Enabling Computer Science Students to Choose Their Own Adventure in a Mandatory and Curricular Challenge-Based Learning Course

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***Abstract*—This research-to-practice full paper describes the results we got from enabling students to fine-tune their own learning experience in a Challenge-Based Learning (CBL) course. Engineering educators have been working for several years on how best to integrate CBL into computing courses, recognizing CBL's role in fostering crucial skills such as critical thinking and problem-solving. At FIE 2023, we proposed a possible scaffold named "Choose Your Own Adventure in Challenge-Based Learning" (*CYOA*-CBL) that aimed to make CBL more adaptable and empower the students to personalise their experience, positioning themselves in a spectrum ranging from a more open and creative approach to a more structured and guided CBL experience. During the past academic year, we implemented *CYOA*-CBL in a mandatory four-month course at a medium-sized European university. With this work, we present the results we got from a qualitative study where we used mixed methods of data collection to evaluate *CYOA*-CBL and verify whether students understood the course process. In this paper, we discuss how students tended to adopt both open and structured approach and they appreciated the flexible nature of the course, leveraging the opportunity to change their path during the process to adapt it to their challenges. Students also valued the recurring structure of *CYOA*-CBL mentoring and tutorials and they had a general good understanding of the "next steps" to perform. At the same time, they highlighted the need to improve the tutorials, even if in a controversial way.**

***Index Terms*—Challenge-Based Learning, innovation and entrepreneurship, active learning, computing education, mixed methods**

I. Introduction

Challenge-based learning (CBL) has gained popularity in recent years, particularly in the STEM fields and computing [1]. This rise in popularity can be attributed to the skills that CBL has been suggested to develop in students [2]. Indeed, CBL stimulates in students skills such as critical thinking, problem-solving, and teamwork, qualities that are now highly requested [3].

CBL, however, is still in an emerging phase and therefore is not yet an established practice. Some aspects of CBL, such as guidelines on how it should be implemented, still need to be developed [4], and further research is needed to establish new approaches to make CBL more adaptable to various learning contexts. As well explained by Perna et al. [5], one of the current challenges for CBL is to tackle the barriers that prevent its implementation in higher education institutions. There is indeed a need to make this methodology more widely available, and develop an approach to CBL that accommodates various needs, ranging from the variable number of students, courses being compulsory or not, level of student motivation, teacher expertise, available resources, and more.

During FIE 2023, we presented a scaffold named "Choose Your Own Adventure in Challenge-Based Learning" (*CYOA*-CBL) that aim to make CBL more adaptable to a broader range of contexts, such as those described above, by empowering students to self-tune their own learning path.

CYOA-CBL divides a CBL course in six phases and for each phase, teachers prepare several packages of teaching materials and exercises. The sequence of the six pairings between phases and specific content students used in each phase is called a "path". Students can follow a predefined path proposed by the teacher and have a more structured experience or switch between different paths on a phase-by-phase basis and have a more open experience.

In fall 2023, we decided to adopt and test *CYOA*-CBL in one of our curricular and mandatory courses: with this work, we want to present some reflections on the implementation of this new approach based on data gathered from surveys and interviews. By sharing our experiences, insights, and points of improvement, we seek to contribute to the ongoing research on CBL in computing education, going towards making CBL deployable in a greater variety of learning environments.

This article will proceed in the following way: Section II will open by outlining *CYOA*-CBL's theoretical basis, positioning it in the literature and discussing its implications for the practice of computing education; Section III will go more in depth on our proposal, describing the pedagogical context where we implemented *CYOA*-CBL; Section IV will present the methods used and the sampling of this study; Section V will presents and discusses the data gathered; lastly, Section VI will provide some points of reflection on our successes, failures, potential improvements and future work.

II. Background

In computing education, teachers are adapting to fast-sweeping digital transformation by exploring new teaching methods. The widespread availability of information and the ease of accessing it, have led to the question of whether traditional teaching methods are still adequate or if it is necessary to adapt them to the new era [6]. Some authors now consider traditional teaching to be ineffective [1], viewing education not merely as "acquiring knowledge" but more as "critically evaluating knowledge", which aligns with the perspectives in [6].

