# Exploring Creativity and Learning through the Construction of (Non-Digital) Board Games in HCI Courses

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## ABSTRACT

Several non-technical skills – such as teamwork, verbal and written communication, time management, problem-solving, and critical thinking - are currently being highlighted in discussions about curriculum recommendations for the computing field. In the same way, methodological alternatives are discussed in order to support the development of these skills and engage students in the learning process. In this scenario, we report an experience carried out in three distinct Human-Computer Interaction (HCI) courses, in graduate and undergraduate programs, where the students created their own (non-digital) board games to explore specific HCI concepts. The experience involved 84 students. We observed student engagement during the proposed activities and their impressions of the impact of those activities on their learning process.

## CCS CONCEPTS

• Social and professional topics → Computing education
• Human-centered computing → HCI design and evaluation methods

## KEYWORDS

Human-Computer Interaction, board games, student engagement, computing students' skills

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## 1 INTRODUCTION

Teamwork, verbal and written communication, time management, problem-solving, and critical thinking are skills that are frequently highlighted when curriculum recommendations for the computing field are discussed [3][6][7][8][13]. Aiming to develop these skills, several alternatives to traditional classes have been proposed.

Problem and project-based learning, inverted classroom, peer instruction, games, and gamification, are some of those methodological alternatives. Common to all of them is the need for greater student engagement, moving from passive to active participation, allowing them to become the protagonists of the(ir) learning process [5][10].

Our focus here is on board games and the possibilities of using them in the teaching and learning process. In this context, we can find initiatives such as board games built specifically to teach a computing topic - e.g. the principles of quantum computing [14] - or to teach methods, like Kanban [4] or Scrum [1], among many others. In our case, the domain area is Human-Computer Interaction (HCI). Instead of describing the design process of a specific board game or describing the use of traditional or computing-related ones, we will describe an experience in which groups of students created (and used) their own (non-digital) board games to explore specific HCI concepts.

The activities we report here were carried out during the first semester of 2019, in three distinct HCI courses: one related to a Software Engineering undergraduate program, another related to an Information Systems undergraduate program, and a third one, related to a Computer Science graduate program. A total of 84 students participated. The results show student engagement, their satisfaction with the range of possibilities provided by the activities, and the associated learning gains.

To report the experience, the paper is organized as follows. In Section 2, we describe the method, the students involved, and details about the creation process and students' use of the games created. Section 3 brings the obtained results, presenting the students' impressions and discussing some lessons learned. In Section 4 we discuss some Related Works and in Section 5 our final considerations.

## 2 CREATING THE BOARD GAME

The following sections present the work method, the number of students in each course, and details about the creation process and about the "play".

### 2.1 Method

One of the topics discussed in all three courses is HCI Evaluation. To explore this topic in an alternative (and more creative and proactive) way, the students were invited to create their own board games, related to specific HCI Evaluation contents.

In each course, the activity was composed of three phases, as presented in Figure 1.

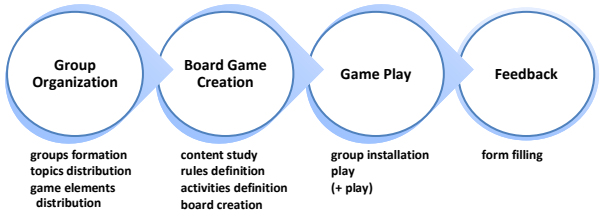


**Figure 1: Phases of the work method**

The steps followed in each phase were:

1. Group organization:
   - The class was divided into groups of 3 to 5 students;
   - A specific topic (HCI evaluation planning, Ethics in HCI Evaluation, Heuristic Evaluation, Usability Evaluation, and so on) and a set of class notes (slides) summarizing the topic was distributed to each group;
   - A set of (non-digital) game elements, including examples of paper boards, two dice, 5 game pieces (pawns), one spinner, and one hourglass (Figure 2) was distributed to each group.
2. Board game creation:
   - Students studied the content;
   - They defined game rules and instructions on how to play;
   - They defined game activities (challenges, questions, and answers, etc, all focused on exploring and learning the related content);
   - They created (or customized) the paper boards.
3. Gameplay:
   - Each group organized their game and related materials on a desk;
   - One student per group stayed at the desk and students from other groups came to play;
   - After a period of 10-15 minutes, students moved to another game station in order to explore all the games.
4. Feedback:
   - At the end of the activity, students were invited to fill in a feedback form.

