DOI: https://doi.org/10.5380/ef.v1i35.95528

The curricularization of extension into the physics curriculum at UEMASUL: reflections, challenges and perspectives

REVISTA EXTENSÃO EM FOCO
ISSN 2358-7180

A curricularização da extensão no curso de Física da UEMASUL: reflexões, desafios e perspectivas

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ABSTRACT

The curriculum integration of extension represents an innovation in Brazilian higher education, integrating extension activities into the curriculum of undergraduate courses. This initiative aims to promote broader and more contextualized training for students, linking academic learning to the demands and realities of the community. This text discusses the implementation of the extension curriculum integration in the Physics course at UEMASUL in 2023, focusing on the authors' experiences in preparing the Course's Pedagogical Project (PPC). The text covers a brief history of extension curriculum integration, the legislation involved, reflections, practical experiences and future perspectives. The implementation of the extension curriculum in the Physics course at UEMASUL is a dynamic and continuous process, which requires engagement and flexibility from everyone involved. Initial experiences are promising and indicate that the integration of extension activities into the curriculum can bring great benefits to both students and the external community.

Keywords: University education. Comprehensive training. Curriculum integration of extension

RESUMO

A curricularização da extensão representa uma inovação no ensino superior brasileiro, integrando atividades de extensão à grade curricular dos cursos de graduação. Esta iniciativa visa promover uma formação mais ampla e contextualizada para os estudantes, ligando o aprendizado acadêmico às demandas e realidades da comunidade. Este texto discute a implementação da curricularização da extensão no curso de Física da Universidade Estadual da Região Tocantina do Maranhão - UEMASUL em 2023, com enfoque nas experiências dos autores na elaboração do Projeto Pedagógico do Curso (PPC). Aborda-se um breve histórico da curricularização da extensão, a legislação envolvida, as reflexões, as experiências práticas e as perspectivas futuras. A

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DOI: https://doi.org/10.5380/ef.v1i35.95528

implementação da curricularização da extensão no curso de Física da UEMASUL é um processo dinâmico e contínuo, que exige engajamento e flexibilidade de todos os envolvidos. As experiências iniciais são promissoras e indicam que a integração das atividades de extensão ao currículo pode trazer grandes benefícios tanto para os alunos quanto para a comunidade externa.

Palavras-chave: Ensino superior. Formação integral. Integração curricular da extensão.

INTRODUCTION

The promotion of the inseparability between teaching, research, and extension within universities is essential to meet social demands and provide students with a more comprehensive education. The autonomy of universities, guaranteed by the 1988 Federal Constitution of Brazil, highlights the importance of this integration. University outreach, as highlighted by Siveres (2013), can serve as a learning principle by offering experiences beyond formal settings, thereby motivating students' autonomy and active engagement.

The year 2023 marked the implementation of the Curricular Integration of Extension in undergraduate programs across Brazil. In the specific context of Physics, the use of teaching laboratories stands out as a fundamental tool to make learning less abstract and to promote students' ability to reason and argue scientifically. Recent studies on the need for laboratories and demonstrative classes reinforce the importance of these resources in facilitating the understanding of physical concepts and their application in everyday life (SILVA; CARNEIRO; SANTOS, 2019). Thus, the integration of teaching, research, and extension, combined with a practical and contextualized approach, contributes to a more comprehensive education aligned with the needs of contemporary society.

This paper aims to analyze the process of implementing the curricular integration of extension, with a particular focus on the authors' experiences in developing the pedagogical project of an undergraduate Physics program.

HISTORY OF THE CURRICULAR INTEGRATION OF EXTENSION

The first extension activity initiatives developed in Brazil sought to bring society closer to the newly established University of Rio de Janeiro and to the knowledge produced within it, by "opening its gates" to community participation in seminars and conferences on specific topics—still far removed from discussions on how this institution was influenced by the political and social conceptions of the time (BRAZIL, 2018).

It was only from 1922 onward that university extension began to take on the character of community service through undergraduate programs related to agricultural sciences. These faculties provided technical assistance, prepared educational booklets, answered inquiries through correspondence, and conducted technical visits and campaigns with farmers and livestock breeders. From that point on, it became evident that extension activities were highly effective in ensuring that the benefits of the university reached those not directly connected to it, significantly raising the general population's cultural level (BRAZIL, 2018).

