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PROGRESS REPORT

DEVELOPMENT OF HARD AND SOFT SKILLS WITH ACTIVE METHODOLOGIES IN THE GOVERNANCE AND PROCESS IMPROVEMENT COMPETENCY DISCIPLINES

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# 1 INTRODUCTION

The dynamic Information Technology (IT) market continually faces a demand for professionals skilled not only in technical competencies but also in interpersonal abilities, known as hard and soft skills, respectively. Recent research by Brasscom (2020) reveals a significant shortage of qualified workforce in the IT sector, emphasizing the urgency to develop professionals adaptable to contemporary demands. This undergraduate research project focuses on filling a gap in teaching practices at Higher Education Institutions (HEIs), specifically in the Software Engineering course, prioritizing the development of competencies related to governance and process improvement.

The dynamic nature of Software Engineering, coupled with changes in professional profiles required in the 21st century, as outlined by the Employability Profiles of the Conference Board of Canada, underscores the importance not only of technical skills but also of fundamental personal and teamwork management competencies. However, traditional teaching approaches prove insufficient to fully meet the demands of this field.

This research is grounded in relevant studies exploring the effectiveness of active learning methodologies in promoting hard and soft skills. For instance, Andrea Betti et al.'s study (2020) investigated the Flipped Classroom method to establish a relationship between the development of both skills. Bruce R. Maxim et al. (2023) focused on student engagement in Software Engineering courses using active methods such as Game-Based Learning (GBL). Another study was conducted by Ivan Garcia et al. (2020), exploring the effects of Game-Based Learning (GBL) on the acquisition of soft skills in Software Engineering courses.

In light of this panorama, this research aims to deepen the understanding of the development of hard and soft skills in disciplines related to governance and process improvement in the Software Engineering course, using active learning methodologies.

We recognize the complexity of this relationship, considering the variables inherent in the academic context and the specific characteristics of the disciplines. We believe that active methodologies play a crucial role in developing these skills, although we acknowledge that they do not represent a singular and absolute solution.

Therefore, this research aims to contribute to the improvement of educational practices, providing insights on how to optimize the use of active methodologies to shape more comprehensive Software Engineering professionals aligned with market demands.

# 2 OBJECTIVE(S)

The overall objective of this project is to investigate how hard and soft skills are developed in the training of Software Engineering professionals through competency-oriented curricula and active learning methodologies, with a focus on the disciplines within the governance and process improvement competency.

In order to achieve this objective, the following specific objectives are going to be developed:

1. Conduct a literature review on the use of active learning methodologies in courses related to the development of governance and process improvement competency.
2. Conduct case studies to identify how hard and soft skills are developed in disciplines related to governance and process improvement competency, utilizing active learning methodologies.
3. Analisar os resultados de como são desenvolvidas as hard e soft skills nas disciplinas da competência de governança e melhoria de processos.

# 3 MATERIALS AND METHODS

The selected research method for this project is the case study, as it allows for the collection and analysis of information within the specific context where the phenomenon under study occurs. This will be accomplished through semi-structured interviews with educators who employ active methodologies to develop hard and soft skills in disciplines related to the governance and process improvement competency.

O protocolo de pesquisa do estudo de caso será construído a partir da questão norteadora e dos construtos teóricos advindos da revisão da literatura. Os casos (disciplinas), serão escolhidos de acordo com estas características:

▪ It concerns a subject present in the current curriculum of a Software Engineering undergraduate program offered by a Brazilian Higher Education Institution (HEI);

▪ It is a discipline that belongs to the set of courses aimed at the development of hard and soft skills within the governance and process improvement competency;

▪ Encompass cases from both public and private Higher Education Institutions (HEIs) that apply active learning methodologies, either institutionally or in isolated instances;

▪ It involves faculty members who willingly and voluntarily agree to participate in the study. The stages of the case study process can be observed in Figure 3-1, adapted from Yin (2017).

Diagrama

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Figure 3-1. Case Study, adapted from Yin (2017).

It is as follows:

▪ Understanding the research context through literature review: This activity will be carried out collaboratively by the four PIBIC students participating in this project, each focusing on a specific area. The goal is to map the literature on the use of active methodologies in Software Engineering education. Additionally, research conducted by the Software Engineering Research Group on this topic will also be studied.

▪ Research Planning: In this stage, the selection of cases (disciplines) and the preparation of the research protocol will be conducted. At this point, propositions will be defined, and points of analysis that will guide the field study will be mapped. The Informed Consent Form (ICF) and the Confidentiality Agreement will be signed by the involved parties.

▪ Pilot testing with developed data collection instruments: A pilot case will be conducted to allow for adjustments to the research protocol, if necessary. The supervising professor will guide the student during this initial case.

▪ Process Report: Compilation and submission of the interim report containing the research progress up to the current point, in accordance with the PIBIC schedule.