For this reason, in recent years, new teaching methodologies have gained popularity, particularly the so-called active learning approaches. A particular case is that of methods such as Project-Based Learning (PjBL), Problem-Based Learning (PbBL), Team-Based Learning (TBL), Case-Based Learning (CsBL), and Challenge-Based Learning (CBL), which have been grouped as a single family of methods called X-Based Learning (XBL) [7]. These methodologies have been proven to foster essential skills in students, such as collaboration and creative thinking, which align with the competencies sought by employers today [8], [9]. They also align with the requirements of computing curricula, which typically focus on student employability and post-university life [10].

As discussed by Sukacke et al. [2], while XBL approaches share many common features, CBL seems to be the most advanced and an evolution of the previous ones. Nichols and Cator proposed the initial definition of CBL, describing it as "a [...] multidisciplinary approach [...] that encourages students to [...] solve real-world problems. [CBL] is collaborative and hands-on, asking students to work with peers, teachers, and experts [...] to ask good questions, develop deeper subject area knowledge, accept and solve challenges, take action, and share their experience" [1]. The open-ended nature of CBL challenges, provided by external stakeholders, allows learners to be more independent in setting their own goals [11], [12].

Since 2017, research on CBL has increased across various academic disciplines, with a notable focus on higher education in engineering. CBL is frequently used in engineering education [13], as it develops skills for the development of new engineers in a rapidly changing world. These skills include working in multidisciplinary teams, effective communication, conflict resolution, resource management, entrepreneurship, and problem-solving [2], [13]. As such, CBL appears to be well-suited for teaching non-technical courses in computing curricula, particularly those involving innovation skills [10].

While CBL is positioning itself as a teaching and learning approach that responds to the evolving educational landscape, Leijon et al. [13] and Perna et al. [5] alike highlight that there is a need for additional longitudinal and rigorous research across the spectrum. The same sources also point out that many institutions still face substantial troubles in deploying CBL, as the research in this area is still limited and not well-established. The literature also highlights several obstacles to the adoption of CBL, including uncertainty and resistance to change, curriculum alignment, limited time, workload distribution, interdisciplinary perspectives, and ensuring external stakeholder involvement [5].

At FIE 2022, Bombaerts and colleagues hinted at a tension between what they called "structured" and "open" CBL [14]. In the article, the authors defined *structured* CBL as a context where "[the] university [defines] what the important aspects are that have to be learned", and *open* CBL as one where "students [decide] for themselves how much or how little [content the course] should entail". The authors also discuss some trade-offs that ensue from both approaches: structured approaches are easier to assess, more comfortable, and favour depth; open approaches are more demanding, better reflect the wicked nature of challenges, and are more creative.

Last year, still at FIE, we proposed *CYOA*-CBL, a scaffold that aimed to overcome this tension. In our previous article, we outlined a teaching model that can flexibly cater to students with different preferences by reframing the structured/open trade-off from a problem of course design to a student choice [15]. *CYOA*-CBL structures the course in a sequence of "phases", and defines alternative "paths" that students can take. Students have several alternatives to tackle each phase, representing alternative ways to explore solutions to challenges, and may opt to follow a pre-defined path (a structured approach), create their own path and leverage their own knowledge (an open approach), or adopt an in-between solution.

With *CYOA*-CBL, the aim is to redefine Bombaerts' structured/open trade-off as a spectrum rather than as a duality. The goal is also to address the matter of enabling universities to more easily adopt CBL by designing courses with a replicable yet flexible structure.

III. Research goals and pedagogical context

CYOA-CBL divides a CBL course in various phases and steps. While in our previous article we presented the theoretical grounding of the method, *CYOA*-CBL still needed to be tested in practice. We implemented *CYOA*-CBL during fall 2023, in a mandatory four-month (September-December) course at our medium-sized European university. The aim was not only to determine *CYOA*-CBL's feasibility, but also to verify whether students understood the new course process. Indeed, *CYOA*-CBL was initially designed to address the challenges associated with the heterogeneous student population in the same CBL course, as detailed in Section II. This study explores whether students seized the opportunity to customize and personalize their course experience according to their needs and challenges by autonomously “choosing their own adventure”.

To do so, we adopted *CYOA*-CBL in a course called “Innovation and Entrepreneurship Studies” (I&E Studies) at the University of Trento. This is a 6-ECTS mandatory curricular course designed for second-year Master’s students in Computer Science (CS) who are following a curriculum that integrates CS with Innovation and Entrepreneurship (I&E). For the purpose of this study, the course involved 54 second-year CS students and it served as the final course of their “minor in I&E” in their Master’s programme. Half of the class was from a double degree program called *EIT Digital Master School*[1], which combines digital competencies with practical skills in I&E, while the others were students from a degree in ICT Innovation, or Erasmus students.

