Water analysis from the Jacuba Stream in Araguaína, Brazil: A generative theme for Chemistry teaching

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ABSTRACT

It is known that the study of chemistry and its education are of great value for improving the quality of life of a society, and this is the crucial point that we have to worry about trying to increase the interest of our students for this discipline. It is also clear that many schools, especially public ones, do not provide the educational resources that contribute to the appeal of these students. To contribute to chemistry education, this study aims to investigate possible progress in increasing the interest and academic achievement of chemistry students through field and experimental classes, which will facilitate the teaching/learning in this discipline so important for the advancement of our society and to contemplate the process of Environmental Education for Sustainable Development. The study was conducted through qualitative/quantitative methods with 95 state school students from high school in Araguaína/TO, Brazil. Initially, a pre-test was applied in the form of a questionnaire to assess the interest of the participants for chemistry; following this is the theoretical basis for discussing the theme "water chemistry" and its social and environmental importance. In sequence, the students went through an environmental trail and collected water samples from the Jacuba stream, which were subjected to laboratory analysis in order to verify the quality of the water consumed by inhabitants who use the stream water. Following this step, a visit to the municipal water treatment plant was carried out, where students received information about potability techniques. We also collected and analyzed treated water samples stored in household deposits from the students, to check for possible quality changes related to storage. At the end of the research, a post-test was used to assess whether there was an increase of interest in the discipline, after the application of the developed methodology. There was a positive change in the students regarding their view about the study of chemistry after the development of this methodology. The analytical results were compared with the parameters of Ordinance No. 2914 of the Ministry of Health, 2011, which establishes potability standards. The results of the analyzed parameters indicate that the Jacuba stream water is not potable and can cause health problems for the local population. The analysis of water samples from the domestic containers indicated, in some cases, modification of the parameters analyzed, probably related to non-occurrence of periodical cleaning of the containers. The methodology used in this research indicates one of the ways that can contribute to improving the teaching-learning process in

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chemistry, and may provide an increased interest and, consequently, a significant increase in their school performance and their ability to build scientific knowledge.

Keywords: Chemistry Teaching. Environmental Samples. Analysis of Potability Parameters.

Análise de água do córrego Jacuba, em Araguaína, Brasil: um tema gerador para o ensino de química

RESUMO

Sabe-se que o estudo da Química e seu aprendizado são de grande valia para a melhoria da qualidade de vida de uma sociedade, e esse é o ponto crucial para que tenhamos a preocupação em tentar fazer com que aumente o interesse de nossos alunos por essa disciplina. Percebe-se, também, que muitas escolas, principalmente as públicas, não disponibilizam de meios didáticos que venham contribuir para o atrativo desses discentes. Visando contribuir com o aprendizado em química, este trabalho tem como objetivo pesquisar possíveis progressos no aumento do interesse e rendimento escolar dos alunos de química, através de aulas de campo e experimentais, que venham facilitar o ensino/aprendizado nessa disciplina tão importante para o avanço de nossa sociedade e para contemplar o processo de Educação Ambiental para o Desenvolvimento Sustentável. A pesquisa foi desenvolvida através de métodos quali/quantitativos com 95 alunos de escola Estadual de Ensino Médio, em Araguaína/TO. Inicialmente, foi aplicado um pré-teste, em forma de questionário, para sondar o interesse dos participantes pela disciplina de Química; após, foi realizada uma fundamentação teórica discutindo a temática "química da água" e sua importância socioambiental. Em sequência, os alunos percorreram trilha ambiental e realizaram coletas de amostras de água do córrego Jacuba, as quais foram submetidas a análises laboratoriais, com o intuito de verificar a qualidade da água consumida por ribeirinhos que utilizam as águas do córrego. Seguindo esta etapa, foi realizada uma visita à Estação de Tratamento de água do município, onde os alunos receberam explicações sobre as técnicas de potabilização. Foram também coletadas e analisadas amostras de água tratada armazenadas em depósitos domiciliares dos alunos, para verificar possíveis alterações de qualidade relacionadas com o armazenamento. Ao final da pesquisa, foi aplicado um pós-teste para avaliar se houve um aumento de interesse pela disciplina, após a aplicação da metodologia desenvolvida. Observou-se uma mudança positiva de posicionamento dos alunos em relação ao estudo de Química após o desenvolvimento desta metodologia. Os resultados analíticos foram comparados com os parâmetros da Portaria N° 2.914 do Ministério da Saúde, 2011, a qual estabelece os Padrões de Potabilidade. Os resultados dos parâmetros analisados indicam que as águas do córrego Jacuba não são potáveis, podendo trazer problemas de saúde à população ribeirinha. A análise das amostras de água dos reservatórios domiciliares indicou, em alguns casos, alteração dos parâmetros analisados, provavelmente relacionados a não ocorrência de limpeza periódica dos reservatórios. A metodologia aplicada nesta pesquisa indica um dos caminhos que pode contribuir para melhoria do processo de ensino-aprendizagem na disciplina de Química, podendo proporcionar um aumento de interesse e, em consequência, um expressivo aumento em seus rendimentos escolares e de sua capacidade de construir o conhecimento científico.

