A puzzle instructional framework for creating narratives with an OCC-RDD technique

Mario Madureira Fontes * Ítalo Santiago Vega

Pontifícia Universidade Católica de São Paulo, Departamento de Computação, Brasil

ABSTRACT

This paper presents a puzzle instructional framework comprising different types of puzzles for creating narratives with a technique called OCC-RDD. To demonstrate its application, the procedural map generation was chosen as an object to be explored in an introductory way. The intended context of application is the teaching of Computer Science contents to students of Digital Games. Puzzles are important challenging tools and can help developing critical thinking. This article shows how puzzles can help writing more efficient narratives comprising types of OCC's scenes such as the Objective, the Conflict and the Catastrophe. The following types of puzzles are proposed to be introduced into the narratives: Riddle, Lateral Thinking, Spatial Reasoning, Pattern Recognition, Logic, Exploration and Item Use. The challenges created by the puzzles are thought to motivate and engage undergraduate students of Digital Game Courses and other Computer Science related courses in learning specific computational contents and help teachers to achieve their instructional objectives.

Keywords: puzzles, OCC-RDD technique, Narrative-Centered Learning, critical thinking

1 INTRODUCTION

This paper focuses the use of puzzles for instructional purposes. Its main contribution is to add a puzzle framework in order to create narratives containing some challenges to be solved. These narratives, whose script is written with an OCC-RDD technique, can provide instances for the learner to experience a great deal of situations and to overcome personal learning difficulties as discussed in [10] and [13]. The scope of the OCC-RDD technique is explained in section 1 of this article. Related works with puzzles applied for instructional purposes, educational context and narratives are discussed at [8],[5],[6],[2] and [4].

Innovative ways for achieving instructional goals are proposed by [3] and [14] in their study of the causes which prompt students to give up studying. Their discussion is useful in considering the scenario commonly found in Digital Game courses and other computer science related courses.

Puzzles are important challenging tools and can help developing critical thinking. The challenges created by the puzzles are thought to motivate and engage undergraduate students of Digital Game courses and other Computer Science related courses in learning specific computational contents and help teachers to achieve their instructional objectives.

To deal with the problem of the students' engagement in learning specific computational contents and make learning more attractive to Digital Game students, the following types of puzzles: Riddles, Lateral Thinking, Spatial Reasoning, Pattern Recognition, Logic, Exploration and Item Use, discussed by [9], are proposed to be introduced into the scenes of the OCC-RDD technique. These types of puzzles are defined in section 2 of this article.

In this article we propose that puzzles can help writing more efficient narratives using the OCC-RDD technique. The challenges created by the puzzles are thought to motivate and engage undergraduate students of Digital Game Courses and other Computer Science related courses in learning specific computational contents and help teachers to achieve their instructional objectives.

The Procedural Map Generation (PGM) was chosen as the object of the application of the puzzle framework in this article because it is a relevant didactic topic to be taught to Digital Game students. The basic main taxonomic PGM categories [12] are: online versus offline content, necessary versus optional content, random seeds versus parameter vectors, stochastic versus deterministic generation, constructive versus generate-and-test.

The PGM is a process defined by Togelius et al. [11] as "*a fresh map each time the game is played*". The procedural map is thought to allow the players to explore new specific challenges each time the game is played and that is considered by the authors to extend the life-span of the game.

This article comprises the following sections. In section 1, the OCC-RDD technique is described. In section 2, the types of puzzles to be used in the OCC-RDD technique are defined and in section 3, an example, in a teaching scenario, is given to demonstrate how to apply the puzzle framework we propose. The category online versus offline is explored in the section 3 to illustrate how the puzzle framework can be used in the process of creating narratives with the OCC-RDD technique. Section 4 is dedicated to final considerations.

2 OCC-RDD TECHNIQUE

The technique used to produce the script of the narratives is called OCC-RDD, an acronym which stands for Objective, Conflict, Catastrophe, Reaction, Dilemma and Decision. This technique introduces a plot and a set of characters modeled in such a way as to make the students interact in an easier way with the narrative presented by the teacher in the classroom [13],[1] and it is thought to help students in the learning process.

The OCC-RDD narrative structure is split into two cognitive sets of semantic scenes: the OCC and the RDD. The first set is the OCC which defines the narrative setup to be narrated in the third person by the teacher and the second set is the RDD which defines the physical and psychological aspects of the characters and is narrated in the first person singular, that is, the characters address the learners (the addressees) in direct ways, prompting questions to be answered or comments to be discussed. Basically the OCC set defines the elements in the narrative which refer to the ambience, the events and the interactions among the characters and the RDD set defines the characters' individual features such as their physical appearance and their psychological qualities and the way these characters interact and affect the learners.