The course in which we deployed *CYOA*-CBL uses CBL since 2018, dividing students into teams and asking them to address a challenge proposed by an external stakeholder. During the course, teams must identify and address the challenge within the context of their assigned case, such as considering alternative business models for a technological startup or analyzing go-to-market scenarios for the launch of a digital product. Students are required to ground their reflections by exploring specific areas like the business environment, competition, suppliers, partners, environmental and sustainability issues, etc., using both deductive methods (i.e., through desk research) and inductive methods (i.e., through field work) as appropriate. This approach allows them to apply knowledge gained throughout their academic careers, particularly concepts related to I&E, to real-world problems.

In this edition of the course, students were divided into 12 teams of 4-5 members each, assigned to challenges presented by 7 external entities, mostly start-ups.

Following our previous article [15], we divided the course in six phases, as described in Fig. 1. In each phase, we organized two main activities: a tutorial and a mentoring session. The tutorial took place first and consisted of a regular two-hour class slot. During these sessions, teachers explained the main concept of the phase and proposed to the students small exercises to help them address the phase, that could be started in class, and continued at home. The week after each tutorial, teams attended mentoring sessions of 30 minutes, where the student team met with a pair of teachers. During mentorings, the team presented their work to the teachers, and students had the opportunity to discuss any issues, receive feedback, and reflect on their progress. The mentoring sessions were guided by “mentoring worksheets”, which served as both a checklist for students to ensure they had fulfilled all requirements for the phase, and as an assessment tool. Worksheets contained guiding questions such as “Have you completed the suggested exercise for this phase?” or “Have you written a short meeting agenda with new content questions for the Challenge Provider?” and were common to all groups.

[1] https://masterschool.eitdigital.eu/

The course started, in phase 1, with a case presentation session, during which the Challenge Providers (CPs) described their challenges to the students, shortly followed by a class where students formed teams and bid on what challenges they wanted to work, while ensuring that each challenge had at least one team assigned to it.

The course closed at the end of January, when each team prepared a 10-minute presentation of their solution proposal and submitted a final report detailing their work. For the report, we provided a template with suggested sections, but students were encouraged to modify the report’s structure to align with the work they actually performed during the course.

IV. Methods

This article presents results we acquired from a qualitative study where we used mixed methods of data collection to evaluate *CYOA*-CBL. This study is characterized by the collection and analysis of survey data, followed by the collection and analysis of interviews [16] (see Fig. 2). The structure of the study follows a sequential explanatory design, aiming to use the interview data to provide a deeper understanding and explanation of the surveys’ findings.

This design consists of two distinct phases, similar to the approach used by Doulougeri et al. in a study on factors influencing students’ experience with CBL [17]:

1) an anonymous *group-based phase survey* delivered at the end of each phase of the course, providing a general understanding of students’ comprehension of the process;
2) in-depth *semi-structured interviews* to further refine and explain the results by delving into students’ views in more depth [16], [17].

In addition to this, we added an anonymous *individual survey at the end of the course* to gather general impressions on the course and validate the results that we had from the phase surveys.

The logic of phase surveys follows the approach of [18] to evaluate a framework for a CBL course. Their primary objective was to gather reflections on what students learned or struggled with, assess the effectiveness of tutorials and mentoring sessions, and determine which path they followed.

The sample population for phase surveys included the total number of teams in the class (this year, 12 groups) and the survey was filled as a group (teams decided one group member to complete this for everyone) at the end of each single phase, resulting in a total of 6 surveys for each of the 12 teams. The survey consisted of closed questions on a 5-point Likert scale ranging from strongly disagree to strongly agree, along with short open-ended questions. The open-ended questions used the following prompts:

- In one word, what did you learn the most during this phase (tutorial and mentoring)?
- In one word, what did you struggle the most with during this phase (tutorial and mentoring)?
- In one word, what would you have done differently in the tutorial/mentoring for this phase?

