# Assessing the Development of Soft Skills for Project Management using PBL: A Case Study

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***Abstract*—This research-to-practice full paper presents an investigation on how to develop soft skills for project management using PBL in the context of undergraduate degree programs of higher education in computing. Projects are a key way to create value and benefits in organizations and the project manager plays a critical role in the leadership of a project team in order to achieve the project's objectives. In order to fulfill this role, the project manager must have some technical and soft skills. In a related perspective, there are several studies concerned with the comparison between what is covered by Computer Science Education and what are the software industry needs. Such studies point out in which areas graduates most frequently do not meet industry expectations, including technical skills and also soft skills. In this context, among the several approaches that have been proposed and applied to improve Computer Science Education, we highlight Project Based Learning (PBL). Aiming to address the lack of approaches focused on the development of soft skills in technology students, in this paper we discuss the conduction of a case study in Information Systems courses, adopting the PBL approach. In this case study, a real project was developed by the students, and soft skills were evaluated before and after performing the project, in order to verify if the PBL approach had any impact on their development. As a result, it was possible to identify improvements in the development of six out of the seven skills assessed, which indicates a satisfactory result for our study.**

***Index Terms*—Soft Skills, Project Based Learning, Project Management**

## I. Introduction

Projects are a key way to create value and benefits in organizations. In today's business environment, organizational leaders need to be able to manage with tighter budgets, shorter timelines, scarcity of resources, and rapidly changing technology [1]. According to the PMBOK® Guide, project management is the application of knowledge, skills, tools and techniques to project activities to meet the project requirements [1]. Project management is accomplished through the appropriate application and integration of the project management processes identified for the project and enables organizations to execute projects effectively and efficiently.

In this context, the Project Manager (PM) plays a critical role in the leadership of a project team in order to achieve the project objectives [1]. The PM works with the project team and other stakeholders to determine and use the appropriate generally recognized good practices for each project, i.e., determining the appropriate combination of processes, inputs, tools, techniques, outputs and life cycle phases to manage a project. In short, the PM is the person assigned by the performing organization to lead the team that is responsible for achieving the project objectives. In order to fulfill this role, the PM must have some technical and soft skills [1].

According to the PMBOK® Guide [1], technical project management skills are defined as the skills to effectively apply project management knowledge to deliver the desired outcomes for programs or projects. In addition to any specific technical skills and general management proficiencies required for the project, project managers should have skills to effectively lead the project team, coordinate the work, collaborate with stakeholders, solve problems, and make decisions.

In today's rapidly changing global economy, organizations are fraught with an increasingly complex, and volatile, unpredictable, chaotic, and ambiguous (VUCA) business environment [2]. In this sense, the importance of soft skills has been expounded repeatedly as a crucial factor to thrive in the workplace, as opposed to mere knowledge of content, since it is important to be able to adapt to new situations.

Perreault [3] defined soft skills as a personal quality, attribute or level of one's commitment which sets apart individuals with the same skill and experience. James and James [4] concurred that soft skills is a new trend in explaining a set of ability or talent which could be utilized at a workplace. Soft skills have the ability to categorize specific career attribute which an individual has such as team spirit, communication skills, leadership skills, customer service skills and problem solving skills [4]. Mitchell *et al.* [5] states that a person who communicates effectively, adapts well with others, works well in a team, takes initiative and has a formidable work ethics is considered as having the required level of set soft skills. Also, Sutton [6] considered soft skills as instrumental to the point that many employers feel that soft skills can be used to set apart job applicants in most industries. Glenn [7] additionally feels that hiring a person with soft skills is crucial as it promotes competitiveness in high-prestige organizations.

While there are common features among definitions in the literature, there is little consensus on a definition of the list of soft skills. In most cases, they are understood primarily in opposition to technical or hard, i.e., the non-domain-specific skills that help individuals thrive in a professional context [8]–[10].

In a different but related perspective, there are several studies concerned with the comparison between what is covered by Computer Science Education and what are the software industry needs [11]–[13]. Considering the Computer

Science Education scenario, there is a set of challenges that researchers, curriculum designers and instructors still have to address in order to improve software education [11]. Radermacher and Walia [12], for instance, pointed out in which areas graduates most frequently do not meet industry expectations, including technical skills and also soft skills (such as written and oral communication, teamwork, leadership, etc.). More recently, Tuzun *et al.* [13] analyzed if Computer Science and Engineering graduates are ready for software industry.

