



The PET-Chemistry strengthening teacher training from the leveling course in basic mathematics

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ABSTRACT

The main objective of this research was to provide the students of the Chemistry Course at UFCG, the fundamental knowledge necessary for a better performance in their higher education, enabling them to face the different academic challenges. This methodology aims to develop basic skills that may not have been adequately trained in previous years or grades in which the student is enrolled. The Leveling Course in Basic Mathematics was conducted by undergraduate students in Chemistry from the PET-Chemistry group of the Federal University of Campina Grande. This course was taught in the institution's classrooms, on Wednesdays and Fridays, both for students enrolled in the day and night shifts. The leveling took place in the form of dialogued lectures, with the aim of stimulating students' oral communication and improving their cognitive skills; as well as troubleshooting for the purpose of demonstrating examples. These classes were presented in a certain order, covering the following contents: Numerical Sets, Functions, Four Operations involving Fractions, Percentage, Scientific Notation and Potentiation.

Keywords: Higher education, Motivation, Teaching and Learning.

1 INTRODUCTION

Students who enter the chemistry degree course have the opportunity and possibility to have another view of the world, a critical opinion, so that they can build and use specific knowledge in their area, which will be used when they graduate and work in their profession, according to Silva (2021).

Currently, it is notorious that when students enter higher education, it is necessary for them to adapt to new teaching and learning methodologies and bring with them a baggage of knowledge that they have built since high school (Agostini, 2017).

But, according to Agostini (2017), he agrees that this student brings with him gaps in high school, in several disciplines. Among them is the discipline of chemistry, which in addition to chemical concepts,



a large part of its curriculum has mathematical calculations that are fundamental for the training of teachers in the chemistry degree course. As a result, they claim that the teaching of chemistry has such problems and brings content that is totally dependent on mathematics (Pozo and Gómez Crespo apud Silva, 2021).

Despite the fact that the Law of Guidelines and Bases of National Education (LDBEN) establishes guidelines for the quality of teaching, Brazilian education faces challenges at all levels, being particularly critical in secondary education. This has a significant impact on the learning of chemistry-related content (SILVA, 2021), and other essential subjects. As a result, the obstruction of learning pathways, preventing students from advancing towards new knowledge.

One consequence of these gaps that come from high school is the dropout from the chemistry course. A study carried out at the University of Brasília showed that the Full Degree in Chemistry at the Federal University of Mato Grosso has dropout rates of up to 77.7%. It also reveals that in his research, the students who dropped out of the chemistry course had frequent failures and lockouts in the same disciplines, including Calculus I (Cunha, Tunes and Silva 2001).

It is of paramount importance to fill the knowledge gaps, but it is also essential that there is a change in the professional perspective of these students, who were not encouraged to be autonomous in the learning process (FERREIRA et al., 2001); It is essential that students understand that they must take responsibility for their own learning.

In the sense of the dropout of freshmen in undergraduate courses, Almeida and Soares (2004) point out that the beginning of the academic journey is marked by a series of new challenges and difficulties, being considered a critical stage for the university student. The challenge faced by Brazilian universities is also discussed in several nations, revealing that the dropout and repeated failures of undergraduate students are complex issues that represent both an educational and a social problem (VIDALES, 2009), when it comes to the educational problem, it is at this point that the difficulty in following the syllabus presented during classes arises.

Two reasons are highlighted to explain the difficulties that students have in assimilating the knowledge transmitted in the classroom: the lack of appreciation on the part of the student in relation to the subject, or the lack of basic knowledge, which represents an obstacle to the progression of learning the syllabus in higher education (TOSTA et al., 2017).

As a consequence, it is necessary to offer leveling courses in Higher Education in order to neutralize deficiencies in High School. It is evident that there is a disparity between the two levels of education, which places on higher education the responsibility of filling the gaps in the training of new entrants, in order to prepare them to follow the undergraduate courses.

