Using an Abstract Card Game for Teaching Design Patterns

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Teaching design patterns is not an easy task, because the students need to understand not only the pattern structure or how to implement, but to judge when it is suitable and applicable. This present paper of applied research was done by an evaluation questionnaire with graduate students of the Applied Computing course which was answered after an assessment of the Design Patterns subject in May,2016. The assessment took advantage of a commercial abstract card game named Dixit to reinforce the characteristics of the design patterns. Nineteen students joined four groups and played simultaneously. In the end, an auto-assessment and a questionnaire were delivered to students. Two were the points of this paper: the merging of an analogical game and its use in an adult population, something not very usual when it comes to games in education.

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1. INTRODUCTION

Teaching design patterns is a complex task. It is not only about how objects should relate and how they can be implemented in code, but also about its consequences and applicability. It is a common mistake to focus on the pattern structure, and not on other important pattern characteristics, such as context and consequences.

This paper is about an assessment that took place at INPE (National Institute of Space Research) in May, 2016, in a class of the Design Patterns course using a card game (Dixit) as a evaluation tool. The idea was to make students practice the concepts that involve each design pattern in an informal way and then, collect their concepts about game in the classroom.

2. TEACHING DESIGN PATTERNS

Design patterns are an important subject for learning software design, specially on object-oriented languages. Specially the core patterns described on GoF [Gamma et al. 1995] are included in the list of topics of several subjects on graduate and undergraduate courses. However, learning a pattern does not include only to know the theory behind it, but also to understand when and how it should be applied and its associated positive and negative consequences.

Learning patterns is different from learning a technology or how to use a component. For using a technology, knowing what you need to do, it is easy to search on a documentation or code samples, how to achieve your goal.

However, to apply a pattern in your code, you need to know it previously and identify if the context is suitable for its application. Because of that characteristic, it is important to understand and memorize a significant number of patterns, for a developer to be able to consider different design options when creating a code. Despite it is possible to search for the pattern to consult its implementation details, before that you should identify the patterns applicability to your problem.

Because of that characteristic, a course that focuses on teaching design patterns, should not focus only on explaining each pattern individually, but also to provide resources that allow the learners to retain that knowledge. It is also important to make the learners to relate the characteristics of the scenarios and the consequences to each pattern.

The complexity of teaching design patterns s to research that experimented several approaches. A pattern language [Köppe 2013] documented several practices that can be applied when teaching design patterns. Other works focused on different approaches, such as a problem-based [Cinnéide and Tynan 2004] and through refactoring and role-play [Jimenez-Diaz et al. 2008]. None of the previous works applied games for teaching design patterns, and the approach presented in this paper can be considered complimentary and not concurrent to the existing techniques.

3. RESEARCH METHODOLOGY

The study documented in this paper is about an applied research called by Gunther [Gunther 2006] as a case study which is both quantitative and qualitative, analyzing data from a questionnaire that was distributed to graduate students of the Design Patterns course. The questionnaire was given after an activity on the discipline that took place as a card game session using the commercial (non-educational) game Dixit, adapted for so. The study aimed to know from students how much they believed to have learned with this approach and what were their conceptions on the usage of games, if they believed the game is a mere entertainment or if the game was able to undermine the teaching credibility.

3.1 Goals

The main goal of the research performed is to verify if the use of games can help in pedagogic activities for teaching design patterns. As a second goal, it also aims to know if the game could be better used as a learning and teaching tool as well in college education, and to show that the game does not need to be previously designed for educational goals to reach a learning objective.

3.2 Execution Steps

The study should be performed in students that are learning design patterns. They should already know the patterns, and this activity is supposed to help them to fix better some concepts and to get from their colleagues information that they were not able to learn.

They will be exposed to a game called Dixit, which is a commercial (non-educational) game, and will be instructed to use only design patterns and related words as in the game. They should play two matches with different students.

After playing the game, they will be assessed about how that activity contributed for their learning in design patterns.

3.3 Evaluation Technique

The questionnaire was used as an evaluation technique of direct and extensive observation, which gives quicker and more specific answers [Lakatos and de Andrade Marconi 2005], better patterns of answers and also protects the identity of the respondents. The questionnaire reaches a good amount of people and it is to be considered, here, the research subjects as an homogeneous group.

4. STUDY EXECUTION

This section describe how the study was executed. The following subsections describe the audience and give details of how the Dixit game works and was adapted to this activity.

4.1 The Audience

Took part of this research 19 students of the Design Patterns course in the graduate course of Applied Computing from the National Institute of Space Research in Brazil. This course is offered to students of master and doctoral degree as well as an isolated subject. It was taught in May 2016. Fig. 1 presents a photo of the activity in the classroom.

