The implementation of Electronic Spreadsheets in the initial formation of the Chemistry Teacher: Perspectives and difficulties

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ABSTRACT
The Electronic Spreadsheet is a powerful digital spreadsheet that has several tools for the treatment, analysis, simulation and sharing of data. All this functionality makes it an excellent resource to use in the classroom. For this, this resource must be included and experienced in the initial training of the teacher. Thus, the present work aims to analyze the first experience of a Chemistry Degree class using electronic spreadsheets for experimental data processing in Physical Chemistry classes. For data collection, a questionnaire was used, based on a qualitative approach, about the perspective and difficulties faced by the students in this first experience. The results indicate that there is a mutual recognition of the class that the Electronic Spreadsheet is a very useful tool that allows the resolution of calculations faster, optimizing a considerable time compared to manual calculations, in addition to facilitating the construction and analysis of tables and graphs, means of representation of data widely used that enable the use of regression analysis, a technique that allows verifying the existence of a relationship between a dependent variable and one or more independent variables. Still, much of the class found it difficult to use the tool because it was their first experience. It is clear that the implementation of technology in education brings great benefits in the process of teaching learning, but that for this, it is necessary to have security in its application, since the new technologies bring with them a certain degree of complexity. The Electronic Spreadsheet, being one of these technologies, should be implemented in the initial training of the teacher so that the future teacher obtains mastery and can enjoy its functionality in the exercise of his profession.

Keywords: Electronic Spreadsheet, Technology in Education, Teacher Education, Chemistry.

1 INTRODUCTION

Technology is increasingly present in our lives and it is undeniable that its use provides numerous facilities, allowing society to develop even faster. In this sense, Denari, Saciloto and Cavalheiro (2016, p. 371) clarify that:

> Contemporary society is full of new technologies that offer access to information and promote constant evolution of knowledge. One of the main factors of these rapid advances are undoubtedly the Information and Communication Technologies (ICTs), increasingly present in people's daily lives.

Faced with this technological society, access to information is practically instantaneous. Teachers cannot be tied to "archaic" modes of teaching, they must always be updating and making use of new technologies in their teaching methodology, because the students themselves are increasingly familiar with new technologies, which can provide a better understanding of the content when used correctly. Reaching such a point that those who are not familiar with technologies run the risk of being on the margins of society in relation to their professional training (DENARI; SACILOTO; GENTLEMAN, 2016).

One of these technologies are electronic spreadsheets, their use has stood out in several areas and levels of education, and can be used in classrooms, laboratory practices and scientific research (VALESCO, 2021). For the teaching of exacts, Saldanha (2006) emphasizes that they provide that the relationships between the different types of representations, such as tables, equations, matrices and graphs can be seen at the same time connected to each other, which makes them more easily understandable to students.

In the study of Physical Chemistry, especially in the treatment of experimental data, as well as in other areas of exacts, it is recurrent the need to use the same mathematical formula for different conditions, consequently for different numerical values. Doing all the calculations individually can make teaching this science dull for students. In this sense, electronic spreadsheets have functionalities that make it possible to perform these calculations quickly and practically, because:

> Electronic spreadsheets, already widespread and well known, are practical in the sense of data entry and equations, in addition to providing excellent visualization of results, easy data transfer, graphs and tables, being powerful tools to implement and perform different types of calculations, such as experimental planning. (THEOPHILUS; FERREIRA, 2006, p. 338)

Implementing this resource in the classroom can enrich the student's learning process, considering that electronic spreadsheets have great versatility and utility (GERMANNA; MORAL; ARAÚJO, 2013), providing a functionality capable of assisting students in their personal, academic and professional life.

The use of electronic spreadsheets, according to Teófilo and Ferreira (2006), provides numerous advantages, such as: there are free versions for use; provide a friendly and user-friendly environment; experimental calculations are easily added and controlled, offering ease of visualization of the equations and adaptations for specific planning; Charts, tables, and data can be easily constructed and transferred to text files; among others.