According to Nunes (2021), the discipline that incoming students experience the greatest difficulties is the discipline of Integral Differential Calculus I, therefore, the need for an Introduction to Calculus



leveling course is evident, which is offered to new students in the course, so that the deficiency from high school is filled or minimized.

For Santos (2018), the leveling course offers the opportunity for the student to make up for the deficiencies that have been created in the area of exact sciences. The basic math leveling course for freshmen in the chemistry course can be a tactic to help the students' growth, which will fill the gaps coming from high school. The leveling course will help in the promotion of skills that have not been previously worked on by them, so that dropout is not increasing (Silva, 2021).

In this work, a mini-course of leveling of introduction to calculus was addressed for students entering the course, who are enrolled in the discipline of introduction to calculus, in addition to these, students who are late in the course are also participating in the mini-course, so that they can progress in the Chemistry Degree course of the Federal University of Campina Grande - Cuité campus (UFCG-CES).

2 OBJECTIVE

To provide students with the fundamental knowledge necessary to perform better in their higher education, enabling them to face the different academic challenges. This methodology aims to develop basic skills that may not have been adequately trained in previous years or grades in which the student is enrolled.

3 METHODOLOGY

The Leveling Course in Basic Mathematics was conducted by undergraduate students in Chemistry, more precisely, students of the PET-Chemistry group of the Federal University of Campina Grande, located in Cuité - Paraíba, which is part of the Academic Unit of Biology and Chemistry. This course was taught in the institution's classrooms, on Wednesdays and Fridays, both for students enrolled in the day and night shifts.

The leveling took place in the form of dialogued lectures, with the aim of stimulating students' oral communication and improving their cognitive skills; as well as troubleshooting for the purpose of demonstrating examples. These classes were presented in a certain order, covering the following contents: Numerical Sets, Functions, Four Operations involving Fractions, Percentage, Scientific Notation and Potentiation.

In the process of evaluating the course, a quantitative research was carried out through questionnaires that were applied in the last class of the leveling, in order to collect information about the degree of satisfaction of the participants with the basic mathematics leveling course. These questionnaires will also serve to obtain data on the progress and difficulties of the students in relation to the content presented during the classes, as well as to evaluate the effectiveness of the methodologies used.



It is important to point out that the classes are activities related to Teaching, which is one of the aspects of the Tutorial Education Program - PET which the course teachers are part of, under the supervision of Prof. Dr. José Carlos Oliveira Santos, tutor of the program.

4 DEVELOPMENT

In the process of mathematical teaching and learning, Silva (2014) reports two types of difficulties: the difficulty of teaching and the difficulty of learning. This leads us to understand that the aforementioned process is a two-way street, the willingness to want to teach and teach well must be joined to the willingness to learn and learn well. Motivation is one of the elements pointed out by Ausubel as being essential for this disposition (PELIZZARI, et al., 2002). The deficits in learning in Mathematics are also related to the teaching system adopted by some teachers, who pass on the content in a mechanical way, without making significant associations of the new contents with what the student already knows, contrary to what Ausubel proposes (PELIZZARI, et al., 2002).

In Ausubel's theory of Meaningful Learning, the importance of valuing students' prior knowledge is emphasized as a basis for the construction of mental structures that facilitate the acquisition of new knowledge, making learning meaningful. This means that the teacher, by presenting numbers and then introducing the concept of addition, allows students to understand addition from elements that are part of their everyday experiences. When students achieve this understanding, learning becomes meaningful, thus facilitating the later assimilation of the concept of subtraction, which means that many do not understand this methodology and carry deficits since elementary school, arriving at university with several difficulties.

