

PROJECT BASED LEARNING AND DESIGN THINKING IN AN EXCHANGE PROJECT

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PROJECT BASED LEARNING Y DESIGN THINKING EN UN PROYECTO DE INTERCAMBIO

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ABSTRACT: This paper is about the integration of two methodologies that aim to develop the Soft Skills. The idea is to integrate the Project Based Learning (PBL) methodology with a practical method for innovative mindset, known as Design Thinking - DT. This integration was developed and tested in an international exchange project with student teams from different countries, from different courses, with other languages, culture and knowledge area. The project was developed over ten weeks. Develop the Soft Skills for students in this multiplicity of differences has become an even greater challenge because it occurred in a pandemic period. The results of the PBL-DT integration demonstrate the great potential of these methods used in an integrated manner and had achieved the project goals.

KEYWORDS: Project based learning. Design thinking. Soft skills.

RESUMO: Este artigo apresenta a integração de duas metodologias que visam o desenvolvimento das Soft Skills, integrando a metodologia de Aprendizagem Baseada em Projeto (Project Based Learning – PBL) a um método prático para a integração de habilidades e mentalidade inovadora no desenvolvimento de soluções, conhecido por Design Thinking - DT. Esta integração se deu no âmbito de um projeto de intercâmbio internacional com equipes formadas por alunos de países diferentes, oriundos de cursos diversos, com outros idiomas, cultura e base de conhecimento, desenvolvido ao longo de dez semanas. Levar aos alunos a formação em Soft Skills nesta multiplicidade se tornou um desafio ainda maior por ter ocorrido em um período de pandemia. Os resultados da integração PBL-DT demonstram o grande potencial destes métodos utilizados de maneira integrada, e atingiu aos objetivos do projeto.

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PALAVRAS-CHAVE: *Aprendizagem baseada em projetos. Design thinking. Habilidades interpessoais.*

RESUMEN: *Este artículo trata sobre la integración de dos metodologías que tienen como objetivo desarrollar las Soft Skills. La idea es integrar la metodología Project Based Learning (PBL) con un método práctico para la mentalidad innovadora, conocido como Design Thinking - DT. Esta integración fue desarrollada y probada en un proyecto de intercambio internacional con equipos de estudiantes de diferentes países, de diferentes cursos, con otros idiomas, cultura y área de conocimiento. El proyecto se desarrolló durante diez semanas. Desarrollar las Soft Skills para los estudiantes en esta multiplicidad de diferencias se ha convertido en un desafío aún mayor porque ocurrió en un período de pandemia. Los resultados de la integración PBL-DT demuestran el gran potencial de estos métodos utilizados de manera integrada y han logrado los objetivos del proyecto.*

PALABRAS CLAVE: *Aprendizaje em base a proyectos. Design thinking. Habilidades interpersonales.*

Introduction

On the track of countries like Finland, Canada and Australia, Brazil has been looking for alternatives to improve its professional education system; among these is the use of active methodologies, which allow activities that facilitate a look at an integral human formation (BARBOSA; MOURA, 2013). Therefore, among the possibilities for reinventing educational work, the use of active methodologies was expanded as a pedagogical path in overcoming the dichotomies present in the new school scenario.

Professional education also seeks this integral human formation, which prepares the student for real life, as “[...] a strategic element for the construction of citizenship and for the better insertion of young people and workers in contemporary society, full of great transformations and markedly technological” (BRASIL, 2004, p. 7, our translation). Therefore, educational practices must involve, in addition to technical knowledge and skills (hard skills), aspects relevant to the formation of interpersonal skills (soft skills) of students, without which they would have difficulties in enhancing their specific professional knowledge. In addition, innovation-oriented formation is necessary in an increasingly competitive environment, in which the country needs to leverage its talents and strengthen the culture and practice of innovation.

In 2018, the Federal Institute of Amazonas (IFAM) signed an agreement with national, Latin American and European institutions for the development of the project entitled "Latin America Practices and Soft Skills for an Innovation Oriented Network (LAPASSION)",

financed with resources coming from the Erasmus Plus Program of the European Union. The LAPASSION Project is coordinated by the Polytechnic Institute of Porto - IPP and has the participation of a Finnish institution (TAMK), two Spanish (University of Vigo, University of Salamanca), two Chilean (DUOC, PUC), two Uruguayan (UDELAR, DEOC) and five Brazilian (IFAM, IFMA, IFG, IFTM and IFsul). The project aims to exchange higher education students, guided by professors and external partners, in which working groups are formed with students from different courses and countries, to work on specific projects, and who dedicate themselves for 10 weeks to present a solution to a problem or challenge proposed by a company, non-governmental organization or public institution, according to a previously defined theme. The official language of the project is English.

