Curricularization of Extension through the Development of Computational Solutions Supporting the Sustainable Development Goals

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ABSTRACT

This work presents an experience report on the Community Projects II course, which focuses on integrating institutional outreach activities into the curriculum. Aimed at contributing to society and the Sustainable Development Goals (SDGs), the class developed five computational solutions during the 2023.2 semester. Interaction with the external community enhanced students' empathy and understanding of social needs. The course combined classroom instruction for project guidance and analysis with practical activities for solution development. Agile methods SDGs and bi-weekly sprints were employed, allowing students to assess the value generated and make necessary adjustments for subsequent development stages.

CCS CONCEPTS

• **Social and professional topics → Computing education**; **Software engineering education**; **Information systems education**; **Computer science education**.

KEYWORDS

Agile Methods, Teaching Experiences, Computer Science Education, curricularization of Extension, and Community Projects.

1 INTRODUCTION

The 21st-century university is expected to prioritize opportunities, envision solutions, identify potentials, value continuous evolution, and have the courage to take risks and establish its own strategies capable of promoting transformative and beneficial results for society [26]. In this context, the curricularization of extension comes into play, which is part of the inseparability of teaching, research, and extension within the university on one hand, and the necessary connection between the university and society on the other. This emphasizes the university's social role as well as the social relevance of teaching and research [16].

Extension activities in Brazilian higher education are integrated into the curricular framework and the organization of research, constituting an interdisciplinary, political-educational, cultural, scientific, and technological process. This promotes a transformative interaction between higher education institutions and other sectors of society through the production and application of knowledge, in continuous coordination with teaching and research [5]. Extension in higher education is not merely an academic dimension required for higher education training; it is, as defined by the National Extension Policy, the expression of a citizen university [39].

Resolution No. 07 of December 18, 2018 [5], from the National Education Council (NEC), establishes the Guidelines for Extension in Brazilian Higher Education, which regulate the academic extension activities of undergraduate courses in the form of curricular components. This document mandates that at least 10% of the total curricular credits required for graduation be dedicated to extension programs and projects in Brazilian higher education, with a primary focus on areas of significant social relevance.

In the Bachelor's degree program in Information Systems (IS) at the Federal Institute of Paraná (IFPR), Palmas campus, the curricular components of Community Projects I and II have been included since the 2019 Course Pedagogical Project (PPC) [23]. These courses are offered to students in the 5th and 6th semesters, respectively, and together comprise 360 class hours—300 clock hours, meeting the requirement of NEC Resolution No. 07 for this program [5]. This work presents an experience report on the Community Project II component, which, according to its syllabus, aims to integrate, through a contextualized project activity with extensionist research character, the knowledge developed in the initial years of the course [23]. Applying agile project execution methodologies [12] aims to develop the competencies acquired in the course through the production of computational solutions with environmental, social, or cultural significance.

One of the requirements for a project to qualify for development during the Community Projects II component is that the solution to be developed must be capable of supporting in some way the Sustainable Development Goals (SDGs) of the United Nations (UN), also known as the Global Goals [40]. The SDGs were adopted by UN member countries in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity. They consist of 17 integrated goals aimed at balancing social, economic, and environmental sustainability [34].

To access the needs of the external community, students rely on the Academic Practices Center (CPA) of the Information Systems course at IFPR Palmas campus. The CPA guides community demands in the following areas: computer networks, hardware, software projects, and information systems. It assists in community

projects involving information technology and related fields, and supports workshops and short courses focused on IT topics [25]. The activities of the CPA are carried out by students affiliated with the Practices Center each semester and directly supervised by a professor of the course [24]. The demands recorded from CPA service interactions are shared with students enrolled in the Community Projects II component at the beginning of each offering.

The experience reported in this work can be adapted and replicated in extension curricularization activities for bachelor's degree programs in the field of Computing, as defined in Resolution No. 05 of November 16, 2016 [4]. These programs should provide professional training that develops in students, among other skills and competencies, those related to software and hardware development and their applications, referred to in this work as computational solutions. The bachelor's degree programs covered by the cited resolution [4] are: Computer Science, Information Systems, Computer Engineering, and Software Engineering.

This experience report is organized into sections. In Section 2, important definitions for understanding the curricularization of extension in higher education are detailed. The importance of the SDGs, which guide the scope definition of the projects developed in the curricular component, is covered. Additionally, important aspects of using agile methods in the teaching-learning process are presented, and related works to this experience report are described. In Section 3, the current process adopted for conducting the curricular component is detailed. Section 4 presents some of the results achieved by the students in the 2023.2 semester. Section 5 offers reflections on the importance of the curricularization of extension in the Information Systems program at IFPR Palmas campus, as well as lessons learned from the execution of the Community Projects II component. Finally, Section 6 concludes this experience report and outlines possibilities for future work.

2 BACKGROUND

In this section, we address the essential conceptual foundations for understanding Extension in Brazilian Higher Education, the importance of the SDGs, and some important aspects of using agile methods in the teaching-learning process. Additionally, we present works that describe actions of extension curricularization in Computing courses and/or works related to projects that use agile methods for their development.