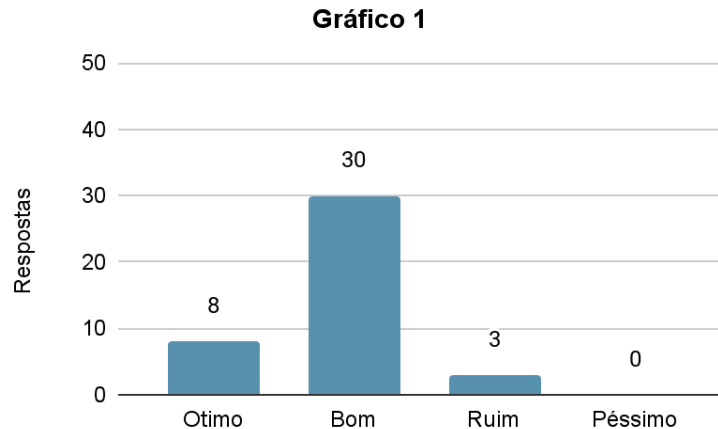
Faced with this problem, it is imperative that teachers develop strategies to reverse this situation. However, there is often a lack of interest and underperformance on the part of students during the first few months of the course, an aspect that is often overlooked by teachers. This, in turn, results in negative impacts on undergraduate chemistry courses. In this context, it is crucial to seek new methodologies that prioritize inclusion as a determining factor to arouse students' interest in academia. Thus, a university professor must not only have deep knowledge in chemistry, but must also be able to address didactic topics that stimulate students' interest (OLIVEIRA, 2017). This is one of the reasons that lead to the implementation of the Basic Mathematics Leveling Course.

Therefore, the Basic Leveling Course, promoted by the Tutorial Education Program in Chemistry (PET-Chemistry) at UFCG-CES, plays a fundamental role in the training and preparation of students who are starting their journey in the broad field of chemistry. In this phase of the study, more details about this educational experience will be presented, with emphasis on the application of a final questionnaire, which aims to evaluate the real impact of this pedagogical intervention.



The teaching-learning process in mathematics, as already mentioned, often faces challenges, especially for students entering university with different levels of academic preparation. A solid understanding of the fundamental principles of mathematics is essential for students to succeed in more advanced courses, and it is in this context that leveling plays a crucial role. In this stage of the analysis, the data obtained through the questionnaire applied to the group of 41 students who participated in this course and answered the questionnaire will be explored. These elements can offer valuable insights to help improve the chemistry teaching and learning process. We used a questionnaire that was developed and submitted to previous tests to be applied in the final stage of the lecture. The questionnaire was created with the objective of evaluating the perception of the participants and collecting pertinent information about the absorption of the content applied during the mini-course. Throughout the process, our main emphasis was to ensure that the questionnaire addressed in a comprehensive and in-depth manner all aspects of the investigated problem, exploring its various dimensions in detail. For data collection, we chose to employ individual semi-structured questionnaires as our main tool. These questionnaires were designed with two fundamental objectives in mind: first, to create a profile of the participants, and second, to obtain a detailed understanding of what difficulties are still pertinent and to analyze the use of the process

Graph 1. How do you assess your understanding of basic math content?



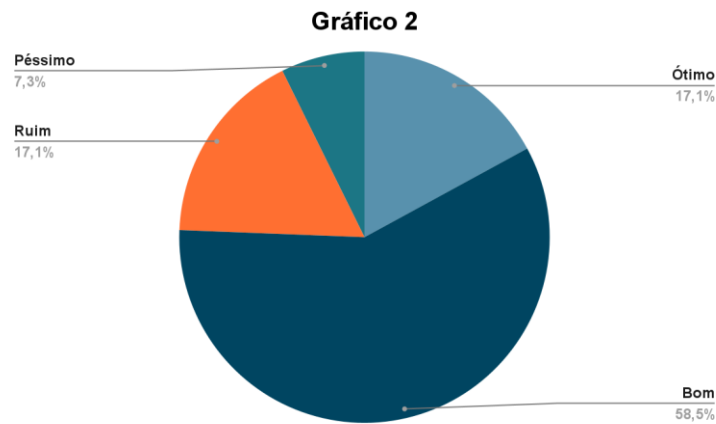
Source: The author (2023).