Students had one class (about 1h30min) to accomplish Phases 1 and 2. If they could not finish their game in class, they had to do it at home before the following class, in which they performed Phase 3. Phase 4 was assigned to be done at home, after Phase 3.

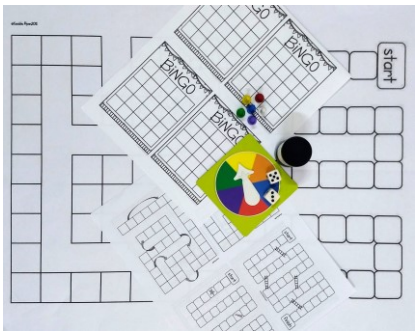


**Figure 2: Support material for game creation**

### 2.2 Participants

The board game creation activity was carried out in three HCI courses:

- one HCI introductory course in a Software Engineering (SE) undergraduate program (this program has two compulsory HCI courses);
- one HCI course in an Information Systems (IS) undergraduate program (this program has only one compulsory HCI course);
- one HCI course in a Computer Science (CS) graduate program (this program has two elective HCI courses: one related specifically to HCI evaluation and another related to Interaction Design - the course described here is the former).

Figure 3 shows the distribution of the 84 students that participated in the activity, according to their origin program: 47 from SE, 18 from IS, and 19 from CS. These numbers correspond to the total number of students enrolled in each discipline since the activity was done during class time.

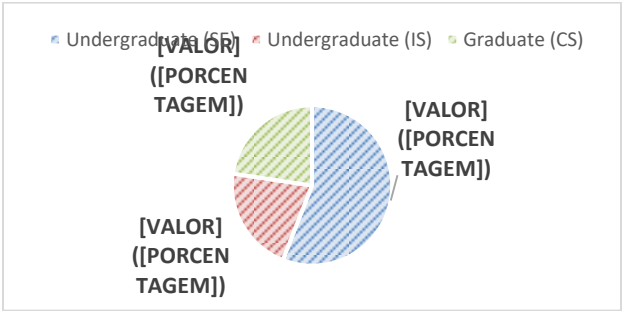


**Figure 3: Students per Course**

### 2.3 The Creation Process

The students were stimulated to bring HCI textbooks and/or their personal computers to help them find related materials. Some

groups brought those supplementary tools, but others (mainly the undergraduate students) relied only on the summary provided and on internet search on their smartphones.

Each group sat at a different desk. They used almost the entire allotted time (phases 1 and 2) to reach a decision about the kind of game they wanted to create and to determine the first few associated rules and instructions: the set of (non-digital) game elements provided to each group was used as inspiration for the choices made (Figure 4). Many of the activities related to the specific content of each topic were developed at home.

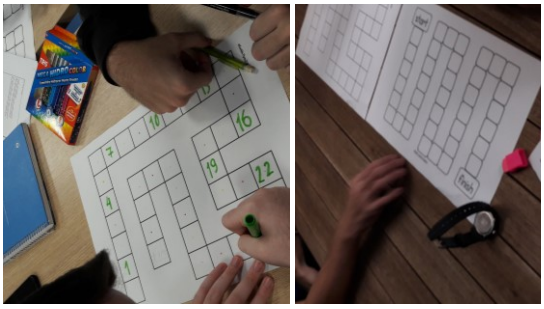

**Figure 4: Students during the creation process**

Most groups created board games based on the paper boards provided, in which players have to answer questions in order to move forward in the game. Some of them created elaborate cards with questions and answers, while others put together printed lists to help them make the questions. In addition to "traditional" roll-and-move games (inspired by the game elements provided), they created quizzes, cooperative games, card games, a "battle-royale-inspired" game, bingos, and a Role-Playing Game (RPG), with all the associated resources (examples of the games are presented in Figure 5).