2.1 Extension in Brazilian Higher Education

The practice of extension activities in higher education in Brazil dates back to the early 20th century, coinciding with the establishment of Higher Education. Its first manifestations were courses and lectures held at the University of São Paulo in 1911, and services provided by the Higher School of Agriculture and Veterinary Medicine in Viçosa, developed in the 1920s [35].

In the late 1950s and early 1960s, Brazilian university students, organized under the National Union of Students (NUS), led cultural and political movements recognized for their strong social commitment and pursuit of inter-professional engagement through methodologies that encouraged reflection on their practices. However, the student movement of that time contributed little to the institutionalization of university extension [35].

With the increasing importance of Extension in Brazilian Higher Education, the Brazilian Constitution [13], in Article 207, declares that universities enjoy didactic-scientific, administrative, and financial and patrimonial management autonomy, and shall adhere to the principle of inseparability between teaching, research, and extension. Despite advancements towards ensuring the inseparability between teaching, research, and extension, many institutions in Brazil have not yet achieved the goals set forth. In 2014, with the publication of the National Education Plan, under Goal 12.7 [14], the strategy was proposed to ensure that at least 10% of the total curricular credits required for graduation are dedicated to extension programs and projects in Brazilian Higher Education, with a priority focus on areas of significant social relevance.

In 2018, Resolution Nº 07 [5] from the Ministry of Education/National Council of Education/Higher Education Chamber established Guidelines for Extension in Brazilian Higher Education and regulated the provisions of Law Nº 13,005/2014, stating that extension activities must constitute part of the curricular workload of undergraduate courses and should be integrated into the curriculum structure of these courses. This same resolution, in its Article 5, describes that for the structuring of the conception and practice of the Guidelines for Extension in Higher Education, the following is required:

I) the dialogical interaction of the academic community with society through the exchange of knowledge, participation, and engagement with complex contemporary issues present in the social context;
II) the citizen education of students, shaped and constituted by their practical experience of knowledge, which, in an interprofessional and interdisciplinary manner, to be valued and integrated into the curriculum;
III) the production of changes within the higher education institution itself and in other sectors of society, through the construction and application of knowledge, as well as through other academic and social activities;
IV) the integration of teaching/extension/research, grounded in a unified pedagogical process that is interdisciplinary, political-educational, cultural, scientific, and technological.

There is still much progress needed to achieve an extension that allows students to have effective contact with reality and the external world beyond the university walls. To accomplish this, it is essential to overcome the narrow view of Extension in Brazilian Higher Education that is still entrenched within the academic community, so that extension becomes a strong pillar of the university and we can advance in the process of curricularization [28].

2.2 Sustainable Development Goals

The Agenda proposed by a Working Group convened by the United Nations is a plan of action for people, planet, and prosperity. It also aims to strengthen universal peace and freedom. It is expected that all countries and stakeholders will act in collaborative partnership to implement this plan [40]. The 17 Sustainable Development Goals (SDGs) and their 169 targets, announced in 2015, demonstrate the scale and ambition of this "Universal Agenda." The SDGs aim to realize human rights for all and achieve gender equality and empowerment of women and girls. They are integrated and indivisible,

balancing the three dimensions of sustainable development: economic, social, and environmental [40]. It is expected that these goals and targets will stimulate action until 2030 in crucial areas for humanity and the planet. The list of the 17 SDGs can be found on the United Nations website United Nations.

Agencies and partners contribute to advancing the achievement of the Sustainable Development Goals worldwide [40]. Projects, research, classes, and extension actions can also help implement actions. By doing so, it is possible to empower universities, schools, institutes, and other educational spaces, as well as individuals, to become agents in building the desired future. The synergy among all SDGs themselves, which can only be implemented concurrently in partnership with all implementers on the planet, provides this powerful tool for managers, researchers, educators, and extensionists [6].

2.3 Agile Methods in Teaching and Learning Experiences

In 2001, the Agile Manifesto for Software Development was published, which aided in the popularization of methods such as Scrum [38] and Kanban [32]. Agile methodologies can be used to support activities across various fields, including project management [11, 12] and education [30], contrasting with traditional software engineering techniques that used the waterfall model. These methods allow for some project aspects to be defined before execution begins, maintaining better alignment among stakeholders and delivering value earlier compared to traditional methodologies [29]. Over the past years, especially since the publication of the Agile Manifesto, and as exemplified in works with a decade-long gap between their publications [7] [18], it's noticeable that agile methodologies are increasingly gaining ground in professional environments related to software engineering.

The Agile methods are also gaining more space and attention in the teaching and learning process, as highlighted by the benefits identified in the study conducted by Pessoa et al. [33]. The authors reported that, with the use of Agile methods, students become more active in the teaching-learning process, becoming protagonists in the construction of their knowledge and even demonstrating an entrepreneurial spirit, through innovative and creative presentations on various topics related to the content of the disciplines they are studying.