There are several approaches other than the traditional one to teach and also motivate students to engage in the learning process, that is, become active. In this context, according to Bonwell and Eison [14], active learning can be essentially defined as "*students doing things and thinking about what they are doing*". In another perspective, Felder and Brent [15] define active learning as "anything course-related that all students in a class session are called upon to do other than simply watching, listening and taking notes".

In short, active learning refers to a broad range of teaching strategies which engage students as active participants in their learning during class time with their instructor [16]. The aim of active learning is to provide opportunities for learners to critically think about content through a range of activities that help prepare learners for the challenges of professional situations.

According to Krajcik and Blumenfeld [17], Project Based Learning (PBL) is a form of situated learning and it is based on the constructivist finding that students gain a deeper understanding of material when they actively construct their understanding by working with and using ideas. The authors [17] also state that in project-based learning, students engage in real, meaningful problems that are important to them and that are similar to what scientists, mathematicians, writers, and historians do. A project-based classroom allows students to investigate questions, propose hypotheses and explanations, discuss their ideas, challenge the ideas of others, and try out new ideas. In short, as stated by Blumenfeld *et al.* [18], PBL is a comprehensive approach to classroom teaching and learning that is designed to engage students in investigation of authentic problems. In this sense, PBL involves deep learning, as it focuses on real-world problems and challenges and relies on problem solving, decision making and investigative skills. These characteristics are suitable for improving soft skills.

Aiming to address the lack of approaches focused on the development of soft skills in technology students, in this paper we discuss the conduction of a case study in Information Systems courses, adopting the PBL approach. In this case study, a real project was developed by the students, and the soft skills were evaluated before and after the conduction of the project, in order to verify if the PBL approach had any impact on their development. As a result, it was possible to identify improvement in the development of six out of the seven skills assessed, which indicates a satisfactory result for our study. Results can help to shed light on how to improve Computer Science Education, particularly with regard to soft skills.

The remainder of the paper is organized as follows. In Section II, we discuss the case study design and analyze the threats to validity. Results are presented and discussed in Section III. Finally, we draw conclusions and provide directions for future work in Section IV.

## II. Case Study

We followed the guidelines proposed by Runeson and Höst [19] to design and report on this case study. The following subsections present the protocol details.

### A. Goal, Research Question and Subject Selection

The goal of the case study was formulated using the Goal-Question-Metric approach [20] and was to investigate the following research question:

*In what ways does Project Based Learning improve the essential project manager soft skills for technology-based undergraduate students?*

Yin [21] states that a case is a contemporary phenomenon in its real-life context. Considering such definition [21] and the guidelines of Runeson and Höst [19], we classify this case study as explanatory [21], since it focuses on evaluating the effectiveness of using PBL to improve undergraduate students soft skills.

In this work, one case (i.e., a course project) was conducted at University of São Paulo with 55 students, who took Information Systems course in two different undergraduate degree programs: Information Systems and Computer Science.

It is worth mentioning that 150 students were enrolled in these courses and participated in the course project (in groups of 4-5 students). Of this total of students, all were invited to voluntarily participate in the case study, and 55 agreed to participate.

### B. Students as Subjects

The research community has long debated on the scientific value of treating students as subjects in experiments, case studies, etc. [22]. Sjøberg *et al.* [23], for instance, conducted a study on the state of how software engineering controlled experiments were conducted and reported. Although in the domain of software engineering there can be a significant difference in experience between practitioners and students, Host *et al.* [24] mention that, for some tasks (e.g., in the context of project impact assessment and risk management), software engineering students can be considered equal to practitioners. Berander [25] also pointed out that for some tasks (e.g., identifying trends and behaviors), students could be suitable subjects. For example, the author found that the requirements prioritizations made by students and practitioners could be similar under certain conditions.

Based on the studies previously discussed, even though the data collection questionnaires (discussed in Section II-E) having been designed for practitioner, we considered that they would also be suitable for students. We also followed the guidelines from Carver *et al.* [26] to ensure that the case study

contributed to the students' education, as well as the students were committed to the study.

