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Analytical Chemistry For High School

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Abstract: The Chemistry is the slope of the science that investigates the composition, the properties and transformations of the atoms that form the matter, by definition. In this way the current methodology used in the basic education cycle, mainly in secondary education, which seeks to be broad in a short period of time, limits the action of teachers to the theoretical content, making it impossible to carry out practices. These classes make it possible to integrate the subjects taught in the classroom with the reality of the students and, in this context, Analytical Chemistry is one of the branches of Chemistry that best integrates the theoretical contents into practical applications. In this project, analytical contents used: "Degree Technique" for the deepening of Chemistry in two groups of third year of secondary education of the State School Eponina Soares dos Santos, located in the municipality of Sete Lagoas-MG. In the meetings, visual resources used in the form of seminars associated with the adaptation of the theoretical contents with the premise of allowing the students to perform analysis. A primer was prepared with the contents presented and with the scripts of low-cost analytical practices. As a parameter, two evaluations of the students made at the beginning and end of the project and it observed that there was an improvement in performance in the area of general knowledge of chemistry in terms of concepts and everyday applications.
Keywords: Analytical Chemistry; Secondary education; Degrees

Introduction

The secondary education is the most important component of Brazilian basic education, because in this phase there is a greater deepening of the content, promoting and creating, mainly the critical sense in the understanding of reality for the exercise of the student's citizenship. It causing growth and maturity in the process, the future job market and a possible entry into higher education.

The Brazilian scenario shows that there is a high dose of information in which, in some cases, incorrect. The school has added the role of meeting the demand to clarify the students, forcing the teacher to develop technical-scientific knowledge, in a comprehensive and contextualized (VEIGA et al., 2013)

In this period, the area of Natural Sciences taught in detail, composed of the subjects Physics, Biology and Chemistry for high school students. According to the data of the Ministry of Education (MEC), in 2015, the average of the grades considering these disciplines are the lowest to the other contents that make up the National Examination of Secondary Education (ENEM), indicating the low performance of learning on the part of the students, mainly in Chemistry.

In this scenario, the need to teach Chemistry prioritizing learning, in a contextualized way and always stimulating the students' reasoning so that they can perceive the socio-economic and technological importance of chemistry. (ROCHA and VASCONCELOS - 2016).

Chemistry is the science that studies the composition, properties, transformations and interactions of the atoms that form matter and for teaching purposes divided into the Middle Teaching in Inorganic Chemistry, Organic Chemistry and Physic-chemistry. In this sense, chemistry can be considered an interdisciplinary discipline, very easy to work with and be passed on to students, essentially for being very experimental, possessing a huge range of practices with a great variety of subjects, allowing the discipline to be integrated with reality. .

The low performance in Chemistry can related to the methodology of the exclusively theoretical approach, in which the schools apply, making the subject disconnected with the scientific reality and of any social or technological parameter (Mortimer et

al., 2000) a distorted and disconnected vision with everyday applications.

In this context, the change of current methodology is perceptible, allowing the students of secondary education to apply the concepts obtained in the classroom, in a clearer and more objective way. In the problem addressed, Analytical Chemistry is a branch of chemistry that determines the chemical species that make up the material and develops techniques based on trivial reactions (HAGE et al., 2011).

This gap traced throughout the student's career and that fact is evident in the difficulty of students who did not have the proper contact in practical activities, mainly Chemistry, as observed in the courses of Agricultural Sciences at the Sete Lagoas campus. The Federal University of São In this scenario, it provided extensionist intervention measures in the student community of the city, seeking to improve the quality of teaching. (FERREIRA et al., 2016, MORAES et al., 2016, RODRIGUES et al., 2016, COSTA et al., 2017).

In the problem addressed, Analytical Chemistry is a branch of chemistry that determines the chemical species that make up the material and develops techniques based on trivial reactions (HAGE et al., 2011). As the preparation of a lemon juice, which would be the application of the concepts of solutions, to neutralize fish odors, carrying out a neutralization reaction of the amines present.