The project is divided into missions that take place in different cities and has already taken place in Chile (Santiago), Uruguay (Montevideo) and Brazil (São Luiz, Uberaba, Goiânia and Manaus). LAPASSION Manaus, in Amazonas/Brazil, took place from 2 of March to 8 of May 2020, and had as its general theme the “Socio-environmental technologies for the sustainability of the Amazon”. In Manaus, the project received 08 students from abroad (02 from Finland, 02 from Portugal and 4 from Chile) and 06 from Brazilian Federal Institutes (Piauí, Pará, Rondônia, Pernambuco, Amapá and Alagoas). Due to the SARS COV2 pandemic, the project had its face-to-face activities suspended after the third week in which it was being carried out.

LAPASSION Manaus used as an active methodology, for the development of Soft Skills, an integration of the Project Based Learning (PBL) methodology to a practical method for the integration of skills and innovative mindset in the development of solutions, known as Design Thinking – DT. This integration is shown to be a learning process that generates autonomous students, which requires knowledge and willingness from the teacher to act as a mentor and, mainly, brings with it a learning process where the student is perceived as the center of the process and acts autonomously, in a perspective for an integral human formation (BARBOSA; MOURA, 2013). Interactions in collaboration with multidisciplinary, multicultural and multilingual teams created the ideal environment for the development of Soft Skills, among which we can highlight leadership, communication, conflict resolution, empathy, ethics, flexibility and management of teams.

The Project Based Learning (PBL) method

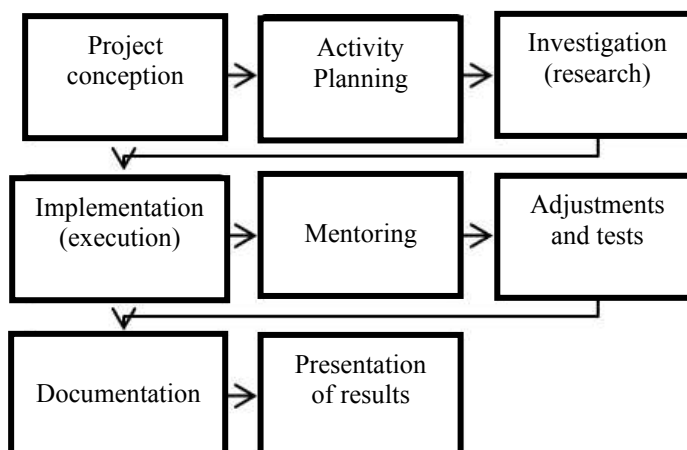
Project Based Learning (PBL) emerged in 1900, when John Dewey (1859-1952) proved that it is possible to "learn by doing", when students are instigated to think, solve problems through projects and develop physically, emotionally and intellectually (MASSON *et al.*, 2012). However, according to Zabala (1998), it was the American William Kilpatrick (1871-1965), based on the ideas of John Dewey, who structured and spread the project method, being the practical performer of the method, which for him has as a presupposition interest and effort.

Masson *et al.* (2012, p. 1, our translation) defines PBL as “[...] a systemic approach, which involves students in the acquisition of knowledge and skills through a process of investigation of complex issues, authentic tasks and products, carefully planned towards efficient and effective learning”. Marques (2016, p. 21) adds that PBL uses a problem-situation to motivate students to study, placing them at the center of the teaching-learning process.

In PBL, the student is the generator of his own knowledge, which can be applied in the environment of the classroom itself or in another environment/place outside the classroom, breaking the paradigms of traditionalism and making the student the main actor in the process of learning, with the teacher being the one who makes the link between theory and practice, breaking with the traditional way of transmitting the content (STAHNKE *et al.*, 2015).

Diniz (2015) presents the following sequence: planning; theme definition; establishment of the problem question; knowledge structuring; monitoring of different learnings; evaluation and socialization of the project. For the author, the organization of activities by projects is essential to obtain positive results.

