

THE LEVELS AND NATURE OF PRE-SERVICE CHEMISTRY TEACHERS' REFLECTIONS IN A PUBLIC UNIVERSITY IN SOUTHERN BRAZIL

Sandro Lucas Reis Costa, Fabiele Cristiane Dias Broietti

Londrina State University, Brazil

E-mail: lucasrc_1995@outlook.com, fabieledias@uel.br

Marinez Meneghelo Passos

Londrina State University, Brazil

State University of Northern Paraná, Brazil

E-mail: marinezpassos@uel.br

Abstract

The development of teacher education focusing on reflective practice as well as the study of pre-service teacher reflections are educational concerns. This research seeks to categorize the levels and the nature of pre-service Chemistry teachers' reflections in a public university in Southern Brazil. For this, autoscopies of the pre-service teachers' microteachings were conducted in a supervised internship discipline. Data were collected through an open questionnaire and with the autoscopies of their microteachings. The analytical procedures were performed according to Content Analysis, from which the results show that the pre-service teachers engaged in three distinct levels of reflection: technical descriptions, deliberate reflections and critical reflections when thinking about their own microteaching experiences. By analysing the nature of the reflections, six categories emerged; reflections on: class planning; their teaching; the objectives; personal aspects; the autoscopies; and the students. The research results showed a low incidence of critical reflections, presenting the possible difficulty pre-service teachers had in this level of reflection. The Reflective Intervention proved to be useful for promoting reflections of the three levels of reflection, especially level 2 reflections, which consists of deliberate reflections. The results and analyses of this study contribute to the research in reflective teacher education in science, specifically in regards to a greater understanding of the levels and nature of pre-service teachers' reflections and the use of reflective interventions as an approach to promote critical and deliberate reflections in science teacher education.

Keywords: *autoscopy, reflection level, reflection nature, science teacher education.*

Introduction

According to Pimenta and Lima (2012), the supervised internship discipline allows pre-service teachers to analyse, discuss and reflect on the school and their future work environment. These are moments in which undergraduate students have the opportunity to face school reality supported by their experiences as students, the theories discussed during their education, their own conceptions about teaching and learning, their reflections during and after practices and all the skills developed in their academic trajectories.

For Almeida and Pimenta (2015, p.73), during the undergraduate course, knowledge, skills and attitudes that form the teacher begin to be built. In internship periods, this knowledge is signified by student interns through their personal experiences in direct contact with their

teaching experiences. Pimenta and Lima (2012) also pointed out that the supervised internship discipline can encourage students' reflective process, allowing analysis and elaboration of conceptions related to teaching and the challenges involved, that is, it can contribute to the elaboration of a better understanding of the school context.

This research sought to categorize the levels and nature of the pre-service Chemistry teachers' reflections; and to engage students in a Reflective Intervention consisting of a microteaching and an autoscopia to support the improvement of their teaching practice.

In order to guide such searches a research question was formulated: What are the levels and the nature of the reflections presented by the pre-service Chemistry teachers after performing the autoscopies of their microteachings?

Theoretical Foundation

Reflective Teacher Education

Day (1999) considered reflection essential for building and developing teacher capacities. Since the publication of *The Reflective Practitioner* in 1983 by Schön (1983), several studies aimed at training critically reflective practitioners, as seen in Power, Clarke and Hine (2002), have relied on Schön's considerations to discuss teacher education focusing on reflective practice. Schön (1983) refers to reflection-in-action as an 'art', by which professionals deal with situations of uncertainty, instability and uniqueness. According to Schön (1983, p.147), the practitioner has an interest in transforming the situation from what it is, to something he/she likes better. The practitioner also has an interest in understanding the situation, but in the service of his/her interest in change.

For Alarcão (1996), the movement of reflective teaching and reflective teacher education can be understood as a reaction against the view of the teacher as a mere technician or passive participant, present in the technocratic conception of education. In this sense, the reflective practice movement recognizes the teacher's active role in the construction of his/her work's purposes and allows the development of a new understanding of teaching that includes the teacher's theories (Cochran-Smith & Lytle, 1993).

Zeichner and Liu (2010) stated that the concept of the reflective teacher seems to recognize the expertise present in teachers' practice, which Schön (1983) defines as knowing-in-action. For the teacher, this is the process of understanding and improving one's teaching due to reflection on one's own experience and realizing that knowledge based solely on other's experience is insufficient.

According to Schön (1983), reflection-in-action is an active process in which doing and thinking are complementary. During reflection-in-action, some actions may trigger reflections and a subject's (investigator's) continuous conversation with his/her own situation, which may lead to a renewal of reflection, or a cycle of reflective inquiry (Colton & Sparks-Langer, 1993). For Moon (2013), although many teachers may reflect on their teaching practice, most teachers do not deliberately do so to allow progress in their thinking or action.

Levels of Reflection

Day (1999) proposed the existence of different levels or types of reflection. In literature these terms may vary, however, they describe the quality of reflections that move beyond descriptions or concerns with technical aspects to more critical or dialectical ways of reconstructing practice (Muir & Beswick, 2007). Based on considerations of theoretical frameworks used and adapted by other researchers (Alger, 2006; Day, 1999; Muir & Beswick, 2007), in the present study a similar theoretical framework was adopted (Table 1), in which: the

first column presents the names of the levels of reflection; the second column, explanations for each level; and, in the third column, two examples for each level of reflection for illustration purposes.