Palavras-chave: Ensino de Química. Amostras ambientais. Análises de parâmetros de potabilidade.

INTRODUCTION

According to the National Curricular Parameters (PCN)-(BRAZIL, 2000), learning must contribute not only to the technical knowledge, but also to a wider culture, developing means of interpretation of natural facts, understanding of procedures and everyday social and professional equipment, as well as to the articulation of a vision of the natural and social world. According to the PCNs, chemistry emphasizes transformations that create new materials. It is present and must be recognized in food and medicines, in textile fibers and dyes, in building materials and paper, in fuels and lubricants, in packaging and containers.

According to Lima (2012) and Silva (2008), in the great majority of the Brazilian public schools, the teaching process is based on a simple transmission of content and, with that, the students have little interest in studying chemistry, claiming lack of contextualization of the contents taught. As a high school teacher in Araguaína, Tocantins, Brazil, it was realized that the chemistry classes are virtually all theoretical, even because the workload, from 2013, was extremely reduced (a weekly class) and, in addition, many schools are not equipped with laboratories for experimental classes.

So often students ask the true meaning and purpose of this discipline; they treat chemistry as the great villain when talking about soil, air and primarily water pollutants. Another perceived problem is that, in the public schools of Araguaína, just four chemical teachers have adequate training to perform their job, which may be increasingly raising difficulties for the learning of the students.

Using water as a generative theme and as a methodology (quali/quanti) to contemplate the teaching through field and laboratory lessons, where the environment served also as a natural laboratory, we sought to show students the positive side of chemistry and its importance to the survival of all beings and to improving the quality of life of a population. Another concerning factor is related to the quantity and, especially, with the quality of the water consumed by the communities, in view of the exponential growth of population and water contamination by solid residues disposed inappropriately.

This study has as main objective to search possible progress in the increase of interest and performance of students in the chemistry discipline in the high school of a public school in Araguaína, Brazil, after the development of practical/demonstrative classes and involving field work, to facilitate the teaching-learning process. The results of this study show that the methodology applied here can be a path to facilitate the teaching/learning process and, with that, increase the interest of students and consequently their school performance.

THE PNCs AND THE SCIENCE AREA

In the area of natural sciences, mathematics and its technologies are included the competences related to the appropriation of knowledge of physics, chemistry, biology and their interactions or developments as essential ways of understanding and resignifying

the world in an organized and rational way, and also of participating in the enchantment that the mysteries of nature have over the spirit that learns to be curious, ask and discover, with the objective of contributing to the understanding of the meaning of science and technology in human and social life. The technology integrates natural sciences, once a contemporary understanding of the physical universe, the planetary life and human life cannot do without the understanding of the instruments by which the human being manages and investigates the natural world (BRAZIL, 2000).

In the face of the challenges posed to basic education, it is necessary to reflect on the actions that may contribute to its improvement to both the achievement of educational goals, as well as to meet the needs and interests of the community in which the school is located. In this perspective, the chemistry teaching is an important knowledge at school for the formation of students in many different dimensions. (MACENO and GUIMARÃES, 2013).

THE TEACHING OF CHEMISTRY IN BRAZIL

According to Lima (2013), the lack of interest of students in Brazilian public schools is evident. The students distort the true meaning of chemistry, claiming that this discipline is not part of their daily lives. The author states that the Brazilian schools, especially public ones, do not have laboratories for conducting practical classes and lessons, and that they all end up being mainly theoretical, where students do not pose questions, do not search, do not experience, do not argue, they just accept what is transmitted. Therefore, the lack of laboratories in the Brazilian high schools makes the teaching of chemistry too abstract, shallow and, with it, the teachers cannot transmit efficiently such content to the students (BRAZIL, 2009).

For Chassot (2004), in Brazilian high school, even those considered being of good quality (private), chemistry classes serve solely to train students to take tests. For this did not come to happen, Pavão and Denise (2008) argue that the teaching of science should be encouraged from the initial grades, when children have a lot of curiosity and anticipation of seeing in practice everything that is taught in the classroom and, with it, make them student-researchers.