From a legal standpoint, Decree nº 19,851 of April 11, 1931, and the Law of Guidelines and Bases of Education (LDB) nº 4,024 of 1961 were the first legal instruments to establish the need for extension activities and to assign the responsibility for organizing them to the universities' senior administration. These documents determined that university extension activities should occur through educational courses and lectures and attributed to it the role of disseminating knowledge for both individual and collective benefit. This formative and assistance-oriented model of extension activity was maintained under Decree nº 252/1967 and Law nº 5,540/1968. However, the latter introduced in its Article 40 the recommendation that universities should ensure student participation in activities aimed at "improving the living conditions of the community."

After this long period of development, during the 1987 Forum of Deans for Extension of Brazilian Universities, held at the University of Brasília, the first formal concept of extension was established:

> Extension is the educational, cultural, and scientific process that integrates teaching and research in an inseparable manner, enabling a transformative relationship between the university and society. Extension is a two-way path, guaranteeing movement for the academic community, which finds in society the opportunity to develop praxis and academic knowledge." (PEDERNEIRAS, 2005, p. 07)

The Law of Guidelines and Bases of National Education (LDB) nº 9,394/1996 establishes that one of the purposes of higher education is to promote extension activities open to public participation, aiming to disseminate all the knowledge and technology generated within the institution and to contribute to the improvement of basic education. The idea of extension courses is still maintained, although without clearly prioritizing access for the external community to these activities. Significant progress in these actions was achieved through the authorization of public funding for university activities, including scholarships, and the inclusion of research-based initiatives related to culture (BRAZIL, 1996).

A consequence of this renewed perspective on university extension was that the National Education Plan (PNE), effective from 2001 to 2014, included for the first time specific goals for university extension. Within this framework, noteworthy advances included the creation of evaluation instruments for developed projects, the encouragement of community and civil society participation through councils in the planning and assessment of extension activities, and the establishment, through the University Extension Development Program, that at least 10% of the total undergraduate course credits should correspond to extension activities (BRAZIL, 2001).

The curricular integration of extension, established by Law nº 13,005/2014 as one of the strategies to achieve the goal of increasing university enrollment rates among the 18-to-24-year-old population, in accordance with the 2014–2024 National Education Plan (PNE), is the result of a long process of debate and efforts to strengthen this essential component of Brazilian higher education. The understanding of what constitutes extension and how to assess its impact has evolved since its conception, reaching a significant milestone with Resolution CNE/CES nº 7 of December 18, 2018, which was heavily influenced by the National Extension Forums (STEIGLEDER; ZUCCHETTI; MARTINS, 2019; PEREIRA; VITORINI, 2019).

The first step toward implementing this strategy was taken on February 16, 2017, with the establishment of a commission tasked with developing guidelines and standards for extension activities within the context of Brazilian higher education. These guidelines were submitted for consideration by the Chamber of Higher Education on October 1, 2018, following contributions from the main national extension forums and key representatives in this field (BRAZIL, 2023).

LEGISLATION AND REGULATORY FRAMEWORK

University autonomy, as guaranteed by the 1988 Federal Constitution (BRAZIL, 1988), grants higher education institutions the necessary flexibility to develop extension activities according to their specific contexts. Although extension is not explicitly mentioned in the Constitution, the emphasis on strengthening education and universities as essential elements for national development creates a favorable environment for these initiatives.

Brazilian legislation highlights university extension as a fundamental component of higher education, promoting an education that is more engaged and committed to social demands. The integration of extension into curricula, continuous evaluation, and adaptation to new realities are crucial for the effective development of these activities, always aiming at social transformation and the benefit of society.

Table 1 - a brief overview of the legislation related to university extension and the key contributions that culminated in the curricular integration of extension.

Document	**Description**	**Articles/relevance for Extension**
Federal Constitution of 1988	Establishes the fundamental principles of the Federative Republic of Brazil.	**Arts. 205–214:** education as a universal right and a duty of the State and the family. **Art. 207:** principle of inseparability among teaching, research, and extension within universities.
Constitutional Amendment nº 85, 2015	Updates provisions on scientific, technological, and innovation development.	**Art. 218:** state support for the training of human resources and technological extension activities.
Law of Guidelines and Bases of National Education (LDBEN), 1996	Defines and regulates national education.	**Arts. 43 and 52:** extension as part of higher education curricula, integrating teaching, research, and extension.
National Education Plan (PNE) – Law nº 13.005/2014	Establishes goals and strategies for national education.	**Goal 12.7:** expansion of extension activities in higher education institutions.
National System for the Evaluation of Higher Education (SINAES) – Law nº 10.861/2004	Evaluates higher education in Brazil.	Considers extension activities for authorization, recognition, and renewal of courses and accreditation of institutions.

