Problem proposition	Proposed by the teacher or from a question of the student.
2ª) Hypothesis Formulations	In groups, ideas are created to solve the problem, noting the initial responses.
3ª) Data collection and analysis	The students develop the path to solve the problem, collecting and analyze data together.
4ª) Crossing of results with initial hypotheses	Students should analyze and interpret the results along with the theoretical contribution.
5ª) Formulation of final considerations	The students show, through written or oral accounts, what they did, comparing with their initial hypotheses and the result of the research.

Source: the authors.

In a second moment the teaching model based on Design Thinking was presented. According to Rocha (2017), this project methodology is developed mainly by designers to generate, improve ideas and implement solutions. For the realization of activities through this approach it is necessary to go through some principles that characterize it, such as: empathy, collaboration, creativity and optimism. In addition to the principles for performing design thinking, the project based on design thinking must go through five process, to which they were described on Frame 2.

[2] It is worth mentioning here that all participants in these research were informed about the reasons for the class being recorded on video and audio, authorizing the use of these videos and audios for the purpose of the research, through the signature of the Free Consent Form and Enlightened (FCFE). It is important to mention that to safeguard the identity of the participants, no names were mentioned in this research.

Frame 2. Description of Design Thinking approach processes

***Design Thinking* Processes**	**Description of processes**
1º) Inspiration	Choose the subject of great scope that appears by empathy.
2º) Definition	Proposition of a problem on the theme chosen in inspiration.
3º) Ideation (*brainstorm*)	All the ideas that the group for solving the proposed problem were placed.
4º) Action or prototyping	The action plan proposed by the problem with the ideas that emerged in the group and which are effective for this resolution is developed.
5º) Testing	Application of the plan or testing of the developed product.

Source: the authors.

The interpretation of the data obtained in this research was based on discursive textual analysis, according to Moraes (2003), in order to deepen the understanding of the phenomena investigated. Therefore, three elements were necessary in the organization of this analytical process: unitization (disassembly of texts), categorization (establishment of relationship) and communication (capturing the new emerging).

The Didactic Experience

The students were organized into groups to perform an investigative class in the experimental approach in order to provide an experience of this approach and, consequently, a possible appropriation of the methods to be followed when they were developing their lesson plans.

The teacher-researcher distributed the materials, oil, water, salt, spoons, food scale, glass with measurements in milliliters and pet bottles in a central table, in addition to a sheet of paper containing the problematizing issue for each group. Students were asked if "All the liquids have the same density?" and "How could this be demonstrated?"

The groups then began to describe the hypothesis for such questions. After the description and discussions of how to proceed with the experiment, the students were directed to the tables that contained the material for the realization of the practical activity. As soon as they finished the practical part, they returned to the groups and completed the description of the activity.

As a closure and systemization of this stage, the teacher-researcher made a final explanation on how they could end this approach in a classroom of the Basic Education. At that time, he explained that students should be asked to describe how the experiment was done, what results they obtained, whether the experiment worked, or went wrong, and, if it went wrong, ask them to write what went wrong. Based on this information the teacher-researcher demonstrated that students can be asked to answer some questions related to the

theme proposed in the activity and that it can be part of their daily life, so that they can think about what they did and the concepts learned during the development of the experimental activity.

Regarding the teaching approach by Design thinking, students received a piece of paper with a problematizing question considered as the initial inspiration: “What are the challenges of the education/school today?”, and, in the same group as the previous activity, the students defined the main theme of this inspiration proposing a problem to be solved, then described their ideas for this problem and, finally, discussed and reported the action plan for the execution of the same activity.

At the end of the survey, the students answered the two guiding questions: “What does today’s lesson allow you to compose the lesson plans and your own practices as future teachers?” and “What do this knowledge collaborate for your education?”

From these methodological approaches, we sought to cut out in the dialogues of audio recordings, made during the activities, and from the productions described by the groups, episodes that showed some effect for the training of undergraduate students in Chemistry, research participants.