Another study that describes the benefits of integrating Agile methods into teaching methodologies is conducted by Grota [20], who conducted a case study with over 150 students using Agile Project-Based Learning for teaching computer programming in higher education. The case study results identified benefits related to extrinsic motivation, school attendance, and active listening. In addition to using agile methods combined with higher education methodologies, it is necessary that the curriculum of Computing courses prepare students for the job market, so that students are aware of the challenges and demands of the companies they use in a mature way agile methods. Some skills are required for professionals who work on agile projects, according to the following list, which is not exhaustive and was adapted from research by Gonçalves et al. [19]:

- Knowledge: technical, related to project management, and of tracking and communication tools.
- Skill: communication, active listening, flexibility, teamwork, leadership, task execution, and meeting deadlines.
- Attitude: adhering to each method's ceremonies, collaboration, adaptability, and proactivity.

Considering the demands of the workplace and the responsibilities of undergraduate courses in the field of Computer Science, integrating agile methods into teaching and learning experiences represents a strategic opportunity to prepare students, through practical experiences, for their professional careers.

2.4 Related Work

The study by Melo et al. [31], conducted at the Federal University of Pampa (Unipampa), campus Alegrete-RS, describes the enhancement of university extension programs in Computer Science and Software Engineering courses aimed at integrating extension activities into the curriculum. These programs are linked to the course councils and have several objectives, including maintaining and evolving software of interest to the civilian community, with students playing a leading role in the solutions developed. Additionally, they aim to provide meaningful practical experiences for the professional and civic education of students.

The experience report on the operationalization of integrating extension activities into the curriculum of the Bachelor of Information Systems program at IFSULDEMINAS [15] described decisions made by the Course Structuring Teaching Nucleus (NDE). This included deliberation to amend the Course Pedagogical Project and the establishment of six curriculum units dedicated to extension, aimed at conducting actions aligned with community needs. This curriculum structure aims to engage students as active participants in extension processes, facilitating the integration of knowledge from various course disciplines. The extension-focused curriculum components are distributed between the third and eighth academic periods, with varying workload ranging from 50 to 60 hours. This distribution is planned so that the content learned and developed during the respective semester can be applied in activities including: I - programs; II - projects; III - courses and workshops; IV - events; and V - service provision.

Silva Jr. [27] developed a computational solution in the form of an application to optimize waste management systems. The project was implemented in the Coelhos neighborhood, Recife-PE, a community facing significant environmental challenges such as blocked storm-water drains due to waste accumulation and inadequate sanitation systems. The work aimed to promote environmental policies for sustainable development and their implementation within the community, resulting in several positive impacts including the installation of collection points for common waste, recyclables, organic waste, and electronic waste.

In experience report by Andrade et al. [2], the Scrum method was employed in a Information Systems class within the Software Engineering component to support application development. The outcomes of changing the methodology for this component showed improved task control and the team's ability to meet established deadlines, along with significant maturity in dividing the activities to be developed.

Masson et al. [30] presented an experience report on the dynamics of the Scrum Game Challenge, using a customized version of LEGO4Scrum. The goal was to teach Scrum concepts by simulating the reconstruction of a city in Mariana, Minas Gerais, while exploring tools commonly used in the software industry. The report found that most students believed the concepts covered in the activity could be applied in their professional practice as software developers. The dynamics effectively illustrated how Scrum is applied in software development, providing a clear, easy-to-understand, and enjoyable learning experience. Both students and teachers emphasized the importance of practical knowledge alongside theoretical understanding of agile methodologies in Computer Science courses.

The related works presented address actions that benefit communities through extension activities or the preparation of academics for professional challenges. The combination of traditional teaching methods with agile methods has provided students with a more comprehensive education, integrating business practices, community engagement, and the efficiency facilitated by agile methods.

3 METHODOLOGY

The Information Systems program at IFPR, Palmas campus, primarily operates during the evening, with some classes also held during the day and on selected Saturdays. The overall objective of the Community Projects II component of this course, as outlined in the 2019 Pedagogical Project (PPC) [23], is to develop computational solutions to address community needs of environmental, social, or cultural significance. Based on this objective, the methodology for conducting the curriculum component draws from the SDGs [40] to guide the selection of projects undertaken by students. Starting from the 2023.2 academic term, the curriculum formally integrates agile methods to provide students with structured guidance in project execution.

This component is offered annually, always in the second academic semester of each year, to students in the 6th period of the Information Systems program. It requires prerequisites such as Computer Programming III and Database II, and completion of the Community Projects I component, which has a similar workload, is not mandatory. Community Projects I involves activities that provide community experience, such as lectures, workshops, gaming tournaments, round table discussions, and other activities related to Computing [23].

Community Projects II is a component consisting of 80 classroom sessions with direct guidance from the instructor, and 100 practical sessions where students have autonomy to manage the time and execution of project activities. These practical sessions, scheduled jointly by the instructor and students, can take place in the computer labs at IFPR or at the CPA, facilitating direct engagement with the community. During these sessions, students receive support and guidance from other instructors within the Information Systems department.