Table 1
Levels of reflection

Levels of reflection	Explanation	Examples
Level 1: technical description	The participant describes general situations or experiences of classroom practice, often focusing on technical aspects, without considering the value of experiences.	<i>I didn't ask enough questions.</i> <i>All students were able to do the task.</i>
Level 2: deliberate reflection	The participant identifies 'critical incidents' or specific situations and provides justification or an explanation for the action or behaviour.	<i>Johnny was very disengaged today - I think the question was very difficult for him; the way he was working with the area showed me that he was confusing it with the perimeter.</i> <i>I really wanted them to use the concrete materials because I felt they didn't have a good conceptual understanding of why the addition algorithm works.</i>
Level 3: critical reflection	The participant moves beyond identifying 'critical incidents' and providing explanations or justifications. The participant considers the perspectives of others and offers alternatives.	<i>I shouldn't have put him on the spot by asking him to explain what a square number was. He was clearly uncomfortable. Perhaps I could incorporate a 'think in pairs' strategy whereby students could talk to each other before sharing more publicly.</i> <i>I've always taught division that way, but I could see students' eyes get bored, I think there must be a better way - I need to make them more engaged in the process - maybe using concrete materials can help.</i>

Source: adapted from Muir and Beswick (2007, p.79).

Day (1999) suggested that not all teachers are at a readiness to engage in all levels of reflection but recommended that teachers should be involved in all levels of reflection throughout their careers. For Muir and Beswick (2007), reflection often occurs non-systematically or informally, either alone or with others who have not observed their practice. In order to achieve critical reflection, Day (1999) writes that other subjects are needed in this process. Thus, Muir and Beswick (2007) advocated the participation of a 'mentor' or critical friend in or out of school to assist in the systematic investigation of the practice and the improvement of the reflective process. Day's research (1998) revealed that teachers are often moved to look for ways they can change only when they realize that their personal solutions to classroom 'problems' are insufficient.

This research seeks to categorize the levels and nature of undergraduate students' reflections, collected through autoscopies of their microteachings, performed during the development of the supervised internship discipline of the Undergraduate degree in Chemistry Education. The levels of reflection proposed by Muir and Beswick (2007) were used as a priori categories to allocate students' reflections.

Research Methodology

Autoscopy and Microteaching

This research involved the reflections of 13 pre-service Chemistry teachers in the fourth year of an Undergraduate degree in Chemistry Education and the autoscopies of their microteachings. For Bourron, Chaduc, and Chauvin (1998, cited by Fernandes, 2004), autoscopy is a process that aims at self-observation and self-criticism, as it is characterized as an opportunity to diagnose pedagogical behaviours to improve. These researchers present autoscopy in five phases: preparation, development, visualization, analysis and synthesis. In preparation, a theme is selected and a lesson plan, containing objectives, content and strategies to be used, is constructed. In development, the student teaches his/her lesson and is observed by peers and the teacher trainer, while the lesson is video recorded. In visualization, the student watches the video recording of his/her lesson and confronts his/her own practice. At this point, the student can review attitudes and behaviours to perceive the more and less 'positive' aspects of the lesson. During analysis, analysis criteria are defined for the student to observe the lesson. Finally, in synthesis, the student identifies the aspects to improve in his/her teaching action and recognizes 'positive' and 'negative' aspects.

Microteaching involves simulating teaching practice in a learning environment. This technical resource is characterized as a moment to prepare student teachers to enter the classroom; a means to practice teaching; develop specific procedures for teaching; or reflect on practice. The resource can be used to test innovations, materials, and lesson plans. In microteaching, the student prepares and teaches a short lesson of about 20 to 30 minutes to his/her teachers and colleagues, who take the role of students. After the class, the teacher trainer and peers who observed the microteaching provide feedback to the student in order to rearrange actions based on the task initially proposed or to review the lesson plan (Sant'Anna, 1979).

Sample and General Background

The research participants were 13 pre-service Chemistry teachers in the fourth year of an Undergraduate degree in Chemistry Education from a public university in Southern Brazil. All research participants were students of the supervised internship discipline, offered in the fourth year of the course curriculum, which focuses on conducting activities related to teaching practice. The discipline was composed of 13 students. Therefore, the whole class participated in this research. Students were from urban, suburban and rural regions of the state; ranged from 20-25 years of age and had no prior teaching experience other than the teaching experience acquired during the internship discipline. Of the 13 students, seven were female and six were male.

In this discipline students participate in various teaching-related activities, both at the university and in the schools in which they develop their teaching practice. The activities were: i) discussion of texts at the university; ii) preparation and development of lessons (microteaching) with subsequent autoscopy of the class; iii) planning and development of experimental classes in schools; iv) planning and development of didactic sequences in schools.

Instrument and Procedures

This research focused on one of the activities performed - the reflection process made possible by the autoscopy of the microteaching activities. The microteachings were planned and developed individually, whereby each student prepared a 30-minute class, addressing a previously selected chemical content. At the teacher trainer's suggestion, these classes should

be designed using approaches discussed in previous disciplines, such as the CTSA approach (STSE - Science, Technology, Society and Environment) (Santos & Auler, 2011) and the Investigative Experimentation approach (Gil-Pérez & Valdés Castro, 1996; Newman et al., 2004).

After performing their autoscopies, students answered questions that composed a guiding script adapted from Arrigo (2015, p.122) for a Reflective Intervention, titled Reflective Intervention Questionnaire, which consists of nine items, as can be seen below.

After watching the video of your own lesson [autoscopy] and reflecting on your teaching, answer the following questions:

1. In planning, do you tend to think about content or objectives first? Explain.
2. What difficulties and facilities did you encounter in planning the lesson?
3. Were you nervous? When you finished the lesson, did you consider your objectives as achieved? Explain.
4. Do you consider that you have achieved the intended objectives? Explain.
5. Did the lesson occur according to what you planned? Did something unexpected happen? Explain.
6. Did you feel confident?
7. How was the lesson in your view?
8. How did you feel watching your own lesson?
9. Do you think the video contributed to your education? Explain.

For the data collection, the research followed the norms stipulated by the Ethics Committee in Research and obtained approval from the University's Ethics Committee.