As the proposed activities were carried out in four groups, the participants’ statements were described from those groups, without the indication of the student to whom it refers. Thus, the codes, Group 1, Group 2, Group 3 and Group 4 were used; as well as Extract 1 and Extract 2, referring to the moments reported by the students from the guiding questions of the research.

Result Analysis

In the analysis of the process developed by the groups it was possible, during the unitization process proposed by Moraes (2003), to separate the statements and descriptions of the students in units of analysis for the formation of two categories: the understanding for the development of the lesson plan and collaboration in teacher education, according to Frame 3.

Frame 3. Analysis units selected in the formation of categories

Categories	Analysis unit
Understanding for the development of the lesson plan	Group 1: "*Respect the continuity of contents".* Group 3: *"We can think better, it is better designed, because we didn't have much notion of how to start".* Group 4: *"With the activity you've given, it helps a lot because we have a basis of what we can do".*
Contribution in teacher training	Group 1: *"Understanding the real need for learning is essential to direct our knowledge to the student".* Group 2: *"Knowing how to bring interest to the student and content".* Group 3: *"Improving didactics, because we had never seen this before, if we had seen, I think it had made it easier in some things".* Group 4: *"It helps a lot because you see what you are writing, so you can put your theory into practice".*

Source: the authors.

From the guiding question ""What does today's lesson allow you to compose the lesson plans and your own practices as future teachers?", it was possible to extract the following episodes:

> **Extract 1:**
> Group 1: "It was beneficial because we were able to visualize the real focus of practices as well as respect the continuity of the contents".
>
> Group 2: "It brought ideas to bring innovative methods to pass on to the student".
>
> Group 3: "You can think about it, it is better designed, because we didn't have much notion of how to star. It got better organized. To perceive a better way to pass on to the student, an effective way, because we know for ourselves, but passing is difficult".
> Group 4: "The practice you've given helps a lot because we have a foundation of what we can do, in addition to our lesson plan that we can apply to students".

The groups demonstrated that the activities proposed during the class were important for the organization of the lesson plans they should develop during the discipline and in their teaching practice, the experimentation assisted in the visualization of the process of a content in a classroom. According to Nóvoa (1992a, p.16), "the education goes through experimentation, innovation, the testing of new modes of pedagogical work". When working towards diversification of methodologies, pedagogical practices of training, new ways of relating the pedagogical knowledge and scientific knowledge with teachers can be instituted (NÓVOA, 1992a).

In this way, students can more clearly configure how to set up a plan and how to execute it at the time they are teaching. From the experience provided at the university, the students are able to understand that planning will guide the teacher's work and that it is from this that the teacher can reflect on teaching and learning for his/her students (KLOSOUSKI e REALI, 2008).

From the fragment of the report from Group 3 “[...] To perceive a better way to pass on to the student [...]” it is possible to realize that the research teaching has provided greater clarity in the application of plans in a classroom. As in Group 2, it reported “[...] bringing innovative methods to pass on to the student”. Demonstrating that for these students the research teaching is an innovative methodology and that, once they have experienced it, it is easier for them to use this methodological approach with their student in the future. According to Carvalho and Gil-Pérez (2011), in order for the teacher to guide the learning of students, it is necessary that the teacher himself experience this investigative process previously.

Therefore, it is possible to develop in future teachers the reflection on how to teach and especially how to plan a class with different methodologies, making the General Didactics class more dynamic and mainly, clarifying the meaning of didactics and planning in the teaching process of these students. Libâneo (2017), reports that from didactics it can be investigated the reasons, strategies and circumstances of execution of instruction and teaching.

Regarding the second question, “What do this knowledge contribute to your training?”, it was possible to glimpse the challenges that undergraduate students encounter, when they reported that:

> **Extract 2:**
> Group 1: “As teachers, understanding the real need for learning, it is essential to direct our knowledge to the student”.
>
> Group 2: “Much can be taken as an improvement, knowledge. Knowing how to bring student’s interest and achieve, this interest, to the content, thus having a quality class for both the student and the teacher”.
>
> Group 3: “I think so, because we have never seen it before, if we had seen it, I think it had made it easier in some things, like other presentations, seminars. We know how to do things with a script, all the stories we do today are like this. Improve didactics”.
>
> Group 4: “Practice itself helps a lot, because you see what you are writing, so you can put your theory into practice and it helps a lot to see what they are studying. The biggest difficulty even is to create the problem, what goes forward is more quiet”.