The pedagogical methods used in the component include Project-Based Learning, where students apply theoretical knowledge gained in the course and from professional experiences to develop computational solutions. Active Learning is employed during practical sessions throughout the component, aiming to challenge students in all stages of the solution development cycle. With projects conducted in groups of two to four members, Collaborative Learning occurs through the exchange of experiences, contributing to a more comprehensive education for students.

In the design of solutions, Design Thinking [1, 9] is used to enhance empathy [8, 10] with the target audience and understand community needs, fostering innovations that genuinely contribute to meeting both the target audience's demands and the SDGs. The use of Agile Methods provides students with ceremonies, practices, and guidance that enable the development of comprehensive computational solutions within the academic semester.

For project development, students primarily use Agile methods, especially Scrum [3, 17, 38] and Kanban [21, 32, 36, 37], which are widely employed in other course components such as Software Engineering and Project Management. Due to their prior familiarity with these methods, students are well-prepared to apply them; nevertheless, theoretical materials are available on Moodle Ava, and instructors monitor the implementation of recommended practices. An agreement is reached in the classroom for all projects to adopt 15-day sprints, a duration that allows projects to be completed within the academic semester and facilitates ongoing monitoring of the value generated in each project routinely.

Prototyping is also important as it provides an early insight into the functionalities and interface of solutions, which can be enhanced throughout the semester. Among the tools used by students are Git for version control, Trello for organizing the backlog into boards, facilitating project status visualization, and Visual Studio Code as the primary code editor.

The main activities carried out during the academic semester are presented below. At the end of each activity description, the teaching workload allocated to the activity is included in parentheses.

(1) **Presentation of the component to the students**: Sharing the syllabus of the component, detailing the objectives to be achieved, reaching agreements on the working methods throughout the semester, while maintaining focus on the need to deliver a functional computational solution and using agile methods (2 classes);
(2) **Introduction to the Sustainable Development Goals**: Interactive lecture with a presentation on the origin, importance, and details of the Sustainable Development Goals (2 classes);
(3) **Individual research by students to present real-life examples of supporting the Sustainable Development Goals through computational solutions**: Activity aimed at enhancing students' understanding of each of the Sustainable Development Goals and supporting them in the ideation and project definition phase for the semester (4 classes);
(4) **Formation of groups**: Students are guided to organize themselves into groups of two to four participants. Throughout the project execution, the students themselves are responsible for project management during the entire semester (1 class);
(5) **Determination of project scope**: As a starting point, students should define the project scope by outlining the main function of the solution to be developed. If there are community demands from the Community Projects Agency (CPA),

the professor presents them to the students to inspire project definitions. If a project originating from the CPA is chosen by a group, the practical hours of the component will also be linked with the CPA to support better understanding of the demand and strengthen the relationship with the external community. Even if the project is not derived from CPA demands, students maintain a connection with the nucleus to receive support from other professors and foster community relations (2 classes);

(6) **Project qualification with the class**: Each pre-project is presented by the groups to the class. During this stage, suggestions are made by peers and the professor to support the refinement of project scopes (1 class);
(7) **Analysis and design of the solution**: Every eight classes, corresponding to 15-day sprints, groups submit a version of the project's technical report to the professor. This report primarily details the progress of the analysis and design of the solution, including information on how value generation for the community is expected from the solution in the functional definition phase (24 classes).
(8) **Internal project seminar**: Activity marking the end of the first academic term, during which groups present details of the solution's analysis and design, along with the development schedule and identified risks for project continuity (4 classes);
(9) **Development, testing, and validation**: Every four classes, or weekly, through the Weekly Meeting for monitoring and support, groups engage in a discussion with the professor to present the progress of their work and receive guidance for project continuity. During the second academic term, the main focus is on developing the solution for final delivery. It is agreed with the students to maintain the two-week sprint pattern to assess value generation, but only two formal intermediate deliveries of the project's technical report are requested from the groups (32 classes);
(10) **Presentation at the academic week**: It's an event organized by the Information Systems course that allows sharing information about the progress of community projects with students, faculty, and the wider community of IFPR. The preparation of presentations for the academic week is considered part of the practical classes, with the teaching activity focusing specifically on the seminar presentation classes (4 classes);
(11) **Final seminar**: Final seminar activity marking the end of the academic semester, including the formal submission of completed projects, including the code of the developed solutions (4 classes).

With the completion of these activities, the component's workload of 80 classes is fulfilled, divided into 40 classes per semester. The 100 practical classes are mainly conducted with indirect guidance and scheduled appointments at the CPA, as most students work during the day and are unavailable to carry out all activities on IFPR premises. Formal submissions of project technical report versions are made through Moodle Ava, in the component's dedicated classroom. Groups have autonomy to choose technologies and materials to be used during project development.

4 RESULTS

In this section, the results achieved by students during the Community Projects II component in the 2023.2 semester are presented. The component had 15 enrolled students, and there were no dropouts throughout the semester.

Following the proposed methodology, students were guided to form teams and discuss real-world problems to be solved with the support of Computing, based on the understanding of the SDGs and the use of agile methods. In the 2023.2 semester offering of the component, five projects were carried out. The objectives and results of each project will be presented in the following subsections.