Data Analysis

The students were coded from A01 to A13 and their answers were coded as AXX.Y.Z, of which AXX informed the student's code (for example: A01; ... A13), Y informed the question's code (1-9) and Z informed the analysed excerpt of the respective question (each answer was fragmented in order to reach greater understandings).

The analytical procedures were performed according to Content Analysis (Bardin, 2011) in order to analyse the reflections presented by the students when they performed the autoscopies of their microteachings. In this process, the semantic analyses through thematic categories were conducted. According to Bardin (2011), Content Analysis has as one of its main intentions the inference of knowledge concerning the conditions of message production. Bardin (2011, p.37) initially defined Content Analysis as a set of communications analysis techniques, not considered an instrument but a range of accoutrements; marked by a variety of forms and adaptable to a wide field of application: communications.

To complete the definition, Bardin (2011) discussed the existence of correspondences between semantic or linguistic structures and psychological or sociological structures, which are determinant in the characteristics of the analysed texts. Thus, Bardin (2011, p.48) later designates the term Content Analysis as a set of communication analysis techniques aimed at obtaining, by systematic and objective procedures, the description of the content of the message, indicators (quantitative or not) that allow the inference of knowledge regarding the conditions of production/reception (inferred variables) of these messages.

Bardin (2011) also discussed the relevance of the term 'conditions of production' and the many variables that it includes. The term 'conditions of production' is sufficiently vague to allow varied possibilities of inference: psychological variables of the individual, sociological and cultural variables, variables related to the communication situation or the context of message production (Bardin, 2011, p.46).

Thus, through the treatment of messages that the analyst manipulates, the analyst can infer knowledge about the writer of the message or the medium. In addition, Content Analysis is considered by Bardin (2011) as a set of communication analysis techniques that aims to overcome uncertainties and enrich the reading of the collected data.

In this research, in addition to the fragmentation and encoding described above, colour coding was used to facilitate visual identification, from which distinct colours identified the different types of reflections presented in the thirteen students' questionnaires. Categorization was performed in two movements. In the first movement the analysis of the nature of the reflections was done, i.e., what these students reflected on, such as reflections on: class planning; their teaching; objectives; personal aspects; autoscoping; and students. In this first movement the emerging categories, which were formed after reading the answers to the Reflective Intervention Questionnaire were used.

In the second categorization movement, the levels of reflection, proposed by Muir and Beswick (2007) were used as a priori categories in order to allocate the students' statements regarding the level of reflection presented (level 1: technical description; level 2: deliberate reflection; level 3: critical reflection). The allocation criteria were the descriptions of the levels of reflection presented by Muir and Beswick (2007) and the similarity of reflections' meanings to the researchers. In order to validate the categorization, the analyses were conducted by the three researchers individually and at the end the categorizations were compared, obtaining 90% of reliability.

Finally, in step 3, Treatment of results, inference and interpretation, the analyst must propose inferences and advance interpretations of the intended objectives (Bardin, 2011). In this study, the third step consisted of presenting results about the categorization of the reflections and discussing the similarities found among the reflections of the thirteen undergraduate students.

Therefore, the research involved three main phases. The first consisted of observing and recording the students' microteachings, the second of performing autoscopies and obtaining the answers from the Reflective Intervention Questionnaires and the third of analysing students' answers and categorizing the reflections presented.

Research Results

The first categorization movement consisted of classifying the reflections of the undergraduates according to their nature, i.e., what these undergraduates reflected on. These categories emerged during contact with the analysis material and the readings and rereadings of students' answers. The analysis assumed in this first movement was categorical, since the answers were fragmented into units, due to interpretative diversity, and later categorized according to analogical regroupings. Table 2 presents these emerging categories, the criteria used in this movement and examples of excerpts of these categories.

Table 2
Emerging categories related to the nature of reflections

Emerging categories	Criteria	Examples of excerpts
C1: Reflection on class planning	Reflections on lesson planning, lesson plan, lesson structure, material selection, i.e., all processes prior to lesson application.	[about class planning] <i>First I think about the content and then I adjust my objectives and what I find interesting to emphasize, because we can relate countless aspects to the student's context. I don't know exactly why I do this. I think it turns out to be easier to organize ideas. (A02.1.1)</i>
C2: Reflection on their teaching	Reflections on their teaching or teaching actions performed or not performed during the microteaching.	<i>It was a good class, but it lacked emphasis on the main concepts that students should know, after all, the content of my class is essential for understanding other content in chemistry. (A03.7.1)</i>
C3: Reflection on the objectives	Reflections on objectives or goals achieved or not achieved after performing their microteaching.	<i>By finishing class earlier than planned many of my objectives were not met. Regarding the overall goal, I believe that I defined nuclear reactions dynamically and interactively, but I would like to have related it to the treatment - radiotherapy, but this was not possible, because I finished class before the planned time. (A12.4.1)</i>
C4: Reflection on personal aspects	Reflections on their posture, language, emotions, anxiety, confidence and insecurity.	[if the student felt confident] <i>Yes, I felt confident throughout the class, even when I was questioned by my classmates, because that was the time to review all the planning of my class, discuss with people able to analyse not only the content covered, but all aspects, so that suggestions and criticisms would be heard and reflected on, aiming at my growth as a teacher. (A01.6.1)</i>
C5: Reflection on the autoscapy	Reflections on the characteristics and contributions of the autoscapy to initial teacher education.	[if the video contributed to his/her education] <i>Yes, because I had the opportunity to be a student in my own class and be able to learn more about my current posture as a teacher, which is very valuable in my future activities as a teacher, because I could critically analyse my own class. (A12.9.1)</i>
C6: Reflection on the students	Reflections on real school students or their classmates who participated in the microteaching as students.	<i>I also think that having applied the lesson at the university made classroom management easier, as students collaborated when dividing and returning to groups. Applying at school would require much greater management. (A04.7.3)</i>

The second categorization movement consisted of allocating student's reflections, according to their level. Muir and Beswick's levels of reflection (2007) were used as a priori categories to allocate the reflections. Table 3 contains the three categories defined a priori, criteria for each category and examples of excerpts that were allocated to these categories.