Queiroz-Neto *et al.* (2015, p. 4-5) present a proposal of steps for the application of PBL, which can be adapted according to the situation, but which in general has the steps and flow as shown in Figure 1:

Figure 1 – Stages of *Project Based Learning* – PBL

Source: Translated from Queiroz-Neto *et al.* (2015, p. 4, our translation)

Thus, it is understood that to carry out the PBL method it is necessary to organize and prepare in advance, so that students, with the guidance of teachers, can design the project, carry out the planning, execution, evaluation and socialization of the final product. It is on this path that formation in Soft Skills materializes. For Diniz (2015, p. 13, our translation), “Project-based learning encourages students to acquire knowledge and skills, enabling interdisciplinarity around the investigation of complex issues”.

Design Thinking (DT) method

Design Thinking (DT) is a process focused on designing innovative products and services that solve people's real needs. To carry out the project, we adopted Vianna *et al.* (2012), which presents the DT in three phases: immersion, ideation, and prototyping. The immersion aims to study the problem, its implications, based on data collection, understanding of the target audience, organization, and analysis of information. The ideation phase aims to generate solutions based on information from the immersion that collaborate to solve the proposed problem; and the prototyping phase transforms ideas into action plans or a digital or physical artifact, through a conceptual or analogous representation, which approximates a final version of a product.

Immersion is the first part of the process, in which there are two focuses: gathering data that lead to a deeper understanding and delimitation of the problem and defining the target audience involved in the issue. Immersion is divided into preliminary and in-depth immersion.

Preliminary immersion is a way of approaching the problem to understand it from different perspectives and define the project's limits. In addition, the target audience is listened to and an initial understanding of the needs to be addressed is created. Research, experiences and pertinent information that contribute to the development of the project are also considered.

In deep immersion, the focus is on the target audience, a deepening of the context and needs of the people involved with the problem. For this, interviews, observations and records are carried out that serve as inputs for thinking about innovative solutions.

After collecting and recording data there is a sub-phase called analysis and synthesis. Data are organized and grouped in order to indicate criteria that will guide the creative process, that is, direct and feed the ideation phase.

In the ideation phase, proposals for solutions are generated, oriented by the guiding criteria, arising from the analysis and synthesis, so that they meet the mapped needs of the target audience and respond to the defined problem. As a result of the phase, there is a selection of one or more alternatives that can be tested, or combined, in the next phase, prototyping.

The prototyping phase aims to quickly and inexpensively test the solution found. The objective is to verify which errors can occur, the relationship of the result found with the applied means and with people. In this way, the project is changed more quickly, returning to previous phases for adjustments, deepening information or changing the problem.

The DT has the characteristics of being an *interactive* process, the phases are interconnected; *incremental*, data can be added at any time during the process; and *iterative*, returning to necessary phases, involving people with multidisciplinary knowledge and with the participation of the target audience.

Its dynamism makes it applicable to projects focused on creativity, innovation and teamwork, such as LAPASSION, and which are relevant to PBL's proposal.

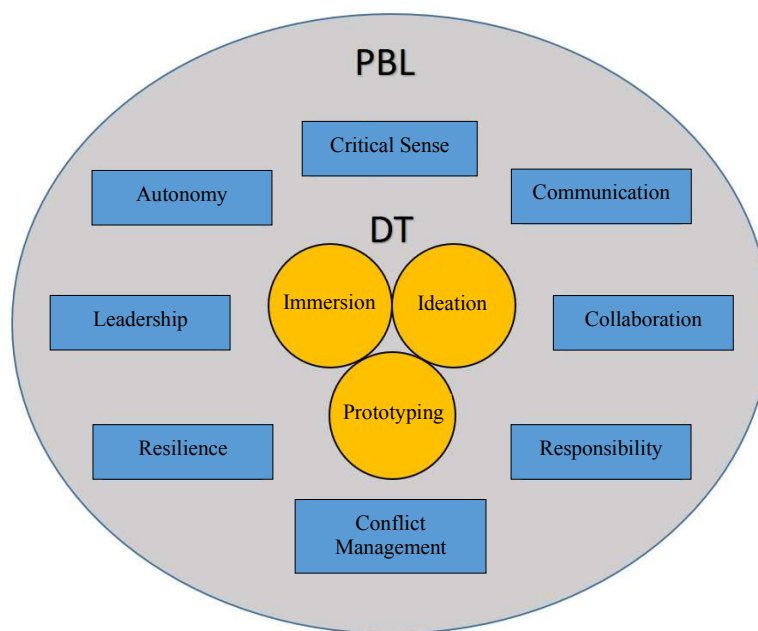
Project Based Learning and Design Thinking integrated to the LAPASSION Project

The LAPASSION project needed a dynamism to develop in students the Soft Skills, and at the same time an objectivity to, in 10 weeks, obtain tangible results from the challenges presented by partnerships with companies and institutions. The solution was to integrate PBL, which has proven to be useful for developing Soft Skills, with DT, a successful method for thinking and developing innovative solutions in an organized and concrete way.

