

TUTORIAL EDUCATION PROGRAM PRE-CALCULUS COURSE - PET CIÊNCIA AT THE FEDERAL UNIVERSITY OF ALFENAS: CONTRIBUTIONS TO THE INSERTION OF STUDENTS IN THE ACADEMIC CONTEXT

P. V.C. MARCONDES¹, R.S. FERREIRA, A.G. S. MARQUES, A.M. IMPERADOR, T.S. MADUREIRA, M.V.B. VIANNA, I.C. DUTRA

Universidade Federal de Alfenas

ORCID ID: <https://orcid.org/0000-0003-3677-3585>¹

paulovmarcondes@gmail.com¹

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ABSTRACT

The evasion rate observed in several universities in Brazil is also a fact at UNIFAL - MG. Although there are no studies on this, students at the Poços de Caldas Campus observed that the dropout of students in the Interdisciplinary Bachelor's Degree in Science and Technology was concentrated in the first periods and was generally related to difficulty in subjects such as Functions of a Variable (Calculus I). Therefore, PET Ciência developed a mini-course to help and level students' knowledge. This work aims to publicize the

structure of this mini-course, offered twice so far by the petians. It is noted that there was a decrease in the number of registrants from one edition to another, but we observed a higher approval rate. Improvements were made to the material and a better distribution of the content taught, in addition to improving dissemination on campus. Therefore, replicating the project in other universities can improve the basic understanding of mathematics.

KEYWORDS: Short course to students, Basic Math, Functions of a Variable.

CURSO DE PRÉ-CÁLCULO DO PROGRAMA DE EDUCAÇÃO TUTORIAL - PET CIÊNCIA DA UNIVERSIDADE FEDERAL DE ALFENAS: CONTRIBUIÇÕES PARA A INSERÇÃO DE DISCENTES NO CONTEXTO ACADÊMICO

RESUMO

A evasão observada em diversas universidades do Brasil, também é fato na UNIFAL - MG. Ainda que não existam estudos sobre isso, os alunos do Campus de Poços de Caldas observaram que a desistência de discentes no Bacharelado Interdisciplinar em Ciência e Tecnologia se concentrava nos primeiros períodos e, geralmente estava relacionada com a dificuldade em disciplinas como Funções de Uma Variável (Cálculo I). Assim, o PET Ciência desenvolveu um minicurso para auxiliar e nivelar o conhecimento dos alunos. Este

trabalho tem como objetivo divulgar a estruturação desse minicurso, oferecido duas vezes até o momento pelos petianos. Nota-se que ocorreu diminuição no número de inscritos de uma edição para outra, mas observamos maior índice de aprovação. Foram realizadas melhorias no material e uma melhor distribuição do conteúdo ministrado, além de aprimorar a divulgação no campus. Logo, a replicação do projeto em outras universidades pode melhorar o entendimento básico da matemática.

PALAVRAS-CHAVE: Minicurso ao discentes, Matemática básica, Funções de Uma Variável.



1 INTRODUCTION

The Universidade Federal de Alfenas (UNIFAL-MG) was founded on April 3, 1914, and was recognized the following year as the Escola de Farmácia e Odontologia (EFOA). Its federalization in 1960 was crucial for its development and enabled the creation of new courses, becoming in 2001 the Centro Universitário Federal (EFOA/CEUFE), which in 2004 also sought to expand its distance learning courses, inaugurating the Centro de Educação a Distância (CEAD). In 2005, EFOA/CEUFE was transformed into the Universidade Federal de Alfenas, linked to the Ministério da Educação (MEC). Currently the institution has four units: the headquarters and the Santa Clara Educational Unit in Alfenas, and the campuses of Poços de Caldas and Varginha (UNIFAL MG, 2017).