The fact of finding free versions allows the teacher and students to enjoy all the functionality of electronic spreadsheets in a broad and collective way, because programs that need to be paid for are unfeasible in the classroom, in the sense that not all students can or will pay to use the tool designated by the teacher.

The virtual environment of electronic spreadsheets offers an immense facility in the treatment of experimental data, being able to generate tables, graphs and even new data from the initial data added to the spreadsheet, because it provides regression analysis, a technique that consists of performing an analysis that makes it possible to verify the existence of a functional relationship between a dependent variable with one or more independent variables. With regression analysis, one can model the relationship between the chosen variables, as well as predict values based on the model. There are numerous applications of these functionalities for the teaching of chemistry, which further emphasizes the need for this program to be included in the initial training of the Chemistry Teacher.

The present work was developed by a student of the Degree in Chemistry of the Federal Institute of Education, Sciences and Technology of Rio Grande do Norte, Pau dos Ferros campus, with the objective of analyzing the first experience of a Chemistry Degree class using electronic spreadsheets for treatment of experimental data in Physical Chemistry classes, in order to analyze the perspectives and difficulties faced by students about these tools, considering that the teacher separated some classes to explain how it works and how students would make use of the spreadsheet, emphasizing that the electronic spreadsheets in question were Excel and Google Sheets.

2 METHODOLOGY

The work was developed in the perspective of a field research of an exploratory nature, using a qualitative approach, a research approach that is concerned with the "aspects of reality that cannot be quantified, focusing on the understanding and explanation of the dynamics of social relations" (SILVEIRA; CORDOVA, 2009, p. 32).

The work began after verifying that the students of the Degree in Chemistry had difficulties in understanding how to use electronic spreadsheets to carry out the activities proposed by the professor of the discipline of Theoretical and Experimental Physical Chemistry. In this sense, the teacher of the discipline dedicated some classes to explain the operation of electronic spreadsheets and how the students would use them to solve the activities. These activities consisted of reports with tables and graphs, in which the students filled in experimental data that they themselves obtained in practical Physical Chemistry classes. Then, the data were treated and analyzed within the spreadsheets, which can be both in Excel and Google Sheets, which do not present many differences. To minimize the difficulties, the students made use of the computer laboratory of the educational institution, where they had access to individual computers and direct contact with the electronic spreadsheets, enabling, through guidance from the teacher, a greater interactivity with these tools that cannot be achieved within the common classroom.

For data collection, a questionnaire was used, allowing students to feel free to express their perspectives and difficulties regarding the use of electronic spreadsheets, by offering anonymity in the

answers. This instrument was chosen for data collection because the questionnaire is an instrument consisting of a set of questions or questions with the intention of determining attributes or characteristics related to people or phenomena (COELHO; SOUZA; ALBUQUERQUE, 2020), which makes it an appropriate instrument for the purpose of this work.

The questionnaire was constructed of 5 directed questions, 4 subjective and 1 objective, without the need for identification. In this way, it does not become a boring activity, in the perspective of not being a very extensive questionnaire, and the students would not feel shy in their answers because they are not identified.

3 RESULTS AND DISCUSSION

The application of the questionnaire obtained a considerable response from the class, being answered by 75% of the students, the class consists of 16 students, among which, 12 participated in the research. To analyze the answers it is necessary to take into account that it was the first experience of the class with the program, that is, the students had never used electronic spreadsheets in the treatment of data and do not have extensive knowledge on the subject. Thus, their first impression about the program, described here, can serve as a guide for teachers of chemistry and related areas to plan the implementation of electronic spreadsheets in their classes.