Figure 2 shows the integration of PBL and DT. In this, the DT is inserted, as a development method organizing an innovative product, within the framework of PBL, with its steps described in Figure 1, which are integrated with the steps of the DT. With this, we give students the opportunity to develop autonomy, leadership, resilience, conflict management, responsibilities, collaboration, communication and critical thinking, among other skills.

This proposal provides the student with an integral human education, contrary to that proposed by the dual school, in which Brazilian professional and technological education was built. Thus, there is an understanding of integral human formation as one that revolves around the integration of all dimensions and potential of the individual in the educational process. These dimensions, according to Frigotto (2012, p. 267, our translation), “involve their material corporeal life and their intellectual, cultural, educational, psychosocial, affective, aesthetic and playful development”.

Figure 2 – The integrated PBL-DT proposal for the formation of Soft Skills



Source: Devised by the authors

Therefore, the omni-lateral formation of subjects implies the integration of fundamental aspects of life as a social practice. According to Ramos (2008), these aspects are work, understood as a human achievement inherent to being and as an economic practice; science, understood as the knowledge produced by humanity and which enables the contradictory advance of capitalism; and culture, which corresponds to the ethical and aesthetic values that guide the norms of conduct in a society.

Pragmatically, the PBL-DT integration took place in a symbiotic process, in which the relationship was mutually advantageous, where both methods benefited from this integration. PBL developed the entire general organization of the project, defining its macro stages, over ten weeks, the concept of mentoring instead of classes, the option to focus on the student and on their autonomy and protagonism. The PBL also brought weekly formative evaluations (BATISTA *et al.*, 2007), in which the groups presented the evolution of the projects, and the final presentation, which is also consistent with the DT.

DT brought in the internal organization of the project. Inserted in the context of PBL, it defined stages within the context of the development of the project itself, supported by the triad immersion, ideation and prototyping, without disconnecting from the organization of PBL.

With this, the LAPASSION project had its entire development based on the integrated PBL-DT proposal. The results of the project, presented below, demonstrate that this was an option with great potential for integral human formation.

PBL-DT results in the LAPASSION project

The LAPASSION Manaus project aimed to work on projects that meet challenges proposed by partner companies, with participants from different nationalities and with multidisciplinary knowledge. During the project, the so-called Soft Skills were worked on, with the guidance of IFAM mentors and a consultant specialized in Design Thinking to assist in the development of six projects.

Within the scope of the project, initial formation on methodologies was necessary, which took place well before the application of the project itself with the students. PBL was already a methodology known by some teachers and, therefore, a two-day workshop was used to level the concept and understand everyone.

The first part was given by the project coordinator, researcher and specialist in PBL, consolidating and leveling concepts, as well as structuring in a macro way the guidelines for the project. The second part emphasized mentoring, necessary for the success of DT/PBL and unusual for teachers. This part was taught by Dr. Tiina Koskiranta, from the University of Applied Science of Tampere (TAMK) of Finland, partner institution of the LAPASSION project.

The DT was worked on in three stages: training with mentors, training with participating students and application in the development of the teams' projects. The training

was necessary to align the knowledge of the participants, as some were unaware of DT, and to delimit the results to be presented by the teams and the time needed to carry out each phase in the project.

Project mentors went through a DT workshop before starting mentoring with students. The aim was to level the knowledge of the team of teachers and that they would go through the experience of developing a project using the DT method.

The workshop lasted five days, with four hours a day, and the mentors were challenged to think of solutions with the same theme that would be presented to the students participating in the LAPASSION project: “*Tecnologias Socioambientais para a sustentabilidade da Amazônia*” (Socio-environmental Technologies for the sustainability of the Amazon).