Taking into account that Analytical Chemistry is little or not exploited in the middle school in a practical way, and to apply it requires global knowledge of all areas of Chemistry. The main objective of this project was to bring the knowledge of students more clearly and objectively to Analytical Chemistry, addressing the degrees for better illustration, possessing a great potential to involve and develop all the areas exploited in the school curriculum.

Methods

For the best performance of the project and logistics of the objectives, the target audience was students of the State School Eponina Soares dos Santos located in the District of Industries, in the municipality of Sete Lagoas - MG, which were in the third and second year of secondary education, totalizing 50 adolescents. To evaluate the impacts generated by the intervention, two questionnaires applied at different times, one at the beginning and the other at the end, between months of August and December 2016. The questionnaire was composed of nine questions, divided into three groups: with 3abordando "Knowledge about Chemistry "," General concepts of Chemistry "and" Applications of Chemistry in the everyday ".

For a greater interaction of the students with the intervention, a booklet has been prepared addressing a review of basic chemical concepts, such as the explanation of some stained glass windows, pH, solutions, definition of indicators and practices carried out in the project. All the subjects addressed in the book had practical examples bringing the approach of the adolescents involved with the subject of Chemistry and the everyday.

Figures 01, 02 and 03: Layer and pages of the primer.

Figure 04: Poster that promoted the intervention in the school.

In addition to the primer, a poster produced to show the student community and residents that the school was participating in the project. The visual disclosure is very important because it encourages the students involved and promotes the support of parents and other teachers.

The interventions scheduled with two moments, the first a review of the content addressed and then the application of the practices. It observed that the students did not have any previous contact with the space that the school had for science classes. With this, the practices formulated in a simple way, with alternative materials of low cost and risk of manipulation, making possible the future replication by the teachers of the school. In total there were 6 workshops addressing:

Preparation of solutions of organic and inorganic substances:

Practice whose purpose was to address the issue of solutions, concepts between chemical compounds and introduce the first contacts with stained glass and laboratory equipment. The organic compounds used were crystal sugar (glucose) and ethyl alcohol, as well as inorganic cooking salt (NaCℓ) and sodium bicarbonate ($NaHCO_3$), all homemade products.

The students have divided into groups and produce their own solutions of different masses already duly indicated. They were also required to calculate the concentrations of each solution.

Practice of natural and synthetic indicators:

Before the meeting, a solution of purple cabbage extract was prepared from 200g of the leaves with the addition of 500mL of water for 10 minutes and then cooked (Figure 01). A solution of phenolphthalein ($C_{20}H_{14}O_4$) and pH tapes also made as representatives of synthetic indicators.

Figure 05: Production of natural indicator from purple cabbage.

For the realization, one lemon juice, vinegar (4.0% v/v acetic acid solution), drinking water, sodium bicarbonate (10% m/v solution) and 0,01 mol/L NaOH were used, representing respectively strong acid, weak acid, neutral solution, weak base and strong base.

As this practice is visual, he asked the students to find out what the approximate pH of the solutions would be. For this, data on the coloring of each track have provided as shown in the following image.

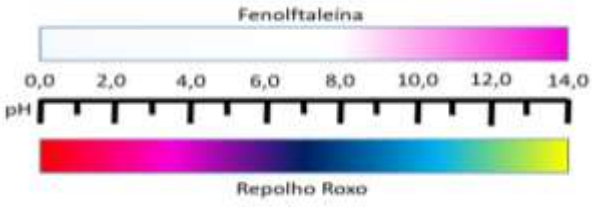
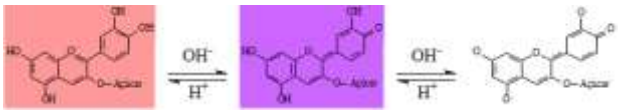


Figure 06: Diagram of the colors of the indicators in correspondence with the pH.

The visual practices are those that have the best return on the part of the students, being the best applied the theoretical contents taught.