▪ Data Collection: Conducting the remaining planned case studies using the semi-structured interview approach, in addition to collecting artifacts used by the instructor when relevant.

▪ Analysis of individual data collection results: As the cases are conducted, transcripts will be created, mapped, and analyzed using the Atlas.ti tool.

▪ Cross-data analysis: Cross-analysis of all conducted interviews and mapping of conclusions. Comparison with research conducted by other students involved in different competencies of software engineer formation.

▪ Analysis of results in light of related works: Evaluation of the obtained results in relation to the works identified in the literature.

▪ Final Report: Compilation and submission of the final report, containing the results obtained from the research. Preparation of the presentation (oral or poster) to be delivered at SEMIC 2023.

Approved by CEP on 25/05/2023: **6.079.297**

# 4 INTERIM RESULTS

At this point, the development of this research has progressed significantly, directing efforts towards a more profound understanding of the role of active learning methodologies in the development of hard and soft skills in the context of Software Engineering. Initially, an extensive literature review was conducted, focusing on three crucial studies investigating the use of active methodologies: Andrea Betti et al. (2020), Bruce R. Maxim et al. (2023), and Ivan Garcia et al. (2020).

The first study called "Can active learning techniques simultaneously develop student’s hard and soft skills?" by Andrea Betti et al (2020) sought to correlate the development of hard and soft skills using the active learning methodology known as Flipped Classroom. The experiment involved two classes, one following traditional methods and another exclusively utilizing the flipped approach. However, the results did not exhibit a clear pattern between the development of soft and hard skills. Despite the increase in students' grades in the flipped classroom, it was not possible to assert that this approach improves or worsens the relationship between these skills. It is concluded that further research is necessary to identify the most effective methodologies for the development of each skill.

The second one called "Student Engagement in Active Learning Software Engineering Courses" by Bruce R. Maxim et al, (2023) investigated the involvement of students in Software Engineering courses with active learning methods. It was observed that methods such as Game-Based Learning (GBL), peer discussions, and reviews significantly increased student engagement. GBL, in particular, proved to be the most effective technique for keeping students involved, challenging them, and encouraging continuous development. Although engagement is not a direct guarantee of learning, it creates a conducive environment for students to seek learning autonomously.

The last one is called "The effects of game‐based learning in the acquisition of 'soft skills' on undergraduate software engineering courses: A systematic literature review" by Ivan Garcia et al (2020) conducted a systematic review of 96 studies on Game-Based Learning (GBL) in Software Engineering courses. The results indicate that GBL can promote both technical and interpersonal skills. Digital and non-digital games were categorized by genres, with digital ones being more effective in various areas, while non-digital ones were more applied in software management. Regarding soft skills, GBL favored the development of motivation, willingness to learn, competition, and problem-solving. However, effectiveness varied depending on the game type and the desired skill, emphasizing the need to consider the method's appropriateness for the specific objective.

The critical analysis of these studies provided a solid foundation for formulating hypotheses and more specific guidelines for the ongoing research. The diversity of methodological approaches and results in these studies highlights the complexity of the subject matter, emphasizing the need for a more detailed and contextualized analysis within the scope of Software Engineering.

A crucial step in conducting this research involved the selection of teachers to be interviewed. These professionals, specialized in the area of governance and process improvement, were strategically chosen to provide a practical and in-depth perspective on the active learning methodologies implemented in their disciplines. Some interviews have already been conducted, providing valuable insights into the perceived effectiveness of these approaches, as well as challenges encountered in practical implementation.

The interviews so far have revealed a range of perceptions, from identifying tangible benefits in skill development to challenges associated with adapting active methods in an academic environment. The accounts of the interviewed teachers have been crucial for understanding the specific dynamics involved in the application of these methodologies in disciplines related to governance and process improvement in Software Engineering.

At this early stage, the analysis of interim results highlights the complexity and multifaceted nature of interactions between active methodologies, the development of hard and soft skills, and the specific context of Software Engineering. Based on these preliminary findings, the research continues to advance, aiming to deepen understanding and provide significant contributions to enhance educational practices in this dynamic and strategic field.

# 5 FUTURE STEPS

Considering the proposed schedule in the work plan, we have outlined a series of steps that will play a crucial role in deepening our understanding of the impact of active methodologies on the development of hard and soft skills in Software Engineering disciplines.

Our focus at this moment is on the meticulous analysis of data obtained through semi-structured interviews and the examination of artifacts used by the instructors. We will use the Atlas.ti tool to identify patterns and essential insights emerging from the teachers' accounts.