At each stage of the DT process (immersion, analysis and synthesis, ideation and prototyping), the teams formed presented the results and observations on the understanding of each phase. At the end, everyone presented the results of their proposed solutions to the previously defined problems, as shown in Figure 3.

Figure 3 – DT workshop with mentors



Source: Authors archive

By going through the experience of developing solutions to problems with the same theme as the project that would act as mentors, they realized the most complex points of the process and were able, by guiding, to better understand the students' doubts.

In the first week of the project, with the arrival of the students, the guidelines, project objectives and schedule of activities were presented. A DT workshop was also held with students to present the process to be used in the project. For three days, the students learned about the steps and the results they should present according to the proposed ten-week schedule.

Over the ten weeks, students worked as a team, resolved conflicts and differences of ideas, developed communication skills, collaboration, resilience, creative thinking, interpersonal relationships, leadership and ethics. They learned to solve complex problems and seek specific knowledge to meet the needs of the six projects.

The teams were formed to bring together students with complementary knowledge, to have at least one foreign student and local students who could help in the orientation and logistics of the city. The first immersion activity took place over a weekend at the Rio Negro Sustainable Development Reserve, in the community of Tumbira. In this, students were able to live with the forest, its inhabitants, the challenges, sustainable solutions and, above all, get to know each other better and create emotional bonds that contributed to the development of the project.

Figure 4 shows the face-to-face phases of the project, such as immersion in the reserve and teams meeting and being guided by mentors. However, due to the SARS COV2 pandemic (COVID19), part of the project was developed remotely, using online tools for meetings and discussions via web conferencing.

Figure 4 – Project development by students

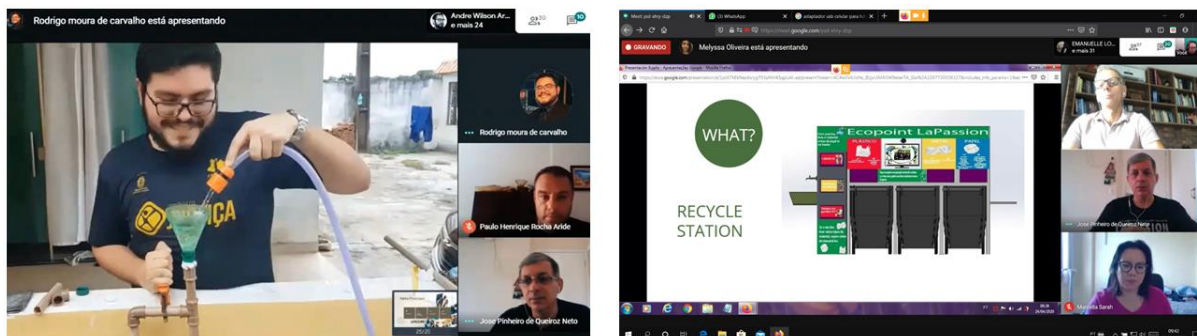


Source: Authors archive

Figure 5 shows two moments of this online period, with the weekly presentation of students demonstrating the evolution of the projects, and another with the guidance of

mentors. Despite the difficulties imposed by the pandemic, the integrated DT/PBL methodology proved to be robust and maintained the level of motivation of the students, who developed their autonomy, responsibility and resilience skills.

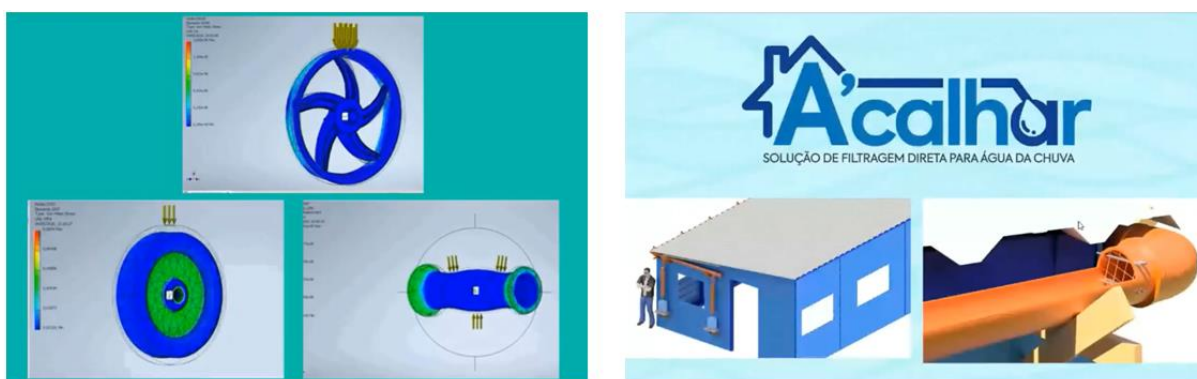
Figure 5 – Partial evaluations and mentoring in the period of remote activities