This practice based on the change in the conformation of the presence of a certain pH, absorbing H^+ or OH^- ions, generating alteration in the absorption of light, promoting the alteration of color. The two examples represented below:

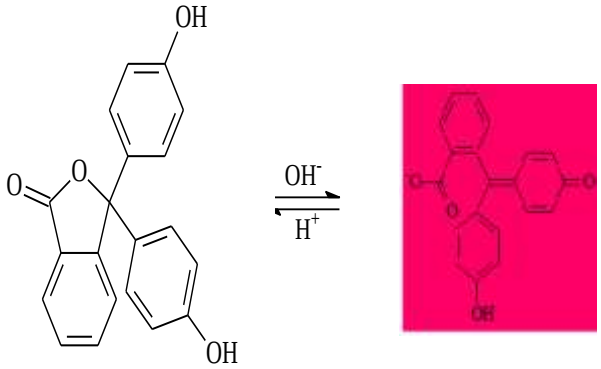
I. Purple cabbage



pH 1,0 pH 7,0 pH 14

The pigment responsible for the purple coloration of the purple cabbage is anthocyanin, which has the ability to absorb and release H^+ ions together with the alteration of the double connections, resulting in the change of color depending on the pH of the solution. Red coloration is obtained in media close to pH = 0, purple at pH = 7,0 and yellowish near pH = 14,0.

II. Phenolphthalein



pH < 8,0 pH ≥ 8,0

Phenolphthalein is an organic compound widely used in chemical analysis because it has a very clear turning point (change of color). In acidic and neutral media, the compound is colorless, but when at pH ≥ 8,0 the molecule undergoes a change in structure and exhibits intentional pink coloration.

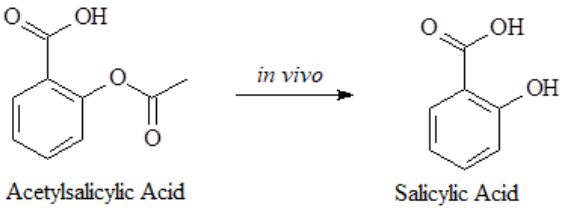
Acid volumetry practice:

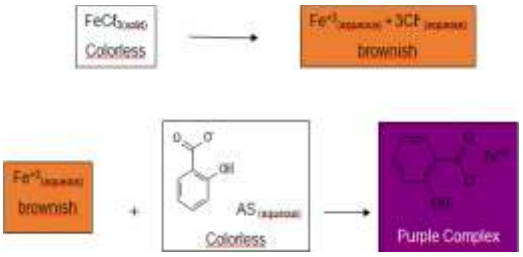
Practice that was based on the determination of the content of acetic acid in vinegar with NaOH titrant solution at 0,01 mol/L. The need to express the content of certain components in products for consumer safety addressed.

The phenolphthalein and purple cabbage extract used in the previous practice were used to exemplify the turning point, the former being more efficient than the latter because it is more specific.

Complexometric volumetry practice:

It used as titrant $FeC\ell_3$ in concentration 0,03mol/L and urine of a user of acetylsalicylic acid (AAS), which is a drug used as an anti-inflammatory and analgesic. This acid when metabolized by the body generating salicylic acid (AS) that reacts with the Fe^{+3} ion, as follows:





When the body metabolizes acetylsalicylic acid, it generates salicylic acid as a substrate that eliminated in the urine. Then the Fe^{+3} ion acts as an indicator of salicylic acid, completing and displaying the purple coloration, exemplifying an antidoping determination operation, so used in sports practices in the current days.

