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HIGH SCHOOL CHEMISTRY TEACHER TRAINING: “BEHIND”, “IN” OR “BEYOND” TECHNICAL RATIONALITY?

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Abstract: This research arose from the need to reflect on the nature of teacher training in a chemistry degree course at a public university, from the perspective of undergraduates. The analysis of the nature of said training was based on the conception of Contreras (2002), specifically on ideas related to technical rationality, practical rationality and the training of teachers as transforming intellectuals. A qualitative study was carried out, using a semi-structured questionnaire as a data collection instrument. The study included 22 students graduating from a chemistry degree course at a public university in São Paulo. Data were analyzed based on Content Analysis, in correlation with ideas taken from Contreras (2002). The research made it possible to understand the perspective of training carried out in the university space in the conception of undergraduates, in order to conclude that the pedagogical training of these students is fragile, below technical rationality.

Keywords: Teacher education. Chemistry teaching. High school.

INTRODUCTION

When we think about the elements that support the quality of education, we can list: the curriculum, the professional career plan, the infrastructure conditions of the school space, the actions of the management team, the educational public policies in a given government, the demands arising from of the society in which the school is inserted and teacher training. In this article, we will talk about teacher education at the university, having as reference the perception of the undergraduate student, since the analysis of teaching work is an indispensable aspect to achieve quality education (OLIVEIRA; ARAÚJO, 2006).

The teacher is responsible for the pedagogical mediation process. Currently,

knowledge is available in books, magazines, newspapers, social networks. Among the challenges of teaching, it is necessary to work with students so that they deal with this repertoire of information in a critical, articulated and reasoned way (GONZÁLEZ; MARTÍNEZ, 2018). We can cite the case of the pandemic which, in 2020, demanded that it be imperative for the citizen to consider that reading, writing and mathematical knowledge alone were not enough to understand the confluence of the phenomena that involved it. Scientific knowledge is also a relevant resource for society to be able to develop a reading of nature and the recurrent consequences of human actions.

Therefore, commitment to teacher training aligned with the construction of a democratic, inclusive, socially and environmentally responsible school is required. The act of teaching can be understood as: "... a profoundly political activity, committed to the formation of an active citizenship and the construction of a fairer, freer and, therefore, more humane society." (FANFANI, 2007, p. 351, our translation).

We experience a dichotomy in education, as highlighted by Libâneo (2012). What we have is a school fragmented into two opposing perspectives: one for the poor and the other for the rich. The school for the poor has its origins in the World Declaration on Education for All, proposed in 1990. In this line, the school must prioritize attention to differences and the social integration of students. We are not denying the social role of the school, the point is that this line puts access to culture, science and knowledge produced by humanity in the background - prioritized in the school of those with greater purchasing power. For the less favored, the school is in line with the perspective of exclusive inclusion, not fulfilling the principle that, initially and theoretically, justifies its existence. Schooling

is defined according to classes, as Kuenzer (2000) points out, something to be overcome when discussing the type of society we need:

[...] a society in which young people can exercise the right to be different without this constituting inequality, in such a way that the choice for an educational and professional path is not socially determined by class origin. (KUENZER, 2000, p. 27).

Libâneo (2012) points out that we have a school for the rich, essentially based on knowledge, learning and technologies. A school whose curriculum is aligned with training young people so that they have access to universities, generally public ones. To satisfy the perspective of maintaining the *status* of a school for the rich and a school for the poor, there is also a similar perspective regarding the teacher training process that is attentive to the interests of the World Bank. This situation contributes to the emergence of a reductionist conception of the teacher training process.

In the same way that a survival skills kit is offered to students, the teacher is offered a teaching survival kit (training in methods and techniques, use of textbooks, training through EaD). The World Bank's position is for the streamlined training of a part-time teacher, aiming to lower the costs of the training/training/salary package. (LIBÂNEO, 2012, p. 20).

The focus is on the materialization of diplomas and certificates to meet the short-term interests of the labor market. In this case, it is only interesting to endorse a mass of teaching workers with no clear concern for the quality of training in terms of the contents of the areas of knowledge and pedagogical knowledge. This scenario of inequality regarding the role of the school and of fragility in teacher training causes damage to the advancement of the quality of Brazilian education. A clear example in this sense is the articulation between the current secondary education reform, in which there

is an emphasis on the National Common Curricular Base (BNCC) and the legislation for teacher training, represented by Resolution nº 2, of December 20, 2019, which defines the National Curriculum Guidelines for the Initial Training of Teachers for Basic Education and establishes the National Common Base for the Initial Training of Basic Education Teachers (BNC-Training).