Source: Authors archive

As for the projects developed, *team one* was challenged by the company Caloi to develop a sustainable bicycle. As a result, they developed a proposal to replace parts of the product with an alternative raw material. *Team two* was challenged to devise a method to get clean water proposed by the Transires Institute. The result was a filter gutter that collects rainwater and provides drinking water. Figure 6 presents an illustration of the result of teams 1 and 2, presented to partner companies and the academic community.

Figure 6 – Sustainable bike and rainwater filter

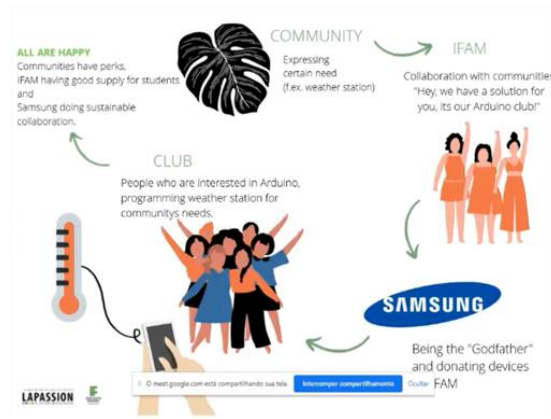


Source: Authors archive

Team three was challenged by the Samsung company to develop a solution for the reuse of electronic devices. The result involves the use of Arduino and the use of cell phones. *Team four* received from the IFAM the challenge of proposing a solution to raise awareness among students and employees about waste recycling. As a final product, an ecopoint was

created that helps in the separation of waste. Figure 7 presents an illustration of the result of teams 3 and 4, presented to partner companies and the academic community.

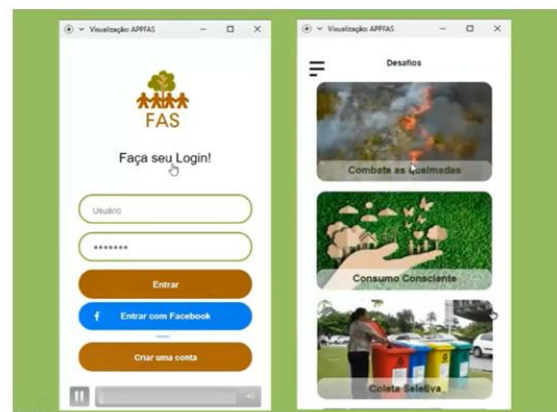
Figure 7 – Cellular and Ecopoint reuse



Source: Authors archive

Team five was challenged by the Environmental State Secretariat to work with the insertion of production chains in the local market. The result was the elaboration of a visual identity with local characteristics, which emphasizes the local culture for application in products developed by the production chains. *Team six* received the challenge from the Sustainable Amazon Foundation (FAS) to work with remote learning for communities. As a result, the proposal focused on a prototype of an application that shares the material created by teachers and that can be accessed by communities of difficult access. Figure 8 presents an illustration of the result of teams 5 and 6, presented to partner companies and the academic community.

Figure 8 – Forest products and Application for sharing classes in communities

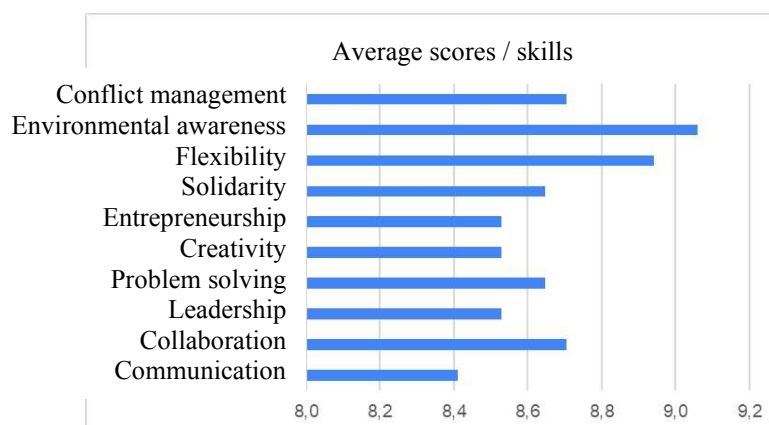


Source: Authors archive

All projects were presented on the Demo Day at the end of the LAPASSION Manaus project, which, because of the pandemic, was carried out online. The project website can be accessed at the link: <https://lapassionmanaus.wordpress.com/> where all phases of the project, participants, links to the projects, final report of activities and other materials elaborated during the execution of the activities are described .