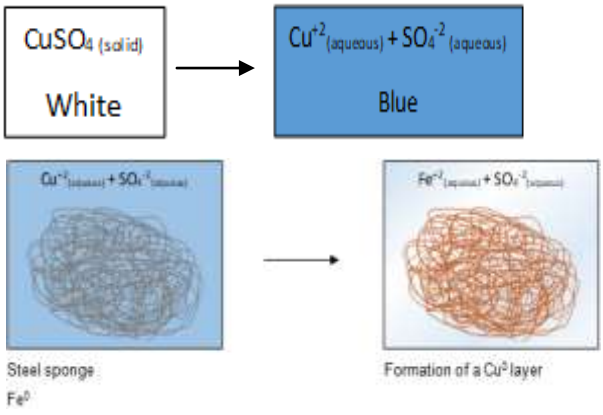
Precipitation volumetry practice:

In the case of the sample, the sample was UHT milk that has in its constitution caseins, which are proteins that form micelles and which have an isoelectric point at pH 4,2.

In practice, the titrant was $HC\ell$ at 0,01 mol/L that added until the formation of two distinct phases: one formed by the serum (translucent) and another one by the precipitated casein (opaque white). After the formation of the phases it has been demonstrated the processing of yoghurts, which instead of adding hydrochloric acid, to reduce the pH of the milk, are lactic acid bacteria responsible for the acidification of the solution.

Oxidation reaction practice:

In this approach, the oxirreduction process of metals presented, exemplified with the $CuSO_4$ solution at 0,01 mol/L and steel sponge, following the scheme:



The students produced the $CuSO_4$ solution and to observe the formation of blue coloration in the solution, which represents the presence of the Cu^{+2} ion in the aqueous medium. In a glass, the $CuSO_4$ solution and the steel sponge added. They observed the color of the steel sponge (metallic gray) before it submerged in the solution, that tonality shows the presence of Fe0 on the surface of the sponge.

After some time after the two reagents combined the formation of metallic copper on the surface of the steel sponge and the decrease in the blue tonality of the solution observed, justified by the reaction to followed:

$$Cu^{+2}_{(aqueous)} + 2e^- \rightarrow Cu^0_{(solid)}$$

$$Fe^0_{(solid)} \rightarrow Fe^{+2}_{(aqueous)} + 2e^- \text{ (colorless)}$$

Results and discussion

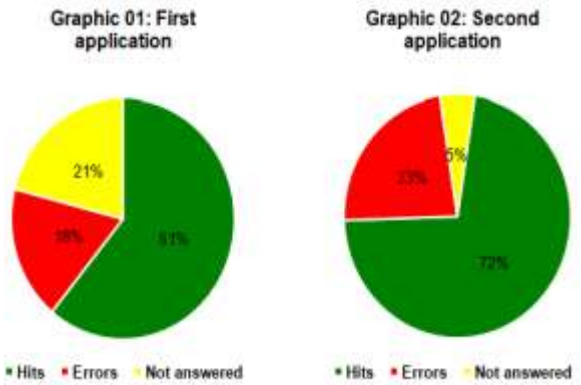
The school management reported that there were 50 students in the third year. However, in the days of application of the questionnaire, there were no students, and thus 47 counted in the first and 43 in the second. It also saw that the age group was between 16 and 19 years old.

In the two evaluations, the same 9 questions used these divided into three blocks: "Knowledge on Chemistry", "General concepts of Chemistry" and "Applications of Chemistry in everyday life". For the data collection, the answers divided into hits, errors and not answered. The score of each question was added and divided by three times the number of students, and thus, generating a percentage.

When dealing with a school content, it is extremely necessary that there is knowledge of basic concepts on the part of the students, such as the historical one and the one; it is about, and from the concepts to develop the discipline itself. In the first block,it hasasked: "What is Chemistry?", "What is the need for the study of Chemistry?" and "What would a solution be?" It observed that 61% of the students had knowledge of what Chemistry was, 18% answered satisfactorily and 21% did not respond in the first application. However, in the second application, it observed that 72% of the students responded adequately, 18% inadequately and 5% did not respond. He could see that the students became more participatory, as there was a drop in the percentage of students who did not answer the questions (Graphics 01 and 02).