The details of the activities linked to Software Engineering of the practices conducted during the Community Projects II component, especially in relation to the results generated by the groups in the ideation, analysis and design stages, are shared in the folder provided[1].

4.1 IFAcad: the Academic Repository of IFPR Palmas campus

The IFAcad Development Journey project, the Academic Repository of the IFPR Palmas campus, aimed to create a solution to digitally store course completion work and internship reports of IFPR students, aiming to facilitate access for the general public, enhance the visibility and recognition of scientific production.

The project was based on the 4th Sustainable Development Goal, "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all", which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. The group hopes that the use of the developed solution will expand access to and dissemination of papers produced in undergraduate and high school courses at IFPR, serving both the internal and external community by providing access to a database of scientific publications. Currently, IFPR does not have any active system for academic repository.

Figure 1 shows the main screen of the system, which exemplifies how jobs are registered in the system and allows searching for jobs in the system. On the screen you can check the main information of the registered works, such as: title, author(s), course and date of defense/presentation of the work.

Figure 1: Work search and viewing screen

[1]Link to folder: https://drive.google.com/drive/folders/12JI8HlZoVj9bbzfr6I8jP-3f9LI7wGbG?usp=sharing

After analyzing the system's functional requirements, the following functionalities were defined: viewing and downloading papers; publishing Course Completion Works and internship reports; registering new users; and user login. Figure 2 illustrates the user interface displaying a registered paper on the platform, with an example of how the system is filled out.

Figure 2: Screen that details the work description.

This group completed the development of the system, and at the end of the curriculum component, they delivered the tested and validated project code for use, authorizing the system for public use.

4.2 Dengue Alert - Dengue Breeding Site Locator in Action

The focus Dengue project was developed to support the identification of locations susceptible to breeding of the Aedes aegypti mosquito or already showing visible breeding sites. The group members based their work on the 3rd Sustainable Development Goal, "Good Health and Well-being," to define the project scope.

The group conducted a survey to identify the most suitable mechanisms for obtaining information from the population about locations that could be breeding grounds for mosquitoes. This functionality aims to facilitate public administration access to relevant information for combating the spread of dengue.

After raising this issue, the group members developed a web application for registering reports made by the community. Figure 3 presents the main screen of the system, describing its functionality and emphasizing the importance of reporting dengue breeding sites.

Figure 3: Main Screen of Dengue Alert System

The developed functionalities were: Report Registration and Report Viewing. However, the group was unable to develop the proposed functionality for tracking and feedback on reports, which are essential for the practical use of the solution. Figure 4 shows the report registration screen of the solution.

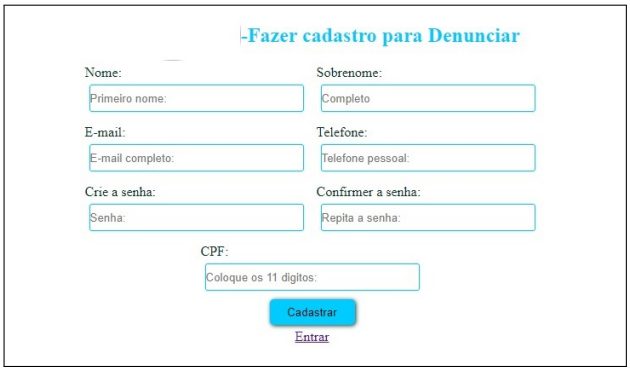

Figure 4: Screen for Report Registration

Although the developed system still requires additional features before being made available to the community, the group intends to finalize the solution outside the curriculum component and deliver it for use by the Municipal Government of Palmas-PR. This effort aims to address a social demand identified by the students through their community experience in the municipality.

4.3 Temporary Jobs Access Platform

The Temporary Jobs Access Platform project focused on addressing the challenges faced by individuals seeking employment, aiming to support the 8th Sustainable Development Goal, "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all," and the 10th SDG, "Reduced Inequalities." Identifying existing gaps in the job market, the group found that there is significant misinformation about available temporary positions and difficulties for people to travel for in-person job applications.

Based on informal conversations with colleagues seeking their first job or temporary employment opportunities, the group prioritized the following functional requirements: User registration; Job search; Applying for job vacancies; Account management; and Reviews and comments.

The Figure 5 shows the initial screen of the web system, displaying menus for accessing the main functionalities.

Figure 6 presents the system's focus and how it can be utilized are presented.

This group developed the entire frontend of the system, but the solution's functionalities were delivered partially. They did not show interest in completing the project for social use, having focused solely on finishing the academic assignment.

4.4 Electronic Waste Collection Project

The Electronic Waste Collection Project developed a solution to support the context of electronic waste generation and its environmental, economic, and social consequences. The project aimed

Figure 5: Initial Screen of the Temporary Jobs Platform

Figure 6: Screen displaying additional information about the system

to contribute to the 12th Sustainable Development Goal, “Ensure sustainable consumption and production patterns".

The main goal of the project was to create a solution to serve as a source of information and awareness for the population about the importance of disposing electronic waste in appropriate places, as well as to register and indicate locations that collect and properly dispose of this waste.

