A game model for supporting children learning about emergency situations

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ABSTRACT

Despite the undeniable value of computer games as educational resources for teaching children, its actual application in educational processes is hampered due the complexity of their design and the high cost of developing them. In order to foster their adoption for emergency training, we propose a model for describing the different elements of an educational game for this domain. The model might serve to support the game designing process as well as a communication tool between educators and game designers. This way, the educator can specify the requirements of the educational experience he aims to construct, and based on that information the game designer can propose a set of possible configurations of the game elements that can help to attain the specified objectives.

Keywords

Games, models, emergency, education, training

INTRODUCTION

Population preparation for emergencies is essential and children constitute a vulnerable group that should be considered in a special way during that preparation process (WHO, 1999). Computer serious games have proved to be a valuable educational resource in different areas from medicine to military training, including emergency response (Freitas, 2006). Furthermore, the ability of the games to motivate active participation (Arango, Aziz, Esche, and Chassapis, 2008), together with other features such as their intrinsic and prompt feedback, or the proposal of challenging by achievable goals, makes them especially suitable for training children. Following this idea, many Websites of government agencies (FEMA, 2009, Italian Civil Protection, 2009; US Fire 2009) provide educational games which address the special requirements of this group and help to prepare children to react to different types and levels of emergency.

However, the design and development of educational games is a complex task. Due to the exponential growth in the development complexity of the games over the last few decades, the need for design methodologies to improve productivity has been highlighted (Henderson, 2006; Fullerton, Swain, and Hoffman, 2004). Following this idea, different domain-specific languages and authoring-tools have been proposed during the last few years, especially in the area of educational games (Moreno-Ger, Sancho Thomas, Martínez-Ortiz, Sierra1, and Fernández-Manjón, 2007; Maloney, Burd, Kafai, Rusk, Silverman, and Resnick, 2004; Furtado, 2006). Nevertheless, methods and tools that take into account the special requirements of the emergency training for children are still needed in order to take advantage of the benefits of the application of games in this domain. The aim of this work is to help educators in the process of designing computer game based educational experiences for teaching children about emergency risks. As a first step of the project we propose a model for describing the different elements of the game to be used in that experience. As the type of game characteristics will be different depending on the learner and emergency risk features at hand and on the educational objective of the experience, the proposed model includes the necessary elements to provide all this information. The model could serve to support the game designing process as well as a communication tool between educators and game designers. This way, the educator can specify the requirements of the educational experience he aims to achieve, and the game designer will propose a set of possible configurations of the game elements that would help to attain the educational objectives. In the next section we provide a detailed explanation of the proposed model. For clarification purposed a case of use will be described. The paper ends with some conclusions and future work lines.

Reviewing Statement: This paper represents work in progress, an issue for discussion, a case study, best practice or other matters of interest and has been reviewed for clarity, relevance and significance.

THE EDUCATIONAL EXPERIENCE MODEL

In order to construct a satisfactory educational experience it is important to take into account the particular characteristics of its participants. Figure1 depicts the elements of the model proposed to support this requirement. As a first step the learner profile has to collect information about his/her age, educational and technical background and possible disabilities among other factors that might help to shape the educational experience to the child needs and expectations. As an adequate educational experience may significantly change depending on the presence or not of adults and the characteristics of the available devices, this information will be specified to describe the actual educational context. This context may correspond to a wide range of different learning situations like learning at home on his/her own or accompanied by family members, learning at school supported by specialists with different technology backgrounds, learning using computers with Internet connection, or whether with advanced interface interaction or just simply keyboards.

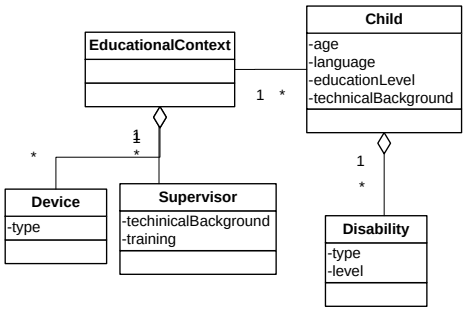

Figure 1. Learner Profile Model

The second step will be the specification of the characteristics of the emergency situation in which the learner will be trained. Figure2 shows the model proposed to support this task. The educator will describe the different facts, effects and consequences of an emergency risk the learner should master, as well as the warning signs or possible causes he/she should learn to identify. Furthermore, the educator may want the child to learn the recommendations about how to react when a warning sign of a risk is spotted, or how to mitigate the effects of a risk or prevent it. These recommendations may be part of an emergency plan and they may be different depending on the context of the risk. For instance, the recommended procedure that the child must follow in case of fire will be different depending on whether he/she is at home, at school, or in the presence of an adult or other child. It is also important to note that a risk may be composed of a set of other different risks. This help to make the point that in the case of an earthquake, for instance, the risks of fire or flooding are also closely related.