The students demonstrated that practices in groups helped in the understanding of the knowledge that is passed on to students and in the different methodologies that can be articulated for the organization and application of classes. Carvalho and Gil-Pérez (2011) state that, thus, teaching ceases to be seen as an obstacle to efficacy and a factor of discouragement, braking with a monotonous teaching. Those authors point out that the ideal is to guide the teacher towards a collective work of innovation, research and continuing teacher education.

The insertion of experimentation in didactics during academic training becomes a tool that helps students in the construction of knowledge that may allow the intermediation between what needs to be taught and what should be learned, in addition to perceiving and distinguishing structured knowledge from teachable knowledge, depending on the conditions and circumstances in which they find themselves, and understanding new ways to reconstruct the relationships with knowledge (PIMENTA, *et al*, 2013).

Based on the fragment of Group 4 that comments: "[...] The biggest difficult is to create the problem [...]", it is possible to note that students perceived the importance of the problem issue for the development of research teaching, but presented difficulties in creating a problem to be used in the classroom. Carvalho (2013) describes that this problem needs to be within the student's culture to instruct him to research, i.e., it needs to be interesting for the student to engage in the search for solutions and expose their previous knowledge.

When analyzing the fragment of Group 3 that says: "[...] For we've never seen this before [...] [...]. We know how to do things with a script, all the subjects that we do are like this [...]", demonstrates how productive the investigative class was for the didactic knowledge of these students. Because they had not known this methodology, providing a new way of thinking about their future lesson plans. In this sense, Carvalho and Gil-Pérez (2011, p.67) affirm that a brief initial formation can be done through a repeated experience of new theoretical propositions, i.e., to be associated with a "task of constant research and innovations".

Zômpero and Laburú (2011, p.73) report that currently the methodology of inquiry teaching is used in education with the purpose of developing "cognitive skills in students, performing procedures such as hypothesis making, data annotation and analysis, and developing argumentation skills." By participating in a class on the investigative methodology and then building their lesson plans following this same teaching strategy, the students were able to add to their repertoire of didactic experiences another way of working.

Thus, the evidence revealed in the statement of student teachers allow us to infer that the research-based teaching class made it possible to understand this differentiated methodology, pointing out to be an approach that can improve student's didactics as well as development of the proposed lesson plans in the initial teacher training. Therefore, the subject of didactics in initial teacher training can fulfill its objectives by addressing the specific units of pedagogical activity and not only the specific contents that guide (MARCONDES, *et al*, 2011).

Final Considerations

The investigative class proposed for this research had a positive effect on the initial training of the Chemistry Undergraduate students by providing a methodology considered innovative for these students. Student teachers were able to perceive different ways of

working in the classroom, without the mandatory transmission of total concepts, participating and constructing the concepts proposed by the activity through the methodology of teaching y investigation.

The results show that experiencing inquiry-based teaching was effective in clarifying and facilitating the development of lesson plans for chemistry teaching, as well as collaborating with the understanding of knowledge to be transmitted to students and different approaches that a teacher can use to teach the various contents of his discipline.

When analyzing the class performed for this research it is possible to notice the importance of an initial training of quality teachers, because undergraduate students have not yet created a teacher's identity and when they leave graduation they end up repeating it who experienced as students.

The dialogues and descriptions developed in this research reveal to us that the investigative class applied in two different methodologies disseminated, according to Borges (2010), knowledge, dexterities and attitudes in students so that they could understand and create new ways of building quality teaching.

In general, it was possible to perceive, through the reports, that the proposed activities were promising for the process of understanding how to develop a teaching lesson plan, in addition to demonstrating a different methodology for the development of its future teaching practices.