In this context, when we think of offering quality education, we must turn our attention to the socially less favored, so that the right to access and permanence in the school space, as recommended by the Constitution (1988), is met. For this to become viable, it is necessary to have a solid, adequate initial and continuing education, adequate to the social demands and aspirations of young people, constituting a bridge for the advancement of Brazilian society.

Anyone who defends the democratization of education cannot refuse, cannot criticize the quality of students at our school. The precarious performance of our school is a fact of our national reality. We can't change the population: that's not possible, that's our population. We need to make the school respond to this population. (BEISIEGEL, 2005, p. 117).

From this background, it is important to think about the structuring and development of educators' knowledge. A quality education is intrinsically related to the quality of teacher education. We need to reflect on how much training courses have provided future teachers with conditions to overcome their horizons and their possibilities of acting in the school environment. Teaching knowledge, ideally, must not be imbued with perspectives based on technical rationality, technicism and traditional methods of transmission.

It is vital to form a critical-reflective professional, in the perspective of Contreras (2002). Faced with all these previously mentioned problems and confluences in which

teaching work is immersed, this research begins to discuss the following question: do teaching degrees form reflective teachers or are we tied to the anachronistic perspective of technical rationality? An undergraduate course in Chemistry was investigated to understand some elements about the training process based on the voice of undergraduates. The interest was to understand how “teachers are leaving the course” and, from that point, to reflect on teacher training.

The research sought to reveal the following themes: 1- the students’ intention to be teachers; 2- the intention of teaching after the conclusion of the course; 3- mastering pedagogical knowledge to teach; 4- the interdisciplinarity between the specific knowledge of Chemistry and the didactic-pedagogical knowledge and 5- suggestions to improve the formative processes in the university.

TEACHER EDUCATION UNDER THE AEGIS OF TECHNICAL RATIONALITY AND PRACTICAL RATIONALITY: GENERAL CONSIDERATIONS

Thinking about the formative aspects of teachers is, above all, providing opportunities for reflection on the school space in a wide spectrum of vicissitudes engendered by historical, political, social events that reverberate in social constructions. The school lives in times of ultramodernity, however, it presents traits and pedagogical perspectives built in the last century to serve students of our times.

Education can be interpreted as a public policy. The teacher consists of a social actor capable of materializing propositions and projects of different governments. Teachers can be interpreted as transformative intellectuals.

Transformative intellectuals need to develop

a discourse that unites the language of critique and the language of possibility, so that educators recognize that they can bring about change. This way, they must speak out against economic, political and social injustices inside and outside schools. At the same time, they must work to create the conditions that give students the opportunity to become citizens who have the knowledge and courage to fight so that despair is unconvincing and hope is viable. (GIROUX, 1997, p. 163).

From this reflection, it must be understood that the role of the school is not restricted to the transmission and construction of curricular knowledge that is plastered, inert and disconnected from social phenomena. The school contributes to legitimize social practices as it represents forms of knowledge, incorporates internal and external power disputes and redefines the line of past and future through the confluence of pedagogical practices.

When teachers take ownership of the proposition of the “transforming intellectual being” we will be able to offer an education from a popular and democratic perspective, in a perspective close to Freire (1992). As previously mentioned, the quality of education is intrinsically linked to the teacher.

It is essential to emphasize the importance of the teacher’s role in quality education. There is no quality education without a quality teacher. And, from the civil-democratic perspective, a quality teacher is a well-educated, motivated professional, with continuing education based on practical problems, carried out mainly at the school itself, who actively participates in the political-pedagogical project, who thinks about their practice. **He is the intellectual, critical-reflective teacher** (DI GIORGI, LEITE, 2010, p. 320, grifo nosso).

It is essential that teachers reflect on their practice, as such action allows planning, re-planning, defining and redefining the way in

which they conduct the teaching and learning processes. In this context, it is inevitable to conceive the teaching process also as an act of research and to extend the investigative perception imbued to teaching (ROLDÃO, 2007). The teacher can even be defined as a democratizing agent. It is known that public policies in their legislative, normative, pedagogical characteristics and in areas of educational planning influence professional action. At this point, Rua (1998) interprets the teacher as an agent who executes public policies, as he has direct contact with the target public of the government's educational proposals and projects. It is necessary to promote actions to promote the formation of critical-reflective teachers to develop contextualized, democratic, inclusive pedagogical actions that allow the appropriation of knowledge.