Among the developed features are: User registration; User login; Detailed map of collection points; and Information page about the importance of proper electronic waste disposal.

Figure 7 shows the system screen displaying the registered collection points along with the description of their operating hours and the types of electronic waste accepted at each location.

Figure 8 presents the screen that allows the population to suggest new collection points or new types of electronic waste that are not currently being collected by the points registered on the platform.

This group developed the functionality for registering and viewing electronic waste disposal points but did not complete the development of user registration and login. They also stated that they are not interested in making the developed solution available for community use.

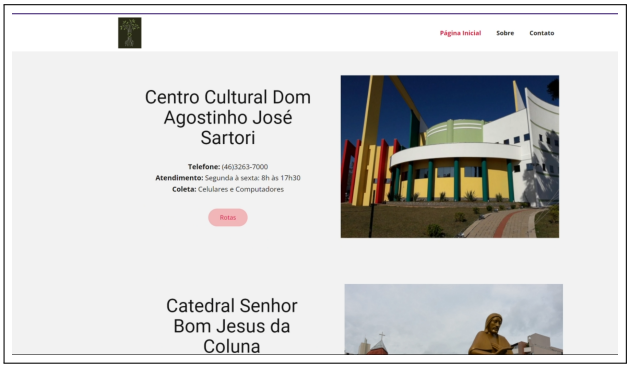

Figure 7: Screen for Locating Collection Points

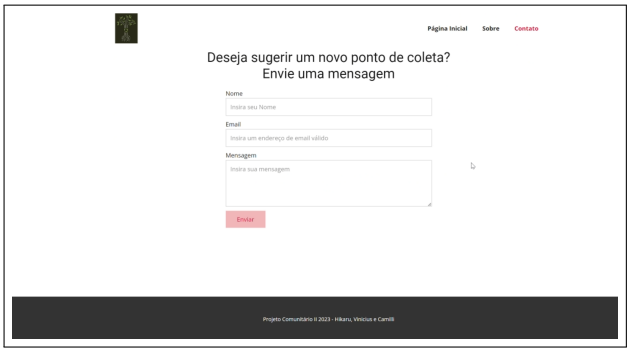

Figure 8: Screen for Suggesting New Collection Points

4.5 Sigga Events: Disclosure and Registration System for students and Participants in Lectures and Events

The Sigga Events project was developed in response to a challenge faced by students at IFPR Palmas campus, identified by group members through their interactions with fellow students. Students from various courses expressed difficulties in obtaining certificates for lectures and courses, as well as a lack of information about event schedules. The project aimed to support Sustainable Development Goal 4 “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" and 11 “Make cities and human settlements inclusive, safe, resilient and sustainable".

The computational solution aimed to support the dissemination of information to students at the campus about events taking place at the institution, as well as enabling online registrations. The group developed a web system with the following main functionalities: User registration; User login; Academic events calendar; Certificate issuance via the website; Registration for academic events; Addition of academic events; and Viewing of registered participants.

Figure 9 shows the system’s initial screen, providing access to the available functionalities.

In Figure 10, an example of a certificate generated by the system after event completion and participant confirmation is shown. This group developed all proposed functionalities. To access information about ongoing events at the educational institution, users only need

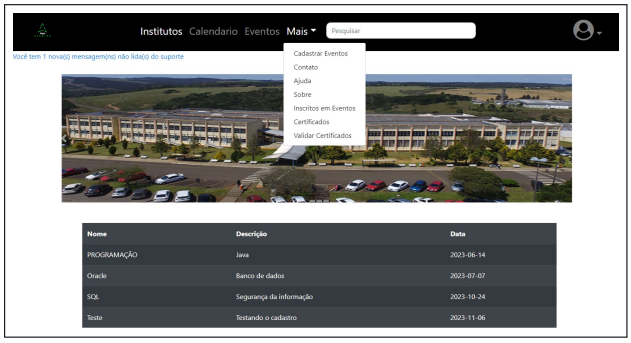

Figure 9: Initial Screen of the Sigga Events System

to visit the platform's website, without requiring any registration. However, to register for events and obtain certifications, users must create an account and provide their personal information.

Figure 10: Example of certificate generated by the system

Part of this group is advancing the solution developed during the Community Projects II component and has transformed the project into their Thesis for Completion of Course, spanning over two academic semesters. In addition to the web system, the group aims to also release a mobile application to increase engagement with the solution.

4.6 Analysis of the offerings of the Community Projects II component

Since its first offering in 2020, the focus of the Community Projects II component has been to guide students in developing complete and functional computational solutions, aiming to connect them closely with real community needs. Following the course curriculum schedule, students should have already engaged with the community through the Community Projects I component, offered during the 5th semester. In this component, activities take place outside the IFPR campus, in schools or other institutions where students conduct lectures, discussions, workshops, and other extension activities. This reinforces the university's social role and underscores the cultural, economic, and social relevance of these activities.