The main objective of chemistry within this educational level is centered in the study of matter, its characteristics, properties and transformations from their intimate composition (atoms, molecules, etc.). In short, the aim is to teach the student to understand, interpret and analyze the world in which he/she lives; their properties and their transformations, with a little of imagination and thoughts, using models that refer to particles, which according to what science teaches, constitute the matter (POZO, 2009).

The Brazilian education has been under a crisis through the years. This is reflected, among other effects, in low levels of learning, in high rates of repetition and dropout, in poor results of the official assessments and, mainly, in the absence of intellectual preparation of their graduates. Note that this crisis is present in all levels of education (QUADROS, 2003).

It was created a routine of bad education, in which a teaching segment will transfer the responsibility for the poor results to the next segment. The break of this cycle has been one of the major goals of educators of this country. But where to break them? Who should start it? (QUADROS, 2003).

> Chemistry, as one of the disciplines present in high school is included in the list of necessary knowledge to the formation of a full citizen, able to interfere in the world in which he lives to make it better. (QUADROS, 2003, p.109)

Carvalho (2004), when referring to the methodology applied in the Brazilian high schools, acknowledges that since the mid-20th century, science education has been going through changes. The author points out that with the expansion of the concept of content, the teaching of sciences takes a new stance regarding teaching science and it starts to teach about science. According to Carvalho (2004), high school students of Brazilian schools, tend to absorb the content in a completed way and not use the research as a way of acquiring new knowledge. This methodological thinking comes from de 1920's, when a philosophical school of thought was implemented known as logical positivism, which has been influencing, until today the didactics of sciences in classrooms, through a multidisciplinary and fragmented curriculum (LEAL; ISKANDAR, 2002).

Currently there is a strong tendency for chemistry classes to be contextualized, incorporating in the curriculum social-scientific aspects and content directed to the student's daily life, which would facilitate learning and spark the interest of students (SANTOS, 2002, p.23).

According to Ausubel (1978 apud LEMOS, 2005), one should always take into account the previous knowledge brought by the student, their experiences, their surroundings and from that build new knowledge, through a significant learning.

> If I had to reduce the entire educational psychology to one principle, I would say the following: the most important isolated factor influencing learning is what the learner already knows. Discover it and teach it accordingly. (AUSUBEL et al., 1978 apud LEMOS, 2005, p.41)

Contradicting the philosophy of logical positivism, to Bachelard (1996) scientific knowledge must be placed in terms of obstacle and that what we have as real must be placed in doubt, because what we have as real can dim what we really should know.

> You can't base anything on opinion: first of all, you need to destroy it. This is the first obstacle to overcome. It is not enough, for example, correct it at certain points, maintaining, as a kind of temporary morality. The scientific spirit prohibits

> us to have an opinion on issues we do not understand, on matters that we do not formulate clearly. (BACHELARD, 1996, p.12)

According to Bachelard (1996), scientific knowledge always comes up with a question, posing a problem. If there is no question you will not have scientific knowledge.

Carvalho (2004) states that when starting a content from an experiment of an investigation, the students can relate this content taught with their daily lives, they start to question and to understand that scientific knowledge is a construction and that they are part of building it.

Often those that act as science teachers, even for not having adequate training, teach what is within their boundaries, making the teaching of science very passive, undermining its true meaning (DELIZOICOV; ANGOTTI, 1992).

> The work cannot be developed in a single transmission perspective, it should ensure a critical approach, featuring the scientific enterprise as a human activity, not neutral, funded and with economic and political linkages. (DELIZOICOV; ANGOTTI, 1992, p.46)

Galiazzi and Gonçalves (2004) argue that experimental classes should serve to answer the questions of the students, to confirm theories that are presented to them in the classroom, so they can make comparisons with their daily lives and not just demonstrations where the students are mere spectators.

> Experimental activities must, however, be part of a speech such that teachers and students can learn not only the theories of science, including chemistry, but also how to build scientific knowledge in a process of questioning, discussion of arguments and validation of these arguments by means of oral and written dialogue, with a argumentative community that begins in the classroom but transcends it. (GALIAZZI; GONÇALVES, 2004, p.331)

USING WATER AS A GENERATIVE THEME IN CHEMISTRY TEACHING

In this study, we intended to use water as a generative theme in teaching chemistry. The generative themes are an idea originated by Paulo Freire in the 1950's. To Freire:

> The generative theme is not isolated from reality, nor is from the reality isolated of men. It can only be understood in the man-world relation. What you want to investigate are men and their worldview. (FREIRE, 1987. p.56)

The generative theme is a point that the knowledge areas interrelate, when there is interdisciplinarity (GADOTTI, 2004). It is an object of study that teachers seek to make students get from them some knowledge, that there is reflection, which can relate theory and practice (ANTUNES; PADILHA, 2014).