### C. Soft Skills Selection

As discussed in Section I, the project manager must have some technical and soft skills. Aiming to answer our research question, we selected a set of soft skills considered important for someone who wants to become a project manager.

The Project Management Institute has proposed one of the best consolidated structures to define the skills required in a project manager, entitled *PMI Talent Triangle* (Figure 1). In this structure, skills are divided into three major groups: (i) technical project management; (ii) strategic and business management; and (iii) leadership.


Fig. 1. PMI Talent Triangle [1]

Technical project management, and strategic and business management are a set of hard skills, i. e., skills that can be learned throughout theoretical project management classes. On the other hand, leadership, defined as "knowledge, skills and behaviors necessary to guide, motivate and direct a team to help organize a business" [1], is composed of a set of soft skills that cannot be formally learned, but developed over time.

Therefore, considering PMBOK definitions and the available literature [27], [28], a set of six skills was selected to be addressed in this study, namely: (i) feedback ability; (ii) self-awareness; (iii) self-control; (iv) motivation; (v) empathy; and (vi) social skills. It is worth mentioning that the last five make up a macro skill called *emotional intelligence*, that is, the ability to recognize and understand emotions in oneself and others and the ability to use that awareness to manage their behavior and relationships [29].

### D. Tasks

As the study was carried out in the context of the Information Systems courses, activities should be related. Therefore, each group should choose a tech company and carry out the organizational modeling of that company.

The details of each task are described following:

1. **Organization overview:** Students identified and contacted a company of interest. Next, they performed the analysis of such organization.
2. **Current Business Process Modeling:** The students modeled the business processes of the chosen company, in addition to identifying the problems that were found in the current process.
3. **Business Process Improvement Proposal:** The students proposed changes to solve the problems previously found. In addition, they analyzed the feasibility of the changes, as well as a deployment plan.

It is noteworthy that the course activities were not changed to carry out the case study.

### E. Data collection

As metrics and data sources for evaluation, two cycles of questionnaires were applied to the students. The first cycle was applied at the beginning of the semester, before any contact of students with the project or with management-related content; and the second cycle at the end of the semester, when all the content had already been taught and the project developed by them had already been completed. The purpose of the questionnaires was to measure the skills selected in each of the students quantitatively.

Several studies in the literature propose different forms to quantify soft skills and, therefore, allow their development [30]. Regarding those that were selected to be used in this case study, they are composed of two parts that measure respectively (i) feedback; and (ii) emotional intelligence, which includes the 5 different skills discussed previously: self-control, self-awareness, empathy, motivation and social skills. The questionnaires were developed by the British company MindTools[1], responsible for leveraging the development of soft skills in professionals who aim for management and leadership positions in their business segments, and adapted for application in this case study.

Thus, to assess the ability to give feedback, the questionnaire shown in Table I was used.

TABLE I
FEEDBACK ASSESSMENT FORM

| Behaviors | Usually | Sometimes | Rarely |
|---|---|---|---|
| (1) I focus my comments on specific, work-related behaviors. | ☐ | ☐ | ☐ |
| (2) I keep my comments descriptive rather than evaluative. | ☐ | ☐ | ☐ |
| (3) I prefer to save comments so that they can be presented and discussed in detail during the annual performance review. | ☐ | ☐ | ☐ |
| (4) I try to ensure that my feedback is clearly understood. | ☐ | ☐ | ☐ |
| (5) I complement the criticism with suggestions on what people can do to improve. | ☐ | ☐ | ☐ |
| (6) I choose the type of feedback to reflect the person's past performance and future potential. | ☐ | ☐ | ☐ |

For questions 1, 2, 4, 5 and 6, 3 points were given in the case where the answer given by the student was "*Usually*", 2 points

[1]https://www.mindtools.com/

for "*Sometimes*" and 1 point for "*Rarely*". For question 3, 3 points were given for "*Rarely*", 2 for "*Sometimes*" and 1 for "*Usually*". A sum of 16 points or more suggests competence for feedback; between 13 and 15 indicates that there is room for improvement; and a result of less than 13 indicates low feedback capacity.

Similarly, Table II presents the questionnaire used to assess emotional intelligence, which includes the five skills previously discussed.