Fig. 1. Students performing the activity in the classroom.

About the audience, some information: just one of the students has ongoing graduation and the others ones have a complete graduate course. Most of them has a stricto sensu graduation. They work in technology field, computing and software development, which means 15 of 19 students. They are, in the average, 31 years old (from 20 to 57), 14 of them have no kids and 5 have so. In their free time, 9 said to play games. 15 of 19 considered themselves occasional gamers of video game or board game, as presented in Fig. 2. Only 4 said they do not play, not even eventually.

The students were said that there would be a test on the day this study took place. It was made so that they might come to classroom after studying a set of design patterns. The included patterns were: Null Object, Template Method, Factory Method, Strategy, Bridge, State, Observer, Composite, Chain of Responsibility, Proxy, Decorator e Adapter, Static Factory Method, Singleton, Builder, Abstract Factory, Dynamic Object Factory, Service Locator, Dependency Injection, Command, Double Dispatch, Visitor, Facade, Mediator, and Flyweight. Because of that, the evaluation activity could run without checking any texts.
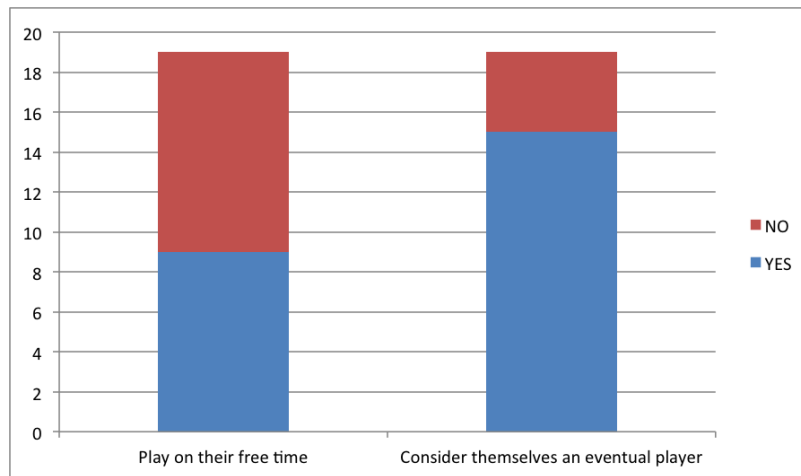
Fig. 2.   Participants' previous experiences with games.

4.2   The Game

For the activity, four copies of the game Dixit were used, a card game exclusively developed for entertainment goal, but that, here, was used into an educational approach. Four groups were formed, in a random way, and played one match each, simultaneously. After coffee break, the groups were rearranged and four new matches were played. Fig. 3 presents the groups playing the game.

Fig. 3.   Pictures of groups playing the game.

Dixit is an abstract card game that uses contextual or lexical clues applied to the very oneiric drawings of the cards. Game rules: each player has 6 cards, each turn, a player is the storyteller. The storyteller chooses one of her cards and says a sentence, a word, or, yet, mimics or even sings part of a song so that it refers to the

chosen image. She does not show the card. All the other players search among their hand of cards, the one that better fits the description of the storyteller. The storyteller receives all the players cards, without seeing or showing them, then she shuffles them with her one included, and opens all the cards on the table, giving them a numerical sequence (pointing the number one card). Now, the storyteller is almost done with her task because it is time for the players to vote, using markers (numbers from 1 to 6), the card they believe to be the one card of the storyteller. The score is according to the votes received. The players (not storytellers) that receive vote also make points. However, the game mechanics brings a condition for the storyteller to score: she will not make any point and all the other will score if the storyteller card receives all or zero votes. Unanimity is the misfortune of the storyteller. Then, the storyteller may not say too obvious nor too far from the meaning.

All the mechanics, the cards, markers and scoring were kept in our experience, except the fact that the storyteller could only say a name of a design pattern or a related concept to object oriented design, such as hook class, hook method or inheritance. It was added to the rules that, after voting and scoring, all players should justify their choices (relating it to a pattern). Some examples the students said were Singleton, Abstract Factory, Mediator and Adapter.

After two matches (each of them in a group with different players), the students filled in a questionnaire that meant to listen to their opinions about this kind of assessment, without the monitoring of a professor, just shared among classmates.

4.3   Example of a Game Turn

In his turn, a player select in his hand a card that has a humanized rabbit looking for three different doors. He thinks that this card relates to the Strategy pattern, where you can choose different implementations for an algorithm. Them, he put his card backwards in the table, saying "Strategy". Each other player them should select the card in his hand that he thinks that is the most related to the Startegy pattern. For instance, another player should select a card with several water drops, relating that in the Strategy pattern there are several classes encapsulated in the same abstraction.