The Poços de Caldas campus was founded following UNIFAL-MG's participation in the Program for the Restructuring and Expansion of Federal Universities - REUNI, starting its activities in March 2009. In August 2010, the campus was transferred to its permanent installation, where it currently offers undergraduate courses including the Interdisciplinary Bachelor's Degree in Science and Technology, Chemical Engineering, Mining Engineering and Environmental Engineering, in addition to the Institute of Science and Technology (ICT) and master's degree programs in Environmental Science and Engineering, Materials Science and Engineering, Chemical Engineering and Physics (UNIFAL MG, 2017). The Interdisciplinary Bachelor's Degree in Science and Technology (BICT) program was started in January 2009 with a methodology based on interdisciplinarity and flexibility, aimed at ensuring the training of generalist professionals with integration of scientific knowledge, motivated for technological innovation and entrepreneurship already in the first cycle at the undergraduate level of engineering (MEC, 2016).

However, despite all the structure offered at the Poços de Caldas campus, UNIFAL-MG faces one of the biggest problems in public higher education in Brazil: the evasion rate. This phenomenon, along with a high rate of repetition, demotivation and low student performance, has been investigated in various studies and researches (FERREIRA, 2013), mainly focusing on engineering degrees, among which we can mention Pinheiro and Oliveira (2014), who conducted a study on engineering courses at the Federal Center for Technological Education of Minas Gerais in 2014, categorizing the increase in dropout rates in three types. These manifest in different degrees: individual factors; internal (institutional) factors; and factors external to the institution. Classifying more specifically, we can perceive that the reasons leading to evasion rates in Brazil are primarily: choice of course (48.34%); balancing work and study (32.45%); personal issues (9.93%); institutional issues (9.27%).

Although there isn't a specific study directly linked to the exact sciences courses taught at the Poços de Caldas campus, we perceive that the dropout rate of students at the beginning of their undergraduate studies is notable, mainly due to difficulties in mathematics, which demotivate incoming students in the first years. This condition stems from a regular high school education that

does not prepare students for the teaching methodology presented at the university. Consequently, they do not correspond to the level of rigor expected by professors, leading to a very high rate of failures in the initial subjects of the Interdisciplinary Bachelor's Degree in Science and Technology (BICT), with a particular emphasis on Single Variable Functions (Calculus 1).

Bartelmebs et al. (2019) states, "it is necessary to think of a university that includes, that allows access to and the permanence of students in Higher Education" furthermore, Barbosa et al. (2020) also highlights that, "mathematics is essential for the basic development and the evolution of critical and thinking individuals." Faced with this scenario, the need arose to create an action within the campus capable of leveling the students' mathematical knowledge, addressing topics that enable students to follow the course of interest without the need to drop out of college due to a lack of adequate foundation. Thus, the PET Ciência group saw the opportunity to initiate a project.

Created in 1979, the Programa de Educação Tutorial (PET) was founded by Cláudio de Moura e Castro. The description proposed by the Ministry of Education for the program is:

"the PET is developed by groups of students, with tutoring from a faculty member, organized based on undergraduate formations in Higher Education Institutions of the country guided by the principle of inseparability between teaching, research, and extension, and tutorial education."

Currently, there are 842 groups distributed among 121 Higher Education Institutions (MEC).

The PET Ciência was founded in 2010 at UNIFAL-MG Poços de Caldas campus by Prof. Dr. Rodrigo Fernando Costa Marques, the group's first tutor. The group was created with the intention of being a PET linked to the Bachelor of Science and Technology (BICT) program. Since its inception, the group has also been under the tutoring of Prof. Dr. Daniel Juliano Pamplona from 2013 to 2019 and is currently tutored by Prof. Dr. Adriana Maria Imperador.

The group's name carries its objective, which is based on the production and dissemination of science to society through the execution of projects and actions that encompass three pillars: Research, Teaching and Extension. In addition, the opportunities that participation brings to PET Ciência students can be described according to a study conducted by Rosin (2017), as a comprehensive academic formation that values teamwork, while also stimulating social, political, and cultural involvement and contributing to a greater development of critical thinking. In this regard, the main projects developed by the group include PET Registration, PET Incentive, Workshops, Collective Scientific Initiation and PET Training.

