Active Learning Approaches Applied in Teaching Agile Methodologies

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Abstract

We need to modernize education to form adaptable leaders who can tackle evolving challenges in our dynamic world. Insper's computer science program is designed to reflect this need with an innovative infrastructure, curriculum, and industry partnerships. We use active learning methodologies to teach agile methodologies and develop soft skills to solve real-world problems. Our focus is on non-violent communication, feedback techniques, and teamwork, along with constant interaction with industry professionals who share their experiences with students. Our goal is to provide students with a well-rounded education that equips them for success in the digital age. This work-in-progress research project describes our approach to teaching and our objective to prepare students for the future in the context of an innovative first semester experience on a CS program.

Keywords: Active Learning; Engineering Education; Developer Life; Agile Methodologies; Soft Skills.

1 Introduction

Computer Science education has been evolving to keep pace with the rapidly changing technology landscape. Venkateswaran (2022) notes that one reason for this evolution is to bridge the gap between industry needs and academic training. Disciplines such as Software Engineering, which were not previously part of the curriculum, are now mandatory, covering topics like Agile Methodology, Scrum, Kanban, and Lean. Soft skills development has also become a major focus, as software engineering professionals often collaborate with people from diverse cultures and time zones.

Active Learning approaches have been used in computer science courses as an alternative to passive and sequential teaching methods. The active learning approaches include hands-on activities, problem-solving, projects, collaboration learning, and other interactive practices.

In this paper, we describe the approaches used to teach agile and develop soft skills in an undergraduate Computer Science course at Insper Institute. The course, called Developer Life, is offered in the first semester of the program, and covers topics such as algorithms, logic, programming, design, agile methods, and soft skills. The course is distributed throughout the semester, with emphasis on hands-on activities, real-world problem-solving, and constant interaction with industry professionals.

2 Literature Review

In recent years, considerable research has discussed and shared active learning practices to teach agile methods and soft skills in computer science courses. This section has described the studies that guided the research.

2.1 Active Learning Approaches

Active learning is a student-centered approach to teaching and learning and can lead to more meaningful and effective educational experiences. In this approach, students participate more actively rather than passively receive information from the professor.

2.2 Active Learning Applied to teaching Agile Methodology and Soft Skills

Agile is a collaborative and iterative approach to software development. Active learning has been used to help teams to understand better and implement Agile practices and principles. Both strategies go very well together, since Agile focuses more on having quality implementations and productive interaction between team members, which required active participation on the part of the whole team.

The work of Polack-Wahl (2012) used active methodologies like practical games on the context of a half day workshop to teach agile methods. Some of the Games include the marshmallow tower challenge, collaborative origami.

Tribehorn (2021) exemplified active learning of the who software development lifecycle, mirroring the real-world practice in a twice a week 85 minute class. They implement six agile ceremonies: daily stand-up, sprint planning, retrospectives, sprint review, short iterations, planning poker to guide the students throughout the semester project. This work reported that they had both the professor playing the role of a client and a real client from the industry at some editions of the class. Soft skills approached were communication and negotiation, as requirements were kept evolving to simulate a real software project.

Another strategy on the context of a work-based degree was reported by Barr (2022), where a CS program alternates between periods in the industry (80%) with periods in the classroom (20%). Their approach teaches agile development and software testing in class in conjunction with a work-based module where students will harden the learned concepts in practice. They emphasize that his approach enables student confidence. Students are able to collaborate on their professional teams from the start and also are not afraid to ask questions at the workplace.

Finally, Agile methods have been proposed as a way to structure learning itself in Angellacio (2011), where learning of software concepts where planned as a sprint, where the the sprint planning involved studying the concepts and the end of the sprint corresponded to a demo were a software that involved the concepts was demonstrated.

2.3 Active Learning Applied to teaching Soft Skills

Developing soft skills is crucial to the modern workplace and highly valued by the software industry. *Soft skills* are a attributes and abilities that enable individuals to interact effectively with others. Some active learning approaches could be applied to develop soft skills, such as communication, teamwork, empathy, emotional intelligence, and collaboration.

Techniques such as reflection, group discussions, case studies, and group projects could contribute to student development.