Table 3
A priori categories related to the levels of reflections

A priori categories	Criteria	Examples of excerpts
Level 1: Technical description	Descriptions of situations or general experiences of classroom practice. The descriptions are often based on technical aspects and don't consider the value of the experiences. Also, the reflections offer no justification or explanation for actions or behaviours.	[about the planning] <i>Usually when I start planning, I analyse the basic content and what content should be addressed. Then I weigh the objectives and from that I plan the order of the contents and the strategies to achieve the objectives.</i> (A08.1.1)
Level 2: Deliberate reflection	Reflections that include 'critical incidents' or specific situations and provide justification or explanation for the action or behaviour.	[about being anxious] <i>Yes, I was anxious, mainly because it was a moment of evaluation for me. But at some point, the class just gets easier, because I could see that I was in the right time I had set for each activity, and I was able to discuss the ideas and concepts the way I had planned.</i> (A05.3.1)
Level 3: Critical reflection	Reflections that move beyond identifying 'critical incidents' or specific situations and providing explanations or justifications. These reflections consider the perspectives of others and offer alternatives for actions or behaviours.	<i>When I was lesson planning, I already knew the content would be chemical kinetics, so I first chose what part of the content I wanted to address and then organized my objectives. But I think the two should be thought together, so that the goals integrate the content.</i> (A04.1.1)

In the following subsections some of the students' reflections are presented and their nature and levels discussed. The sections have been divided according to the emerging categories (C1-C6) in order to discuss each category individually. At least one excerpt representing a level 1, level 2, and level 3 reflection for each category is shown.

C1: Reflection on Class Planning

All undergraduates presented reflections of this nature and, in total, 35 reflections were allocated to this category. This number is high, when compared to other categories, and is related to questions 1 and 2 that specifically asked about planning, since, of the 35 reflections allocated to this category, 34 emerged from these questions. Table 4 presents the number of reflections of each level identified in category C1, which helps us to quickly observe at which level most of the reflections were allocated.

Table 4
Levels of reflections of category C1

Levels	Level 1	Level 2	Level 3	Total
Quantity	05	27	03	35

An example of a category C1 and Level 1 reflection is the answer from A08 when asked whether he/she thinks about content or objectives first during planning, A08 answered:

[about the planning] *Usually when I start planning, I analyse the basic content and what content should be addressed. Then I weigh the objectives and from that I plan the order of the contents and the strategies to achieve the objectives.* (A08.1.1)

A08 reflected on the planning and indicated the sequence of thought he/she believes to follow. This reflection was allocated to Level 1, as the student only described the sequence of thoughts during planning, without considering the value of the experience or presenting 'critical incidents' or specific situations. Similar to A08, all undergraduate students that were investigated indicated to think of the content before the objectives.

A01 also presented a reflection of nature C1, but Level 2:

The organization of the structure of the class, where the discussion of a given concept can fit in, when to let students think for themselves based on the teacher's speech, which activities are capable of leading the student to reflect critically on the subject, are obstacles I found in planning the class. (A01.2.1)

A01's reflection was allocated to category C1, as A01 reflected on several difficulties encountered during class planning. Difficulties in structuring the class, selecting activities and choosing moments for the discussion of concepts, i.e., specific processes prior to the class are indicated. Thus, the reflection was allocated to Level 2, as it presented specific situations and explanations for the difficulties encountered in class planning.

In category C1 there were also Level 3 reflections, such as A04's reflection:

When I was lesson planning, I already knew the content would be chemical kinetics, so I first chose what part of the content I wanted to address and then organized my objectives. But I think the two should be thought together, so that the goals integrate the content. (A04.1.1)

A04 reflected on class planning and indicated thinking first about the contents and then the objectives. The student justified the sequence of thought by writing 'I already knew the content would be chemical kinetics, so I first chose what part of the content I wanted to address.' A04 also highlighted an alternative to think about class planning, writing: 'But I think the two should be thought together, so that the goals integrate the content.' Therefore, this reflection was categorized as a Level 3 C1 reflection, as it moved beyond identifying a specific situation and providing explanations. A04's reflection highlighted an alternative to think about class planning - think about the contents and the goals together, so that the goals integrate the content.

C2: Reflection on Their Teaching

In C2 40 reflections from 12 students were allocated. Table 5 presents the number of reflections for each level in category C2.

Table 5
Levels of reflections of category C2

Levels	Level 1	Level 2	Level 3	Total
Quantity	15	14	11	40

A09, when asked if the lesson took place as planned, answered:

The class happened as I planned, but I ended up forgetting one of the geometric isomers.
(A09.5.1)

A09's answer was allocated to category C2 and Level 1, since the student reflected on his/her own teaching and believed that he/she conducted the class as planned. The student also indicated a 'critical incident' during teaching: 'I ended up forgetting one of the geometric isomers.' Nevertheless, A09 did not provide an explanation or justification to clarify why class went as planned. Therefore, this reflection was allocated to Level 1 by describing a general situation or experience of classroom practice.

A04, in the same question, answered the following:

It did not happen entirely as I had planned. According to my time planning, the class would end by the time students returned to their groups to conduct the discussion. However, because the groups were already formed at the beginning of the class, there was time left for the discussions about each experiment. (A04.5.1)

In this excerpt A04 reflected on how his/her teaching took place, realizing that it did not occur entirely as planned. The student explained: 'According to my time planning, the class would end by the time students returned to their groups to conduct the discussion.' A04 also justified how the teaching was conducted by writing: 'because the groups were already formed at the beginning of the class, there was time left for the discussions.' Therefore, this reflection was allocated to C2 and Level 2, as it contains explanations and justifications about specific situations.