TABLE II
EMOTIONAL INTELLIGENCE ASSESSMENT FORM

| Statement | Never | Rarely | Sometimes | Usually | Always |
|---|---|---|---|---|---|
| (1) I can recognize my emotions as I experience them | ☐ | ☐ | ☐ | ☐ | ☐ |
| (2) I lose my patience when I get frustrated | ☐ | ☐ | ☐ | ☐ | ☐ |
| (3) People tell me that I'm a good listener | ☐ | ☐ | ☐ | ☐ | ☐ |
| (4) I know how to calm down when I feel anxious or upset | ☐ | ☐ | ☐ | ☐ | ☐ |
| (5) I like to organize groups | ☐ | ☐ | ☐ | ☐ | ☐ |
| (6) It's hard for me to focus on something in the long term | ☐ | ☐ | ☐ | ☐ | ☐ |
| (7) It is difficult for me to move on when I feel frustrated or unhappy | ☐ | ☐ | ☐ | ☐ | ☐ |
| (8) I know my strengths and weaknesses | ☐ | ☐ | ☐ | ☐ | ☐ |
| (9) I avoid conflicts and negotiations | ☐ | ☐ | ☐ | ☐ | ☐ |
| (10) I feel like I don't like my job | ☐ | ☐ | ☐ | ☐ | ☐ |
| (11) I request feedback from people about the things I do well and ask how I can improve them | ☐ | ☐ | ☐ | ☐ | ☐ |
| (12) I set long-term goals and regularly review my progress | ☐ | ☐ | ☐ | ☐ | ☐ |
| (13) It is difficult for me to recognize people's emotions | ☐ | ☐ | ☐ | ☐ | ☐ |
| (14) It is difficult for me to establish relationships with others | ☐ | ☐ | ☐ | ☐ | ☐ |
| (15) I use active listening skills when others speak to me | ☐ | ☐ | ☐ | ☐ | ☐ |

To map the results of this second questionnaire, the answer for each statement was transformed into points according to the values presented in Table III.

When adding the results, a value between 56 and 75 indicates high emotional intelligence, which generates good relationships and good management skills. A score between 35 and 55 indicates good emotional intelligence, with some strengths and others that need improvement. Finally, a score less than 35 indicates emotional instability and requires that some of the evaluated factors be developed.

To assess the five skills that make up emotional intelligence [29], the following questions can be mapped: (i) self-awareness: questions 1, 8 and 11; (ii) self-control: questions 2, 4 and 7; (iii) motivation: questions 6, 10 and 12; (iv) empathy: questions 3, 13 and 15; and (v) social skills: 5, 9 and 14. For each skill, the sum of the results of the three questions related to it generates a score between 3 and 15, in which 3 indicates a need for improvement and 15 indicates a strong ability of such element.

TABLE III
MAPPING THE RESULTS OF THE EMOTIONAL INTELLIGENCE ASSESSMENT FORM

| Item | Never | Rarely | Sometimes | Usually | Always |
|---|---|---|---|---|---|
| 1 | 1 | 2 | 3 | 4 | 5 |
| 2 | 5 | 4 | 3 | 2 | 1 |
| 3 | 1 | 2 | 3 | 4 | 5 |
| 4 | 1 | 2 | 3 | 4 | 5 |
| 5 | 1 | 2 | 3 | 4 | 5 |
| 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 5 | 4 | 3 | 2 | 1 |
| 8 | 1 | 2 | 3 | 4 | 5 |
| 9 | 5 | 4 | 3 | 2 | 1 |
| 10 | 5 | 4 | 3 | 2 | 1 |
| 11 | 1 | 2 | 3 | 4 | 5 |
| 12 | 1 | 2 | 3 | 4 | 5 |
| 13 | 5 | 4 | 3 | 2 | 1 |
| 14 | 5 | 4 | 3 | 2 | 1 |
| 15 | 1 | 2 | 3 | 4 | 5 |

### *F. Units of analysis and analysis procedure*

The data collected were evaluated using the metrics defined in Section II-E, that is, the index of each student in relation to the skills selected in the case study. Thus, it was possible to assess the number of students who showed an improvement in each skill, how many had no change, and how many showed a worsening.