The Precalculus workshop was planned and executed in 2018 by the PET Ciência group as a teaching project aimed at the academic community, especially incoming students. The creation of

the mini-course was motivated by the improvement of academic performance for these students in curricular units that require a mathematical basis, such as Functions of One Variable (Calculus 1) and Linear Algebra. Thus, Precalculus aims to act as support for freshmen and assist in leveling the mathematical knowledge required in higher education, also serving as an important tool to minimize course retentions in engineering programs. The PET Ciência Precalculus workshop currently features a booklet developed by the group itself, covering topics in basic mathematics such as exponentiation, rationalization, functions, polynomials, among other essential topics for academic performance and formation.

2 METHODOLOGICAL PROCEDURES

The Precalculus mini course is currently developed and executed at the Federal University of Alfenas, Poços de Caldas campus, primarily targeting students enrolled in the Bachelor of Interdisciplinary Science and Technology (BICT) program, in response to a need identified by the academic community and members of the PET Ciência group, with the purpose of addressing this deficiency, they have sought to create this project.

Initially, students from various periods of the university courses participating in the group identified the main topics that freshmen presented difficulties. Based on this, they determined the content that would be covered in the mini course, with some students being responsible for teaching these topics and others serving as monitors. In this way, they studied to fully master the material, which for the most part is related to subjects covered during high school.

Subsequently, the mini course was promoted through social media and the PET Ciência group's blog, as well as through the BICT faculty and notice boards around the university. In this regard, interested students can register online during the specified period. After a few days, classes begin, which are held in classrooms within the buildings on the UNIFAL Poços de Caldas campus, at times and on days that do not conflict with the BICT course curriculum.

Each class lasts around 2 hours of duration and consists basically of three parts, which can be repeated if the material is short. In the first part, the content is explained theoretically and with examples. In the second part, students work on exercises with the assistance of monitors and in the third part, any remaining doubts are addressed. It is worth noting that this mini-course provides a certificate upon completion, subject to achieving a passing grade and presence, and the hours can be counted towards each participant's complementary hours requirement.

Therefore, after some classes, tests are administered, which are prepared and corrected by the PET Ciência group members. The dates and topics covered in these tests are announced in advance. These tests serve to assess the students' performance and to determine whether they are grasping the content of the mini course. Based on these assessments, an average is calculated, which is one of the criteria for certification. So, this average must be equal to or greater than five.

Attendance is taken using the conventional roll call model in all classes, and from this attendance record, it is possible to assess the frequency, which is another criterion for receiving the certificate.

In the first edition of the workshop, no written materials were produced by PET Ciência to offer to the students. However, with a view to improvement, in its second edition, a booklet was prepared by the group members themselves with the assistance of their tutor. This booklet covered generally the same topics as those addressed in the first application of Precalculus. These topics include: Fractions, Exponents and Radicals, Remarkable Products, Factoring, Functions, Trigonometry, Unit Conversion, Polar Coordinates and Complex Numbers. Therefore, the booklet is made available online for download to all students attending the mini-course from its second edition onwards. It contains explanations of the content, application examples and exercises to be completed in class or as extra practice according to the student's interest.

In summary, the Precalculus mini course proven effective in all its editions up to the present moment. However, some difficulties have been identified, and efforts are being made to enhance it for future applications.

3 RESULTS AND DISCUSSION

The Precalculus mini course was offered twice, in the first semester of 2018 and in the second semester of 2019. In 2018, the course duration was a total of 14 hours, divided into 7 classes of 2 hours each. The classes were always held on Tuesdays, starting on April 17th, and ending on June 12th.

In the 2019 course, the workload was reduced to 12 hours, consisting of 6 classes of 2 hours each, starting on August 21st and ending on October 2nd. The course execution team was composed of the following PET members: Adam Luiz Soares, Iago Cipriano, Luis Henrique Nery, Mariana Vianna, Paulo Vitor C. Marcondes and Tayna Silveira.

The PET members organized the course methodology, as previously mentioned, in the following manner: exercises to be solved in class on the topic covered, one PET member for conducted the class, two other PET members act as monitors in the classroom to assist students in solving these exercises.

Some weaknesses of the course identified during the first edition were addressed and the second edition had a higher pass rate, as observed below:

Precalculus Mini-Course 2018/1: 75 enrolled and 17 passed, pass rate = 22,6%.