The cards cannot be showed here for copyright reasons, however this link shows a picture with the cards used in the example: `https://s3.amazonaws.com/galapagosproduction/system/ckeditor_assets/pictures/350/content_jogo-de-tabuleiro-dixit-cartas.png`.

Each other player put one card also backwards on the table. The current player (storyteller) shuffles the cards and put them on the table in order, giving them a number, e.g. from 1 to 5. Then, the other players should try to guess which one is the original card that the current player selected, related to the pattern, in this case, the rabbit one.

It is possible to perceive that the players should exercise their pattern knowledge in three different times: (1) when they are searching a relation between a card in their hands and a pattern; (2) when they are selecting a card in their hands based on a pattern; and (3) when they are looking at the cards on the table and searching for a relationship with the pattern characteristics. After his/her turn, the current player should reveal the pattern characteristic that was related to the pattern.

Also, it is meaningful for students to justify their choices so that players reinforce knowledge and may even debate the choices according to the selected pattern. Justifying is a moment where students may learn from peers and, why not, it is also some fun.

5.   RESULTS

Only one student answered to have already used games in classroom as a student, the other 18 had, in this opportunity their first contact with games in education. All the 19 interviewed said they liked the activity and 18 would like to have mores classes or assessment like this.

Regarding learning, 13 of 19 said they have learned something new and 14 declared the game clarified or facilitated learning, in some point of the subject. All the 19 agreed to have reviewed the concepts and to have

established new thoughts during the activity; and 17 believe to be more interested in this activity than they would be in a conventional one.

About the concept of students on the use of games in the classroom, 18 of them see the possibility to learn the discipline content using games, and 14 believe that game is an efficient teaching tool, as presentec Fig. 4.
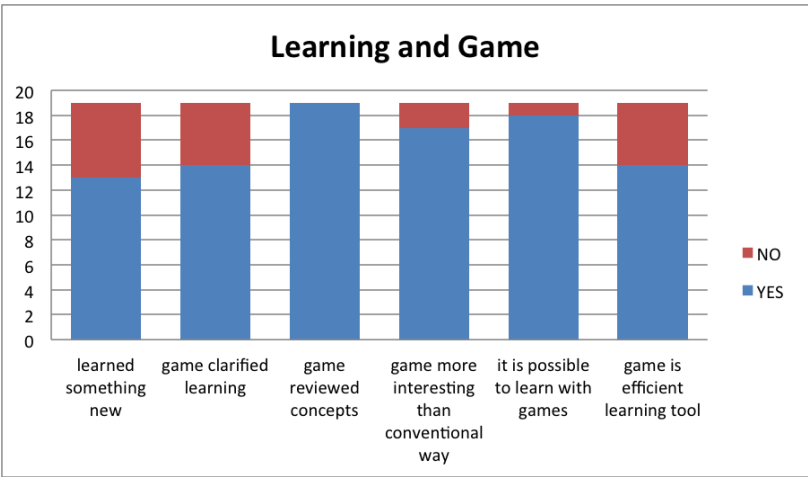

Fig. 4.   Learning experience.

In terms of their opinion on this specific activity, they were asked if they believed they would get a better result in a conventional hypothetical activity: 9 said no; 6 were indifferent; and 4 said yes (they prefer the conventional approach). When asked about if they have actually got a better result playing games than with conventional activities, 11 said yes; 6 were indifferent; and 2 said no. Finally, they were asked which modality of activity they would prefer, considering the fact of the teacher to evaluate their knowledge on the subject, 15 chose the game format; 2 were indifferent; and only one said to prefer the conventional activity. Yet, a student answered a not given option, saying she would prefer constant activities. The chart in Fig. 5 presents these results.
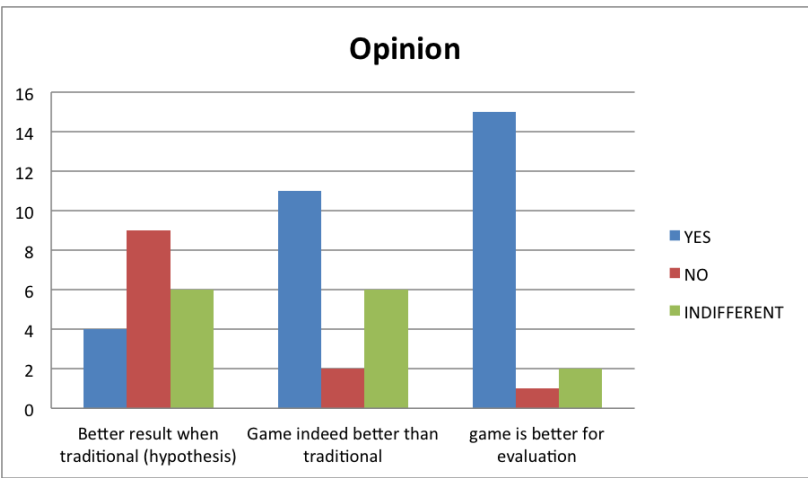

Fig. 5.   Opinion about the activity.