To assess whether there is any statistical significance in the variation of results at the beginning and end of the course, the Wilcoxon Paired Test was applied to the results [31]. The Wilcoxon test has as a null hypothesis the statement that the mean (median, or other defined metric) of the data observed at the beginning of the semester are the same as at the end, that is, it indicates that there was no significant difference between the measurements before and after of the PBL approach. Similarly, the alternative hypothesis is that there is a significant difference between observations at the beginning and at the end of the semester. The paired and non-parametric test was selected because the samples are dependent (that is, the questionnaires were applied with the same students) and because the measures do not follow a normal distribution. To reject the null hypothesis and state that there is a statistical difference, it is necessary that the p-value generated by the test is less than 0.05 (assuming a 95% confidence interval). Otherwise, it is not possible to state anything quantitatively and, therefore, a qualitative analysis is necessary.

The data were summarized by means of statistical analysis and will be presented in Section III.

### *G. Threats to Validity*

To describe the internal validity of empirical results, it is important to exclude or, at least, to explain confounding variables and other sources of potential bias [32]. One potential threat to internal validity (especially construct validity) in questionnaires are ambiguously and poorly-worded questions, which was mitigated by adopting a well-established questionnaire. An additional limitation of questionnaires is the

uncertainty whether the participants answer truthfully. We tried to keep this risk low by ensuring the practitioners that the participation is voluntary and that no data is gathered that would allow us to draw conclusions with respect to the identity of the practitioner. Moreover, if people are not willing to be honest, they usually do not volunteer for such a survey. However, this risk can never be excluded totally.

External validity is the extent to which conclusions can be generalized and capture the objectives of the study [32]. It is primarily concerned with the representativeness of the sample for the target population [33]. The target population of this study is computing undergraduate degree students. We assume that our findings may indicate a pattern in this population.

## III. Results and Discussion

Regarding the analysis of the soft skills previously selected, the main results are presented as follows.

Figure 2 presents the comparison of students at the beginning and at the end of the semester, evaluating whether or not there has been an improvement in the ability to provide feedback. This skill was practiced by students constantly throughout the development of the project. In fact, at the end of the project, students performed peer reviews and were responsible for providing feedback to their peers. The feedback results were monitored by course tutors, not as an evaluative form (the feedback results did not impact the students' grades in the course), but to verify if the criticisms were being made in a constructive way.

At first, many of the students were afraid to start a feedback loop as they were carrying out the project with colleagues. However, many understood the need to develop this skill from the beginning of their professional career to apply it in the industry. Finally, it was the skill in which we had the least number of students without growth during the development of the case, as can be seen from the height of the bars.

According to Srinivasan [34], in *The LinkedIn Learning Blog*[2], when managers provide performance feedback to employees, those employees are two times more likely to believe that they can meet their personal career goals, but few of them are ready for that. Therefore, we believe that we have results that indicate an interesting trend in developing this ability since the projects of undergraduate courses. Quantitatively, the p-value in the Wilcoxon test was 0.04, which is less than 0.05 and therefore indicates a significant difference in the values. Therefore, the overall development was positive in the students.

In regard to the results of the soft skills macro that represents emotional intelligence, the result is shown in Figure 3. From the figure, it is possible to notice a greater number of students who maintained or improved this skill in relation to students who had worsened in its development. However, a p-value greater than 0.05 (0.29) was obtained in the statistical analysis, which does not indicate statistical significance in the variation.

[2]https://learning.linkedin.com/blog

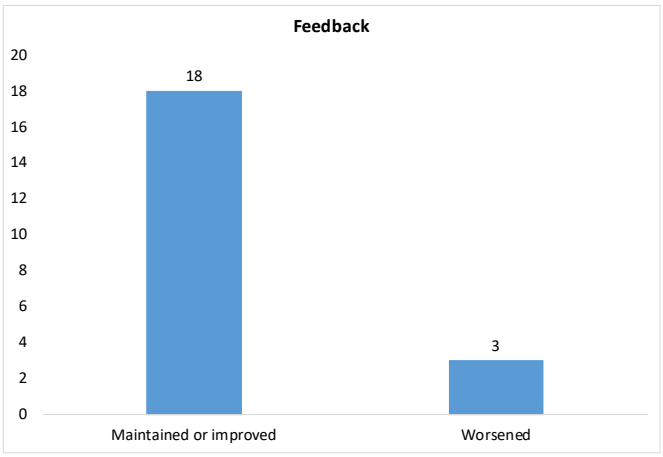


Fig. 2. Feedback test results

The test tells us that the variance of improvement among students is not huge, which can be expected when we consider that we have a restricted group of students and that this soft skill is a set of five others, which vary in different ways.