Precalculus Mini-Course 2019/2: 42 enrolled with 11 passed and pass rate = 26,2%.

Entrance into a Public University offers students methodologies and environments distinct from those experienced in High School, which can bring about insecurity and inherent difficulty in adaptation.

Most students understand that the mini course will serve as a "reinforcement" for the Functions of One Variable discipline. Therefore, there was a need for the group to visit classrooms to explain how the course works, that the content of Functions of One Variable is not covered in it, and that students will not be evaluated as in a mandatory curriculum unit.

With the beginning of the course, the main difficulty observed was maintaining student motivation to participate. The contribution of effective BICT faculty was requested to promote and encourage student participation, resulting in an excellent outcome.

A difficulty related to what was mentioned earlier was the lack of attendance by some students, the miss rate in the classes was high. The solution found to address this issue was to administer tests during the course, with approved students earning complementary hours equivalent to the duration of the mini course. The result was very interesting, as the number of absences decreased.

In the first edition of the Precalculus Mini-Course, the outcome was not as expected; there were some dropouts and a noticeable lack of interest from the class. To prevent this from happening again, a reformulation of the course was undertaken during the first semester of 2019. Among the changes highlighted were: the development of a new booklet and the idea of changing the way classes were conducted, such as incorporating exercises on the subject matter along with the participation of monitors in the classroom to assist students.

In the constant pursuit of improving Precalculus to achieve the best teaching method and aiming to provide as much learning contribution as possible to participants, PET Ciência strives not to stagnate and become accommodate with the outcome of the mini course. Whenever possible, updates are made to examples applied to the contents of the booklet, in addition to holding meetings with instructors, always seeking to refine and eliminate possible errors during the execution of Precalculus, while welcoming suggestions and criticisms from individuals who have taken the mini course, to positively contribute to its future iterations.

For the consolidation of a mini course that truly adds knowledge to the students, the complaints made, both by group members who worked on the project and by students, were important tools for the development of the mini course. Knowing the students' response to the content and how it was applied, the strengths and weaknesses were identified and improved.

In the first edition of the Precalculus mini course, when the project was new both for the PET members and the academic community, the dynamics involved different group members acting as

teachers in a single class. Certification was granted based on a 60% achievement in the tests, like what was adopted in university courses, and the material covered in the class was not yet fully cohesive. Therefore, it was decided that the best option was to have only one teacher present the content per class because the rotation caused student dispersion. Another point that underwent modification was the reference booklet, which was reformulated to address the topics identified as sources of the greatest doubts. The main complaint from students was regarding the required passing grade for the validation of the mini course. On top of that, some argued that the workload of their regular discipline did not allow for greater dedication to the Precalculus mini course. Thus, in response to these requests, the passing grade was reduced to five.

In the second implementation of the mini course, the modifications were put into practice and the result was satisfactory. There were substantial improvements both in the content and in the students' engagement in the class. The amount of negative feedback was considerably reduced, indicating a better acceptance of the project by the students.

Analyzing and considering the two editions of the mini-course offered by the PET Ciência group, it can be observed a substantial improvement in its conduction, as the group has been striving for continuous improvements to the Precalculus Mini-Course. The update of the booklet made the material more comprehensive to provide better learning to the participants of the mini course. Furthermore, there is a growth in visibility and support for the mini-course among university faculty, as well as increased interest from freshmen, since Precalculus offers an opportunity to learn or review content that is used in the Functions of One Variable discipline and subsequently in other curriculum units. Then, there is a need for the group to offer this Mini-Course in both semesters of the year, providing opportunities for all freshmen throughout the year.

As suggestions for the improvement of Precalculus, it can establish partnerships with university teachers, promoting the prestige of the mini-course and thereby gaining greater visibility and significance for it, to attract the interest of more students.

Another suggestion is to increase the promotion of the mini course during the registration period, showcasing positive results achieved by other students in disciplines with the help of Precalculus.

It's also valuable to conduct and formally record a more extensive satisfaction survey with students from each edition of the mini course, in order to gather feedback that can help improve it.