Freire (1987) calls attention to the importance that in an investigation we should not be concerned to research the man, as if it were an anatomical piece, but their perception of reality, its worldview and the awareness of their "generative theme". To the author of the "generative theme" investigation, when this is carried out through an awareness methodology, it can put the man in a critical way of thinking about the world. The author also says that "if, at the stage of literacy, the education poses questions and from communication it searches and investigates the 'generative word', at the post-literacy stage, it searches and investigates the 'generative theme'." (FREIRE, 1987, p.59).

According to Delizoicov (2002), the introduction of content into school activities through meaningful situations (generative theme) may lead the student to build their own knowledge in a critical way, within the context they are.

The theme "WATER" can be worked in a many subjects in the classroom, and can bring interest and motivation of students for chemistry education, because with this theme you can relate to their daily lives, since water is something indispensable for the survival of everybody and can be worked in many disciplines (interdisciplinarity) (GADOTTI, 2004; QUADROS, 2004).

> Water, so important to our life and so abundant on our planet, constitutes an important subject that allows you to bring context to the chemical concepts that, in turn, could allow the formation of the chemical thought. (QUADROS, 2004, p.27)

Field and laboratory studies, using water as a generative theme, are of broad importance so that students can have the opportunity to work with the Chemical content in a practical way, and with it, awaken their interest for the discipline, especially if linking to situations relate water quality with human health.

METHODOLOGY

This research was conducted with bibliographical sources, field studies in the region of the city of Araguaína, Brazil, expository classes and laboratory classes held in a public school and at the UFT (Federal University of Tocantins), by an educational partnership between the two institutions. The research was developed with students from two groups in the second year and two groups in the third year, both in high school, totaling 95 students, aged 15 to 20 years. The class selection criteria took into account the grade in which the students are in, because the approach required a degree with a

more advanced knowledge of Chemistry and the interest shown by the students for field and laboratory lessons.

With regard to bibliographical research, we searched books, magazines, scientific papers, theses, dissertations, journals, both from chemistry education, as well as from other areas such as humanities, social sciences and exact sciences.

After the bibliographical research, a data collection instrument (DCI) was developed and applied to the selected groups, as an early exploration, by the mixed method, in the form of a semi-structured interview (DAL-FARRA; LOPES, 2013), in order to identify possible difficulties encountered by them in learning the discipline of chemistry in high school.

After the application of the early exploration test and the explanation of the water theme in the classroom, when they discussed the process of water treatment, since the capturing of water from rivers as well from tube wells, to the distribution to final consumers; the water cycle; the types and classes of water; water pollution; the importance of quality and potability of water for the health of the population according to the parameters of the CONAMA resolution 357/2005 and Ordinance No. 2.914/2011 from the Ministry of Health (BRAZIL 2005, 2011). In this opportunity, students could review the content that deals with the separation processes of compounds, types of compounds, pure substances, pH, solutions, density and concentration of the solutions. With that, we could contextualize everything they were transmitted, identifying the applicability of such content in their lives.

Later, it was developed a practical activity, involving field work, with the support of two teachers from the school unit and representatives of the NGO NATURATIVA and TAESA (Transmissora Aliança de Energia Elétrica S.A.), and laboratory work.

Two field studies were conducted, in which the students went on an environmental track of about 1500 meters on the banks of the Jacuba stream. During the track, they collected water samples in 10 farms located along the stream, following the techniques and basic requirements for sampling intended for analyses of water quality control (PEDROSA, 2011). The water samples collected during the field study did not undergo any treatment and that are consumed by the population of living near the Jacuba stream, in Araguaína, Brazil.

They also planted seedlings, contemplating environmental education, with the guidance from representatives of NGOs and from the company TAESA which donated about 300 seedlings of native species (diesel tree and courbaril) for planting on farms visited, aiming at the recovery of marginal vegetation and water protection.

On the same day, in the afternoon, there was a technical visit to the ODEBRECHT Ambiental/SANEATINS, the company responsible for the water supply in Araguaína, where they gave a lecture dealing with the rational use of water and about the need to make periodically cleaning in household tanks. Then there was the offset to a Simple Treatment Unit (UTS) of the company; There, the students were able to see the whole

process, from the collection, which is made using tube wells with depth of about 150 meters, until the treatment of water that is distributed to the urban population of Araguaína.