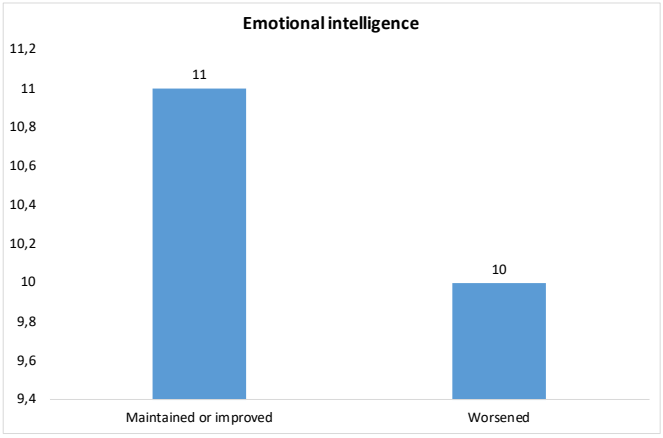


Fig. 3. Emotional intelligence test results

The following are specific analyzes for each of the five pillars that define emotional intelligence: self-awareness, self-control, motivation, empathy, and social skills.

Figure 4 shows the results for the self-awareness test. In general, the same structure as the previous result was maintained, with a greater number of students who maintained or improved than the number of students who worsened. For this test, Wilcoxon's statistic is 0.87, indicating that although there is improvement, it is not statistically significant.

According to Hull and Levy [35], self-awareness is the ability to see yourself clearly through reflection, considering not only your thoughts but your actions. To guide the development of this skill, we asked students to work as a group to create the solution, but to divide themselves into fronts that required individual work. Finally, the students had to evaluate not only their partners but also themselves. The idea was to confront the students with their results so they could reflect on what

they think about their work and how they interacted with the group, identifying their strengths and weaknesses. One of the interesting discussions in this skill is that many students believe they are good at teamwork and in discussing problems, when in fact they end up being inflexible with their opinions within the projects.

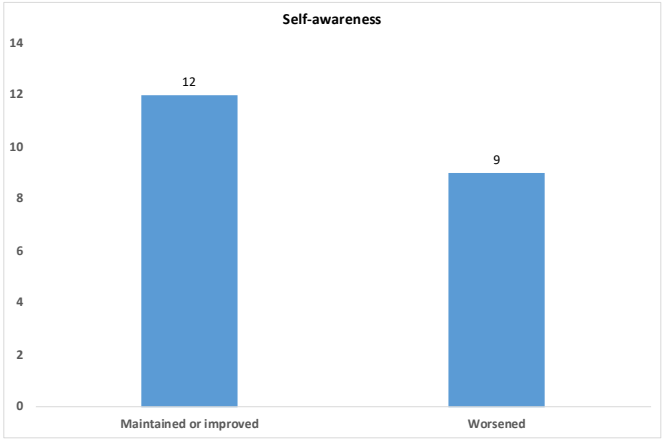


Fig. 4. Self-awareness test results

Concerning the self-control test, it is the only one in which the number of students who had metrics that worsened is greater than the number of students who maintained or improved. Even though it is a low difference, it is still the test in which the p-value is 0.02, that is, it indicates a significant difference. Figure 5 shows the results of this test.

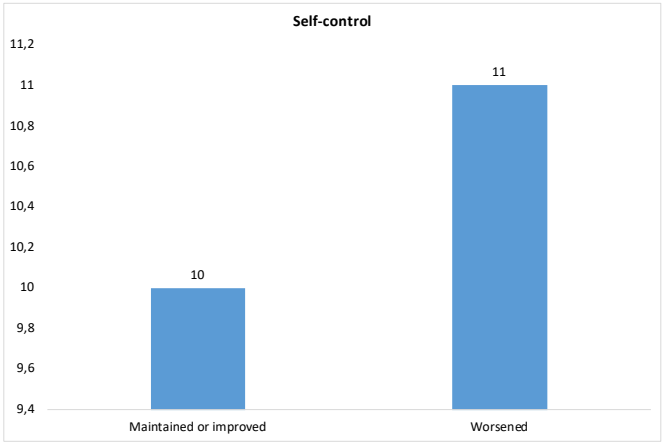


Fig. 5. Self-control test results

In general, this was one of the skills in which students did not have a specific job to help develop it; however, some points were discussed in relation to their contact with the stakeholders that actually work in the companies and that generated pressure over the results expected by the students. As a hypothesis that justifies this worsening, it is possible to mention the students' frustration when proposing solutions that are not realistic for the job market (which include risks, budget or schedule overflow, lack of manpower, etc.) or propose solutions that companies have previously addressed, but have not been successful.