From the perspective of initial teacher training, we consider that this research presents contributions by having promoted the contact of the student teachers with an inquiry-based teaching methodology, potential for the teaching of natural sciences, in whose area they will act in teaching, and which is characterized as a different teaching-learning dynamics from which they were accustomed to experience, during their own training in Basic Education, as students and also as students of the Degree, in order to encourage teaching to investigate.

References

AZEVEDO, Maria. Cristina. P. Stella. Ensino por investigação: problematizando as atividades em sala de aula. *In*: CARVALHO, Anna. Maria. Pessoa. (Org.). **Ensino de ciências**: unindo a pesquisa e a prática. São Paulo: Pioneira Thomson Learning, 2004. p. 19-33.

BOGDAN, Robert. C.; BIKLEN, Sari. Knopp. **Investigação qualitativa em educação**: uma introdução à teoria e aos métodos. Portugal: Porto Editora, 1994.

BORGES, Rita de Cássia Pereira. **Formação de formadores para o ensino de ciências baseado em investigação**. 2010. Tese (Doutorado – Programa de Pós-Graduação em Educação. Área de Concentração: Ensino de Ciências e Matemática) – Faculdade de Educação da Universidade de São Paulo, São Paulo, 2010.

CARVALHO, Anna. Maria. Pessoa. O ensino de ciências e a proposição de sequências de ensino investigativas. *In*: CARVALHO, Anna. Maria. Pessoa. (Org.). **Ensino de ciências por investigação**: condições para implementação em sala de aula. São Paulo: Cengage Learning, 2013. p. 1-20.

CARVALHO, Anna Maria. Pessoa; GIL-PÉREZ, Daniel. **Formação de professores de ciências**: tendências e inovações. 10. ed. São Paulo: Cortez, 2011. ISBN 978-85-249-1725-7.

CONCEIÇÃO, Joecléa Silva, *et al*. **A importância do planejamento no contexto escolar**. Faculdade São Luís de França. 2008. Avaliable on:https://portal.fslf.edu.br/wp-content/uploads/2016/12/A-IMPORTANCIA-DO-PLANEJAMENTO.pdf. Access on: 08 fev. 2022.

CORREIA, Marinêz Luiza. A formação inicial do professor: os desafios e tensões que a prática pedagógica impõe. **ANALECTA**, Guarapuava, v. 9 n. 2, p. 11-20, jul./dez. 2008. Avaliable on:https://revistas.unicentro.br/index.php/analecta/article/viewFile/1717/1546. Access on: 16 maio 2019.

FLORES, Maria Assunção. Algumas reflexões em torno da formação inicial de professores. **Educação**, Porto Alegre, v. 33, n. 3, p. 182-188, set./dez. 2010.

FLORES, Maria Assunção. Formação docente e identidade profissional: tensões e (des)continuidades. **Educação**, Porto Alegre, v. 38, n. 1, p. 138-146, jan./abr. 2015.

FLORES, Maria Assunção. Dilemas e desafios na formação de professores. *In*: MORAES, Maria Célia; PACHECO, José A.; EVANGELISTA, Maria Olinda (Org.). **Formação de professores**: perspectivas educacionais e curriculares. Porto: Porto Editora, 2004. p.127-160.

KLOSOUSKI, Simone Scorsim; REALI, Klevi Mary. Planejamento de Ensino como Ferramenta Básica do Processo Ensino-Aprendizagem. **Revista Eletrônica Lato Sensu** – Unicentro. v.5, p. 1-8, 2008. Avaliable on:https://docplayer.com.br/160057353-Planejamento-de-ensino-como-ferramenta-basica-do-processo-ensino-aprendizagem.html. Access on: 31 jan. 2022.

LIBÂNEO, José Carlos. Formação de Professores e Didática para Desenvolvimento Humano. **Educação & Realidade**, Porto Alegre, v. 40, n. 2, p. 629-650, abr./jun. 2015. Avaliable on:https://www.scielo.br/j/edreal/a/GB5XHxPcm79MNV5vvLqcwfm/?format=pdf&lang=pt. Access on: 08 fev. 2022.