A07's answer to the same question represents a Level 3 reflection:

[if class went as planned] *No, even during class I realized that I could have explored the content in more detail and examples, when I proposed the planning the time seemed appropriate, but during class it was clear that in relation to class time it would be possible to have worked differently.*
(A07.5.1)

A07 reflected on his/her teaching and believed that it did not occur as planned. A07 stated: 'I could have explored the content in more detail and examples.' The student also explained the difference between planned teaching and teaching that was accomplished, clarifying: 'when I proposed the planning the time seemed appropriate, but during class it was clear that in relation to class time it would be possible to have worked differently.' Thus, this reflection was allocated to Level 3, for presenting explanations for behaviour and alternatives for future teaching.

Other students (A04, A07, A08, A10, A12, A13) also commented on differences between practiced and planned teaching, such as A13:

The class took place partially as planned. There was an extrapolation of time and it was not possible to present the theoretical material I prepared in slides. I understood that this part could have been worked on in an upcoming class. (A13.5.1)

In this excerpt A13 indicated differences between planning and teaching and justified these by commenting on the lack of time. In addition, the student wrote: 'this part could have been worked on in an upcoming class.' Thus, the reflection was categorized as Level 3, as it not only identifies a specific situation and justifies it but presents an alternative for future actions.

C3: Reflection on The Objectives

All students presented reflections of this nature and 25 reflections were allocated to category C3. Table 6 presents the number of reflections of each level identified in C3.

Table 6
Levels of reflections of category C3

Levels	Level 1	Level 2	Level 3	Total
Quantity	06	16	03	25

A02, when asked if he/she was nervous during class and if the goals were achieved, replied:

Yes, very nervous. But I thought I was able to meet my goals. (A02.3.1)

A02's answer was allocated to C3 and Level 1 as it consists of a description of the general situation of classroom practice. Moreover, the answer did not consider the value of the experience, nor did it provide a justification or explanation.

However, A11, on the same question, answered:

[...] with the end of the class, I believe the objectives were achieved, as I was able to develop the initial/basic concepts of electrochemistry and oxidoreduction, so that the students could understand the formation of rust and the corrosion process. (A11.3.2)

The reflection highlighted above was allocated to category C3 and Level 2, since A11 reflected on the objectives set and believed that they had been achieved. A11 justified: 'I believe the objectives were achieved, as I was able to develop the initial/basic concepts of electrochemistry and oxidoreduction, so that the students could understand the formation of rust and the corrosion process.' Therefore, the reflection was allocated to Level 2 for presenting the specific objectives achieved and a justification for A11's thinking.

Level 3 reflections were also identified in this category, as represented by A03:

I believe I achieved the intended objectives in the lesson plan, but for a high school classroom, it would be more convenient to have given more emphasis on the desired concepts. I think I could have made a shorter list of exercises that could have been discussed in class. (A03.4.1)

A03 reflected on the intended objectives and critiqued his/her lesson: 'but for a high school classroom, it would be more convenient to have given more emphasis on the desired concepts.' A03 also stated that if the class was developed with high school students: 'I think I could have made a shorter list of exercises that could have been discussed in class.' Therefore, this reflection was allocated to Level 3, as it offers an alternative for future practices.

C4: Reflection on Personal Aspects

In this category, 37 reflections were identified from 13 students. Table 7 presents the number of reflections of each level in category C4.

Table 7
Levels of reflections of category C4

Levels	Level 1	Level 2	Level 3	Total
Quantity	15	22	00	37

Possible justifications for the lack of Level 3 reflections in this category are discussed later in this section.

A09's answer to Question 6 is an example of a Level 1 reflection:

[If the student felt confident] *Yes, throughout the whole class. (A09.6.1)*

In this excerpt A09 only provided a technical description of his/her emotional state during the class. The description is generic and does not consider the value of the experience. A09's answer also offers no justification for feeling confident or an explanation. Thus, the excerpt was allocated to Level 1.

Several students reflected on their emotional states during microteaching and indicated being nervous, insecure and/or anxious (A02, A03, A05, A07, A09, A10, A11, A12, A13). Some students related their nervousness to being evaluated (A03, A05).

A05's answer to Question 3 is presented below for discussion:

[about being anxious] *Yes, I was anxious, mainly because it was a moment of evaluation for me. But at some point, the class just gets easier, because I could see that I was in the right time I had set for each activity, and I was able to discuss the ideas and concepts the way I had planned. (A05.3.1)*

A05 reflected on his/her emotional state during microteaching and explained his/her feelings: 'I was anxious, mainly because it was a moment of evaluation for me.' A05 stated feeling calmer when realizing that the lesson occurred as planned and identified specific moments for these insights. Thus, this reflection was allocated to Level 2, as it included specific moments of reflection and provided an explanation for being nervous.

Other students indicated feeling confident and/or secure during their microteachings (A01, A04, A06, A08, A09, A11, A12, A13), such as A01:

[if the student felt confident] *Yes, I felt confident throughout the class, even when I was questioned by my classmates, because that was the time to review all the planning of my class, discuss with people able to analyse not only the content covered, but all aspects, so that suggestions and criticisms would be heard and reflected on, aiming at my growth as a teacher. (A01.6.1)*

A01 indicated feeling confident; identified a specific situation - when being questioned by classmates; and understood the value of the after-class discussions, since the questions served for reflection and growth. Thus, this reflection was allocated to Level 2, for presenting specific situations and offering explanations.