It is worth mentioning that a solution that was in fact accepted by the company was not part of the students' evaluation in the course, given the lack of scope and time to develop it. However, the students engaged in the projects and tried to propose viable solutions for the companies.

Regarding the students' motivation, most of the students represented in the group "*Maintained or Improved*" refer to students who improved their skills. The statistical test presented a value of 0.47, as shown in Figure 6.

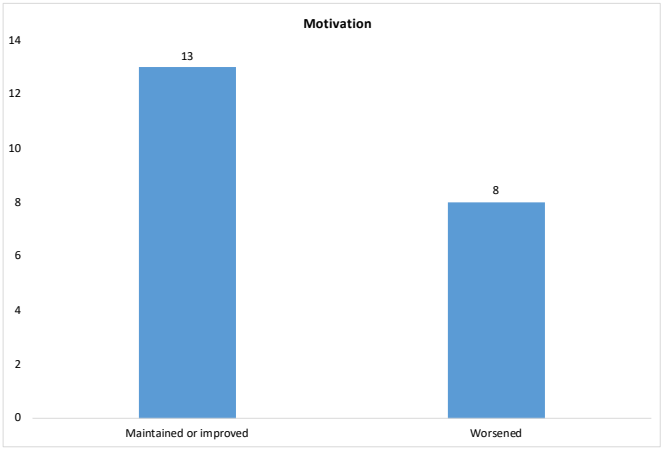


Fig. 6. Motivation test results

From a qualitative perspective, this was one of the most developed skills by students, as they worked on real projects, which is not common in undergraduate courses. Students faced with stakeholders and situations that in fact brought a benefit to the society in which the company operated, instead of working with projects created by teachers to evaluate them.

Students engaged in the projects and proposed interesting solutions for companies. As an example of solution proposed by the students, one of the groups worked on a project with a legislative monitoring company, which aggregates data from several legislative houses, using robots (crawlers) to automate the process of obtaining the data, standing out in the market due this differential. Therefore, clients and lawyers could consult their processes in a structured way and with constant updates. In addition, students pointed out two weaknesses that could be addressed: (i) the restructuring of the company's marketing area, in order to attract more market visibility; and (ii) the absence of an established sector of human resources, which could improve the organizational culture. As a solution, students proposed a new business value chain model, and discussed this new model with company stakeholders presenting technical, organizational and human issues.

Figures 7 and 8 represent, respectively, the results of empathy and social skills tests, with statistical values equal to 0.12 and 0.29. The analysis of the results remains the same as the previous ones, that is, with very satisfactory qualitative results

for obtaining an improvement considering the low number of students.