3 Some Approaches to Teaching Agile and Soft Skills

3.1 Computer Science Course at Insper

This computer science course was created in 2021, starting in the first semester of 2022, with 30 students. In the first semester, the students have only one course called Developer Life. The main idea of this course is

allowing students to experience a little of how is the routine of a software engineer. During the course, they are exposed to various computing disciplines such as agile methods, design (UX and UI), algorithms, programming logic, and problem-solving.

The focus of this paper is to describe some approaches that have been used to teach agile methods and soft skills.

3.2 The Classroom Setup

During the course, students developed four main projects, the first and second by themselves, the second in pairs, and the third in groups. The last project is the Sprint Session, where they work on a real problem proposed by a real client. This problem is brought up by some professionals from industry with predefined user stories. The initial two projects are designed for individual work, aiming to introduce students to the Python programming language, computational logical thinking, and effective learning techniques. In the third project, students transition to collaborative work in pairs, emphasizing the importance of non-violent communication, task management, organization, and version control practices. The final project presents even more significant challenges as teams expand to include 4 or 5 members. In this stage, the students face increased complexities in code organization and versioning while also dealing with a real client who demands tangible results and frequently changes project requirements.

It is the second cohort of the CS program, with 45 students.

3.3 The Agile Approach

Agile methodologies are widely used in industry around the world. According to the VersionOne report (2023), agile teams have used many methods in recent decades to guide software development teams. One of the most used is the Scrum framework, which students start using at the beginning of the course.

Students have a 2-hour agile and soft skills class at least once a week. In addition, they have an additional 1.5 office hours of the professor's time, which they can use to do exercises and resolve doubts on the subject. Usually in this course the "office hours" take place in the students' classroom.

The schedule for the first semester of 2022 includes subjects such as Agile Principles and Values, Scrum board, ceremonies, user stories, activities, T-Shirt measure, and Scrum roles. They starting use this concept in the third project when they work in pairs on a game project.

3.3.1 Active Learning Approaches used to teach Agile

During the Developer Life course, some active learning approaches are used to teach the agile subject:

- *Problem*-Based *Learning*: Throughout the course, students learn to develop a system that solves four different problems. The first and second problems require the development of a game with specific requirements set by the professors. For the third project, students create a game and a website while defining their own requirements and story. Finally, students collaborate with an industry customer to develop a non-game system that addresses a specific problem. This project requires students to use both front-end and back-end knowledge to implement the system, with requirements and stories defined by the customer.
- *Scrum framework:* In the projects, they followed Scrum practices and ceremonies to manage development and teamwork. It is essential to highlight that it happens in the last two projects, where they work in pairs and groups. We recommend using these artifacts, but they are not considered for the evaluation. They still used the Scrum framework in the second semester to solve real problems. Then they are evaluated strictly considering the Scrum framework. The main objective is to introduce

the values, culture, and mindset of Agile methodology to the team to demonstrate the importance of project success. This will also enable them to understand the challenges of working together as a team to solve real-world problems, with regular meetings and direct interaction with the customer. The use of Agile methodology will help manage these challenges and contribute to the project's success. By emphasizing the Agile values of collaboration, communication, flexibility, and customer focus, the team can create a culture of transparency and continuous improvement, ultimately leading to a more efficient and effective project management process.

- *Academy and Software Industry connection*: During the semester, students have consistent and valuable interactions with industry professionals who share their experiences, challenges, advice, and the latest technology, methodology, and frameworks used in recent projects. In the first semester of 2022, students heard from three senior women in the technology market in Brazil and Canada, as well as two senior men in the Brazilian software industry, and a US-based Agile consultant. In the first semester of 2023, students had the opportunity to learn from an American Agile expert and a CIO leader from a bank company who visited the course. These interactions provide students with insights into real-world industry practices and help them prepare for successful careers in the field.
- *Hands-on activities*: The course is designed to be highly interactive and hands-on, providing students with ample opportunities to create, develop, and refine their skills. Most of the content is delivered through practical activities that enable students to engage with the material and apply it in a real-world context. This approach allows students to build their skills through trial and error, receive feedback from their peers and instructors, and refine their work based on that feedback. By emphasizing hands-on activities, the course aims to foster a dynamic and engaging learning environment that encourages students to explore their creativity, collaborate with their peers, and build their skills in a supportive and constructive setting.