Other students (A09, A11, A12, A13) indicated moments of security and insecurity, certainty and uncertainty, tranquillity and nervousness, that is, a combination of emotions. For example, in Question 6, A09 answered:

During the Initial Problemization and Knowledge Organization [Specific steps of the Three Pedagogical Moments] I felt secure because of the thorough preparation and planning of the class. However, in the Application of Knowledge, insecurity was present, and I let it show, due to some questions made by students. Example: Teacher, what is the explanation for the water being boiled? (A09.6.1)

A09 justified feeling secure due to the thorough preparation and planning, and feeling insecure afterwards in the class, stating: 'I let it [insecurity] show, due to some questions made by students.' The reflection was allocated to Level 2 for indicating specific situations and offering explanations and justifications for A09's feelings.

Most of the reflections allocated to category C4 originated from Questions 3, 6 and 8. The quantity of reflections of this nature is high when compared to other categories, and shows the value of the Reflective Intervention in promoting reflections on personal aspects, mainly due to Questions 3, 6, and 8.

Level 3 reflections were not identified in this category. This can be related to the very nature of category C4: Reflection on personal aspects. For a reflection to be considered critical, that is, belonging to Level 3, it must 'consider the perspectives of others and offer alternatives for actions or behaviours.' Students offered alternatives to their actions or behaviours in other categories using terms such as 'could', 'could have', 'should', 'should have', 'would have done better', 'would have been more convenient to have done', 'I must' etc. However, these terms were not identified in reflections of category C4. Reflections in which alternatives were presented also were not identified.

C5: Reflection on The Autopsy

In this category, 16 reflections from 13 students were identified. Most of the reflections originated from Question 9, which specifically questioned the contributions of the autopsy. Only 02 reflections of the 16 originated from other questions. Table 8 presents the number of reflections from each level identified in category C5.

Table 8
Levels of reflections of category C5

Levels	Level 1	Level 2	Level 3	Total
Quantity	05	09	02	16

An excerpt from A02 is presented below for discussion:

[if the video contributed to their education] Since the beginning of the discipline I was anxious about this video, but I think it adds a lot to our self-assessment. (A02.9.4)

A02 considered that the video contributed to his/her teacher education, in the sense of adding to self-assessment, but only cited a contribution from autopsy and did not indicate specific situations in which it occurred. The student did not provide an explanation or justification for his/her thinking either. Therefore, the excerpt was allocated to Level 1.

A11 also reflected on the autopsy but the reflection was allocated to Level 2.

[...] *I found the video analysis fundamental to my academic and personal education as it enables self-assessment and observation of errors and accomplishments. This activity also makes it possible for students to improve their classes.* (A11.8.2)

A11 reflected on the autoscapy and considered it fundamental: 'I found the video analysis fundamental to my academic and personal education', that is, the student reflected on the value of the autoscapy experience. In addition, the student justified his/her thinking by stating: '[autoscapy] enables self-assessment, and observation of errors and accomplishments.' Thus, this reflection was allocated to Level 2, as it presented justifications for A11's thinking and identified the value of the autoscapy experience.

A05 presented a Level 3 reflection:

[...] *I can say that watching the video brings expectations about what could have been improved, what could continue the same way, which moments could have been faster, or slower. And expectations like these end up forming professionals who think about their own work, how to improve and how to continue facilitating the work, always achieving the necessary goals.* (A05.9.1)

A05 identified specific moments that could have been better conducted, explaining that there were moments when the class could have been conducted faster or slower, continued in the same way, and improved. Thus, the autoscapy allowed A05 to perform a critical analysis of the class. Then, the student stated: 'expectations like these [promoted by autoscapy], end up forming professionals who think about their own work, how to improve and how to continue facilitating the work, always achieving the necessary goals.' Thus, this reflection was allocated to Level 3, as A05 considered the value of the autoscapy experience, offered an explanation, and presented a critical view of his/her microteaching.

Some students (A09, A11, A12) reflected on the autoscapy and identified themselves as teachers. These students used terms such as 'as a teacher', 'as a future teacher' and 'my future activities as a teacher'. 03 of these reflections were identified and the low incidence is associated with the profile of the research subjects, who are teachers still in initial teacher education. Thus, many students do not yet see themselves as teachers, so they still assume the strategic role of the student.

Here is an excerpt from student A12 answering Question 9:

[if the video contributed to their education] *Yes, because I had the opportunity to be a student in my own class and be able to learn more about my current posture as a teacher, which is very valuable in my future activities as a teacher, because I could critically analyse my own class.* (A12.9.1)

In the excerpt: '[the autoscapy allowed me] to learn more about my current posture as a teacher, which is very valuable in my future activities as a teacher,' A12 identified the value of the autoscapy for his/her future activities as a teacher. Besides this, A12 had already identified himself/herself as a teacher in the excerpt: 'my current posture as a teacher.' Therefore, the reflection was allocated to Level 2, as it identified the value of the autoscapy and offered an explanation of its contributions.

C6: Reflection on The Students

In this category, 04 reflections from 04 students were identified. Table 9 presents the number of reflections of each level identified in category C6.

Table 9
Levels of reflections of category C6

Levels	Level 1	Level 2	Level 3	Total
Quantity	01	02	01	04

The low incidence of reflections of this nature can be related to the fact that a microteaching experience was conducted, that is, a class simulation, from which the undergraduate students were not developing activities with real high school students. Nevertheless, some students (A04, A12) referred to the high school student.