Knowledge on Chemistry

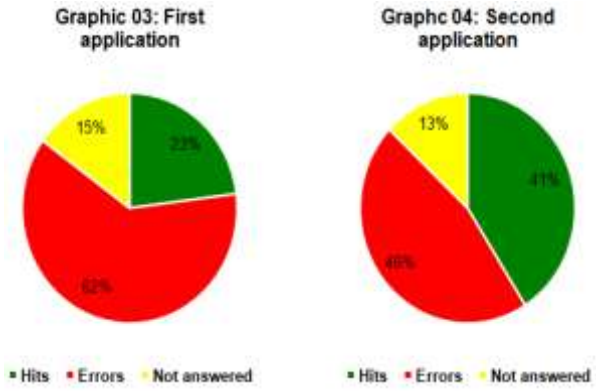
General knowledge is the results generated from the learning of the discipline. From the concepts that a science manages to develop, creating theories and testing them, and in a certain way, creating a new technology. For these reasons, it is necessary to evaluate if the students contemplated the most trivial concepts of Chemistry. It asked about basic concepts: mole fraction; dissociation of acetic acid in aqueous solution; whatthe chemical representation of the hydrogen cation was.



The first application was that 23% of the answers were correct, 62% did not reach and 15% did not respond. The high proportion of wrong answers can be a consequence of the little interaction of the taught content with the student reality, and thus, hindering learning.

However, in the second application there was a considerable growth in the number of correct answers, which is due to the deepening of the project in Chemistry. The following data obtained: 41% were correct, 46% were wrong and 13% left blank (Graph 03 and 04).

General concepts of Chemistry

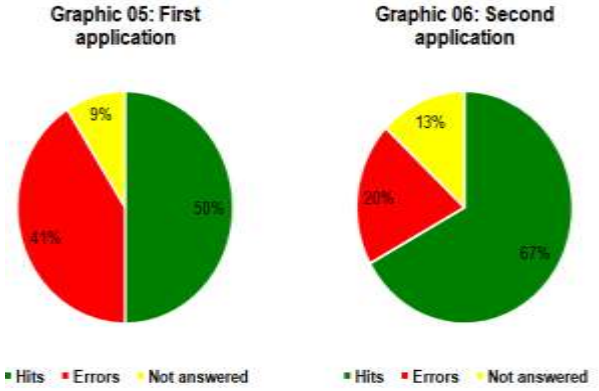


The union of knowledge with concepts enables the application of several topics studied and, thus, facilitates the daily with simple tasks ranging from the composition of food in the containers to what concentration of preservatives in products. They had to respond: "What would a laboratory be and what would be the ideal behavior?", "What are the examples of chemistry in the everyday?" and "What is the name of the product that contains acetic acid?".

According to the data of the first evaluation 50% of the students answered correctly, 41% were wrong and 9% did not answer. In the second evaluation, 67% were correct, 20% were wrong and 11% did not respond. In this block, the reduction of the

percentage of students who missed was remarkable; it is a good indicator of cognitive growth (Graph 05 and 06).

Applications of Chemistry in everyday life



Conclusion

Student participation was slow, but significantly gradual, always interacting with analytical practices. Chemistry is an experimental science, uses various scientific resources to perform analysis, and therefore allows a large number of practices that can used in high school classes.

The introduction of analytical practices allowed the integration of the theoretical content to the daily of the participants, creating critical sense allowing questioning methods widely used by the population.

Consideration given to the level of practical knowledge of Chemistry of the students and was used in the preparation of the primer topics current to explore each content addressed. In discussing the subjects, the teachers perceived that Chemistry surrounds them and that they use it daily when using products or when cooking.

It was possible to observe the significant improvement in the areas of concepts, basic knowledge of Chemistry, compared with the beginning of the project, highlighting the need for practical classes in teaching, even with limited hours and with extensive content reported by teachers.

It was noted that there is a need to extend knowledge throughout middle school, changing the way of teaching and changing a cycle of discontent of generations that did not have real contact with chemistry and, concluding, generating more critical and less alienated professionals.

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