As shown in graph 1, which refers to (Question 1) of the questionnaire in question, how do you assess your understanding of basic mathematics content? It was evaluated that the quantity of 0 students answered very poor in relation to the comprehension of basic mathematics, we can evaluate this as positive presents a high learning index related to regular education. Subsequently, there is a poor evaluation where 3 people stated that they have a poor understanding of the contents applied in the teaching that was based. Soon after, it is asked if these students had a good performance in learning and 30 students answered yes, giving us a positive perspective on the applicability of our mini-course making it even more dynamic and



easier, later when asked if this knowledge would have been great, 8 students answered yes, this can be generated by several questions, It is noticeable that some have different learning methodologies for different reasons, accessibility, necessity, and cooperativeness. These may be points to be highlighted.

Graph 2. What was your foundation like in high school

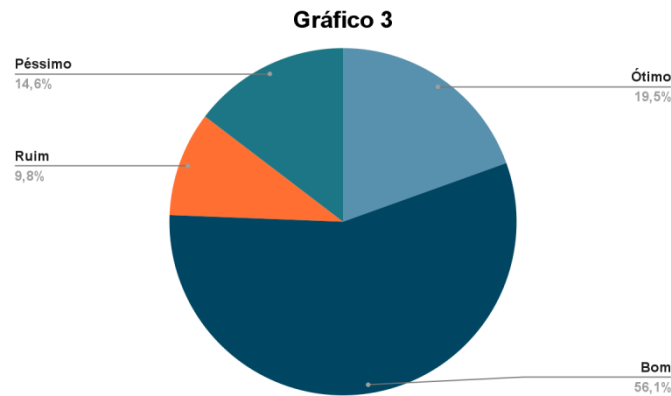


Source: The author(2023)

Graph 2, which refers to (Question 2) of the questionnaire which deals with how the study on the mathematical basis went, shows that 7.3% answered very poorly, This indicates that a small portion of the people who responded to the survey had a very negative experience while teaching basic mathematics. This can include things like poor teachers, lack of adequate educational resources, or other issues that negatively impact your education. 17.1% answered poor, a slightly higher percentage considered their high school foundation as poor. This suggests that a significant portion of people were not satisfied with the quality of education they received during this period. 17.1% of people responded that their high school foundation was great, which indicates that a significant portion had a highly positive experience during this period. This can be attributed to factors such as excellent teachers, high-quality educational resources, or other elements that have contributed to an exceptional education. On the other hand, 58.5% of people answered that their high school foundation was "good." This indicates that the majority had a satisfactory educational experience, suggesting that while it was not exceptionally remarkable, the majority of people rated their education in this period positively.



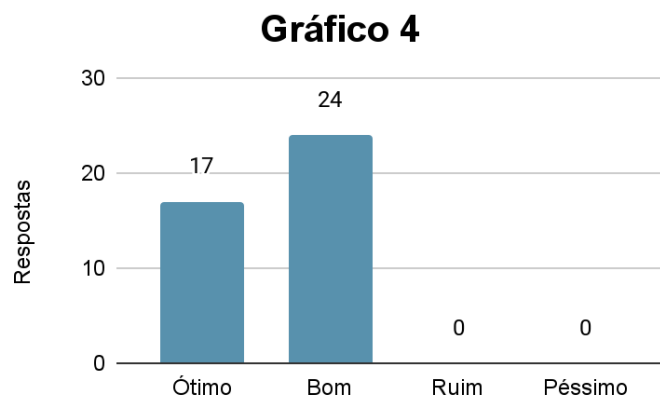
Graph 3. Is the knowledge acquired during your academic journey sufficient to understand mathematics studies in Higher Education?



Source: The author(2023)

As shown in Graph 3, in which 14.6% answered very poorly in relation to the knowledge acquired, this suggests that a relatively small part of the people who responded to the survey believe that the knowledge acquired during their academic journey is insufficient to understand mathematics studies in Higher Education. This may indicate concerns about a lack of preparation or a solid foundation in mathematics. While 9.8% of the responses indicated that the academic preparation was classified as poor. This means that a minority considered their mathematics background inadequate to meet the challenges of Higher Education. However, 19.5% answered excellent, indicating that a considerable part of people feel very well prepared and confident in their mathematical abilities for Higher Education. However, 56.1% answered well, which suggests that the vast majority feel adequately prepared to face mathematical challenges in Higher Education.