**Figure 5: Examples of the games created**[1]

[1] Most board games and instructions are in Portuguese.

## 2.4 The "Play"

Phase 3 was "the play" time. The students had one class (about 1h30min) to explore their classmates' games (Figure 6).

**Figure 6: Students during the "play"**

They played in a "circuit": they had 10 to 15 minutes to play each game, and then had to move to next one. At each "move", the players at each desk changed and the game "moderator" also changed (a member of the group that created the game stayed at the game station to explain the rules, instructions and to moderate the play).

During this phase, we could observe the students' engagement with the activity. They were fully involved in each match: the moderators explained each rule and instigated the players; the players tried to do their best to answer correctly and progress in the game. We could also observe that the more interactive (or cooperative) the game was the more involvement and fun the participants had.

When the moderators were not fully aware of the rules and instructions for their game (to make the players move on or to give them feedback to their answers) the match was brought to a halt, upsetting the players. Some game mechanics had problems; those matches did not have an end or a possible win, which also annoyed some players (others had fun with the fact). On the other hand, we observed a few players that were not interested in learning and used a hit-and-miss approach to play.

In general, most games were well explored in the circuit; only the RPG took too long to be executed and the students could not explore it thoroughly.

## 3 RESULTS

At the end of the activity, the students were invited to fill in an online feedback form. The following sections present students' impressions of the activity based on their answers to the form and our reflection on the process in the form of lessons learned.

### 3.1 Students' Impressions

Although all students were invited to fill in the feedback form, only 39 did it (some reported that it was too long – too many questions – so they gave up halfway through). Figure 7 shows the participants distribution considering their courses.

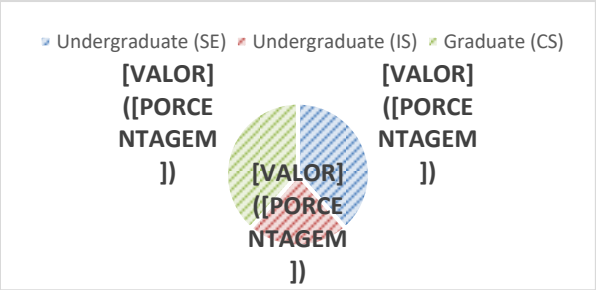


**Figure 7: Participants' (respondents) courses**

To support the content studied, the students received a set of class notes (slides) summarizing the topic they had to explore, and were asked to bring some extra material. Despite the fact that some brought books and almost all of them had internet access during the class, when questioned about the content sources used to create their game, most of them answered that they used only the class notes as we can see in Figure 8. The graduate students were the ones with more varied **content sources**.

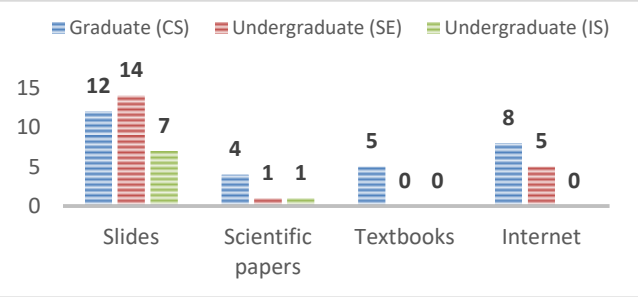


**Figure 8: Materials used as content source**[2]

When asked if the **game elements** (boards, pawns, etc) provided as support **impacted** (favored or restricted) their creation, most participants (25) highlighted that they favored the creation process (Figure 9), being a kick-off to the discussion.

Some said that the shape of the boards (similar to traditional and well-known board games) made it easier to think about how to work with the content; others said that elements such as the spinner and the hourglass allowed them to think about the time factor (and inspired them to use the smartphone timer). Some participants said the elements restricted their creativity, because even if the elements were not for mandatory use, they influenced their choices (leading them to create something simple and easy to construct, which did not please one of the participants).