LIBÂNEO, José Carlos. **Didática**. São Paulo: Cortez, 2017.

LIMA, Maria Socorro Lucena; PIMENTA, Selma Garrido. Estágio e docência: diferentes concepções. **Poíesis Pedagógica**, 3(3 e 4), 5–24. 2006. Avaliable on:https://doi.org/10.5216/rpp.v3i3e4.10542. Access on: 08 fev. 2022.

LÜDKE, Menga; ANDRÉ, Marli. **Pesquisa em educação**: abordagens qualitativas. São Paulo: EPU, 1986.

MARCONDES, Maria Inês; LEITE, Miriam Soares; LEITE, Vania Finholdt. A pesquisa contemporânea em didática: contribuições para a prática pedagógica**. Educação em Revista** [online]. 2011, v. 27, n. 3 pp. 305-334. Avaliable on:https://doi.org/10.1590/S0102-46982011000300015. Access on: 31 jan. 2022.

MORAES, Roque. Uma tempestade de luz: a compreensão possibilitada pela análise textual discursiva. **Revista Ciência & Educação** (*online*), [*s. l.*], v. 9, n. 2, p. 191-211, 2003. ISSN 1516-7313. Avaliable on:http://www.scielo.br/scielo.php?pid=S1516-73132003000200004&script=sci_abstract&tlng=pt. Access on: 08 jun. 2019.

NRC – National Research Council. **Inquiry and the national science education standards**: A guide for teaching and learning. 2000. Washington: National Academies Press.

NSF - National Science Foundation Inquiry. **Thoughts, views, and strategies for the K-5 classroom**. Foundations. 2005. v. 2. Avaliable on:https://www.nsf.gov/pubs/2000/nsf99148/pdf/nsf99148.pdf. Access on: 17 maio 2019.

NÓVOA, António (coord.)[a]. **Formação de professores e profissão docente**: "Os professores e a sua formação". Lisboa: Dom Quixote, 1992. ISBN 972-20-1008-5. Avaliable on:https://core.ac.uk/download/pdf/12424596.pdf. Access on: 16 maio 2019.

NÓVOA, António (Org.)[b]. **Vida de professores**. Lisboa: Dom Quixote, 1992.

PIMENTA, Selma *et al*. A Construção da Didática no GT Didática-análise de seus Referenciais. **Revista Brasileira de Educação**, Rio de Janeiro, v. 18, n. 52, p. 143-162, jan./mar. 2013. Avaliable on: https://www.scielo.br/j/rbedu/a/RFYZ7MKBRypV7WhmcFP34NP/?format=pdf&lang=pt. Access on: 31 jan. 2022.

ROCHA, Julciane. Design thinking na formação de professores: novos olhares para os desafios da educação. *In*: BACICH, Lilian; MORAN; José. **Metodologias ativas para uma educação inovadora**: uma abordagem teórico-prática. São Paulo: Editora Penso, 2017.

SANTOS, Paulo Jorge; MARTINS, Maria Felisbela. A universidade do Porto e a formação inicial de professores. **Revista Portuguesa de Investigação Educacional**, [*s. l.*], v. 16, 2016, p. 181-199. Avaliable on:http://www.fep.porto.ucp.pt/sites/default/files/files/FEP/RPIE/RPIE1608_AUniversidadePortoFormacaoInicialProfessores.pdf. Access on: 16 maio 2019.

SCHIEL, Dietrich; ORLANDI, Angelina Sofia. **Ensino de ciências por investigação**, [*s. l: s. n.*], 2009. Avaliable on:http://www.cdcc.usp.br/livros/2009-EnsinoCienciasInvestigacao.pdf. Access on: 17 maio 2019.

ZÔMPERO, Andréia de Freitas; LABURÚ, Carlos Eduardo. Atividades investigativas no ensino de ciências: aspectos históricos e diferentes abordagens. **Rev. Ensaio: Pesquisa em Educação em Ciências**, v. 13, n. 3, p. 67–80, 2011. Avaliable on:https://www.redalyc.org/html/1295/129521755005/. Access on: 31 jan. 2022.