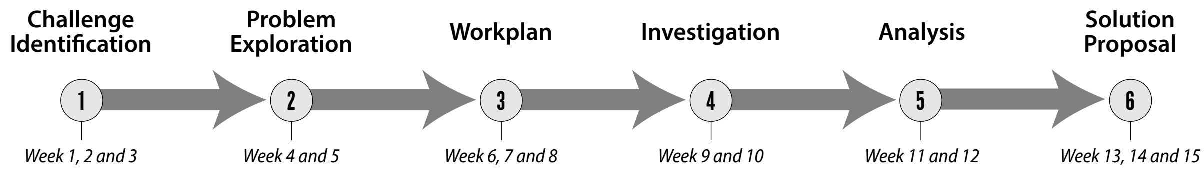

Fig. 1: The division of the course in its six phases, marking what course weeks corresponded to each phase.

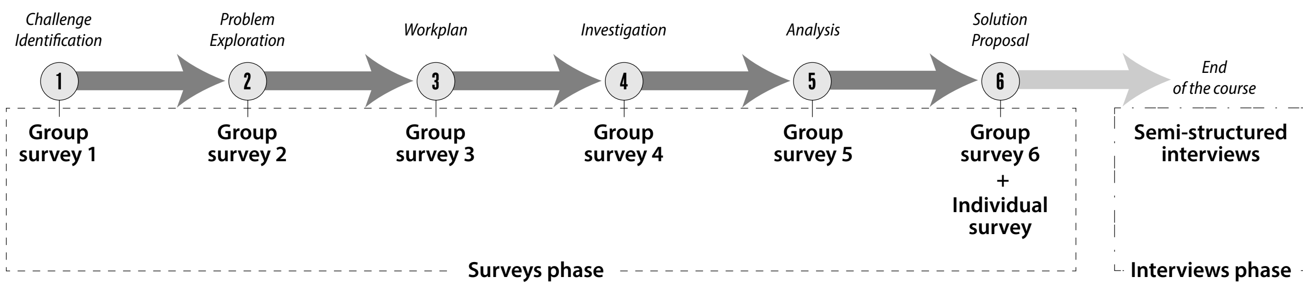

Fig. 2: Mixed methods of data collection.

The questions were designed based on [19] and adjusted to fit the context of this research.

The second survey was given to all students at the conclusion of the course, with each student completing it individually. We received 19 answers out of 54 students, putting response rate at around 35%. The aim of this survey was to assess different course components in a 5-point Likert scale, similar to the previous one, ranging from strongly disagree to strongly agree.

The semi-structured interviews were conducted at the end of the course with a subset of students who voluntarily agree to participate in this study. These interviews were organised after the evaluation process and exam to avoid conflicts of interest. Students did not receive any course credit or any incentive for consenting to data collection, and they did not have any penalty for declining to participate in the study.

We conducted a total of nine interviews, using judgmental sampling as the process of selecting the student population. We chose this sampling technique to remain within a reasonable time constraint while ensuring that we reached a diverse population of students [20]. Interviewing all students in the course would have been not feasible, and random selection might have resulted in clustering of students with similar profiles or, for example, students from the same team. Therefore, we chose to select participants ourselves to ensure a diverse sample based on the following criteria:

- gender;
- course track;
- origin county;
- grade obtained in the course;
- experience during the course (online or in presence or hybrid);
- assigned mentor;

We opted to use these criteria to attain a comprehensive representation of the diverse types of students and their respective experiences encountered this year. While these criteria encompass only some of the factors distinguishing one student from another, they seemed appropriate at this stage for us to delve more deeply into the survey results, which we summarise in Table I.

Criteria	Factor	Students
Gender	Male	4
	Female	5
Course track	ICT innovation	4
	Data Science	2
	HCID	1
	Fintech	1
	Business (Erasmus)	1
Origin country	Italy	4
	Other EU country	4
	Non-EU	1
Grade	$>$ 25/30	7
	$\leq$ 25/30	2
Attendance mode	Fully onsite	6
	Fully online	9
	Hybrid	2
Mentor	Mentor 1	6
	Mentor 2	2

TABLE I: Interview sampling.

Participants were encouraged to discuss their experiences with the course and the *CYOA*-CBL methodology overall. We asked about their challenges throughout the course, how they worked and structured their process and their thoughts on the various activities within the course. Each interview lasted approximately 30 minutes and was conducted in either English or Italian to ensure the students felt comfortable with their native language when possible. Interviews conducted in a language other than English were carefully translated by us without altering meanings or phrases.

In this study, we used the data obtained from interviews to better contextualise the data collected through the surveys. We conducted a thematic analysis of the interviews, identifying recurring themes based on the responses obtained from the surveys, and establishing connections between the data from the two phases [21].