They also collected samples of treated water, from the household tanks in Araguaína, to establish a comparison with the water consumed by the people living near the Jacuba stream and also to check possible changes in the water supply related to storage in the reservoirs.

The samples collected were taken to the lab and analyzed according to the pH, turbidity, color, odor, determination of free chlorine and total dissolved solids. The analyses were carried out for the purpose of checking the quality of the water consumed, based on the Ordinance No. 2.914/2011 from the Ministry of Health. After the laboratory analysis, the results were discussed in the chemistry class and, later, disclosed to the population living near the stream. The analysis of these samples collected was performed by physic-chemical methods indicated by ABNT, as described in Pedrosa (2011).

After the development of this methodology, a test was applied to assess the perceptions of students after the development of it, following the mixed method (CRESWEL, 2010), in order to assess whether the objectives were achieved. In this post-test, the students answered questions regarding their perceptions related to the methodology applied and the vision that they formed about chemistry, whether they can relate better to the content taught in the classroom with their daily lives, whether they changed their opinion about the importance of chemistry in improving the quality of life of a population, and whether there was an increased interest in the discipline of chemistry. The collected data were treated using the descriptive statistics (CRESPO, 2009).

RESULTS AND DISCUSSIONS

The results of the DCI, applied to the students before the development of the activities with the theme of water, could establish a framework indicating the same relation with the discipline of chemistry.

When they were asked if they would like to study chemistry, 57.9% answered "yes" and gave various explanations for their answers: many answered that chemistry is very interesting, others that it will be useful to the official exams to enter university, that it will serve for their professional lives, that it is present in their everyday lives, that the chemical knowledge can help them solve their everyday problems. Other 36.9% answered "sometimes" and explained: they liked some of the contents, that content is too much complicated, that they did not understand the teacher's explanations. The remaining 5.2% answered "no": *"I will not need it for my professional life"; "I do not like chemistry"; "I do not understand the classes"*.

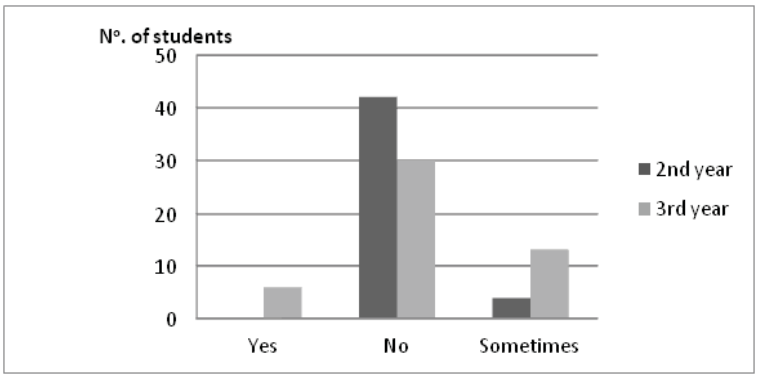
We can observe that more than half of the students answered positively to this question and that 36.9% replied that on certain occasions, too, they like it. It is

believed that this is a big step in the search for a possible solution to solve or at least mitigate the problem of low academic performance of these students. The 5.2% that answered negatively need special attention, in an attempt to stimulate their interest in the discipline.

Carvalho (2004) points out that one of the issues of teaching refers to the content that we want to teach, especially when looking for answering "Why teach the proposed content?" In this sense, so that students have an interest and love of science education, and therefore better performances, the contents that they teach must make sense, contextualizing them, showing them that chemistry is part of their daily lives. For Castro (1991), the present world depends on science to progress in the areas of health, technology, peace, etc.; Therefore with increasing intensity, we need to seek ways and conditions that may encourage students to study science.

When asked whether they had experimental or field lessons at school where they study, only 6.2% said they already had experimental classes, not in that year; 75.9% answered that they never had chemistry experimental lessons, and 17.9% stated that sometimes they participated in lessons involving experiments (Figure 1).

FIGURE 1 – Offer of experimental classes.



Source: research data.

It is known that the chemistry and other natural sciences, is a discipline very focused on experimentation, on practice, on visualization and on understanding certain natural phenomena, it is necessary that the teacher be careful to contextualize these contents, approach them from the reality of the students.

Viveiro and Diniz (2009) also recommend field activities as methodological strategy:

> Among several strategies that the science teacher may appeal (expository classes, discussions, demonstrations, laboratory practical classes, among others), the

> field can be an excellent alternative methodology that allows you to explore multiple possibilities for students' learning, if they are well planned and prepared. (VIVEIRO; DINIZ, 2009. p.27)

Still regarding experimental and field classes, this small amount of practical classes offered to the students who participated in the research can be one of the reasons that make it impossible to understand the chemistry content and not relate them to their daily lives.