Graph 4. How often have the leveling classes in basic mathematics helped in the comprehension of the contents?

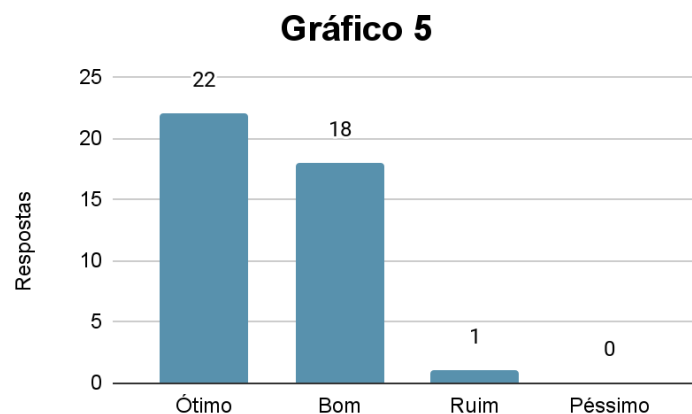


Source: Authored by the authors (2023).



Among the students who answered the questionnaire, 17 of them rated the classes as excellent, which suggests that a significant portion of the participants found the basic mathematics leveling classes extremely useful to improve their understanding of the contents. While, 24 students rated the classes as good. This indicates that an even larger majority of students perceived the classes as beneficial in improving their understanding of the contents. It is important to highlight that none of the students answered with bad or very bad, which indicates that none of the research participants considered the classes as harmful to their understanding of the contents.

Graph 5. How would you rate the quality of the practical activities or demonstrations carried out during the short course?

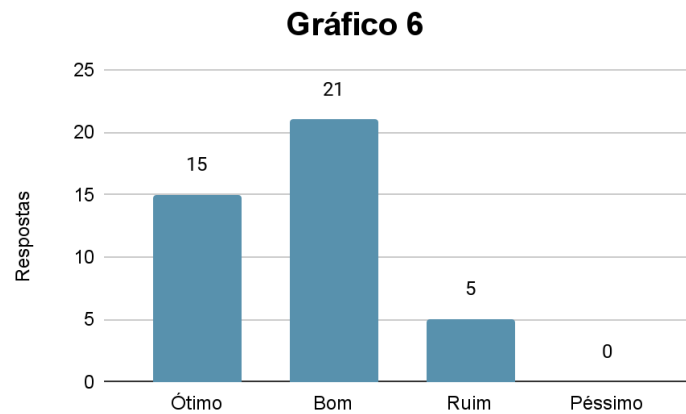


Source: The author(2023)

The majority of students (22) rated the practical activities of the mini-course as excellent, indicating that they were highly effective and of high quality. Another 18 students rated the activities as good, showing a positive evaluation, although not as exceptional as the excellent group. Only 1 student gave a negative evaluation, classifying the activities as poor, possibly due to unmet expectations. None of the students rated the activities as very poor, indicating that no one considered the quality extremely low. In summary, most students considered the practical activities of the mini-course as excellent or good, with only one student expressing a negative (bad) evaluation. In general, the practical activities seem to have been well received and effective in the perception of most participants.