In the OCC set, the Objective provides the contexts and the theoretical basis concerning the theme of the narrative. The Conflict aims to discuss remembrance of things previously learned and/or

*e-mail: mmfontes@pucsp.br

identification of things to be learned. The Catastrophe is a stage of maturation of the activities defined in the Conflict scene.

The Objective is the first type scene of the OCC and it must be reached at the end of the interactive narrative scheme. It contains the contents to be dealt with in the class script and it is followed by the Conflict scene, which provides new challenges and contexts for the students to recall previously learned concepts as well as introduces new contents. The third type scene of the OCC is the Catastrophe which interrupts the Conflict and introduces a challenging question for the student to think over the contents which have been introduced.

In the RDD set, the Reaction defines what kinds of characters' reactions are expected in the narrative. The Dilemma is concerned with the kinds of discussion created by the characters. The Decision refers to the kinds of effects the characters have on the learners who are the addressees of the narrative.

The puzzles are introduced in the Objective, Conflict and Catastrophe scenes of the narrative created with the OCC-RDD. The ordering in which the puzzles are introduced and the way they interact are discussed in the next section which starts with a reference to the concept of puzzle. The main contribution of the use of a puzzle framework in the way we propose it is that it has a structuring function since it organizes the writing of the kinds of OCC-RDD scenes in the narratives.

3 PUZZLE FRAMEWORK

In this article the expression "puzzle framework" is used to refer to a set of puzzles understood as a cognitive action to solve a problem. Similarly,[7] defines puzzle as a process to solve a problem. The presentation of the problem is, according to [7], made by a list of questions and suggestions. Those questions and suggestions guide the reasoning about the problem and can be thought of as puzzles.

According to our proposal, in this article the puzzle framework is to be introduced into the narrative OCC-RDD and it has two functions. The first function is related to the "narrative structure" (OCC) and its goal is to organize the educational objectives presented and elaborated by the teacher. The second function triggers a deep critical thinking experience on the students. This function carried on by the "narrative effect" (RDD) provided by OCC-RDD characters.

The critical thinking experience can be driven in two of the OCC scenes in a story: the Conflict and the Catastrophe. The Conflict scene deals with concepts related to the identification and remembrance and the Catastrophe scene deals with concepts related to application and comprehension.

To create a story using the OCC-RDD technique and incorporating the puzzle framework, seven types of puzzles have been adapted from [9]. Each type of puzzle is thought to contribute to introduce the elements which are used to build the story as well as to set the scenario and to determine the way the characters interact. The seven types are: Riddles, Lateral Thinking, Spatial Reasoning, Pattern Recognition, Logic, Exploration and Item use.

In the next subsections the types of puzzles which suit better the Conflict and the Catastrophe scene are mentioned. There are no specific puzzles for an OCC scene but some of them are more adequate to be incorporated in one of the OCC types scenes.

3.1 Conflict Riddles

[9] define Riddles as "*questions that have one right answer, but that answer is not obvious*". This means that only the one who knows the clues to solve a Riddle can give an answer to a specific question. In the OCC-RDD context, the characters can be used in a narrative in such a way that they are challenged to remember or identify a concept related to a specific objective of the story, for example, a test can be set between a typical notion and an academic notion about a concept. Because of the remembrance and the identification effect, Riddles suit better the Conflict scenes.

3.2 Catastrophic Lateral Thinking

[9] define Lateral Thinking as involving asking trick questions in such a way that players make assumptions that are not true and the solving of the puzzle requires the player to question his or her assumptions. All Lateral Thinking puzzles must be solved in a different way from the Vertical Thinking or Straight Forward Thinking. In the OCC-RDD context, the characters must provide, in a creative way, an alternative concept that solves the puzzle and introduce a new objective in OCC cycle. Because this kind of puzzle introduces a new OCC cycle it suits better the Catastrophe scene.

3.3 Catastrophic Spatial Reasoning

[9] define the Spatial Reasoning puzzles as "*the manipulation of objects, either in the mind or on the playing surface*". In the OCC-RDD context, the characters have to manipulate and test concepts in different points of view to provide a comprehensive application about a concept. Because this kind of puzzle comprises the application of concepts it suits better the Catastrophe scene.

3.4 Conflict Pattern Recognition

[9] mention that the Pattern Recognition puzzles "*require the player to look for and identify a pattern when presented with information*". In the OCC-RDD context, the characters have to identify a pattern among the situations presented. Because of the identification aspect this puzzle it suits better the Conflict scene.

3.5 Catastrophic Logic Deduction

[9] mention that the Logic Deduction or Logic puzzles "*require the player to take a set of given information and derive additional information to find the solution*". In the OCC-RDD context, the characters must provide a dialogue which requires the application of a concept in a deductive way. Because of the application aspect concerning this kind of puzzle it suits better the Catastrophe scene.