[about the his/her own lesson proposal] *I think it is an interesting proposal to work in high school, as it allows the student to play an active role in the educational process, as well as allowing cooperative learning. However, I think this proposal may become limited in view of the reality of different classes, I think I could not apply it in the class I developed the internship, for example. I also think that having applied at [University] made classroom management easier, as students collaborated in times of dividing and returning to groups, applying at school would require much greater management.* (A04.7.2)

A04 reflected on the high school students and their receptiveness to his/her teaching proposal. The student believed that the proposal could contribute to high school students: '[the proposal] allows the student to play an active role in the educational process, as well as allowing cooperative learning.' A04 also reflected on the school reality, in particular, about his/her high school class in the supervised internship discipline and said: 'I think I could not apply in the class where I developed the internship', that is, the student criticized his/her proposal in view of the school reality. Subsequently, the student stated: 'applying at school would require much greater management.' Again, A04 critiqued his/her proposal and suggested an alternative to developing it in high school classes – 'greater management'. Thus, this reflection was allocated to Level 3, for explaining his/her thinking and proposing an alternative to his/her action.

Other excerpts refer to classmates, who participated as students during the microteaching. A03 wrote:

I hoped the students would have interacted more, especially during the explanation of engine operation, however, this did not compromise the approach. (A03.5.1)

A03 reflected on the students and indicated having higher expectations regarding the interaction with the class, highlighting a specific moment when this occurred - 'during the explanation of the engine operation', but A03 did not offer an explanation for this thinking nor did he/she justify the lack of interaction. Therefore, the excerpt was allocated to Level 1.

A12 also referred to classmates, who participated as students during the microteaching, though his/her reflection was allocated to Level 2:

If the class had been done in high school, I would have continued, but since the students had a degree in chemistry, I felt very bothered and decided to finish the class earlier than planned. (A12.3.2)

A12 reflected on the students, which were fellow classmates in the undergraduate degree in Chemistry education. A12 comments that if the class 'had been done in high school' he/she would not have finished it earlier than intended. Thus, this reflection was allocated to Level 2 for offering an explanation for A12's behaviour.

Discussion

Table 10 shows the total number of reflections identified and the number of reflections allocated to the emerging categories related to the nature of the reflections.

Table 10

The number of reflections allocated to the emerging categories

Emerging Categories	Quantity
C1: Reflection on class planning	35
C2: Reflection on their teaching	40
C3: Reflection on the objectives	25
C4: Reflection on personal aspects	37
C5: Reflection on the autoscapy	15
C6: Reflection on the students	04
Total	156

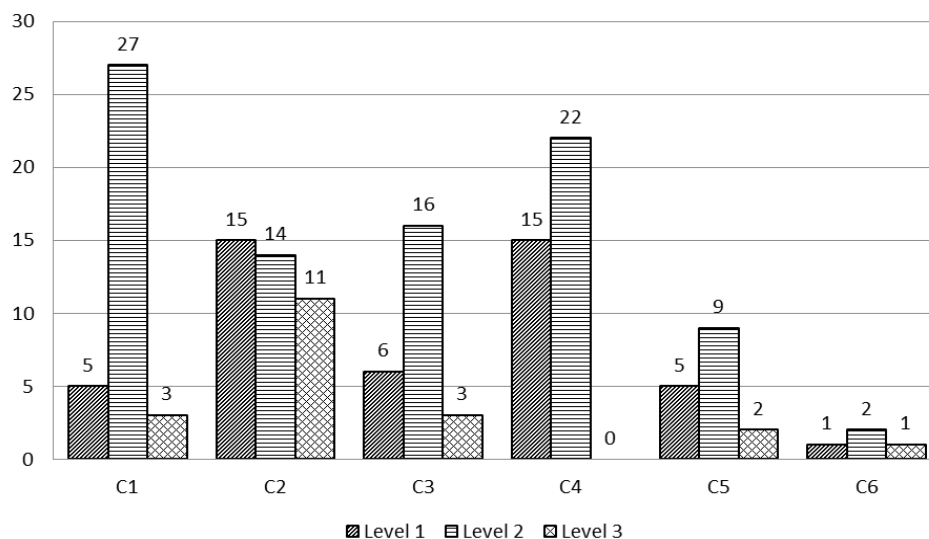
As seen in Table 10 there were a greater number of reflections in the categories C2: Reflection on their teaching, C4: Reflection on personal aspects, and C1: Reflection on class planning, respectively. The high incidence of these reflections is related, in part, to some questions of the Reflective Intervention Questionnaire. Regarding category C1, for example, the questionnaire contains two questions about class planning (question 1 and question 2), from which 34 of the 45 reflections emerged.

In analysing the high incidence of reflections from category C2, the questionnaire contains two questions about the lesson, question 5 and question 7. Of the 40 reflections in this category, 28 emerged from these questions. To justify the large number of reflections in category C2, discussions of other researchers such as Bourron, Chaduc, and Chauvin (1998 cited by Fernandes, 2004) can be used. According to the cited authors, autoscapy is considered a process that allows self-observation and is characterized as an opportunity to diagnose pedagogical behaviours to improve. Therefore, the majority of reflections were allocated to C2 due to the autoscapy's main focus, which is on pedagogical aspects such as the teaching observed during the autoscapy. In the process of autoscapy, each student watches their class and is confronted with their own practice, as an opportunity to review their attitudes and behaviours, and to perceive the more or less 'positive' aspects (Arrigo, Lorencini Jr. & Broiotti, 2017). In fact, students reflected on these aspects of their microteachings. Thus, the greater number of reflections categorized as C2: Reflection on teaching, can be justified due to the specific characteristics and objectives of the autoscapy itself.

Students presented fewer C5 reflections: Reflection on the autoscapy and C6 reflections: Reflection on the students. The low incidence of reflections of category C6 can be understood by the context of the classes. The students prepared and developed microteachings to their teachers and colleagues, the latter performing the role of students. Therefore, the lower number of reflections in C6 may be related to the fact that undergraduate students were not developing activities with high school students.

Regarding the levels of the 156 reflections, 47 reflections were allocated to Level 1; 90 reflections were allocated to Level 2 and 20 reflections were allocated to Level 3. Next, Figure 1 is presented with the information regarding the levels of reflection for each category.