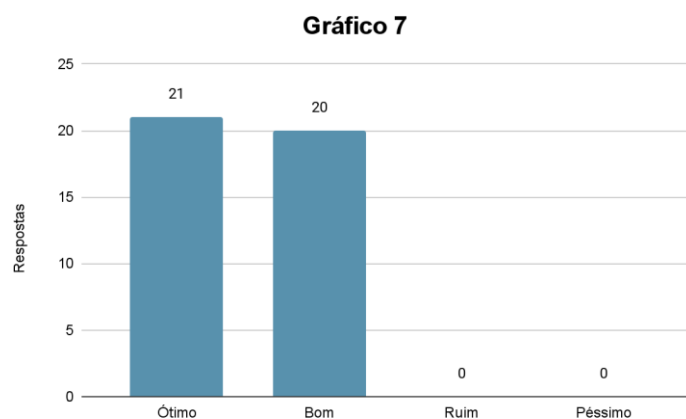
Graph 6. Do you feel more confident in dealing with basic math concepts after completing the short course?



Source: The author(2023)

Graph 6, as depicted, shows that 15 students felt more confident in their basic math skills after completing the mini-course, indicating a significant increase in confidence. However, 21 students rated their confidence as good, suggesting that most participants had a positive assessment of the increase in confidence after the mini-course. On the other hand, 5 students, however, rated their confidence as poor, indicating that a smaller group of students did not experience a positive improvement in confidence after the mini-course. None of the students rated their confidence as very poor, meaning that none of the participants had an extremely negative assessment of their confidence after the mini-course. The majority of students reported an increase in confidence in basic math after completing the mini-course, with the majority rating this confidence as good. However, a smaller group of students did not have a positive improvement in confidence, rating it as poor.

Graph 7. Was the teaching material used helpful for your understanding of the topics?

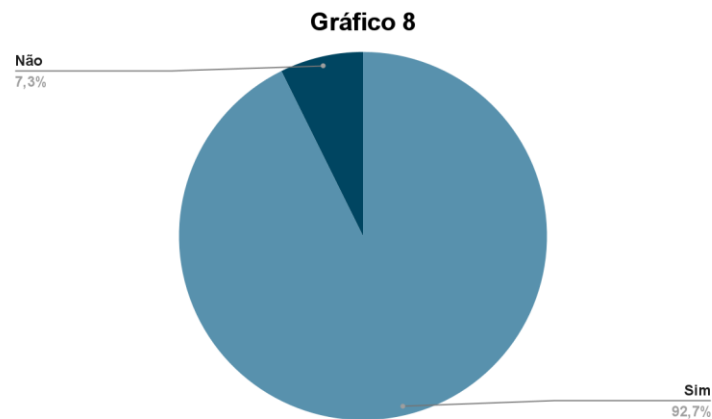


Source:The author(2023)



In graph 7, when asked about "the didactic material and how useful it was for understanding the contents covered", in the mini-course a projector with dynamic slides and manual classes was used, based on the negative answers that were 0 for very bad and 0 for bad, with this we have the premise that the students obtain a good absorption of the content regarding the equipment, As soon as the answers settled in good for 20 students and 21 for great.

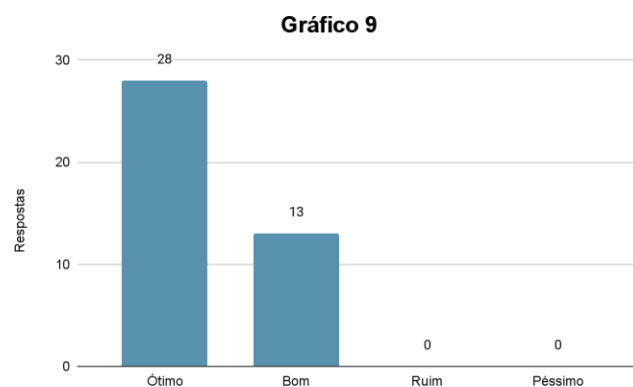
Graph 8. Given the didactics used, were you able to clarify your doubts?



Source: The author(2023)

The data provided indicate that most of the students who participated in the leveling course in basic mathematics applied to the students of the chemistry degree course were able to clarify their doubts with the didactics used. Precisely, 92.7% answered yes, which suggests that the vast majority of students considered didactics effective in clarifying their doubts. On the other hand, 7.3% of the students answered that they were unable to clarify their doubts with the didactics used. This indicates that a smaller portion of students may have encountered difficulties or challenges in understanding the content of the basic mathematics leveling course.