Due to various factors, including the COVID-19 pandemic temporarily shifting the class execution model to online/hybrid, and the replacement of the responsible faculty member in the first two offerings, it was only in the third offering, in 2023.2, that students delivered functional computational solutions; previous offerings resulted in prototypes. A significant change in the third offering was the formal adoption of agile methodologies for developing the computational solutions by the class. For the 2023.2 class, the following results were achieved: 1) Two groups managed to deliver the solution completely functional; 2) One group delivered the solution partially, with about 70% of the planned functionalities, but expressed interest in continuing the development of the solution even after the component ended; and 3) Two groups, despite the instructor's efforts, made it clear that they only intended to meet the component's requirements for curriculum completion. The solutions delivered contained about 60% of the functionalities planned during the analysis and design stage.

Among the goals to be achieved with the Community Projects II component is to assist in the holistic and comprehensive education of students, ensuring that knowledge originates from social practice and returns to it, transforming it. Additionally, it aims to contribute to the formation of citizens who are socially aware, autonomous, and entrepreneurial, as outlined in the IFPR Institutional Development Plan [22]. Despite the progress made in the results delivered in each offering, it is evident that there is still a need to further develop these skills and interests in students, going beyond technical education.

5 DISCUSSIONS

In this section, we discuss the importance of integrating extension activities into the Information Systems curriculum at IFPR Palmas campus and present some lessons learned from the implementation of the Community Projects II component.

One observation specific to the 2023.2 class of the component, considered a consequence of the remote delivery of initial course components during the pandemic, is that these students did not have the same opportunities to engage with the community and participate in research and extension activities as previous classes. This resulted in a group of students reaching the 5th semester of the course (when the Community Projects I component is offered) with little or no experience in activities outside the educational context. It is believed that this lack of experience led to a reduced sensitivity to social and cultural causes and a greater disconnect from community needs among the students.

Engagement in extension activities is fundamental for the education and preparation of students for the professional world, supporting practices necessary to strengthen the knowledge built in educational environments. Close interaction with the external community facilitates an exchange of experiences essential for shaping students' civic education. These opportunities provide interprofessional and interdisciplinary experiences but largely depend on the students' interest in taking the proposed extension activities seriously and making the most of them.

Actions related to the integration of extension activities into the curriculum provide students with better conditions to understand the social and cultural context in which they are embedded. This enables them to more quickly recognize social problems and propose

transformations involving technical knowledge in the field of Computing. Linking extension activities in Brazilian Higher Education with the information and needs described in the UN's 2030 Agenda [40] offers an opportunity to immerse students in contexts not clearly addressed in more technical curricular components. This includes situations that balance social, economic, and environmental sustainability.

The computational solutions developed by the groups are significant for the community where the students are involved. All projects were conceived through a deep understanding of the Sustainable Development Goals, close engagement with the external community through the Academic Practices Nucleus, and discussions and reflections conducted during the teaching activities of the component. For the students, the relevance lies not only in the experience of managing and developing a complete computational solution but also in the profound learning and reflection gained through their interaction with the external community.

While the academic community is the primary beneficiary of the solutions developed by groups that successfully completed the required functionalities, the target audience extends beyond the internal institution community. The external community can be exemplified by individuals interested in accessing published results in the IFAcad solution or participating in events promoted and certified by the Sigaa solution. During the project ideation phase, groups are encouraged to broaden the reach of their solutions to the external community, aiming to support the SDGs. However, in these two cases, as they support Sustainable Development Goals 4 (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all), the expected target audience for using the solutions comprises educators and academics from educational institutions.

The students in the component have exposure to processes, techniques, and tools of Software Engineering across various curriculum components before the 6th semester, when the Community Projects II component is offered. Interdisciplinary activities, practices, and methods related to the professional software development environment are explored. Examples of components that facilitate this interdisciplinary bridge include Introduction to Information and Communication Technology, Scientific Research Methodology, Human-Computer Interface Design, and software development-related disciplines. In the specific Software Engineering component, offered in the 4th semester, there is theoretical and practical deepening of knowledge in the field. All these components contribute to enabling students, with proper guidance, to execute a full lifecycle from ideation to delivery of a computational solution.

Since the projects are developed in groups, support among members helps in dividing project responsibilities. However, despite guidance and support from professors across various curriculum components, some groups struggled to achieve technical development in certain functionalities. The justification from these groups is more related to the shortage of time available to dedicate to the project rather than technical difficulties. As most classes are held in the evening, the vast majority of students (over 95%) work during the day. This situation requires these students to carry out the practical activities of the component (which total 100 hours per semester) during weekends, in between their professional obligations, and in gaps within their weekly schedules. This poses a significant challenge for the component's instructor, who must ensure that students fulfill activities that demonstrate both the practical hours required by the component and maintain their connection with the community. At the same time, the instructor needs to be sensitive to the professional, social, and economic needs of each student. It's a constant balancing act between what is required and what is feasible.