There was a question on the students having children or not, and we believed those who cope with kids would play more often with them. However, only 5 students said they were parent and 15 of 10 consider themselves usual gamers.

Two open questions were asked, they were to list some games that would come to their minds and some they might own. Those lists brought expressions like board (11 times), videogames (10 times), cards (9 times) and game names like Monopoly (Banco Imobiliario) (8 times), Risk (War) (7 times), Pictionary (Imagem Acao) (3 times). Sports were mentioned twice. Those open questions were designed to analyze the knowledge they have on games and the results are presented on Fig. 6.
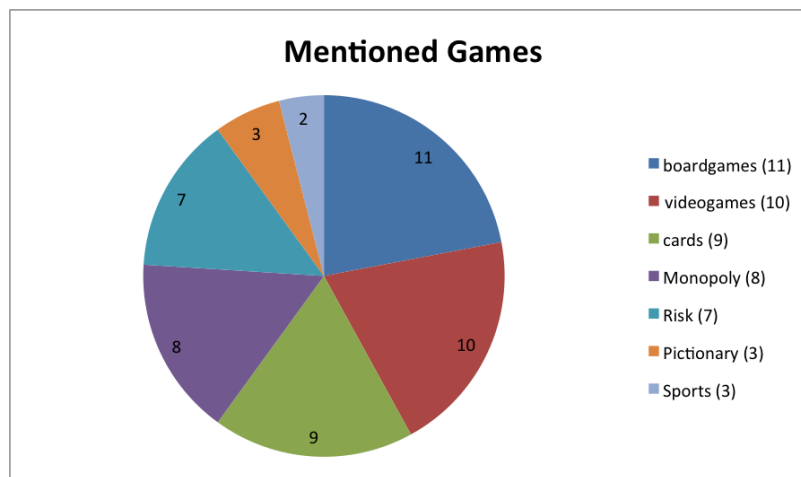

Fig. 6.   Mentioned games.

One question was misunderstood, due to something close to a double negative, and it is believed that the result of the answer may have been harmed. The question was, in Portuguese: Do you consider that game is NOT efficient to teach something to somebody (although it might be pleasant)? Yes or No.; Students answered 5 yes; 14 no. If all of them understood the intention of the question, then, 14 of 19 do not agree game is an inefficient teaching tool and 4 believe game is not a good tool.

This was a paper considering the adult audience but the initial concern were the same usually seen when using boardgames with kids and teenagers, which means, (a) they do not understand all the rules as they are first said, demanding a closer monitoring at the first turns; (b) they show some sort of anxiety and fear to make mistakes in front of classmates, at the beginning of the match; (c) a body reading shows lack of pressure and informality of all players after initial 5 or 10 minutes, and (d) when the game is over, almost all students ask for more game activities.

Unanimity calls attention. All declared to have reviewed the concepts while playing; all said to have established some new thinking; and all of them enjoyed the activity format. There was also a question related to the fact of the game making things clearer or easier for them in some point of learning (they had to support the answer in case of yes). There were 14 yes; 3 no; 2 indifferent and they justified the positive answers with a large range of ways that were arranged in to: different points of view to the same concepts; informality regarding the content; content review; raising important questions; and sharing knowledge.

6.   CONCLUSION

It is possible to note the satisfaction of the students regarding the use of games in the classroom and their belief in this learning tool, not seeing it as entertainment. The game can be seriously seen as it has a didactic potential to

be well explored, joining learning with fun, which turns the class in to a dynamic one, and offers students some level of concentration without tiring.

The point is to choose the right game to each situation intended to be approached. The game can not only review content but can teach (13 students said they had learned something during the activity; 6 said they had not) and, the most interesting, in a sharing way with the classmates. The mistakes are accepted, but, as they reflect on the game score, students try make it right (not for fear of mistake but to get a higher score) and that makes them learning also through observation. And, finally, it demands less of the professor that is free to walk around, being called when necessary, which means the teacher is a mediator and not the knowledge keeper.

As future studies, we plan to explore the usage of other boardgames for teaching design patterns and other subjects related to software design. A more wide study could also be performed to confirm these initial results.

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