When asked whether they had interest in chemistry classes, 69.5% stated they have interest in these classes. The reasons given were:

"I wanted to understand more about where chemistry is applied in my daily life"

"To understand about various processes which may happen in daily life"

"I'm really enjoying organic chemistry"

"Yes, I intend to be a doctor and chemistry is crucial".

"Because we use chemistry to understand many things in our daily life"

"I like the discipline"

"To make the official exams to enter university"

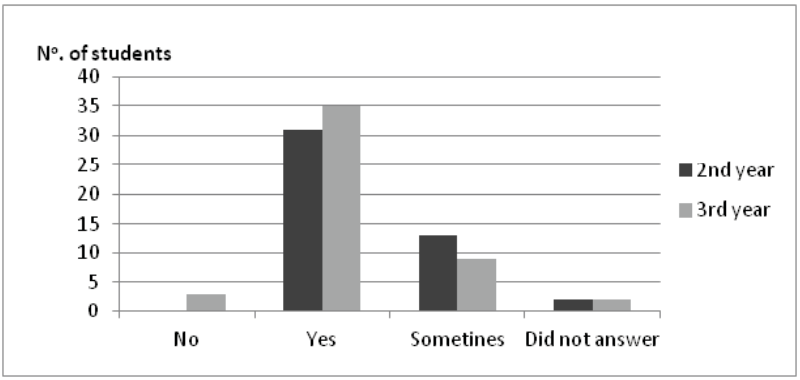
"To get more knowledge"

"Because I need to pass to the other year"

It is also worth noticing that 83% of these students who answered that they care about chemistry classes, the reasons are for the profession they intend to have or to take exams to enter university.

Of the other students, 23.2% answered that only sometimes they have an interest, because, according to them, it depends on the content being taught; 3.1% said they do not have any interest in chemistry classes, they do not think they need it and they will not even need what they are taught in this discipline; 4.2% did not answer (Figure 2). What we can see in this questioning is that students, even those who responded positively, do not give satisfactory reasons according to the purpose of the question. We can note that they do not truly care about chemistry classes, but about their professional prospects.

FIGURE 2 – Students' Interest for Chemistry Classes



Source: research data.

For Silva (2011), the student's interest for chemistry classes is related mostly to the teacher's role, and it depends on a number of factors, including: adequate training of teachers, laboratories for experimental and dynamic classes, fair wage, etc. For him, chemistry classes, for the most part, are very traditional and do not relate what is taught with the daily life of the student, causing a lack of interest from the part of the students.

Still on the reasons that may contribute to the lack of interest of students for chemistry classes, Ribeiro and Ramos (2013) highlight:

> Expository classes in a high degree of difficulty, accompanied by insufficient 'explanations' by educators increase the disinterest of the students for the class. Similarly, content linked to calculations, classifications, and formula also make classes dull and discouraging. (RIBEIRO; RAMOS, 2013)

On the other hand, in an attempt to alleviate this lack of interest of the students, Ribeiro and Ramos (2013), in their research, through statements from high school teachers, present strategies that can contribute to the increased interest of students for classes, they are the following: valuation of questions asked by students; use of prior knowledge from the students; intentional search for the relationship between content and daily life, and contextualization of the contents. For Mortimer (1996), the interest of the student is paramount for the efficiency of the teaching-learning process, according to him: "Learning occurs through the active involvement of the learner in the construction of knowledge".

Another point which, in this research, must be questioned is with respect to school performance. We asked: *"How was your school performance in the previous year? What is the reason for this performance?"*

Of the respondents, 9.5% said they had a great academic performance in the year 2014; 11.5% said they had very good academic performance; 43.1% good; and 9.5% good enough. In all these percentages, considered approved, we have a total of 73.6% of students who claimed to have achieved grades to pass for the following year.

These results do not seem to pose a problem, since the vast majority had satisfactory academic performance. On the other hand, when justifying the reason for this so expressive school performance, we found out that not all are consistent with this reality, as shown by some accounts of students with good performance:

"I did not understand the explanations very well."

"I did not put much effort on the discipline."

"The subjects were good, but we had few classes and the teacher didn't have a lot of patience to explain."

"I dedicated myself enough."

"To my effort."

"The methods of teaching that the teacher struggled to reach."

"Good grades."

"To the teacher."

"Grades"

"The content was very difficult, but I had a good performance."

"I've learned a few things, my performance was not better, because the teacher changed three times."

"The teacher's good explanation, along with my interest in this subject."

"The school where I studied."