The perspective of technical rationality, for Contreras (2002), originates from scientism and positivism. This strand assumes that professional action is based on instrumental problem solving through the application of theoretical and technical knowledge. In addition, it characterizes professional practice to the application of available means for defined purposes.

The fundamental aspect of professional practice is defined, therefore, by the availability of an applied science that allows the development of technical procedures for the analysis and diagnosis of problems and for their treatment and solution. Practice would presuppose the intelligent application of this knowledge to the problems faced by a professional, with the aim of finding a satisfactory solution. (CONTRERAS, 2002, p. 91).

In this regard, Contreras (2002) noticed three principles related to the knowledge obtained through technical rationality: component of science or basic discipline on which the practice is supported and developed; applied science or engineering,

source of diagnostic and problem solving strategies and, finally, component of skill and attitude that is related to acting at the customer's service, having the two previous ideas as support. Technical rationality alludes to three problems: the hierarchical relationship between practice and theory, the idea of considering professional practice as the application of procedures and technical means to achieve ends, and considering that these ends are defined.

It is understood that the pedagogical practice must involve the idiosyncrasies of school spaces. Practices that do not consider this fact easily put themselves at the service of perspectives that may not match the educational needs they must care for. Still, one must not neglect:

In the field of education, the lack of technical application of much of pedagogical knowledge, together with the ambiguous and sometimes conflicting nature of its ends, has led to considering teaching as a profession only in a very weak and limited sense.. However, the acknowledgment of this limitation did not imply a renunciation - in a large part of research, administration and educational practice - to the aspiration and practice of teaching as a profession based on the application of techniques derived from specialized knowledge, that is, as a professional practice conceived from the perspective of technical rationality. (CONTRERAS, 2002, p. 95).

Conceiving teachers as mere applicators of pre-established techniques and methods submits them to researchers - knowledge producers - leading to dependence on material that may not correspond to their projects, pedagogical perspectives and articulation with a given school space. Therefore, defending a view intrinsically linked to technical rationality consists of relating this model to a productivist conception of education. This perception of professional practice received criticism from Contreras (2002) as, when trying to apply

techniques based on pre-established problems and situations, one ignores the multiplicity of factors in a classroom, as well as the following situations: the nature of the problem, the objective in a given situation, what and how it can be done, the individuals involved. These are situations that cannot be defined through a technical repertoire, but based on observation and reflection.

Teaching needs to be seen as:

[...] a practical activity, which requires creativity, intuition and improvisation from the teacher to satisfactorily resolve the situations they face. However, once this aspect has been identified, his proposal addresses the need for a scientific component in which teachers can support their artistic work, knowledge of the regular and stable relationships between variable events that occur in teaching practice. (CONTRERAS, 2002, p. 23).

Another perspective to be highlighted is practical rationality, which is directly opposed to technical rationality. While the productive activity is guided by means of the techniques and knowledge produced by the researchers, the reflective and deliberative attitude in relation to human beings is directed to the good. Practical rationality could be the concept adopted when there is the development of problems of a moral nature, allowing to differentiate the intrinsic actions of individuals. It involves reflective vicissitudes to define and redefine possibilities, given the surprises that affect teachers during pedagogical practice. Contreras (2002) stated that practical knowledge is necessary, as it flows with the knowledge of the theoretical foundation. It is essential to highlight that experience alone does not contribute to teacher training, as it only expresses meaning for teaching action when it is accompanied by pedagogical arguments that support actions. Otherwise, there is an imminent risk of educational practices being referenced by

common sense.

[...] education cannot be determined from the outside. It is the teaching professionals themselves who, ultimately, decide the way in which they plan their classes, through which attempts at external influence are transformed into practices that do not always have much to do with the essence of the intended changes. However, it is not just a matter of impossibilities. It is also a matter of conviction which is deduced from the arguments of practical rationality. It is only possible to develop practices that have the qualities of education based on the decision and autonomous judgment of those who are really responsible for them, because, in a fully Aristotelian sense, what refers to educational values cannot be resolved on the margins of practice in which they are sought. Only those who practice and only in practice can educational values be realized while trying to ask about their meaning. (CONTRERAS, 2002, p. 130).