3.4 The Soft Skills Approach

At the beginning of the course, students face several challenges as they adjust to new approaches to learning and navigate an unfamiliar environment with different rules and assessment methods. They also have the opportunity to interact with peers from diverse backgrounds and cultures, which can be both exciting and challenging. In addition, the course utilizes Agile methodologies, which place a greater emphasis on developing soft skills such as communication, collaboration, and adaptability. However, this can be particularly challenging due to varying levels of self-awareness and perception among students. Nonetheless, the course is designed to help students overcome these challenges by providing a supportive and inclusive learning environment, opportunities for peer-to-peer feedback and collaboration, and regular reflection and self-assessment exercises to help students build their self-awareness and soft skills.

3.4.1 Active Learning Approaches used to teach Soft Skills

The students are invited to follow some approaches from the beginning of the course, including:

- *One*-minute *talk:* Give a one-minute talk to the class about any subject they are comfortable discussing. The idea is to understand the level of safety they must discuss in public and the difficulty they must have in communicating their ideas. In the 2022 semester, we started with this initiative, but since not all the students wanted to be exposed in front of the others, this semester, we kept this talk but also created a new hands-on activity. We called this new activity, Agile Judgment.
- *The Agile Judgment:* Similar to the law judgment, in this activity involves several roles including the judge, witnesses for the defense and prosecution, the defendant and the accuser, defense and prosecution lawyers, and the jury. The primary goal of this activity is to provide every student with an

opportunity to develop and practice their communication skills. Those who feel comfortable speaking, negotiating, and presenting their ideas under pressure can opt for more challenging roles, while those who are less confident can choose more low-key roles to explore their communication abilities. During the first edition of this activity, two cases were discussed and judged.

- *Non*-violent *communication:* The professor delivers lectures on violent and non-violent communication examples, after which the students discuss and practice using non-violent patterns in their daily routines. This was implemented in the first semester of 2022. In the current semester, the course is experimenting with involving other professors and coaches (Figure 1) who conducted more than two workshops on this subject to support and enhanced the students' learning experience.
- *Happiness:* This class was inspired by the most popular Harvard class on Positive Psychology. In the first edition of this class, all hands-on activities were conducted in the classroom environment. However, in the second edition, we took the class to a green park in Sao Paulo called Ibirapuera Park (Figure 1). The main objective of the class is to motivate students to reflect on emotional intelligence and health, as well as to encourage them to practice some simple daily activities to improve their mental health. To achieve this, students participate in guided yoga, practice *ho'oponopono* and gratitude, and engage in mindfulness activities, such as observing the natural environment and listening to the sounds of nature. At the end of the practice, students choose a person who has had the most significant impact on their lives, write a post explaining why this person has influenced them the most, and share what they want to say to that person. Inspired by another scientific study(This study: https://www.youtube.com/watch?v=oHv6vTKD6lg), students are then invited to call that person and read their post to them.
- *Leadership skills and types*: Another important topic covered in the course is leadership skills and types, which is connected to the agile leadership style, such as servant leadership. The professor introduces and explains these concepts, providing relevant examples for students to understand. Following this, students are encouraged to debate this topic, allowing them to share their perspectives and ideas while learning from their peers. This learning approach helps reinforce the concepts and principles of agile leadership and develop students' critical thinking and communication skills.
- *ESG and ODS*: To align with our goal of developing future leaders who can contribute to a better world, we introduce and initiate discussions on the topics of ESG and ODS. As part of this module, students are tasked with researching and analyzing a company that promotes and applies actions connected to the ODS and/or ESG concepts. They identify the company, pinpoint which ODS or ESG items are related, and examine the actions taken by the company, delving into the reasons behind their approach. Through this exercise, we aim to develop critical thinking skills and an understanding of the importance of sustainable and responsible business practices.
- *Pitch Training:* At the end of the semester, students undergo training to prepare and deliver a well-crafted speech and presentation of their final project to the customer. This training focuses on enhancing their communication skills and ensuring that they can effectively communicate the key aspects and benefits of their project to the customer. The training also emphasizes the importance of delivering a polished and professional presentation, with clear and concise messaging that effectively conveys the project's value proposition.

Figure 1. The happiness class.

Figure 2. The Agile Judgement.