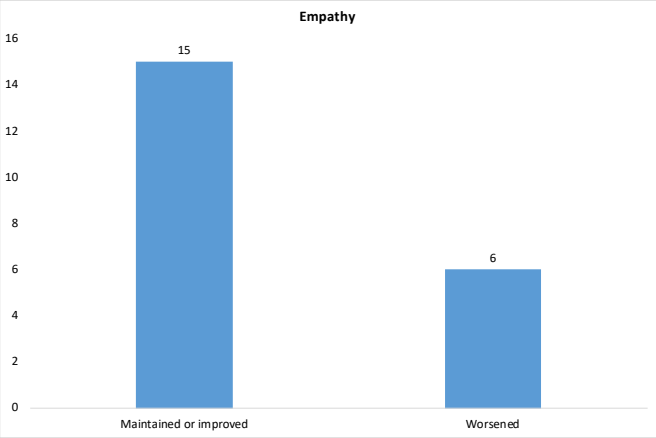


Fig. 7. Empathy test results

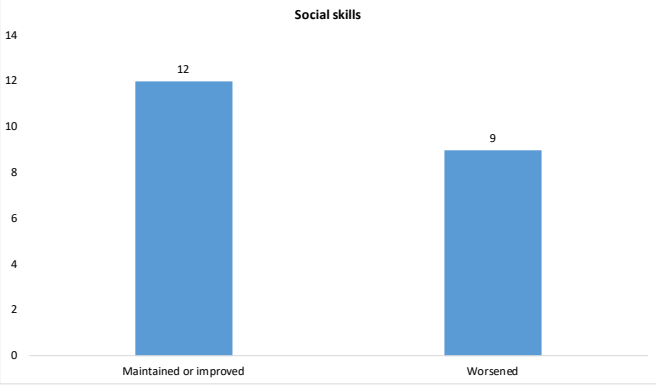


Fig. 8. Social skills test results

In general, empathy was one of the skills that generated the highest absolute values in results, with almost 70% of students in indexes above 13 (on a scale of 3 to 15, indexes above 13 indicate high ability). The project carried out since the beginning of the course helped this skill to improve, since they engaged together towards a great goal. Regarding social skills, the project was important for students to have this improvement, since they spend a good part of their undergrad programs facing challenges with computers instead of interpersonal challenges. Finally, it is possible to note that conducting the project helped in the development of this skill.

Runeson and Höst [19] point out that a case study will never provide conclusions with statistical significance. Even so, we find it interesting to present these results to understand which of the soft skills we had the highest absolute numbers in variation. In our study, the results are relevant, considering the development of essential soft skills. Also, considering this group of students in which the case study was applied, the results were quite satisfactory.

Aiming at the proposed goal of this work, which was to assess whether project-based learning supports the development of essential soft skills for project managers, we verified that 6 of the 7 skills were developed positively and, therefore, generate evidence that PBL is efficient to develop them.

Finally, considering the aforementioned research question, our results indicate that project-based learning improves the development of soft skills in the following ways:

- Students start from the beginning of their career to express their opinions and express the attitudes of the partners that they liked or disliked during the execution;
- Students begin to understand their strengths and weaknesses in teamwork and contact with the stakeholder. In traditional projects, conducted within the university, they are not exposed to conflicts and to a delivery that generates value for a domain. When working with real projects, the execution is more intense and ends up externalizing behaviors and skills that they did not know. With that, it is possible to start a journey of personal development.
- Students practice contact with stakeholders, schedules and resources that a real project requires. The ability to understand the project comes from empathy with the customer to understand what are the real difficulties faced to develop the solution. In addition, it requires a lot of social skill to live and understand the environment where the solution will be applied. Despite abstract skills, excellent contact with stakeholders already helps in part to the success of the projects.

## IV. Conclusions and Future Work

In this paper we presented an assessment of soft skills development using PBL by means of a case study. The selected soft skills are some of those considered essential for a project manager. The case study was conducted in the context of Information Systems courses, with undergraduate students.

In general, seven different skills were assessed throughout the case study: feedback, self-awareness, self-control, motivation, empathy, and social skills (the latter five encompassing a soft skill defined as emotional intelligence). Such skills were measured at the beginning and end of the students' semester, using forms well consolidated in the literature.

As a result, we identified improvements in the development of 6 out of 7 considered skills (with the exception of self-control), which indicates a satisfactory result for our study. Although not statistically significant, such results indicate that PBL approach has a positive impact on the development of these skills in students.

In response to the research question presented in Section II-A, the results indicate that Project Based Learning does improve the essential project manager soft skills for technology-based undergraduate students. This conclusion was obtained qualitatively, since there was an improvement in six skills, although not statistically significant.

The inclusion of a real context project within the classroom showed that PBL has the ability to bring innovation and dynamism. We also expect this approach brings students closer to the real context of software industry and, consequently, that

students better understand the topics of the course and more important, feel more motivated to study it.

As future work, we intend to: (i) replicate this study with a larger number of students; (ii) replicate this study with different soft skills; (iii) replicate this study with different teaching approaches; and (iv) consider how the research question could be answered using qualitative methods. It is worth highlighting that we intend use the findings of this work to improve undergraduate courses, since PBL can be used as an approach in any course in which a project is conducted, such as: Information Systems, Software Engineering, Project Management, and so forth.

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