Finally, the author states that it is not pertinent to expect teachers to apply decisions that they have not made. Sensitivity to the characteristics of each proposition is important, taking into consideration, the objective of provoking student learning. Currently, neoliberal interventions in education have given full focus to results through external evaluations or platform results and sometimes delegate specific interventions based on the reality of the school space to another plan. One sees the image of an education that suffers the reflection of the actions of the World Bank:

Thus, by all indications, the World Bank reinforces learning outcomes, regardless of structural and physical issues in schools. Likewise, it reinforces the defense of enhancing teaching work by increasing the number of students in the classroom, aiming at reducing education costs. The idea of “lifelong learning” supports the concept of employability. In this case, the World Bank argues that the increase in productivity of the poor occurs through the acquisition

of skills and competences (GUERRA, FIGUEIREDO, 2021, p. 14-15).

It is imperative that the teacher reassume the leading role in teaching, as it is a significant foundation for democratic management. Based on these considerations about technical rationality, the intention was to build a backdrop to analyze the process of teacher training in a chemistry degree course, from the perspective of undergraduates.

METHODOLOGY

It is pertinent to recall that the intention of this work was to reflect on the training process of teachers in order to seek elements that allow thinking about how the training of students in a chemistry degree course has been. For this, the research carried out followed the qualitative approach, using as data collection the application of questionnaires with 22 subjects concluding the mentioned course, in a public university in São Paulo. The use of questionnaires promotes impersonality to the research and facilitates the participation of the subjects. However, the application of questionnaires presents an impasse, which are the doubts that eventually arise while respondents fill them out. Therefore, at the time of the application, the researchers were present in the classroom.

Qualitative research was used, as it is concerned with the processes that the subjects describe, not just with the result. As the focus is to understand the formative process of undergraduates, there was an effort to seek meanings in the elements that the respondents brought, to permeate the reflection.

It refers to being this way of approaching the constitution of knowledge on social and educational matters. To offer a possible answer (and not the answer), it must be taken into account that the term Qualitative Research refers to a wide range of perspectives, modalities, approaches, methodologies, designs and techniques used

in planning, conducting and evaluating of studies, inquiries or investigations interested in describing, interpreting, understanding, understanding or overcoming social or educational situations considered problematic by the social actors who are their protagonists or who, for some reason, are interested in approaching such situations in an investigative sense. (GONZÁLEZ, 2020, p. 156).

For data analysis, we resorted to Bardin (2009), through Content Analysis. The author understands that this technique does not only have a descriptive scope, allowing the formulation of reproducible and valid inferences to categorize the subjects' discourse. The data obtained in this process were also collated with the theoretical framework that supports the research.

RESULTS AND DISCUSSION

As mentioned, the questionnaires were applied to 22 undergraduate students from a chemistry degree course at a public university. The composition of the questionnaire is presented below:

In the first question, when asked if the undergraduates would be interested in pursuing a teaching career, the answer given by 90% of them (which is equivalent to 20 students) was "no".

Some highlights among undergraduates who said they had no interest in a teaching career:

"No, I even intended to before doing the internships, but I realized that the educational system is in decline (not considering private education), public school students do not respect teachers, you know that there is no failure (continued progression)". (Licensing 01).

"No, at the moment, because I currently work in another branch that, at the moment, provides me with a better financial condition. (League Student 04).

“No, only if you don’t get a job or don’t pass the master’s degree. Because professors are not respected or valued, except for higher education professors”. (Licensing 06).

These statements contribute to thinking about the fact that it is not possible to only transform the educator. It is necessary to change the environment in which this professional works, as teaching needs to be attractive to future teachers. It is urgent for the government to rethink career plans, teaching working conditions, reflect on training processes in graduations. It is worrying to think that a degree course trains approximately 22 professors a year and 59.1% of them are not interested in teaching.

The factor that discourages students from working with teaching, pointed out by all, refers to salary. However, Imbénon (2016) highlights other issues in this context:

In our view, the teaching profession is developed by several factors: salary, demand in the labor market, the work climate in the schools where it is exercised, promotion in the profession, hierarchical structures, the teaching career, etc. and it is, of course, due to the ongoing training that this person undertakes throughout their professional life. (IMBERNON, 2016, p. 44).