4 Outcomes and Teaching Perception

The students faced coding, team management, and organization challenges in the first two projects. Communication, code repository management, and conflicts were intensified in the third project. They realized the need for an effective approach and sought help to use the Scrum framework. They used a preliminary version of Scrum, including the board, prioritization, and Sprint planning. They followed a similar process in the next semester despite class size increase. Despite initial resistance, they saw the benefits of an organized and efficient approach to teamwork. Though the 2023 cohort was larger, similar problems and dynamics were observed.

The students' close and constant *connection with the industry* is a source of motivation for them, as they are inspired to face challenges and aspire to future positions in the industry. Each time a professional from the industry gives a talk, the students spend the entire week discussing the ideas, seeking advice, and reflecting on what they have learned. Many students even go the extra mile by sending a message and their curriculum vitae to the professional to analyse their suitability for the industry. The high number of questions during these talks is a clear indicator of the students' appreciation, often resulting in discussions that exceed the expected duration of one hour and last for more than two hours. The engagement of the students is remarkable, as they seek to learn from experienced professionals and gain insights into the real-world challenges they will face in their careers.

About the *happiness class*, one student shared their positive feedback, saying, "This class surprised me. Thank you so much." The happiness class provided a space for students to connect with themselves in a light and relaxed environment. This experience carried over into other classes, as students referenced the discussions and reflections from the happiness class in their other course activities. For example, a student says, "Professor, as you mentioned in the happiness class, I'm struggling with this problem and can't seem to find a solution. Maybe I need to take a break." This indicates that the content from the happiness class was relevant and applicable to their daily lives.

Regarding *non-violent communication*, it's great that the students are incorporating it into their interactions with each other. They started using it in a lighter tone, making jokes like: "I do not like your communication, colleague, I think this language is violent..." and as the weeks went by, being more emphatic and pointing out and suggesting better forms of communication when a colleague was upset or used an inappropriate term.

Concerning *one-minute talks*, over time, students did not want to make these presentations since it was voluntary and not mandatory, and the perception collected with conversations about the lack of interest in this action was that as it was not worth a grade, so they did not see many reasons to perform them.

Using *ESG and ODS* concepts to analyse a company that follows specific practices and programs in this area, students often face doubts and questions about which specific actions correspond to each goal and for what reasons. However, some students have shown enthusiasm towards initiatives related to gender issues, environmental sustainability, and animal welfare that are aligned with these concepts.

The *pitch* practice sessions proved to be highly beneficial in preparing the students for their final presentation to the customer, who was a partner from the industry. As the presentation was a crucial aspect of the course, the students devoted a significant amount of time to practicing and utilizing the guide provided in class. Despite feeling nervous, they felt more confident and well-equipped to deliver a compelling pitch, thanks to the practice sessions.

About the *agile judgment* (Figure 2), the students were more motivated after participating in the activity. During a brief discussion at the end of the practice, they expressed a desire to have another edition and judge more cases, allowing more students to develop their roles and have more opportunities to speak. They were super excited after seeing the first judgment case and the iterations during the trial were intense and constant. The students also suggested that future cases should be more detailed, which would allow them to bring and organize more elements to foster the debate.

At the end of the first semester in 2022, we conducted a questionnaire to evaluate the course in general, and the students expressed that they developed their ability to learn how to learn, *"The way in which the content was presented encouraged research and Insper's mode of learning how to learn."*.

When asked whether the dynamics on emotional intelligence and mindfulness contributed to their formation, 17 out of 26 students agreed or completely agreed.

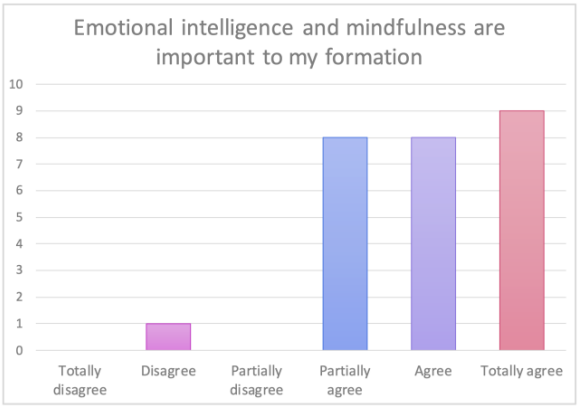

Figure 3. The impact of emotional intelligence and mindfulness on their knowledge

They also emphasized that the hands-on activities and course format helped them to learn. One student said, "Regarding the course format, I loved it. I had never experienced a hands-on teaching mode, and it really helped me to learn." They found the course provided a great real-life experience, with one student stating,

"The Devlife discipline provided an excellent experience of a developer's life," and another student expressing that it was intense and productive learning, "Intense and productive learning. The format is more like professional life, allowing for autonomous learning and enough freedom.".