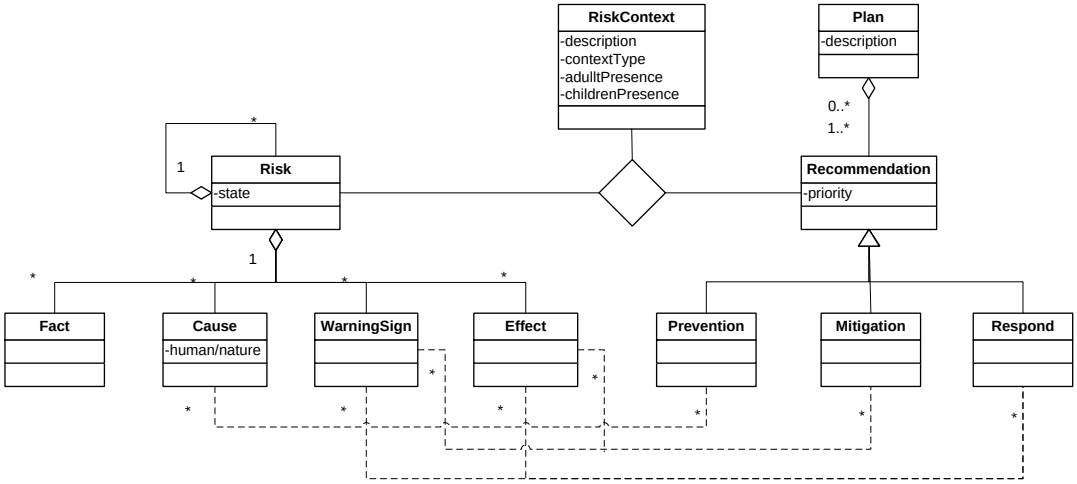

Figure 2. Emergency Context Model

Having specified the subject of the training, it is also necessary to define the learning objectives that the children should attain. This definition will be provided using the widely used Bloom's taxonomy of measurable verbs (Bloom, 1965). This way, educator may want the learner to apply recommendations in a domestic fire

emergency, to recognize the fire warning signs, to categorize objects that may help to mitigate it, etc. Considering the learner profile, risk features and learning objectives, the educational experience will be modeled. As shown in figure3, the modeling will include both the definition of a number of learning activities and the type and characteristics of their participants. With regard to the last ones, two different types of participants will be considered: learners and instructors. The latter group actively will participate during the game as another player, or will just support players providing assistance, solving questions or evaluating their actions. The definition of the number and type of participants of the experience will be produced taking the learner profile, the supervisors profiles defined in the educational context and the risk context into account.

Each of the learning activities of the educational experience corresponds to a different educational game. The proposed model for these activities has been produced according to the model proposed in CESAR (Diaz, Aedo, Torra, Miranda, Martin, 1998). The CESAR training system exercises were divided into information objects and strategies. The formers were composite entities that embodied different representations while the latter described the logic of resolution that must be applied in the exercise. The logic was specified at three different levels: presentation process, interaction process and checking process. This way different strategies of learning can be applied with the same object. Following that approach, each learning activity is composed by four elements: *interactions*, *activity-roles*, *entities*, and *scenes*. *Interaction* elements describe the different types of interactions implemented in the educational experience, such as mouse interactions ("drag and drop" or "click"), keyboards interactions, joystick , touch screens or Wiimote. All the interactions must be supported by at least one of the devices included in the educational context (see Figure 1). The *activity-role*s in turn, describe the different roles that the participants may play during the game. For instance, a participant may be a fireman, policeman, delegate student or teacher during a game. The *entity* elements correspond to the information objects that describe representation of individuals or objects that the participants can interact with during the game. Entities may adopt different status during the game execution and a different set of scripting, audio, image and video resources would be used for each of them. For instance, it may necessary to include an entity "door" and the graphical resources to represent the "door open" and "door closed" status will be different. Finally, the game will be composed of a set of scenes in which participants will play activity-roles interacting with a group of entities to achieve a particular learning objective. A scene may represent a particular emergency situation, but can also adopt any other form that serves to attain the proposed learning objective.

The strategy rules define the elements of the learning activity presented in a particular scene and establish the relations between them. There are five different types of strategy rules: Presentation, Interaction, Check, Sequence and Synchronization. The first ones define the composition of the scene defining the initial location of the entities on the screen. The second ones define the valid interactions within activity roles and entities and the changes introduced in the scene as a consequence of them. The third ones serve to evaluate both the attainment of learning objectives and the completion of the scene. Finally, last two govern the transition between different scenes and define some synchronism required in multiplayer activities, respectively.

CASE OF USE

In this section we explain the use of the model through a case of use. Let's say an educator wants to create an educational experience to train 5 years old children in primary school about how to react in case of an earthquake at home. As an effect of the earthquake objects in the room may fall and in order to mitigate the damage, children have to identify dangerous objects and stay away from them. The child does not suffer any disability and it is expected that the game will be played on a computer in the school, in the presence of teachers who are familiar with technology. The computer will have common input devices such as mouse and keyboard.