At the end of the project, seventeen students (60% of the class) voluntarily answered a project evaluation questionnaire and, mainly, how much they realized they had developed their Soft Skills. The graph shown in Figure 9 demonstrates that the PBL-DT was successful in developing Soft Skills in students, with the lowest average grade being obtained in the "communication" skill, which was already an excellent grade, considering that the project had students with native languages such as Portuguese, Spanish and Finnish, and that they all needed to communicate in English.

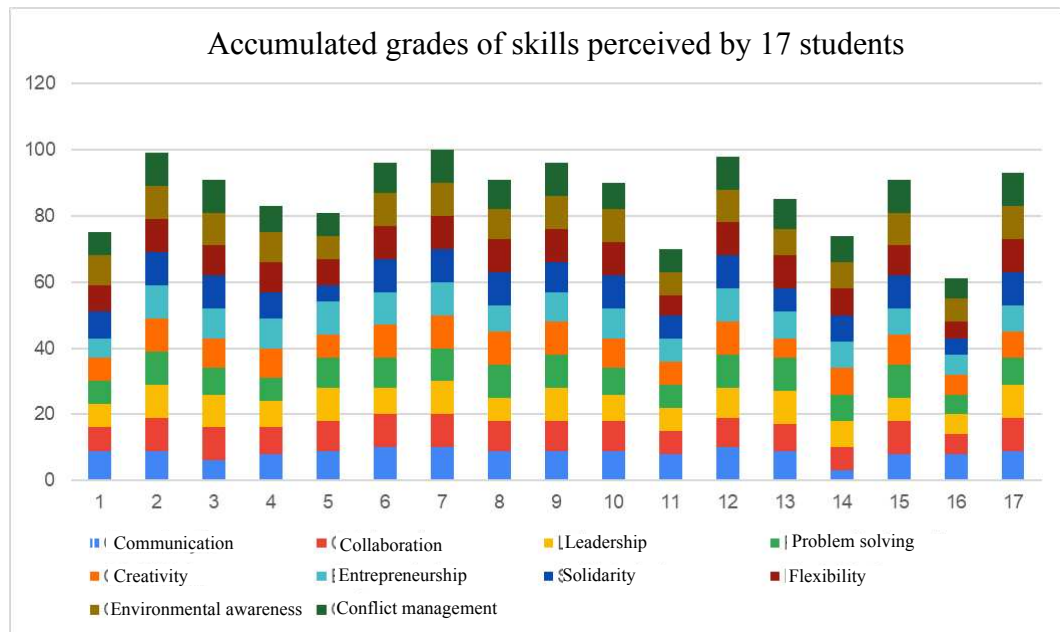
Figure 9 – Average grade given to Soft Skills acquired by the class



Source: Devised by the authors

Individually, all the responding students had the perception of improvement in Soft Skills, as shown in the graph in Figure 10. We can observe that five students had close to 100% achievement, while only three had a perception below 80%, the student with the lowest perception of Soft Skills development was 60%, which means that there is still a need for individual monitoring, without loss of student autonomy.

Figure 10 – Self-perception of Soft Skills acquired by students



Source: Devised by the authors

Final considerations

By reflecting on methodologies for the development of Soft Skills, which maintain the freedom and environment necessary for the autonomy and protagonism of students, without losing focus and with an organized way of structuring innovative thinking, for a better development of the process and its result, we understand the importance of integrating two methodologies that, synergistically, achieve this goal.

Using two consolidated methodologies, such as PBL and DT, extracting the best from each of them in a positive symbiosis, was the great contribution of this work. Additionally, the necessary redimensioning of the teacher's role is evidenced, which in this new context no longer represents the holder of knowledge and a verifier of learning, but a mentor who enables an environment where students are the protagonists of learning.

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