Imbénon (2016) emphasized that training is an important element for professional development, but it is not the only element. All the speeches pointed to the salary issue and no other aspect was prominent in the discussion of the undergraduates, who seem to depreciate teaching. The supervised internship is seen not as a means of training, according to the conception of Canário (1988), but as an experience from which only the negative aspects that mark the profession today stand out. Such responses highlighted the need for the students to know the historical construction of the public school in order to better understand the situation in which they will be immersed.

When they were asked if they arrived at the university with the purpose of being a professor, 72.7% affirmed positively. During the course, 27.3% of the participants (equivalent to 6 undergraduates) reported that they started to intend to continue in the industrial area. This result can be identified in the statements transcribed below:

“Yes, I arrived with the intention of teaching, but the course did not focus on a degree”. (Licensing 02)

“I arrived at the university with the intention of teaching, but throughout the course I fell in love with research. Therefore, I don’t want to teach”. (Licensing 03)

“During the course it changed, because with the professors at the university, I realized that there is no love for the profession, but an obligation to work hours, so in my view there is a lack of committed professors”. (Licensing 07)

Through these reports, it appears that some undergraduates were disappointed with the degree, due to the characteristics of the course itself and some of its professors. This is disturbing, as the course must focus on teacher training, after all, this was its purpose in implementation.

In this context, one can think of Maldaner (1999) who maintains that teacher training takes place in a continuous process. For him, teacher training begins when citizens come into contact with their first teacher, and through this interaction, the formation of the first ideas or concepts about what it means to “be a teacher” will occur. Following his school journey, this conception could evolve into what it means to “be a Chemistry teacher”.

It is imperative to rethink the way of hiring professors for higher education courses in order to contemplate professionals committed to teaching. The hiring of professors at the university level takes place with a deep analysis of the candidate’s research productivity, his

Questions
1. Do you intend to be a Chemistry teacher? Why?
2. Did you ever come to university with the purpose of teaching or during the course did your objective change? Explain.
3. Do a self-assessment. To what extent do you feel equipped to teach Chemistry? Why?
4. In the syllabi of several disciplines related to areas of Chemistry in the course, it is stated that "X" hours must be dedicated to activities related to pedagogical practice. Has this been happening? In what way?
5. What suggestions would you give for improving the training of Chemistry teachers?

Chart 1. Questionnaire applied to research participants

Source: Elaborated by the authors

Category	Subcategory	Students	Percentage
Not	<i>Only if you don't get another chance¹</i>	2	9,1%
	<i>I have a job that provides a better financial condition that is not in the area of education nor in the area of research.</i>	1	4,5%
	<i>I want to pursue a career in industry or scientific research</i>	6	27,3%
	<i>Due to the precariousness of the teaching profession</i>	4	18,2%
Subtotal		13	59,1%
Yes	<i>I want to provide knowledge to other people</i>	3	13,7%
	<i>A teacher committed to the act of teaching is needed</i>	1	4,5%
	<i>If you know how to find the right audience, you can have better financial stability</i>	1	4,5%
Subtotal		5	22,7%
Perhaps	<i>Only if there is an opportunity in a private school</i>	1	4,5%
	<i>Not sure if I want industrial area or educational area</i>	3	13,7%
Subtotal		4	18,2%
Total		22	100%

Table 1. Do you intend to be a Chemistry teacher?

Source: Elaborated by the authors

¹ Excerpts from student records in questionnaires.

Category	Subcategory	Students	Percentage
Not	But during the course I began to see the act of teaching with different eyes.	1	4,5%
	I never thought about the possibility of teaching	11	50,0%
	I wanted to take another course that was not a degree. I feel that I have a vocation to teach	1	4,5%
	University professors did not help to change, as they present teaching as an obligation and have no commitment.	1	4,5%
	It's not my first option	1	4,5%
Subtotal		15	68,0%
Yes	But during the course I changed my mind and I don't want to anymore	2	9,25%
	I intended to work in industry, but during the course I wanted to teach in higher education	2	9,25%
	I entered with the intention of teaching and I intend to pursue a teaching career	1	4,5%
	I never had any worries about whether I would teach or not.	1	4,5%
	I arrived with the intention of teaching, but the course never focused on a degree	1	4,5%
Subtotal		7	32,0%
Total		22	100%