Ordinance nº 1,350/2018	Establishes the National Legal Regulatory Framework for Extension in Brazilian Higher Education.	Defines the inseparability among teaching, research, and extension, emphasizing the importance of students' holistic education through extension.
Resolution nº 7, December 18, 2018	Establishes the Guidelines for extension in Brazilian Higher Education.	Principles: dialogical interaction with society, civic education, institutional and social change. Modalities: programs, projects, courses, workshops, events, and service activities. Workload: 10% of the curriculum must be dedicated to extension activities.
National Common Curricular Base (BNCC), 2017	Adapts basic education to current social dynamics.	Proposes educational pathways and life projects that promote interconnection among subjects and personalized learning paths for students.
CNE/CP Resolution nº 2, 2019	Defines National Curricular Guidelines for the Initial Training of Basic Education Teachers and establishes the National Common Base for Initial Teacher Training (BNC-Formação).	**Art. 6:** emphasizes the importance of integrating teaching, research, and extension in teacher education. **Art. 23, §2:** reinforces the need for diversified assessment processes that consider students' performance in extension activities, among others.
CNE/CES Resolution nº 1.304/2001	Establishes Curricular Guidelines for Bachelor's and Licentiate Degrees in Physics.	Curricular Guidelines: include extension activities as part of comprehensive training, with 10% of total workload dedicated to such activities.
CNE/CES Opinion nº 576/2023 (Revision of Resolution nº 7/2018)	Highlights the importance of developing competencies through university extension, emphasizing practical immersion as a key component.	Proposes changes to Article 9, allowing extension activities to be carried out remotely, synchronously or asynchronously, without being confused with Distance Education (EaD); and art. 12, making extension offerings more flexible

		according to each course's characteristics.

Fonte: Own elaboration, 2023.

Almeida and Sampaio (2010) emphasize that extension contributes to the formation of humane, ethical individuals committed to society, promoting the interrelation between academic and cultural knowledge. The principle of social transformation is presented as a mechanism to establish the interaction of higher education institutions with other sectors of society. Extension activities should be oriented toward transformative action, focused on the interests and needs of the majority of the population, contributing to social and regional development as well as the improvement of public policies.

Resolution nº 7, dated December 18, 2018, aims to establish the Guidelines for Extension in Brazilian Higher Education, defining principles, foundations, and procedures for the implementation of extension activities in higher education institutions. The legal basis is grounded in the Federal Constitution, the Law of Guidelines and Bases of National Education (LDB), Law nº 13,005/2014, and other relevant legal provisions. It emphasizes the importance of extension as an essential component of higher education, promoting interaction between the academy and society, aiming at the formation of critical and responsible citizens, and the promotion of social, equitable, and sustainable development. Principles are established, such as the dialogical interaction of the academic community with society, the civic education of students, the promotion of change within the institution and society, and the articulation among teaching, extension, and research. The resolution defines different types of extension activities, including programs, projects, courses and workshops, events, and service provision. It highlights the importance of contributing to the comprehensive education of students and fostering constructive dialogue with diverse sectors of society.

The National Common Curricular Base (BNCC) seeks to adapt basic education to the current social dynamics, influenced by Bauman's (2001) concept of liquid modernity, which, compared to the liquid state of matter, is highly malleable, fluid, and fleeting. In this sense, Bauman interprets postmodern society as unpredictable and uncertain, with the individual as the central point, which transforms human identity into the responsibility of carrying out tasks and assuming their consequences within society. In the area of Natural Sciences, including Physics, the BNCC proposes a more complex

and diversified approach, stimulating critical thinking and the interrelation between topics. Complementing this perspective, the National Common Base for Teacher Education in Basic Education (BNC Formação) establishes guidelines and parameters for the initial and continuing training of basic education teachers (BRAZIL, 2019). Its main objective is to ensure that education professionals acquire the necessary competencies to promote quality education aligned with BNCC guidelines.