3.6 Conflict Exploration

[9] define the Exploration as "*the thought of going down into a dungeon and mapping its corridors*". In the OCC-RDD context, the characters must exploit all the possible applications of a concept in a specific context. Because of the application aspect concerning this kind of puzzle it suits better the Catastrophe scene.

3.7 Conflict Item Use

[9] define the Item Use as "*involving the use of objects*". The player is supposed to figure out the kinds of objects to be used as well as the order in which they are to be used in order to solve a problem. In the OCC-RDD context, the characters have to identify a concept which can be combined with another concept in a non-obvious way. Because of the identification aspect this puzzle suits better the Conflict scene.

In the next section, these seven types of puzzles are considered in an application to the teaching of Procedural Content Generation which is the object chosen in this article to demonstrate the use of the puzzle framework in the building of narratives for instructional purposes. As the didactic application concerns the PGM and as it is thought to provide new specific challenges each time a game is played, consequently extending the game's life-span, it is a relevant topic to be explored in Digital Game courses. In the next section some examples of types of puzzles which can be used to help students of digital courses to understand and generate procedural maps.

3.8 Examples using the puzzle framework

Considering the context of teaching/learning of PGM, some examples of the use of types of puzzles are given in the following paragraphs to illustrate how the puzzle framework can be applied for instructional purposes.

In the scenes of narratives written to help teaching PGM, the Conflict Riddle puzzle (section 3.1) can be used, for example, to pose a situation in which the characters discuss static or dynamic options to generate a map and based on the arguments they provide students can use previous knowledge in order to favor one of the options.

The Catastrophic Lateral Thinking puzzle (section 3.2) can be introduced in a scene in which a character is supposed to design a game map and this task makes him think about something he had not thought before: implementing a genetic algorithm. He, then, decides to talk the matter over with a friend and finally opts for using the genetic algorithm.

An example of use of the Catastrophic Spatial Reasoning puzzle (section 3.3) is proposing a discussion between two characters about how to generate a procedural game map. One of the characters favors the use of square rooms and the other the use of circular rooms. One of the options must then be chosen.

An example of Catastrophic Logic Deduction puzzle (section 3.5) is understanding an algorithm behaviour by evaluating and observing the parameters and results of a map generation.

An example of Conflict Pattern Recognition puzzle (section 3.4) is introducing a situation in which a character is challenged to identify which is the common source used to generate a procedural game map generation by comparing images from different game scenarios or playing games that use procedural generation contents.

An example scenario of Conflict Exploration puzzle (3.6) is to manipulate all possible parameters in a game map generator to verify if varying combination of parameters generates different maps.

An example of the Conflict Item Use puzzle (section 3.7) can be implemented by providing a situation in which a character is challenged to add graphical elements in a diagram which describes the map generation process of creation. Similar situations are found in games such as Minecraft.

4 APPLICATION

The main examples in this article concern the taxonomic categories for Procedural Content Generation applied to digital games. The ambient construction of a game can be done in different ways, one of the possible ways involves the use of procedural map mechanisms. Two strategies are known: online (runtime) and offline (static). [12] consider the content generation to be online if it is performed during the runtime of the game and offline if it is performed during the game development. Considering the teaching of these strategies to students of Digital Game Courses, narratives are thought to help students to understand these concepts in a better way. Being so, we may ask: how to write a narrative to teach those strategies?

To create a narrative two main procedures must be done. The first procedure is to use an OCC-RDD technique. The second procedure is to identify in the narrative the more adequate parts to introduce the types of puzzles as defined in the section 2.

The process of creating a narrative using the OCC-RDD technique combined with the puzzle framework comprises seven steps. In figure 1 the left column introduces the steps involved in the basic elements of the narrative and the right column the steps concerned with the creation of the Conflict and Catastrophe scenes and the puzzle insertion.

4.1 OCC-RDD narrative construction with puzzles

The writing of OCC-RDD narratives involve the following steps:

1. Defining the cause-effects in the narrative given a determined content to be explored in the teaching/learning environment context. To teach how to construct a PGM, the plot of the narrative could compare, for example, the bad effects of using static maps to the good effects caused by the introduction of dynamic maps.