Data source	**Data type**	**Coverage**
Phase surveys	group survey	6 surveys per 12 teams
Final survey	individual survey	19 out of 54
Post-course interviews	individual interviews	9 out of 54

TABLE II: Data source, type and coverage.

A. Limitations

This study is subject to the context in which it has been developed. The results obtained could be influenced by the type of course, students curricula, and the university context. More tests of the *CYOA*-CBL approach need to be done in order to have a proper understanding of the possible limitations and problems with this new structure.

The results obtained from the final survey are limited to 19 out of 54 students involved in the course. This means that the answers may only partially represent the students' opinions and understanding about the course. We recognise that the study's sample size is not large enough to generalize the results to a broader population.

The results obtained from a study using the judgment sampling method are subject to bias. Samples are selected based on an expert's ability to choose suitable participants, and biases are typically significant factors to consider. The limitations of this method restrict the types of statistical analyses that can be performed with the data [22]. However, in our case, we did not intend to conduct statistical analyses on the responses obtained from the interviews. Instead, the interviews served to confirm (or not) and delve deeper into the responses gathered from previous surveys.

V. Results and discussion

Our multiple sources of data let us gather insights in several different design elements of the *CYOA*-CBL method, that we now illustrate.

A. On teams taking structured or open approaches

In each phase's survey, we asked students what path they were following. By combining the responses of the teams for each phase, we have seen how some groups followed a clear linear process where they stuck with the same path (which we take as a proxy of the students following a *structured* approach), while others changed direction and paths more frequently (which we take as students opting for an *open* approach).

Three out of twelve teams adopted a structured approach, while the others opted for an open or in-between approach. For instance, Team 5 started its work with a business-oriented path but later changed direction to a technological analysis, whereas Team 11 started with a market analysis/scenario collection and concluded the project with a communication strategy. All in all, three teams never changed paths; six teams changed paths once; two teams changed paths twice, and one team changed paths three times. Notably, even the teams that changed paths multiple times never did so in two consecutive phases.

The inclination for either an open or structured approach was confirmed in the interviews. For example, the surveys showed that Student 3's team followed an open approach: while initially they described their path as "market analysis", they changed it to "business modelling" in phase 5, and later changed it again to "collection of scenarios" in phase 6. This was confirmed by the interview: "we stuck to the same [path], but we had some variation towards the end when we found more relevant data.".

Instead, Student 7's team had a structured approach to the process, following a "market analysis" path throughout the entire course. In the interview, Student 7 highlighted how, though the team consistently followed a path, they felt free to choose what their path was to begin with: "We stuck [to the same path] from the beginning [but] I was surprised by the fact that we didn't really have to do a business model during the course. [The course] was more open [...] we weren't expecting to have [the possibility of doing a marketing strategy].". In spite of this, Student 7 stated that it was clear during the whole course that they were free to change paths.

In all interviews, students clearly understood that they could, at any time, change path. Student 3 confirmed that his group "felt quite free", and that "it's more like what the expectations that we had as a team more than what the professor or the course had upon us.".

Student 1 explained how they changed path more than once during the process. In the beginning, the team narrowed down two options, and chose one of the two. However, after collecting some field data, the team understood it was not the right decision, and shifted to the other option: "Let's say, perhaps our mistake was assuming that was the right way to go.". After they realised this, in the 5 phase, the students changed their path and followed it until the end.

B. On changing directions, and the overarching CYOA-CBL structure

The possibility of choosing directions was appreciated by the students even if, as Bombaerts et al. said in their study, an open approach gives student a more demanding experience from a creativity point of view [14]. Echoing these feelings, Student 4 said: "[...] you could spend time on the things you want. [...] And of course, that needs creativity. So it was nice to brainstorm and be a bit more creative instead of like just study from the books. So I really like that about the course.".

At the same time, students realised that the course's overall curated structured helped them make sense of what was expected of them. Student 9 said: "I admit that having the structure like that certainly helped a bit because you had the stakes marked, so you weren't too free to get lost who knows where.". Student 8 also said: "If we had been freer, there would have been the real risk of taking a direction very far from what you actually want, and the risk of digressing. But if it had been more detailed, they would have left us little space to do what we wanted. [The proposed structure] was a good compromise.".