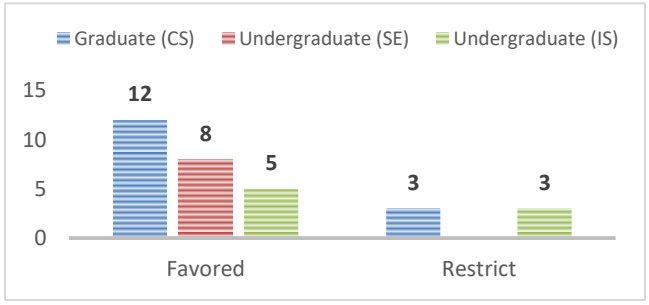


**Figure 9: Game elements impact**[3]

Considering the **game creation process**, group interaction was one of its greatest strengths, regarding group communication during brainstorming, group commitment to work organization, time management and task division. Learning was also one of the strong points; participants emphasized that they were able to consolidate the concepts in a playful way. Even the necessity of extra learning effort was highlighted as positive. The weakest point was the short time allotted to build the games. They wanted more time to study and discuss the content before starting to create the strategies, rules and instructions.

**During the game**, the format – the circuit – was highlighted as positive, because it enabled them to know (and play) all the games. The only downside was that - as previously mentioned - they wanted more time to play each game before having to move to the next. Classmates' creativity, different game alternatives (types), the ease to learn and to share knowledge (cooperation), classmates' feedback and classmates' efforts to create fun and attractive games were pointed out as the strongest points (Figure 10). As weakness, they emphasized - again - the lack of time to thoroughly appreciate (and learn from) their classmates' games. Other weak points were how confusing some games were and the response time of some game moderators.

[2] To some questions, the participants could choose more than one option.

[3] Some students didn't answer some of the questions.


**Figure 10: Words most frequently mentioned about "the play"**

Regarding the kind of activity they thought **better supported content learning** (to create their own game or to use the other students' games) (Figure 11): among the reasons for having chosen **creation**, most students highlighted the need to study the content more thoroughly. In order to be able to transmit the content in a game form, they had to review topics to level the questions, and think creatively about problem-solving to better structure the mechanics of the game, solve any doubts their classmates might have or provide feedback on wrong answers. As for those who preferred the **use** of the games, interaction with classmates during the game, in a collective construction of knowledge, was highlighted as the main reason. Others highlighted the possibility of learning even through wrong answers, receiving an explanation (and/or discussing) of the right ones.

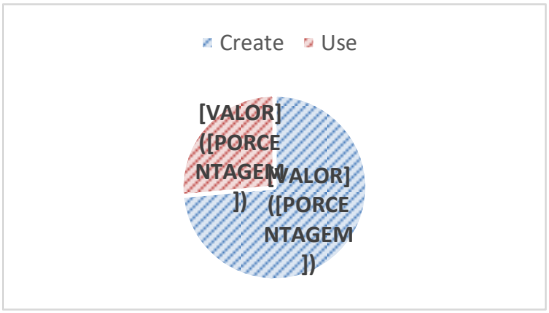


**Figure 11: Best support content learning**

Finally, when asked if this kind of activity **benefits the learning experience**, most of then (37 out of 39) said 'yes' (Figure 12). They emphasized the alternative (and ludic) way of learning, which made students active participants, and not only spectators. They also highlighted that, depending on the game mechanics, they were able to stimulate the discussion among the players, which helped with learning concepts and with student confidence when providing clarification. The participants that said that these activities do not benefit the learning process either reported to prefer lectures or said that the mechanics of some games were difficult to associate with the content.