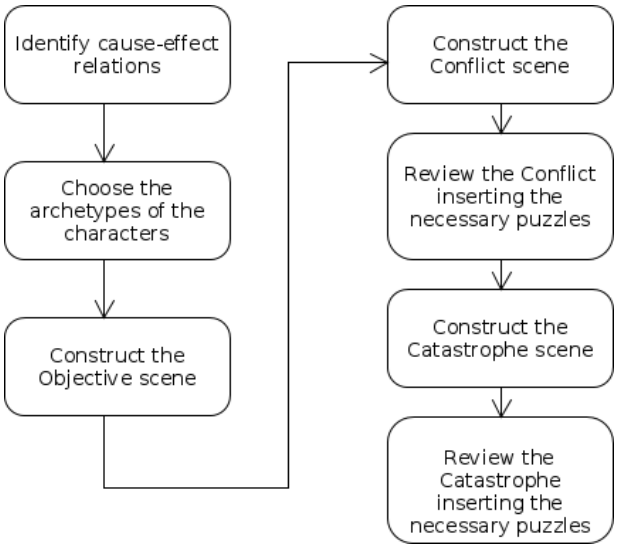

Figure 1: Diagram describing the procedures to generate a OCC-RDD narrative with puzzles.

2. Defining the characters of the narrative. In this narrative three characters are proposed: Ocara, Fubã and Spec.

3. Defining the objective scene. In the narrative proposed the Objective scene refers to constructing an online PGM.

4. Defining the Conflict and the Catastrophe scenes. The Conflict scene in the narrative we propose concerns the identification of what is a static game map generation and a runtime game map generation while the Catastrophe scenario is concerned with random game map generation applications.

5. Reviewing the Conflict and Catastrophe scenes to identify the best parts to introduce the puzzles.

6. Introducing the puzzles in parts of the Conflict and Catastrophe scenes.

4.2 Narrative structure with the puzzle framework introduced

Based on the steps mentioned in previous subsection, the following narrative was created in order to explore the contents related the PGM.

In the first part of the narrative a Riddle puzzle is introduced in the Conflict scene.

> Ocara creates a simple game with a static map and he is anxious to play-test his ”fabulous” game with Fubã. Spec watches them. Fubã starts playing but soon gets bored. After playing the game Fubã asks Spec if he there is a way to improve the game play. Spec says there is a way to do it and he proposes a riddle to Fubã: ”What kind of behaviour is missing in the game?”. Fubã answers: ”It lacks dynamism”. Then, Spec explains a possible improvement is to generate a dynamic dungeons game map at runtime.

In the second part of the narrative a Lateral Thinking puzzle and an Item Use puzzle are introduced in the Conflict scene.

> Spec talks about the basic items to generate the game map. He says: ”Suppose you have two square rooms and

> one corridor, would it be possible to find a random combination of these items to dynamically generate different kinds of game maps?". Fubã starts to think and he draws a random possible solution according to which a corridor connects the edge south of a room with the east edge of the another room. He shows it to Spec. Then, Spec tells Fubã: "Imagine this solution in the context of a game". The runtime aspect would represent every time the player goes to a dungeon since a random combination would be generated as you did."

At this point of the narrative Spec explains how to construct a game with an online PGM. In the end of this narrative a link to another OCC cycle scene is introduced. This should be always introduced in the building of narratives because it provides a new concept to be described in the next Objective scene.

In the final part of the narrative a Lateral Thinking puzzle is introduced in the Conflict scene.

> Great, said Spec and he continues: "Now, think about all possible drawings to combine the rooms and the corridors. Maybe it is not so obvious to define an algorithm to construct the possible rooms. So, what is the kind of model we could use to overgeneralize the generation of the rooms?". Fubã said: "I don't know". Spec said: "We can use a Behaviour Tree model".

In figure 2 the puzzles which were applied to the scenes of the narrative are presented in a schematic way.

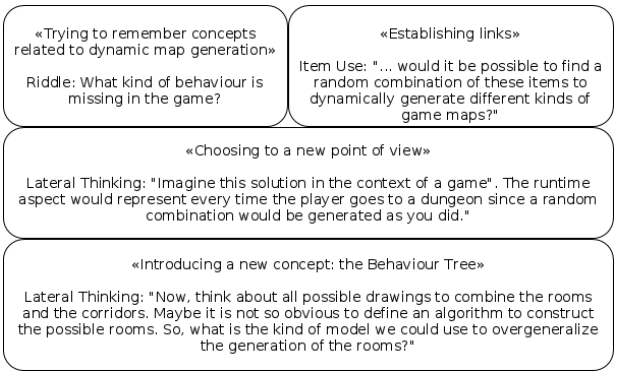

Figure 2: Schematic puzzle organization in the narrative

5 Final Considerations

Introducing the puzzle framework in narratives written with the OCC-RDD technique is thought not only to improve the construction of the stories narrated but also to provide means of engaging students in learning activities since puzzles introduce challenging situations which are attractive to students. Although we have considered the teaching/learning of Computer Science contents to students of Digital Games the framework proposed in this article can be applied to other scientific fields.

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