We summarised in Figure 3 the number of teams that chose a specific path during the various phases. Most of the teams followed a "business modelling" or "market analysis" path though, by looking at final reports, we can see that teams on the same path used different tools during the same phases to complete their work. For example, when performing a market analysis, one team used a combination of strategic interviews and surveys while another relied on desk research looking for example about market size and market dynamics. We take this as a confirmation of the fact that teams understood that they could tune paths to adapt them to their challenges. Student 8 said: "Even in the final report, we indeed added sections and removed some that did not fit our work. So we always adapted, trying to follow the instructions well or poorly, but we adapted to our case.".

In the final survey, 73% of students rated their understanding of the process and "next steps" as 4 or 5 in a 5-point Likert scale. Indeed, during the interview, Student 3 said: "It was actually the first time that I've ever done a course fully digital [...] you have to take a lot of responsibility yourself. And you have really have to plan it in a structure, how you're doing it. [...] But I think the instructions were very clear.". Student 8 reinforced this: "We followed exactly the worksheet that was provided to us and then adapted it to what we had done, but yes, there were never any major doubts about that.".

In the final survey, students indicated the recurring structure of mentoring and tutorials, along with the flexible nature of the course, as strengths that satisfied them. One student wrote: "The main strength is the flexibility and dynamic nature of the course structure.". Someone else added: "The course was conducted in a structured way since the beginning; [however] it really felt like we own the course and there was a sense of extra responsibility.". This positive assessment was then also mentioned during the interviews. Student 5 explained how the mentoring sessions conducted every two weeks helped the group to work "each and every week" because they had to "inform you [the mentors] about what we developed and what we decided to do". This student also explained that with other courses, they could do all the work in the last weeks of the course, whereas with such a course utilizing mentoring sessions, they had to work throughout the entire course period, which helped them maintain high motivation.

This constant work on the challenge helped the students feel less pressure about the final delivery. Student 5 said: "I didn't feel that much pressure [...] because when you are working every week, and you have a work progress in line, then you don't feel too much pressure all of a sudden.". Student 1 added: "I wouldn't say there was pressure because we also had quite involved company mentors who were always there to support us and offer advice. Plus, we could delve into the challenge at our own pace throughout the whole process.". Finally Student 8 explained: "We also completed all the optional tasks [proposed by the mentoring worksheets] to stay ahead. Indeed, they proved to be very useful for the final report.".

C. *On tutorials, a controversial activity*

From the survey we could gathered some points of improvements. 57% of the students rated the effectiveness of the tutorials in helping tackle the group project as 3 or less in a 5-point Likert scale. Some of them, highlighted in the survey the need to improve the tutorials, suggesting that tutorials should be used to teach specific new knowledge which, as of this year's implementation, was instead taught through supporting material.

We tried to investigate more this issue during the interviews process and we noticed that there are some controversial opinions about the tutorial sessions. For example, Student 5 said: "we had really good conversations during the tutorials. So I think tutorials are the best part of the course, where we can share [our ideas] with our group mates.". Students 6 said: "what I like about the tutorials were that we had some activities to do by group and that was actually the part that I liked the most during the I&E studies.". From the interviews we could understand how tutorials can be used from less motivated groups as an activity to progress with their projects. However for more structured teams, these tutorial were less useful as observed by Student 8 who said: "I didn't fully understand the point of working in class [during tutorials] because then we always did it again at home in a more thorough way. For our group, doing the in-class part wasn't particularly useful, especially because if a member was absent, it was a disaster. [...] For me, they should be more frontal lessons.". Another example was Student 9 who said: "[tutorials] led us to do group work right there during the classes, and it helped us a lot" even if in the end "they were less useful because we found ourselves ahead with the work" but "on one hand it was better this way rather than being too repetitive with already covered theory.". From the interviews, we could say that three students out of nine interviewees would keep the tutorials as they are, while the others would change them, adding more theory and traditional lessons to the course. These different opinions could be explained not only by the different intrinsic motivation of the students but maybe also by the different challenges. Student 4 stated: "I would give it more content [but] I think it's very difficult [to decide] because every group has their own challenge, their own work and their own timeline.".