By the report justifying the good academic performance of these students, we do not notice the true reason of their approvals to next year. We can understand that they were approved not by merits, but by an assessment method, proposed by the State Department of Education, which takes into account a number of factors that provide the approval of those students, as can be seen in Table 1.

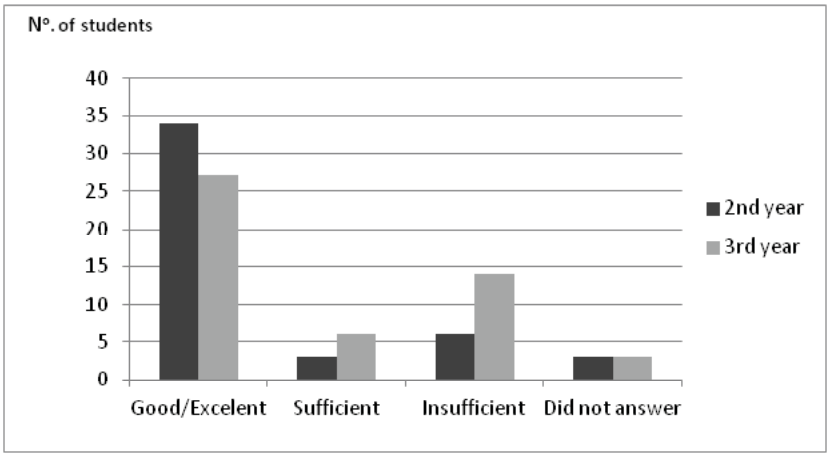
TABLE 1 – Contributions notes from the students on the issue of school performance.

	Good points	Negative points
Student	• Dedication; • Effort; • Good grades; • Capacity;	• I didn't understand well the contents; • I did not put much effort on the discipline;
Teacher	• Method of teaching; • Good explanation;	• Little patience to explain the content;
School		• Few classes; • Change of teachers

Source: research data.

Other 21% responded that their school performance in the previous year was insufficient. Many of those reported coming from other schools and even from other States, which according to them, has been the reason they failed. Some have claimed the small workload of the discipline of chemistry and others the lack of teacher preparation; 6.4% did not answer this question (Figure 4).

FIGURE 4 – School performance of the students surveyed (2014).



Source: survey data.

It is known that, in most cases, the low school performance of students falls mainly under the responsibility of the teacher, as Silva (2012) confirms:

> Doing an approach centered on the discipline of chemistry, you can identify that many times it is presented to students out of context, bringing only the content

> focus, with no relation to the reality of the student, in a process that ends up leading to memorization of it through the traditional model of repetition. (SILVA, 2012, p.4)

It is in this sense that we seek possible strategies, so that the chemistry lessons become more attractive to students, raising their self-esteem and, consequently, their interest in the discipline. For this it is necessary that the teachers have working conditions, especially when it concerns the workload and training. We will not have quality education without teachers well trained, just like we will not have learning without students interested in learning.

ANALYSIS OF WATER SAMPLES

Water samples collected by students, both on the small farms on the shores of the Jacuba stream, as well as in the reservoirs of the residences of the students, were analyzed and their results are presented in tables 2 and 3 and discussed in further detail.

Table 2 – Result of the analyses of water collected in the farms in the region.

Site (farm)	Parameters			
	pH	Turbidity (NTU)	Color (uC)	Chlorine
Bela Vista	6.9	*	17	ND
Barra Bonita	6.1	*	17	ND
3J	6.1	*	15	ND
Imperatriz	6.4	*	15	ND
Diamante	6.2	*	17	ND
Beija flor	6.4	*	16	ND
Nª Sª Aparecida	6.6	*	17	ND
Recanto de Araguaína	6.9	*	16	ND
Dois Irmãos	6.6	*	15	ND
Nova República	6.4	*	17	ND

* Above the limit of detection.

Source: research data.

TABLE 3 – Result of the analyses of the water samples collected at the student's homes

	Before going to the home reservoir			After going to the reservoir		
Samples	pH	Turbidity	Apparent color	pH	Turbidity	Apparent color
1	6.5	1.2	5	7.2	1.5	6
2	6.6	1.2	5	7.5	1.8	6
3	6.4	1.1	5	7.2	1.7	6
4	6.6	1.2	5	6.9	1.4	6
5	6.2	1.1	5	6.8	1.3	6
6	6.4	1.1	5	8.2	2.1	6

Samples	Before going to the home reservoir			After going to the reservoir		
	pH	Turbidity	Apparent color	pH	Turbidity	Apparent color
7	6.3	1.1	5	7.6	1.1	6
8	6.2	1.4	5	7.4	1.2	6
9	6.4	1.2	5	8.8	1.9	6
10	6.3	1.3	5	7.6	1.8	6
11	6.2	1.1	5	7.4	1.7	6

Source: the author.