Graph 9. How satisfied are you with the basic math leveling course?

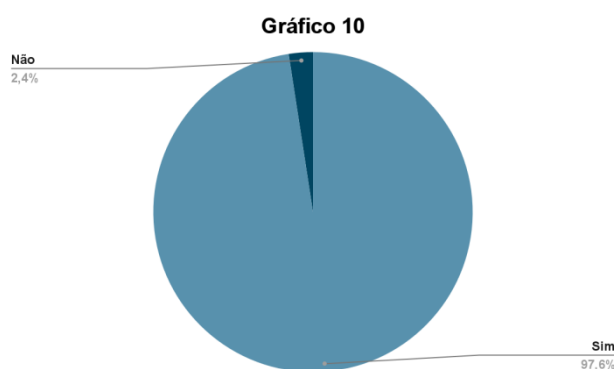


Source: The author(2023)



In graph 9, when asked about "what is your degree of satisfaction with the leveling course in basic mathematics?" we can conclude that the majority of respondents (28 of them) rated the course as "excellent", which suggests a high level of satisfaction. In addition, 13 people rated the course as "good," which also indicates a significant degree of satisfaction. Absence of negative responses, such as "bad" or "very bad", suggests that no one evaluated the basic mathematics placement course negatively based on the data provided. Therefore, based on the available data, we can conclude that the majority of participants are satisfied with the course, with a large proportion rating it as "great".

Figure 10: Were there enough opportunities to ask questions and clarify doubts during the lessons?



Source: The author(2023)

The data provided in graph 10 show that the overwhelming majority of students who participated in the basic mathematics leveling course for chemistry degree students believe that there were sufficient opportunities to ask questions and clarify doubts during classes. Precisely, 97.6% of the students answered yes, indicating that the vast majority felt satisfied with the opportunities for interaction and clarification of doubts offered during the course. Only 2.4% of the students answered that there were not enough opportunities to ask questions and clarify doubts. This represents a small minority who may have felt the need for more opportunities for interaction or clarification during lessons. These results suggest that, overall, the course appears to have been well structured to provide support to students in understanding the material, with the majority of participants reporting that they had adequate opportunities to ask questions and clarify their doubts.

5 FINAL THOUGHTS

The implementation of the leveling course in basic mathematics was a proactive response to the challenge presented by the high rate of failure and dropout in the Chemistry Degree course. Often, students face difficulties in basic mathematics dating back to their school years, hindering their performance in higher education. The main objective of the mini-course was to strengthen the mathematical skills of the students,



equipping them with the necessary knowledge to overcome the difficulties encountered during the higher education course.

According to the data obtained from the questionnaires, they reflect positive results on the part of the participants, reflecting an exceptional educational experience. All aspects analyzed, from the comprehension of the contents to the quality of the practical activities and the use of the didactic material, were classified as "Excellent" or "Good" by all students. This indicates an effective transmission of knowledge obtained. The didactics used were considered effective in resolving doubts, evidencing an interactive and participatory learning environment. The presence of sufficient opportunities to ask questions and clarify doubts during classes reinforced the quality of the course. In summary, the high satisfaction and positive evaluations of the participants highlight the excellence of the leveling course in basic mathematics, demonstrating its positive impact on student learning and confidence.

Emphasizing the positive appreciation in relation to the methodology used by the PET-Chemistry group during the leveling classes. Participants emphasized motivation, which is essential to maintain the interest of university students and encourage them to engage deeply with the content.

In addition, the pedagogical approach adopted by the PET-Chemistry group in the leveling sessions was extremely important. Participants highlighted their ability to motivate learning, which is essential to maintain the interest of university students and encourage them to engage deeply with the subjects. This engagement is fundamental for the outcome of professional training, promoting an in-depth understanding of the topics and contributing significantly to the academic development of students.

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