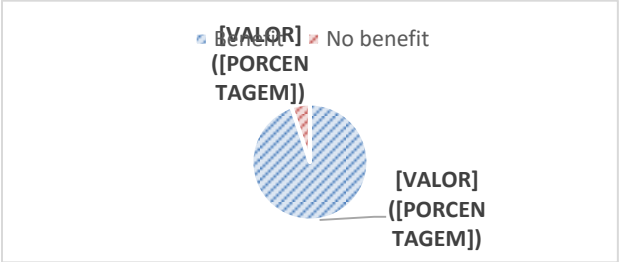


**Figure 12: Game creation in the learning experience**

## 3.2 Lessons Learned

The first time this activity was performed in class was in the semester prior to the one described here. In that first experience, the students only had access to class notes and had to create all game elements, rules, and so on. We observed that the students spent most of the available time elaborating game elements rather than thinking about the content (even the dice were built by one of the groups). Nonetheless, their engagement in the task was remarkable. The second time, a set of game elements was provided to each group, in an attempt to channel their efforts toward the content. The activity performed much better, but – as related by the students – we still need more time for the creation phase. Most of our undergraduate students work during the day and study in the evening; that being so, we must allot more time in class for group work. This semester we plan to perform the same activity again, but with an added associated class.

The students asked for more time to play. Our calendar is too tight to dedicate yet another class to this subject. However, we believe that the extra class for planning will also help in the play. Some of the students complained about confusing games or about long feedback from "moderators". We hope that with more time – in class – for preparation, we will be able to reinforce several planning issues, better monitor game creation and, also, strengthen the necessity of thorough (individual) study on the topics before the classes take place (to better plan and to better play).

# 4 RELATED WORK

Prensky [12] distinguish games in two broad categories: the mini games and the complex games. He highlight that mini games are often created by small teams, their design is relative simple, and in spite of their limited scope they can be used "in concert". Considering these categories, the games developed by the students can be described as mini games working in concert to help the HCI learning process.

Both Prensky [12] and Yang and Chang [15] call attention to the difficulties associated with the digital game production, such as financial and technological constraints. We agree with them, presenting a non-digital approach that helps to overcome these difficulties and beyond that let the students focused on learning the content instead of the technical skills needed to build a digital game.

Considering digital and non-digital games, Petri et al [11] analyze the quality of games developed for teaching Software Engineering (SE), comparing both approaches. Although the focus were only in the games use, their results indicate that non-digital games "seem to more easily promote a positive user experience, principally in terms of fun and social interaction". The authors also highlight that as the majority of educational SE games are developed by the instructors themselves, non-digital games may be a more viable alternative [11]. We add to it the possibility of the students being in the "control" of the game development (and of their learning) process, not only the instructor.

So, we agree with Lim [9] when he says "It is only when students are empowered to take charge of their own learning by co-designing their learning experiences with teachers and other students that they are more likely to engage in their learning process".

## 5 FINAL CONSIDERATIONS

At the Introduction we cited some of the skills highlighted when we discuss curriculum recommendations in the computing field; we believe we managed to work several of them into the proposed activity. Considering **teamwork**, team management and interaction were the strengths mentioned by the participants during game creation, discussion, and collaborative learning during play time. **Verbal communication** was needed to present and to moderate the games during play, and **written communication** was needed to write the rules and instructions. **Time management** was highlighted as a positive point, considering students had to divide and execute their tasks at home in a short period of time. **Problem solving and critical thinking** were both required for the creation process – from the idea to the players' challenges - and for the play – how to "win" the game. Moreover, the need of greater student **engagement**, moving from passive to active participation, was another high point according to the students. Last but not least, **creativity** can be seen in each and every game created.

We believe the main contributions of this work are the support to the **development of several skills**, as cited before, and the possibility to **apply this activity to different contents**, not only HCI. We believe the way the activity was described here could be easily reproduced in other CS (or non-CS) contexts. As Prensky stated, "with imagination and creativity *any and every* topic can be approached through some type of game" [12].

We are now discussing this experience with CS professors and professors in other fields to discuss future possibilities and deepen our thoughts on it. Moreover, as mentioned before, we will apply it again, with refinements from the lessons learned. As future work, we hope to find a way to share the games created, so that they can be widely used (*per se* or as inspiration to new games), inspired by the *living curriculum* approach [2].

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