The pH values of the water collected in the stream as well as at the students' homes are within the parameters established by the Ordinance No. 2.914/2011 from the Ministry of Health, which indicates that the pH of water suitable for human consumption must be between 6.0 and 9.0.

The turbidity of the water analysis of the farms cited presented value greater than 9.99 NTU, which is the limit of detection of the turbidimeter. According to the established by the same Ordinance, the acceptable parameter for turbidity is between 1.0 and 5.0. We noticed that the turbidity of the samples analyzed are far above acceptable, therefore, unfit for human consumption; for the water collected in the student's homes, this parameter is within the limit, with minor changes after going to the reservoir, and the samples collected before entering the reservoir characterize the water of the distribution system (BRAZIL, 2011).

The apparent color of the samples analyzed from stream, was also not in accordance with the established by the legislation. The color higher to 15 uC (unit of color) exceeds the parameters established by the Ministry of Health; the samples from the students' residences are within the parameters, with a small increase also for the samples analyzed after going to the reservoirs.

The lack of hygiene, which should be done every six months, may have been the cause of the change of the analytical results obtained by changing the quality of treated water; even so, all samples, collected at the houses, still meet drinking water standards.

As the samples collected in the streams were from superficial waters and without any treatment, as it might be expected, wed did not detect the presence of free chlorine.

After the analyses carried out on samples collected on farms and at the students' houses, the results were discussed with the students, in order to compare them with the parameters established by the Ordinance No. 2.914/, by the Ministry of Health, from December 12, 2011. In addition, we discussed the application of the content involved in the analysis, such as: pH, solutions, compounds and pure substances, separation of compounds methods, and concentrations of solutions, always linking this content with the student's life.

In another time, with a group of eight students, we went back to the farms where we collected water samples, to present the results to people living there and alert them of the need to treat the water used for human consumption.

FINAL EVALUATION (POST- TEST)

After applying the methodology proposed, the students were subjected to the post-test to check whether the objectives of this research were achieved. When asked about their perceptions regarding the methodology applied, all of them highlighted positive points of this teaching methodology. Some questioned the workload for these classes and if there were financial resources for this end; others stressed the importance of the preservation of watersheds, which was also discussed in the field; others spoke about the need for water treatment, when they said:

"We also saw the part when water gets the chlorine, thus eliminating germs and bacteria. We learned the importance of water treatment, since this is the way to prevent diseases like leptospirosis."

"...when we measured the pH of the water, to make sure it was acidic or basic, we learned that water must have a pH around 7, which is ideal for consumption. And so we learned something else about water and purification procedures."

"We can also learn more about the amount of water that exists in every organ of our body and all the treatment process of water, from collection to distribution at home."

"We have learned, too, that the manganese that comes out of the water, in the process of treatment, serves as a raw material for other companies and also prevents corrosion of hydrometers."

You can see, with this, the importance of practical lessons, and the contextualization of content; the students can show what they are taught; see the applicability of that knowledge in their daily lives and consequently demonstrate greater curiosity and interest for chemistry content. For Silva (2003), contextualizing is approaching the contents of classroom with what learners live in their daily lives. "To contextualize, the teacher explains the social role of chemistry, its applications and implications, as well as demonstrates how the citizen can apply the knowledge in their daily life. (SILVA. et al, 2014, p.482).

FINAL CONSIDERATIONS

The aim of this study was to look for strategies to increase the interest of students for chemistry classes and, at the same time, check the problem of low academic performance of these students. We noticed that the traditional methodology applied by the teachers of the school where the research was carried out can be one of the reasons for the lack of

interest of the students surveyed, even because these teachers do not have the means to facilitate practical/field/ laboratory classes.

We also noticed that after field classes, using water as a generative theme, when students collected water from the Jacuba stream and from their homes, and in the practical/ demonstrative classes, where they could relate the content studied in the classroom with their daily lives, there was a considerable increase in the interest of these students by chemistry classes, because they realized the importance of chemistry knowledge in their lives and for the population in general. As a result, we can predict an improvement in the academic performance of these students as a result of the increase of their interests for chemistry classes, possible by the methodology applied in this research.

We conclude that the proposed methodology used in this research can contribute for the improvement of the teaching/learning process, which was evidenced by the responses of the students, through the different responses to the questionnaires applied before and after the research. In addition, we noticed an improvement in their effective participation in chemistry classes and, more than that, an increase in their ability to build scientific knowledge.

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