Resolution CNE/CES 1,304/2001 establishes the Curricular Guidelines for Bachelor's and Licentiate degrees in Physics. The initial report highlights the need for curriculum flexibility to provide alternatives for students with a workload of approximately 2,400 hours over four years. The document defines four profiles for Physics graduates: Research Physicist, Educator Physicist, Technologist Physicist, and Interdisciplinary Physicist. Each profile has specific competencies and skills, reflecting the diverse areas of activity for physicists in contemporary society. Essential competencies for all graduates include mastery of general principles and fundamentals of Physics, the ability to describe and explain natural phenomena, problem-solving in physics, maintaining an updated scientific culture, and developing professional ethics.

Regarding the importance of general skills, the use of mathematics to express natural phenomena, experimental problem-solving, the proposal and use of physical models, scientific language proficiency, computer literacy, adoption of new techniques, and the presentation of scientific results are highlighted. The proposed curriculum structure consists of a common core for all Physics courses, covering about 50% of the workload, and sequential specialized modules for each graduate profile. Courses may include internships and complementary activities, aiming at integrating theoretical knowledge with professional practice. The resolution highlights the importance of internships conducted in various institutions, such as research centers, universities, industries, companies, or schools, as well as the inclusion of a final course monograph. It also emphasizes flexibility in course structures, allowing the issuance of certificates for completion of specific sequential modules.

Although Resolution CNE/CES 1,304/2001 highlights the importance of internships and complementary activities, it does not provide an explicit approach to university extension and could be updated to include this approach explicitly. Within the context of the resolution, it is possible to interpret that internships conducted in different institutions, such as research centers, industries, companies, or schools, may incorporate elements of university extension. For example, internships in schools may involve

teaching activities, sharing knowledge acquired at the university with primary and secondary school students.

Furthermore, the mention of complementary activities, such as preparing a final course monograph, suggests the possibility for students to develop projects that have an impact on the community, which can also be considered a form of university extension. However, to strengthen the dimension of university extension, it would be beneficial for the curricular guidelines to explicitly encourage or require student participation in extension projects, volunteer activities, or programs that take academic knowledge beyond the traditional academic environment.

DEVELOPMENT OF THE COURSE PEDAGOGICAL PROJECT (PPC): EXPERIENCES, CHALLENGES, AND FUTURE PERSPECTIVES

The integration of extension into higher education curricula represents a complex process, marked by a range of experiences, challenges, and decisions that require careful consideration. In the specific context of the Undergraduate Physics Teaching Program at the State University of the Tocantina Region of Maranhão (UEMASUL), the development of the Course Pedagogical Project (PPC) to incorporate extension activities within the courses proved to be particularly challenging. One of the main issues faced during this process involved identifying opportunities for integration, requiring a thorough analysis to effectively align extension activities with the content of existing courses.

The implementation of this requirement fostered a deep engagement among the faculty in discussions about how to conduct extension activities, as well as about the very concept and purpose of extension within the program. Designing a protocol to guide all activities was essential to ensure that these would not merely serve as a formal requirement, but as an integral and valuable part of students' educational experience, providing meaningful opportunities for practical learning, community engagement, and critical reflection on their role as professionals in training. This contributes not only to students' academic development but also to their formation as responsible citizens, aware of the needs and challenges of the society in which they live.

This protocol establishes clear and objective guidelines for planning, implementing, and assessing extension activities. It allowed for the consideration of aspects such as learning objectives that these activities should achieve, the criteria for ensuring that extension projects are relevant to community needs, and the most effective

assessment methods for each action. The first stage of this process involves a discussion on the history of extension in Brazil, the main conceptions of university extension, and the role of this practice within the university, as well as how it can contribute to improving the quality of education and promoting societal development.

As a second step, it incorporates an understanding of the needs of the community that will be directly affected by the extension action. This entails interaction and dialogue between students, who are initially the protagonists of the action, and those who, up to that point, would be the subjects of the planned activity. However, this stage allows the community to become a protagonist as well, since it gives them the opportunity to express their own needs. This dialogue, as Freire (1970) states, "allows both parties to become subjects in the process in which they grow together. "

The development of extension activities represents a valuable opportunity to bring the community within the university's area of influence closer to the academic program. It allows students and professors to collaborate directly and practically, seeking effective ways to contribute to the development and well-being of this community. In addition to strengthening ties between the university and society, these activities foster the exchange of knowledge and experiences, enriching both academic education and community life.