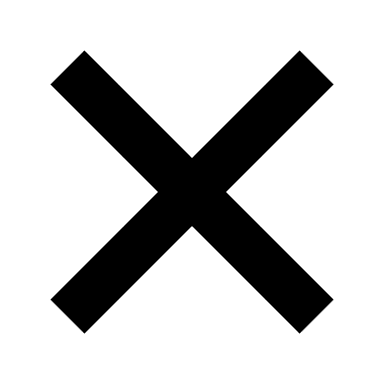
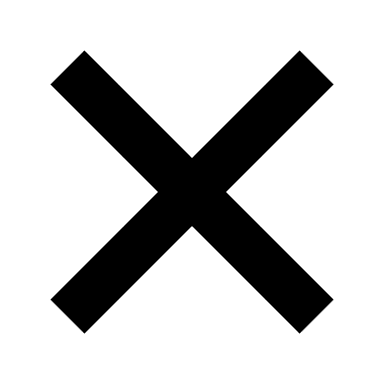
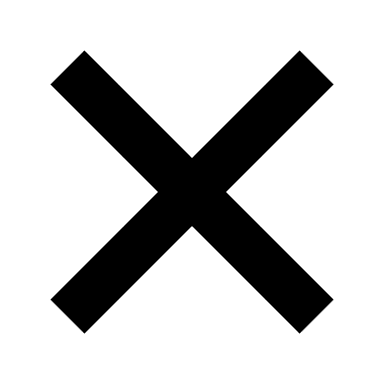
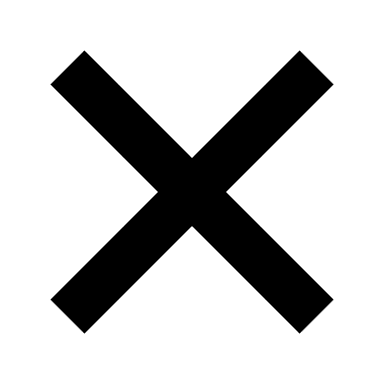
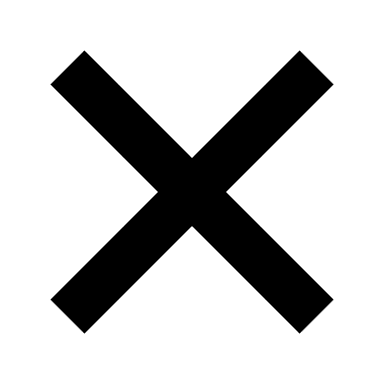
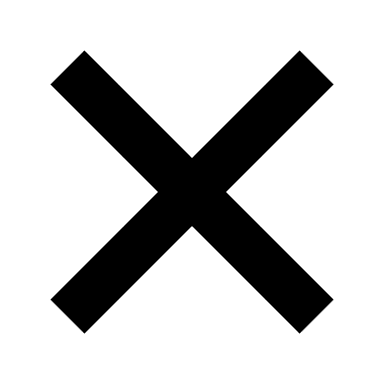
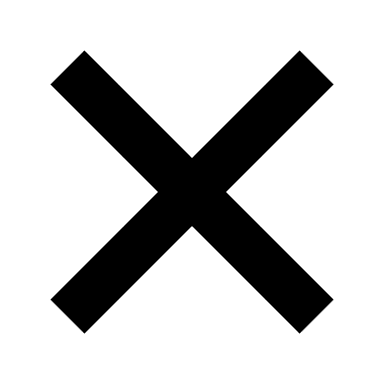
Upon completing the case studies, we will undertake a cross-analysis of the interviews. This step will allow for the comparison and contrasting of teachers' experiences and perceptions regarding active methodologies, aiming to identify consistencies and distinct nuances among the studied cases.

Our work will be integrated with the research conducted by other students involved in different competencies in the software engineer formation. This integration will provide a comprehensive view of the impact of active methodologies across various areas of education, enriching our understanding.

We will conduct a critical evaluation of our results in light of the related works identified in the literature. This process will allow us to position our research in relation to the state of the art, highlighting specific contributions and gaps that our approach aims to fill.

We will proceed with the preparation of the final report, synthesizing our findings and analyses. The final report will be a comprehensive narrative capturing the insights gained throughout the research, providing a valuable contribution to the understanding of the topic at hand.

Our next steps represent a critical phase in the research journey, where we will transform raw data into meaningful conclusions. These stages are essential to consolidate our findings and pave the way for the effective dissemination of knowledge about teaching practices in Software Engineering.

Tabela

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# 6 EXPERIENCE REPORT

Participating in this research project has been an enriching experience in various aspects. Immersing myself in extensive literature review and case studies provided an opportunity to deepen my understanding of the use of active methodologies in Software Engineering education.

Furthermore, close interaction with mentors and specialized professors in the field has offered a richer understanding of the nuances involved in the practical implementation of these methodologies. This close contact with the faculty allowed for a valuable exchange of ideas and perspectives, contributing significantly to the enrichment of my academic repertoire.

Observing closely the process of conducting research and recognizing the importance of each step in building scientific knowledge brought a practical dimension to my academic education.

This experience not only enhanced my understanding of the subject but also strengthened my connection with the academic community. I am confident that the contributions of this project will not only enrich my academic journey but also add valuable knowledge to the field of Software Engineering studies.

# 7 REFERENCES

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