Table 2. Have you already arrived at the University with the purpose of teaching or did your objective change during the course? Explain

Source: Elaborated by the authors

Category	Subcategory	Students	Percentage
Not	I master only the theory of the discipline and contextualize the subjects little	4	18,2%
	Because I dont like	1	4,5%
	I have little idea about pedagogical practices	11	50%
	Pedagogical subjects at the end of the course did not provide enough support	1	4,5%
	The course teaches Chemistry and not to be a Chemistry teacher	1	4,5%
Subtotal		18	81,7%
Yes	I can prepare lessons for different contexts and situations	2	9,15%
	I feel fully prepared to teach	2	9,15%
Subtotal		4	18,3%
Total		22	100%

Table 3. Do a self-assessment. To what extent do you feel equipped to teach Chemistry? Why?

Source: Elaborated by the authors

Category	Subcategory	Students	Percentage
Not	They only emphasize the scientific part	1	4,5%
	The person did not indicate reasons	5	22,5%
	The person didn't even know it existed	5	22,5%
	We only have Chemistry classes, but there is never a relationship with the pedagogical	2	9,3%
	The pedagogical disciplines must be present, from the first year of the course	1	4,5%
	The methodology used makes students more afraid	1	4,5%
	Subtotal		15
Yes	The person did not indicate reasons	2	9,3%
	During internship or classroom practices at seminars, but not in the form it must	3	13,6%
	During the internship through a short course	1	4,5%
Subtotal		6	27,4%
No reply		1	4,8%
Subtotal		1	4,8%
Total		22	100%

Table 4. "In the syllabi of various disciplines related to areas of Chemistry in the course, it is stated that "X" hours must be dedicated to pedagogical practice or activities related to pedagogical practice". Has this been happening? In what way?"

Source: Elaborated by the authors

Category	Students	Percentage
Pedagogical disciplines from the first year of the course	5	16,1%
More moments for discussion about the internship in the classroom	4	12,8%
Discussion on classroom practices in pedagogical disciplines	1	3,2%
More moments for students to deepen the pedagogical theories	5	16,1%
That teachers in the specific area have a greater focus on professionals with the ability to teach and not just focus on research	2	5,7%
Improvement of didactics of teachers in the specific area	1	3,2%
Course evaluations must be related to the class given	1	3,2%
Mandatory practice of regency	1	3,2%
There must be more space in public schools for university students to develop pedagogically.	1	3,2%
More moments for students to relate Chemistry to Education	2	5,7%
Classes that can discuss methodologies for disabled students	1	3,2%
Internship teachers must supervise students in schools	3	9,0%
Experimental subjects for the high school classroom	3	9,0%
Presence of a psychologist at graduation to work with students	1	3,2%
Did not point out suggestions	1	3,2%
Total	31 ¹	100%

Table 5. What suggestions would you give for improving the training of Chemistry teachers?

Source: Elaborated by the authors

¹ Although 22 students answered the questionnaire, 31 results were obtained in categories, as students could offer more than one suggestion. For example, the same student may have suggested two different points that were properly allocated in two categories.

thesis, his orientations, research groups, publications. However, for teaching aspects, it is only evaluated in a short class.

When we begin to think of research as a producer of teaching, we will no longer be satisfied with this way of selecting and hiring professors. Candidates will become involved with another professional field, teaching, preparing themselves with the same seriousness as they do for the specific field of research in chemistry. I see in this a possibility of breaking the vicious cycle of having teachers with few didactic resources, a restricted view of chemical science and its production, a dichotomized practice between chemical practice and theoretical reflection – usually crystallized in chemistry curricula in the form of practical classes dissociated from theoretical classes – linear and cumulative view of structuring chemical knowledge. (MALDANER, 1999).

When questioned about being equipped to teach Chemistry, 18 students (82%) of the respondents said they were not prepared to teach Chemistry.

“I believe that teaching is “mechanical”, it follows pre-established standards”. (Licensing 01).

“Very little, because this course covers a lot of theory, I don’t teach my students 1/3 of what I learn in the classroom. The grid distribution is dull, it has very “heavy” years and years practically composed of internship”. (Licensing 02)

“We learned a lot about ways to act in the classroom, but I still don’t feel prepared, because I don’t have didactics”. (Licensing 04).