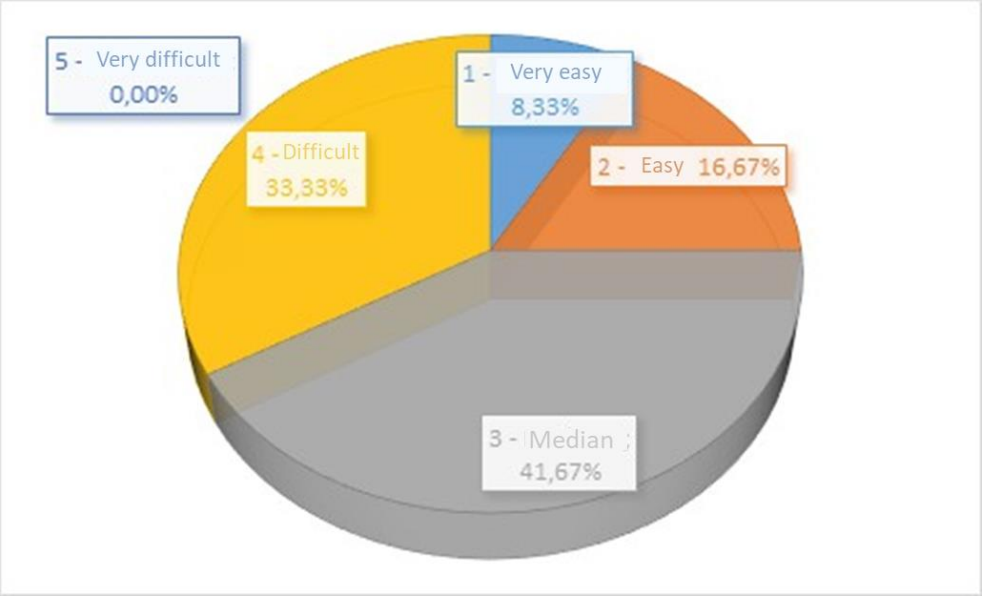
The first question is to know from the students whether, in their view, the electronic spreadsheet is useful or not and why. According to the answers, there is a mutual recognition of the class in relation to the usefulness of electronic spreadsheets, emphasizing the ease and practicality in the development of calculations, tables and graphs, which in turn significantly assist in the teaching and learning process. For, "the worksheets allow students to focus on manipulations, reasoning and "programming" instead of calculations that can be tedious for many students" (SALDANHA, 2016, p. 11). In this way, students stop wasting time repeating the same process over and over again, so they can understand the whole from a broader view of the whole process, without it wearing them out.

In this sense, the students also recognized that activities that involve repetitive calculations can be easily performed in a very short time using electronic spreadsheets, because they allow the calculations of a large database in a unique and fast way.

The second question was objective, in which the students would indicate on a scale of 1 to 5 the difficulty they felt in using the electronic spreadsheets to perform the proposed activities. The scale was distributed as follows: 1 - very easy; 2 - easy; 3 - median; 4 - difficult; 5 - very difficult.

According to the answers shown in Figure 1, a good part of the class felt difficulty in using the electronic spreadsheets, 33% considering it as difficult and 41% considering the median difficulty, that is, they could understand its fundamentals, but at the time of using it they had no security or were lost in the various functionalities that the electronic spreadsheets have.

Figure 1: Level of difficulty when using electronic spreadsheets from the perspective of the student in the discipline of Physical Chemistry



Considering it is the first experience of the class with the program, the difficulties faced by the students are within the forecast, given the large amount of functionalities present in the electronic spreadsheets.

The third question was whether the teacher's explanation of the program was sufficient for the students to understand how it worked, if not, what means they used to understand. Most of the class found the explanation sufficient, but when it came time for them to operate the program themselves, they felt difficulties and looked for other means, such as videos on youtube and conducting research on the internet, in order to better understand the program and find the functions of the spreadsheet that they would use for each activity.

Some students also recognized that even though they were simple tasks, they still had difficulties to perform them in the electronic spreadsheet, when they were not in the presence of the teacher to explain them step by step, because they had no basis on electronic spreadsheets. As recommended by Velasco et al. (2021), for the use of electronic spreadsheets in the classroom, in addition to being necessary a qualification on the part of the teacher, students must have a minimum of knowledge of handling this tool, to have a better use of its potentialities. In fact, spreadsheets facilitate the realization and construction of calculations, graphs and tables, but it is necessary first to have an understanding of their functionalities, before working new contents with them.