Allocating time and workload for extension activities within the curriculum, the model adopted by the university to include extension in its programs, posed a significant logistical challenge. Deciding on the number of hours to be devoted to these activities, without compromising other curricular components, required a balanced and multidisciplinary approach.

For example, by incorporating extension hours into the courses Physics I, Physics II, Physics III, Physics IV, and Modern Physics, opportunities were created for students to engage in practical, socially oriented activities, addressing foundational topics in Physics while also promoting scientific literacy (Sasseron & de Carvalho, 2011) within the communities surrounding the university.

Beyond fulfilling the requirement of sharing university-generated knowledge with the community, there is no single model for conducting university extension. For this reason, we opted to use thematic projects as guiding instruments for extension activities within courses. These projects can be applied across different curricular components and even foster collaborative work among them.

Scientific literacy refers to the ability to understand and apply science in everyday life, developing skills to interpret natural and technological phenomena and to make informed decisions on scientific matters. By engaging in extension activities, students have the opportunity to apply theoretical knowledge in practical situations, which reinforces their understanding and retention of scientific concepts. When associated with extension practices, these processes are amplified, leading to more meaningful and contextualized learning. In this sense, the curricular integration of extension was proposed through the inclusion of extension activities in specific courses, as illustrated in Table 2 below:

Table 2 - Disciplines in the Physics Teaching Degree curriculum that include a specific workload dedicated to extension activities directly related to their respective course content. The disciplines are listed in the order of completion suggested in the Course Pedagogical Project (PPC).

Courses	Total workload of the course(s)	Total workload of extention activities	Proportion
Psychology of Education Sociology of Education Research methods within School Settings Ethnic-racial relations and Human Rights	60	15	25%
Calculus I	60	15	25%
Physics I Physics II Physics III Physics IV Modern Physics	90	15	17%
Experimental Physics I Experimental Physics II	30	15	50%
Computational Physics	60	15	25%
Instrumentation for Physics Teaching	60	30	50%

Physics, Technology and Society	60	15	25%
Origin and Evolution of Physics Concepts	60	15	25%
Everyday Physics	60	30	50%

Fonte: Own elaboration, 2024.

Additionally, in elective courses, of which students in the Physics Teaching Degree program must complete at least three, such as Astronomy, Biophysics, Quantum Computing, Physics and Science Fiction, and Physics, Environment, and Nuclear Physics, each includes 15 hours of extension activities within a total workload of 60 hours.

Subsequently, an ongoing extension project was adapted to serve as the main project to be registered with the Office of the Dean for Extension and to encompass the subprojects developed by each professor responsible for the courses that include extension workloads. This project consists of building equipment and developing experimental demonstrations for science content taught in public elementary and secondary schools in Imperatriz, Maranhão. The primary objective is to construct low-cost equipment capable of presenting and discussing scientific concepts, particularly those related to Physics, with the goal of promoting learning that engages and motivates public school students.

In this context, experimental activities may be promoted to encourage students' active participation through discussions that value their prior knowledge and sociocultural background, highlighting the importance of extension practices in fostering dialogical teaching and the construction of practical knowledge, both of which are essential to the training of future Physics teachers (Domingues, Nascimento & Valério, 2019).

FINAL CONSIDERATIONS

Although it has long been one of the pillars of higher education in Brazil, university extension has historically been neglected in the academic development of Brazilian universities. This can be observed, for instance, in the limited funding

available for such activities from federal and state agencies. The current requirement for curricular integration will allow extension to make its rightful contribution and occupy a more prominent role in the process of knowledge construction in the coming years.

The process of integrating extension into the Physics Teaching Degree program at UEMASUL was complex and challenging, primarily due to the need to define the specific model of university extension to be implemented. Nevertheless, it will provide an opportunity to establish a culture of continuous communication and interaction with the community. As these are new experiences, the curricularized extension practices will be continuously discussed and evaluated with the aim of enhancing the university's engagement with society.

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Received: May 15, 2024.
Accepted: September 02, 2024.