“Little instrumentalized, due to the disciplines being offered at the end of the course”. (Licensing 08).

“From 0 to 10, 3. Because the course teaches Chemistry and not how to be a Chemistry teacher”. (Licensing 10).

The statements made it possible to perceive

that the structure of the course dichotomized theory and practice, providing few moments for reflection on educational praxis. It is imperative that teachers are well trained and prepared to mediate the knowledge of their discipline with pedagogical knowledge, in a reflective practice disconnected from ready-made techniques and strategies. The undergraduates claimed to know teaching techniques, linking the action of teaching to something mechanical. Their answers, therefore, made explicit the presence of technical rationality in the training process.

The course, therefore, presents formative traits that follow the path of technical rationality. In Pereira’s (1999) perception, the teacher is seen as a technician capable of using scientific and pedagogical knowledge in the classroom. The view of the undergraduates places a worrying position: insecurity among students due to little preparation to deal with issues in the classroom. There is an analogy, created by Busquet (1974) and quoted by Pereira (1999), to think about the process of teacher training with reference to a “swimmers preparation course”.

Imagine a swimming school that devotes a year to teaching anatomy and physiology of swimming, swimmer psychology, water chemistry and ocean formation, unit costs of swimming pools per user, sociology of swimming (swimming and social classes), anthropology of swimming (man and water and also the world history of swimming, from the Egyptians to our days). All this, evidently, based on encyclopedic courses, many books, as well as chalk and a blackboard, but without water. In a second stage, student swimmers would be taken to observe experienced swimmers for several months; after this solid preparation, they would be thrown into the sea, in very deep waters, on a stormy day”. (PEREIRA, 1999, p. 112).

Based on this analogy, one can reflect on the formation of undergraduate students

in Chemistry based on their speeches. The methodological proposal of the swimmers course is inappropriate to apply to teacher training. The criticisms of this formative perspective reside in: dissociation between theory and practice and theoretical formation disregarding or taking little into account principles of practical rationality. Therefore, according to the undergraduates, the course in question is aligned with the biggest failure of the technical rationality model: to be a good teacher, it is only necessary to know the curricular component to be worked on. The students criticized the fact that the disciplines in the curricular component were poorly articulated with the pedagogical subjects. To aggravate the situation, the pedagogical disciplines are worked only in the final moments of the course. A course that allows the formation of quality teachers needs to be designed with the idea that:

[...] it is necessary to assume that the initial training of teachers in degree courses suffers from a lack of well-worked theoretical foundation and reflection on the most articulated didactic-pedagogical practices to fulfill its task of constituting the teaching knowledge necessary to overcome of the dichotomy of theory and practice and of the current distance between initial training and everyday school life. Hence, it is urgent and necessary, politically and ethically, to effect profound changes, in order to overcome this problem, so that future teachers are prepared to intervene in a different way in the classroom. (LEITE, 2011, p. 57).

An initiative in favor of inserting the practical dimension within the disciplines arises from the orientation that 15 hours of class, within a 75-hour discipline, for example, are destined to practices, in the undergraduate disciplines. Being aware and considering the relevance of this fact, we tried to find out how this practical dimension has been materialized in the disciplines.

Most students stated that this does not

happen. The few who said that these practices take place attributed the seminars of the Chemistry disciplines as pedagogical actions for teacher training. Highlighted:

"I have not observed these activities effectively." (Licensing 10)

"The minimum. When we carry out practical seminars that we elaborated; for the rest of the class". (Licensing 07)

"I didn't even know it existed. It doesn't happen at all". (Licensing 05)

"No. Most professors have a bachelor's degree and want to know about research and train researchers, not professors". (Licensing 11).

These statements show the dissociation between research and teaching. In fact, these two actions would be more significant if they were treated together. In addition, pedagogical practices need to be seen as an object of investigation and research, in which young teachers realize the importance of research to support teaching actions. This is a fundamental path for breaking training from the technical rationality in the degree course. For Schon (1992), it is important to allow the formative processes to instigate the teachers so that the pedagogical practices are periodically revised, problematized, transformed.