They also highlighted the benefits of the final project, where they had a customer from the industry, stating that it was an "Experience close to reality" and an opportunity to "Experience what it's like to deliver a project in the job market". They described the positive impact on teamwork and agile methods, saying that "It helped to have a better idea about working in a group and it helped in terms of organization with the scrum board". They mentioned that working with a real client helped to motivate the team and increased their maturity level, with one student saying, "When carrying out the project for a client, I felt much more mature." Another student added that it was a "real work experience that forced them to learn quickly and efficiently," while another described it as an "innovative" project. Also, 19 students completely agreed, 6 agreed, and one partially agreed that the last project contributed to their knowledge, as shown in Figure 4. Similarly, when asked if interacting with a real customer enabled better learning, the students gave the same answer, as shown in the same figure.

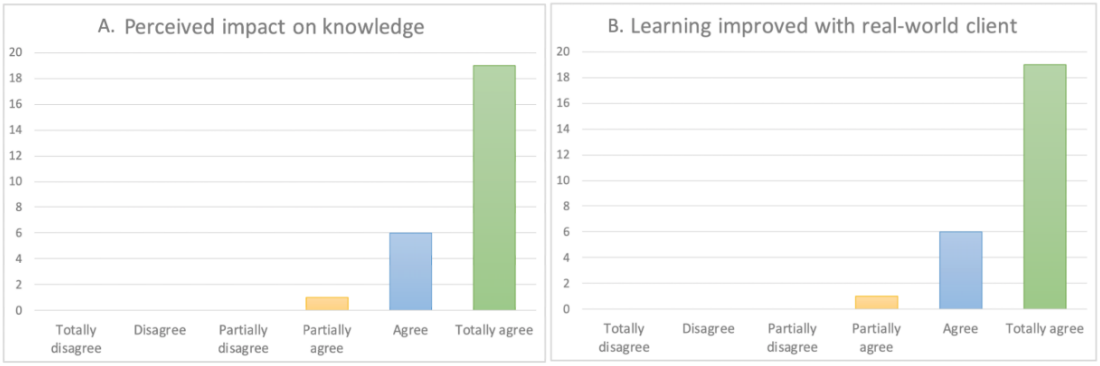

Figure 4. Perception by the students of the project's impact on their knowledge (a) and whether having a real customer enhanced their learning (b)

According to the professor perception, there is a significant impact on the students from these practices, in questionnaire that was made to evaluate the whole developer life course, they said: "Emulation of situations very similar to real work…", and "content with practical value. Interesting to learn. They complement each other and the logic of one helps others.", as the topics covered in the sessions continue to appear in other classes over time. These preliminary results provide support for the professor's perceptions and suggest that the students not only retained their learning, but also found value in the practices and enjoyed them. Furthermore, the results indicate that the students are capable of applying what they learned in different contexts.

5 Conclusion

To summarize, creating contemporary teaching methods that meet the needs and expectations of both new generations and the job market is increasingly challenging. Active learning approaches that encourage hands-on activities have shown promise for developing future professionals. In this paper, we describe some of the approaches we are testing in a computer science course during the first semester in 2022 and 2023. The first impression is that this activity is more attractive for the students and well regarded by the industry. In contrast to Dori's (2007) findings that students are resistant to a new learning approach, our perception is that when we offer classes following the traditional way [y of thinking, students complain about having fewer classes using active learning approaches. This report outlines our preliminary results with the approaches used and our perceptions of the results obtained.

In future work, we aim to collect evidence through questionnaires to gain a deeper understanding of the impacts on student training. Additionally, we plan to replicate this assessment to understand how the approaches evolve over time and across different generations and their potential effects.

6 Acknowledgement.

We want to express our sincere gratitude to all the students who participated in the course and contributed to its success. We also extend our appreciation to our colleagues in the field who face these challenges daily.

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