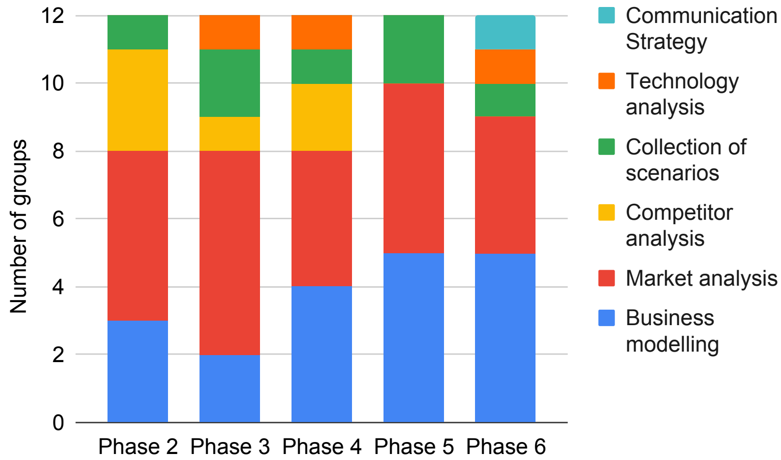

Fig. 3: Groups and paths.

VI. Conclusions and Future Work

In this contribution, we presented the results obtained from a CBL course employing our previously proposed *CYOA*-CBL approach, with a focus on analyzing reflections on the students' experiences.

As we discussed in Section II, the literature previously highlighted CBL's potential in fostering professional skills development in students, though literature also emphasized the challenges inherent in CBL from the perspective of staff and students alike [14]. As CBL exposes students to real challenges and the ambiguity of real-life, students need to have a positive experience throughout the course, allowing them the freedom to explore the challenges while also providing necessary support and guidance when needed [23].

The educational environment in the engineering fields is shifting more than ever from traditional educational towards student-centred approaches to enhance the students' learning experience [3], [24]. Thanks to *CYOA*-CBL, in this course, we observed how students could define their own experiences and processes, personalizing their course and approaching challenges from angles closer to their interests.

In our research, students stated that *CYOA*-CBL provided them with the freedom to be creative while maintaining a structure to avoid losing direction and becoming overwhelmed by the complexity of the challenges. With this preliminary study, we received a first hint on how *CYOA*-CBL may foster an empowering learning environment, offering appropriate teaching and support processes where individuals can personalize their experiences to match their needs and objectives. We also observed how students differ from one another. During this experience, we saw a balance between teams of students who favored a structured approach and those who adopted a more open-ended one. This diversity is also evident in the students' final reports, where the teams decided to change the structure of their reports to fit their chosen approach, leveraging the self-tuning possibilities embedded in our methodology.

Thanks to this study, we also gained insights on what can be improved in *CYOA*-CBL. We learned, contrary to our initial expectations, that structured tutorial sessions and in-class moments are valued by the students. Once again, the diverse needs of the students should be considered when designing course content and activities: in-class moments have proven to be relevant for students who require scheduled time to work with their teammates and engage in predefined activities or exercises. Moreover, more open and organized teams prefer additional content alongside these activities to further explore specific topics. In the upcoming iterations of the course, we aim to strike a balance to meet both legitimate requests from the students.

We plan to re-implement the course in the Fall 2024 semester, gather additional feedback from the students, and refine our process. Our aim is to change as little as possible compared to the implementation reported in this paper, while actively seeking to avoid the problems identified here, addressing critical aspects such as the content of the tutorials. We also hope to enhance this study by increasing the number of interviews conducted at the end of the course, while introducing an assessment phase for the teachers and staff involved in the course to also gather their prospective. We expect this change will give rise to its own challenges but, given the current research landscape where students' perspectives dominate the narrative of teaching and learning, we think gather the teachers' perspective is a much-needed addition.

Then, we propose a reflection about the possibility of integrating iterative student delivery in *CYOA*-CBL. Iterative delivery, where students gradually improve a draft of their final deliverable, and receive teacher feedback multiple times within a single course, is a common feature of many collaboration frameworks, particularly in engineering and computing education, for example with the Agile methodology [25]. We believe that incorporating this iterative characteristic could enhance the course's process, introducing a reflective phase and providing students with opportunities to refine their projects further.

In conclusion, through the insights gleaned from student feedback and interviews, we have gained valuable perspectives on tailoring educational experiences to meet diverse learning needs. While more research needs to be conducted in order to address the gaps still associated with CBL, we lean towards agreeing with Doulgeri et al., who suggest that CBL shows promising benefits when integrated at the course or curriculum level [4]. *CYOA*-CBL can be seen as one of these initiatives that aim to foster students' autonomy and empowerment, paving the way for further advancements in education.

VII. Acknowledgment

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