The Precalculus course is a way that PET Ciência found to help reduce university evasion rates, which is a serious problem faced by many Universities. Actions with the same objective as this course should be implemented in all universities since the difficulties at the beginning of academic life are one of the main motivating of university evasion rates.

For the implementation of this model in other universities, a suggestion is to analyze the main bases of difficulties that students face in a particular subject and outline a syllabus that covers the necessary learning content. Following this analysis, developing a clear and objective teaching method is essential for a successful outcome of the mini-course.

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ABOUT THE AUTHORS

P. V. C. MARCONDES

Bacharel em Engenharia Química pela Universidade Federal de Alfenas/UNIFAL-MG; Bacharel em Ciência e Tecnologia pela Universidade Federal de Alfenas/UNIFAL-MG; Analista de processos no Grupo Adriano Cobuccio.

E-mail: paulovmarcondes@gmail.com

ORCID ID: <https://orcid.org/0000-0003-3677-3585>

A. G. DA S. MARQUES

Bacharela em Engenharia Ambiental pela Universidade Federal de Alfenas/UNIFAL-MG; Bacharela em Ciência e Tecnologia pela Universidade Federal de Alfenas/UNIFAL-MG; Analista ambiental na Prominer Projetos Ltda.

E-mail: anagsmarques@gmail.com

ORCID ID: <https://orcid.org/0000-0002-7219-5754>

A. M. IMPERADOR

Doutora em Ciências da Engenharia Ambiental pela Universidade de São Paulo/USP com licenciatura e bacharelado em Ciências Biológicas pela Universidade de São Paulo/USP; Professora do Programa de Pós-Graduação em Ciências Ambientais PPGCA, da Universidade Federal de Alfenas/UNIFAL-MG; Professora do curso de Bacharelado Interdisciplinar em Ciência e Tecnologia, da Universidade Federal de Alfenas/UNIFAL-MG; Tutora do grupo PET Ciência.

E-mail: adriana.imperador@unifal-mg.edu.br

ORCID ID: <https://orcid.org/0000-0002-9755-2586>

I. C. DUTRA

Bacharel em Engenharia Química pela Universidade Federal de Alfenas/UNIFAL-MG; Bacharel em Ciência e Tecnologia pela Universidade Federal de Alfenas/UNIFAL-MG; Analista de Operações na Neoenergia Elektro.

E-mail: iago.dutra@sou.unifal-mg.edu.br



ORCID ID: <https://orcid.org/0000-0003-4362-9741>

M. V. B. VIANNA

Bacharela em Engenharia Química pela Universidade Federal de Alfenas/UNIFAL-MG; Bacharela em Ciência e Tecnologia pela Universidade Federal de Alfenas/UNIFAL-MG; Estagiária de Excelência em Manufatura na Nestle Brasil Ltda.

E-mail: mariana.vianna@unifal-mg.edu.br

ORCID ID: <https://orcid.org/0000-0001-5919-2818>

R. DOS S. FERREIRA

Bacharela em Ciência e Tecnologia pela Universidade Federal de Alfenas/UNIFAL-MG; Analista Junior de Operações Marítimas Globais na Alcoa Alumínio S/A; Aluna do Programa de Pós-Graduação em Ciência e Engenharia dos Materiais PPGCEM, da Universidade Federal de Alfenas/UNIFAL-MG; Integrante do grupo de pesquisa de Vidros e Vitrocerâmicas.

E-mail: raphaela.ferreira@unifal-mg.edu.br

ORCID ID: <https://orcid.org/0000-0002-9187-8606>

T. S. MADUREIRA

Bacharela em Engenharia Química pela Universidade Federal de Alfenas/UNIFAL-MG; Bacharela em Ciência e Tecnologia pela Universidade Federal de Alfenas/UNIFAL-MG; Analista de Marketing na Cargill.

E-mail: taynasilveiram@gmail.com

ORCID ID: <https://orcid.org/0000-0003-2494-7576>

Editor-in-Charge: Francinaide de Lima Silva Nascimento



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