The fourth question consisted of knowing how the activities were carried out among the students, because they were practical, they were carried out in 2 large groups, in which each group received a report with tables for filling in and analyzing the data obtained in the experiments for each activity. Each group would only need to deliver a single copy of the report to the teacher, that is, only one document per group. In this sense, it is possible that not all students have actually participated in

the construction and analysis of the proposed tables and graphs, taking into account the possibility that some students do not perform the task leaving it up to others more engaged in the proposal. There was also concern about how the groups performed the tasks with their members.

The answers presented two distinct cases, the questionnaire does not require identification, but it was possible to differentiate the groups from the answers to this question: The members of group 1 reported that all members of their group participated and made use of the electronic spreadsheets, but did not describe how the activities were carried out, only one student reported that, Although the group did the activities together, he, in particular, could not learn to calculate through the worksheets due to his level in mathematics being very poor; The members of group 2 reported that not all members of their group made use of spreadsheets, but all participated in the activities developed helping their group in some way. The performance of the activity, in group 2, was developed from the sharing of a document with all its members, in which each member would put the results they found, making the calculations individually, and later, by comparison, the group would reach a consensus of the most appropriate answer. Members who were unable to use the spreadsheets contributed by performing the calculations manually. Given the large amount of calculations required in the activities, the students who performed the calculations manually focused on checking whether the calculation the group was using in the worksheets was correct, for example, the calculation of the expressions of the molar partial volumes for the ethanol and water components from formulas described in the report.

In the last question of the questionnaire, the class was asked to perform a general analysis of the use of electronic spreadsheets in the class of the Degree in Chemistry. According to the data collected, no student criticized or pointed out anything about the methodology used by the teacher, but most students reported that the class did not reach a mutual understanding of how to use the electronic spreadsheets. According to the reports, this can be explained due to the short time that was intended to teach the functionalities of this program, and to get around this problem, a greater amount of classes only to teach the use of electronic spreadsheets in the teaching of chemistry and / or the realization of mini-courses for this purpose.

The class, although they presented difficulties in understanding the use of electronic spreadsheets, recognized the advantages of using these programs for data processing, mainly because they optimize a lot of time in the resolution of calculations, which in large numbers and complexes can be quickly and easily solved in the program.

The use of electronic spreadsheets in the teaching of chemistry brings numerous benefits to its users, because they have a wide variety of functionalities that can be used for the teaching and learning of different contents, also enabling more dynamic and motivating classes, in the sense that large amounts of calculations can be solved quickly as "by magic".

4 FINAL CONSIDERATIONS

Technology has become an indispensable part of society and teaching in a technological world must also integrate it, because the old methods and means no longer attract the attention of students, do not motivate them to participate in classes. Information is everywhere, it is the role of the teacher to be a mediator of this knowledge, directing the student to use the programs, applications and websites that help him develop his learning.

For this, the teacher himself must be able to use these technologies for teaching, implying an initial training that brings with it a certain experience in its use. One of these technologies are the electronic spreadsheets, which despite presenting, at first, a certain complexity in their understanding, can provide numerous facilities in the life of the student.

In the research developed, it can be noted that a considerable number of classes are needed for the use of electronic spreadsheets so that students can really master them, which could culminate in a discipline focused only on the use of new technologies for the teaching of chemistry. In the curriculum of the Degree in Chemistry of the Federal Institute of Education, Sciences and Technology of Rio Grande do Norte, Pau dos Ferros campus, already in the initial periods, there is the discipline of informatics, which presents the basics about the structure of computers and programs present in them, which may not add much to the knowledge of the class, Given that most of the past information is already integrated with the previous knowledge of students who are part of a generation strongly familiar with technology in general.

It would be of much more value if this same discipline dealt with technologies that can be used in the teaching of chemistry, a demand that undergraduates and teachers already trained in the area need to constantly take account.

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