It was perceptible by other speeches of students completing the degree course, that there was no significant internship that promoted reflective actions. When students completing the degree course were asked to make some suggestions for improving the course's teaching activities, the following notes were highlighted:

"Pedagogical subjects and internship from the first year, at the most in the second". (Licensing 03)

"More hours of supervised training, with periodic discussions about experiences in the classroom". (Licensing 06)

*"More practices in pedagogical classes".
(Licensing 07)*

*"Improvement of teachers' didactics and
the presence of teachers at the university".
(Licensing 08)*

*"I believe that the practice of conducting must
be mandatory". (Licensing 09)*

*"Relating Chemistry with Education".
(Licensing 10).*

Most students stated that the course did little to integrate the knowledge listed in the degree. According to Shulman (1986), there are three categories of knowledge, that is, knowledge of the content of the object of study, pedagogical knowledge of the object of study and curricular knowledge. Knowledge of the object of study involves the principle that teachers must not only be trained to define the concepts of the discipline. The teacher needs to explain why a statement is correct and how it relates to others in the same subject. In addition, the teacher needs to master the structure of knowledge in his discipline to the point of identifying what is essential and what is not. If discussions about the specific contents are not carried out in the specific disciplines of Chemistry, Instrumentation for Teaching Chemistry or Supervised Internship, there will not be moments to develop a reflective perspective of the school space.

The pedagogical knowledge allows the teacher to transpose the knowledge of science to the school context. Teaching practice, therefore, must subsidize the construction of school knowledge, based on the students' prior knowledge, using specific teaching and learning strategies, aiming at meaningful learning. The Chemistry approach can occur through an integrated vision between microscopic and macroscopic realities, experimental practices for experiencing the laws and theories and molecular models, use of simulators and creation of videos, exercising

the production of different methodological approaches.

The undergraduates' answers to the questionnaires show that the discussions do not deepen the experiences in the classroom and the internship does not provide enough reflections on the school space and the students' experiences.

A good and true institution of higher education, concerned with training teachers for basic education, must offer the training of teachers with their own identity, and also cannot fail to rethink and redefine the role of the internship in favor of a more consistent professional training of the teacher, in order to better meet the demands imposed on it today. (LEITE, 2011, p. 67).

The need to promote opportunities for reflection on pedagogical practices is linked to the idea that: "... teachers' attention must be turned both inwards, towards their own practice, and outwards, towards the social conditions in which this practice is situated ". (Zeichner, 1993, p. 25). Undergraduates missed teaching practices taught by them in the form of conducting, lectures or other academic activities. To reflect on the pedagogical practice, it would be pertinent for them to participate in moments in which they were the protagonists of the pedagogical practice. In addition, when something is done exceptionally in internships, there are no moments of socialization, reflection and debate. The perceptions of the moment are those that remain and initially form the individual. Without discussions about the observations made in the classroom, there was a risk of training teachers who base their practices on experiences of a few hours encouraged by common sense. Another negative consequence of this practice is that the internship experiences, when not properly socialized and reflected, can lead the undergraduate to escape teaching, something observed in this investigation.

FINAL CONSIDERATIONS

The research allowed reflecting on aspects of the formative process of a degree course in Chemistry, from the point of view of the undergraduates. It would be up to the same to objectify its purpose of implementation: to train teachers. This needs to be linked to the pedagogical quality that overcomes the anachronism installed by intrinsically disconnected practices in terms of theory and practice, configured under traits from the perspective of technical rationality. Teacher training must enable reflective practices for undergraduate students, from the first year of the course, as suggested by graduates and the most current guidelines on teacher training. The specific disciplines, in this case, general chemistry, analytical chemistry, inorganic chemistry, organic chemistry, physical chemistry, biochemistry, must provide moments and spaces for the students' pedagogical training. Above all, university professors need to rethink some pedagogical attitudes, such as the dissociation between theory and practice.

The institution needs to assume

the commitment with the formation of transforming teachers, capable of articulating the political responsibility of democratic inclusion to the teaching and learning processes. If reflection and transformation are not the propelling levers of educational practices, elitist, exclusionary training, based on traits of technical rationality, will continue to persist into the 21st century.

Unfortunately, based on the undergraduates' statements, the conclusion is that the formative conception present in the course, which does not explore the pedagogical training of undergraduates, manages to fall short of technical rationality, as this perspective still requires knowledge of pedagogical techniques. According to the students, not even this knowledge is contemplated sufficiently, which leads to consider that the referred course needs to (re)affirm and (re)construct its conceptions in education, based on its nature: the degree. Otherwise, its purpose of existence will be the materialization of a contradiction.

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