5.1 Lessons Learned

Since the Community Projects II component has been offered three times since its inclusion in the Information Systems curriculum at IFPR Palmas campus, several methodological adjustments and lessons can be shared from these implementations. The main ones are:

- Some of the benefits of using agile methods, identified in the literature [33], were observed in the monitoring of the projects carried out. Among them, notable are the ease of interaction among those involved, mainly due to the structure and transparency of the methods used; the clarity of the established schedule, with few delays and adjustments needed during the semester; and the productivity of the team, driven primarily by the autonomy that academics have in managing all stages of the projects.
- The engagement of students with the community through the activities of the Community Projects I component has been of great importance for raising awareness among students and increasing their commitment to the solutions developed in Community Projects II. In this regard, there is a proposal to establish a prerequisite in the Course Pedagogical Project for this component, which currently does not exist. The expectation is that this will foster greater interest among students in finalizing and implementing the solutions created during the execution of the component.
- A single academic semester has proven to be insufficient for the planning and execution of a complete functional solution (as demonstrated in the Results section). Among the solutions to this problem, proposed jointly by the course instructor and the course committee, is the inclusion of some project ideation stages in the Community Projects I component, which precedes the Community Projects II component by one semester.
- Regarding the lack of time for several groups to complete their solutions, the next offering of the component will include guidance on better limiting the complexity of the functionalities to be developed. Another possibility is to encourage students to continue evolving their projects and adapt them for development in the Mandatory Internship or final year project.
- The existence of the Academic Practices Center serves as an important bridge to the community, but it can be better utilized. Currently, internships and theses, as described in the previous item, are carried out infrequently. By leveraging the Center more effectively, there is potential to increase the frequency and impact of these academic engagements.
- The offering of the component can serve as a source for student experience reports and as motivation for practicing

writing skills. It is believed that the experiences and insights gained through the completion of the Community Projects II component are valuable and should be formally shared.
- The description of this report highlighted the need for more rigorous documentation of the activities carried out by the groups, with greater detail in the technical report submitted at the end of the semester.
- One difficulty reported by the groups is the continued development and maintenance of solutions in production environments for community access. This challenge involves financial issues, infrastructure resources, and the availability of time to continue working on the solutions. An option currently being evaluated to address this difficulty is to continue the solutions through the IFPR incubator, which is in the implementation phase.
- Students also reported difficulties with time management and conflict resolution during the execution of the projects. Sharing these challenges with the professor during follow-up meetings for guidance on conflict resolution methods, as well as with the class during seminars, provides valuable support. In this component, while the professor observes and provides guidance on management, the responsibility for conducting and resolving problems lies with the teams.
- It is important to suggest techniques and tools for project execution, as these suggestions are always well received by the groups. However, it is even more crucial for the students to have the autonomy to decide what will be used during the project. This freedom offers a greater opportunity for the teams to take responsibility and ownership of their work.

For each offering of the component, a list of lessons learned is created and shared with future cohorts. This process has been carried out in previous offerings of the component as part of the teaching activity plan. For the next offering, scheduled for the second semester of 2024, the component will be included in a project being prepared for submission to the IFPR Ethics and Research Committee. This will enable the sharing and publication of not only the component's methodology but also the students' perceptions and experiences.

6 CONCLUSION

The Community Projects II course aims to develop computational solutions within one semester, leveraging the technical knowledge acquired by students in other curriculum components and providing hands-on experience aligned with community needs. Aligning the scope of these computational solutions with the Sustainable Development Goals helps sensitize students to social needs.

Organized into teams, students engage practically in project management activities and the application of agile methods. This includes defining and organizing backlogs, conducting ceremonies to monitor the development cycle, adhering to agreements for sprint completion, and performing testing to enhance the quality of the developed solutions.

The community is engaged through interactions facilitated by demands originating from the Academic Practices Center of the Information Systems course. The academic week of the course provides another opportunity for community interaction, featuring presentations and rounds of questioning about the solutions under development. After each offering of the course component, the responsible professor shares a list of lessons learned with subsequent cohorts, aiding in the continuous improvement of the method adopted for conducting these activities.

After completing three offerings of the course component, it was observed that formally incorporating agile methods into the methodology provided the class with better conditions to deliver complete computational solutions. However, since the application programming components are not prerequisites for students taking the Community Projects II component, it was noticed that the solutions developed in the evaluated semester consistently involved web development projects. These may not always be the most suitable for achieving the highest volume of access and usage of the systems possible.

The project proposals from the 2023.2 class were all aligned with the Sustainable Development Goals, achieving the objective of raising awareness among students for projects with environmental, social, and cultural significance. However, there are opportunities to enhance students' interaction with the community through extension activities, providing a more comprehensive education and better preparing them for the ethical and social demands of the professional world. As a future work, there are plans to submit a project to the Ethics and Research Committee of IFPR, enabling formal research on students' perceptions regarding the Community Projects II component. Additionally, efforts are underway to register some of the solutions developed by the class with the Technology Innovation Center of IFPR.

STATEMENT ON THE USE OF GENERATIVE AI TOOLS IN THE WRITING REVISION PROCESS

In developing this paper, the authors utilized the ChatGPT service, based on the GPT-4 language model, specifically for textual revision purposes. Following the application of this tool, the authors meticulously reviewed and refined the content as necessary. It is imperative to emphasize that the authors take full responsibility for the final content of the publication.

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