Figure 1
The levels of the students' reflections



From the graph, some trends can be observed. 57% of the total reflections made by the undergraduate students were Level 2; 30% were Level 1; and only 13% were Level 3. Therefore, the Reflective Intervention promoted reflections, mostly of Level 2, which consist of reflections that students identified 'critical incidents' or specific situations and justified or explained their actions or behaviours. According to Muir and Beswick (2007), reflections that move students beyond the report of mere technical descriptions or accounts promote teachers to perceive that personal solutions to some classroom 'problems' are insufficient, and promotes other levels of reflection in which students are moved to search for change. In this sense the Reflective Intervention potentiated Level 2 reflections, especially in regard to their teaching, class planning and personal aspects.

Most of the Level 3 reflections were allocated to category C2. In these reflections, the students considered other people's perspectives, being their colleagues, high school students or teachers, and suggested alternatives for their own actions or behaviours. The high incidence of Level 3 reflections in category C2 results largely from students' critiques of their own teaching practices about specific moments and the presentation of alternatives or possibilities for their future teaching experiences. Alger (2006) used different strategies such as interviews and teaching cases to identify critical reflections (Level 3) in pre-service teachers and identified evidence of critical reflections in two of the nine students during the analysis of their teaching cases. On the other hand, six students did not present critical reflection during any of the teaching cases or interviews (Alger, 2006). In this research, with the use of the Reflective Intervention, nine out of the 13 pre-service teachers presented critical reflections. Critical reflections were on various aspects of their teaching experiences, such as class planning, their teaching, the objectives, the autopsychography, and the students. According to Alger (2006) critical reflections promote thinking about multiple perspectives and contexts of teaching, which in this research was visible in the Level 3 reflections allocated to categories C1, C2, C3, C5, and C6 since students considered the perspectives of others and contexts outside of their microteachings.

The results of this research are also related to the context in which the Reflective Intervention was developed. According to Power, Clarke and Hine (2002) there are several factors in internship experiences that can contribute to reflective teaching, such as the extended

professional experience and group meetings. This corroborates with the results of this research since the supervised internship discipline was carried out in one year and provided students the time to reflect and act professionally as well as included group discussions between the students, their peers and the teacher trainer after the microteachings.

Conclusions and Implications

Given the results presented and the resumption of the research question: What are the levels and the nature of the reflections presented by the pre-service Chemistry teachers after performing the autoscopies of their microteachings? In the process of engaging in the autoscopies of their microteachings, students reflected on six aspects: class planning; their teaching; the objectives; personal aspects; the autoscopies; and the students. Most of the reflections' nature was allocated to categories C2: Reflection on their teaching (26%); C4: Reflection on personal aspects (24%); and C1: Reflection on class planning (22%). Regarding the levels of reflection, students reflected about their microteaching on three levels, through: technical descriptions (30%); deliberate reflections (57%); and critical reflections (13%).

The Reflective Intervention and the after-class discussions, held individually, proved to be useful for promoting reflections of the three levels of reflection, especially level 2 reflections, which consist of *deliberate reflections* whereby students identified specific situations or critical 'incidents' and presented justifications or explanations for their actions or behaviours. Thus, the relevance of the Reflective Intervention guided by the autoscopies of the pre-service teachers' microteaching to enable reflections that move beyond mere descriptions of the educational processes or concerns with technical aspects of teaching practice can be noted.

The low incidence of level 3 reflections (13%) presented the possible difficulty pre-service teachers had in reflecting beyond 'critical incidents' in order to consider the perspectives of others and to offer alternatives for future teaching experiences. For many of the students, this was their first contact with autoscopies and a Reflective Intervention, which promoted an opportunity in their initial teacher education for a greater understanding and assessment about specific aspects of their teaching. In addition to this, from the analysis of the reflections, students articulated and organized their thoughts and perceptions regarding their own microteachings; questioned and critiqued specific aspects and moments of their practices; and reflected about their decisions made during class planning, their actions and behaviours during microteaching, the intended objectives, personal aspects, characteristics of the autoscopies process and high school students or their own classmates. Finally, the importance of the levels and nature of teachers' reflections as approaches to study reflection in other educational contexts can be emphasized, such as teachers' reflective diaries, reflective interactions between teachers and students and during in-service teacher education, for example.

The future research about the levels and nature of teachers' reflections can be carried out by other researchers related to the results of this study. The teachers' difficulties in engaging in critical reflections need to be revealed in detail. Utilizing teachers' known difficulties research can follow up and determine strategies, such as other Reflective Interventions, that can be used to overcome them. To identify whether teacher education has been carried out to integrate reflective practice is also important. In addition, research related to the development of teachers' ability to *deliberately* and *critically reflect* starting from initial teacher education needs to be conducted, so that there is comprehensive progress starting from classroom observation in teaching practice. These studies can then serve as references for policies to develop teacher education focusing on reflective practice.

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Sandro Lucas Reis Costa (Corresponding author)	Masters Student, Science Teaching and Mathematics Education (PECEM) program, Londrina State University, Londrina, Brazil. E-mail: lucasrc_1995@outlook.com ORCID: http://orcid.org/0000-0003-4199-9810
Fabiele Cristiane Dias Broietti	Doctor, Professor, Science Teaching and Mathematics Education (PECEM) Program, Londrina State University, Londrina, Brazil. E-mail: fabieledias@uel.br ORCID: http://orcid.org/0000-0002-0638-3036
Marinez Meneghello Passos	Doctor, Professor, Science Teaching and Mathematics Education (PECEM) Program, Londrina State University, Londrina, Brazil. E-mail: marinezpassos@uel.br ORCID: http://orcid.org/0000-0001-8856-5521