With these requirements in mind, the educational experience proposed considers two different participants: a leaner and a non-player instructor who will be in charge of providing assistance both in technical issues as in solving the game. During the unique learning activity of the experience the learner will play the role of a child at home who has to identify dangerous objects during an earthquake (Figure4). Due to the age of the learner the game should be kept simple, and therefore a single interaction will be used to complete the game: clicking the mouse.

The activity will be composed of a set of scenes each of which will represent a room of a house. The designer will define two groups of entities. One group will represent the different objects in the rooms and will have two possible status: "non selected" and "selected". The other group will be used to represent the background of the scene and will have only one status.

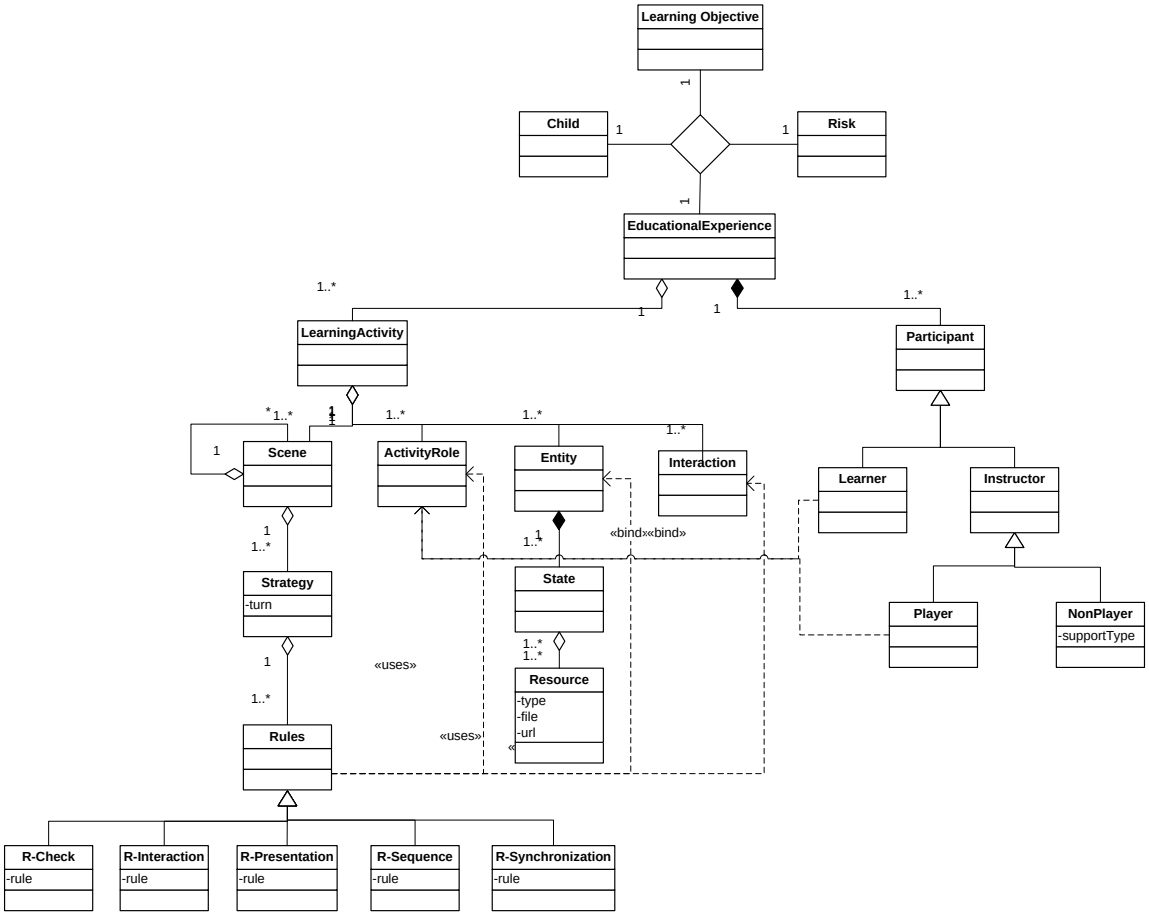

Figure 3. Educative Experience Model

The strategy implemented for each scene will be very similar. The presentation rules select the group of entities presented in the scene and its position in the screen. The interaction rules will define that each time the learner clicks on an entity, its status will change from "non-selected" to "selected". The check rules in turn will define that when the status of all the entities that represent dangerous objects in that scene have been changed to selected, the scene will be completed. The sequence rules will be activated at that moment and the next scene of the game to be played will be selected.

Figure 4. Screenshot the proposed game training children in identifing risks associated with an earthquake. Original image of 3D Artist Rachel Nador from http://www.rachelnador.com/

The different parts of the model can be easily reused to adapt the experience to different requirements or introduce variations. For instance, mouse interaction can be changed when a touch screen is available. Changing the resources and entities the game can be easily adapted to train children in other emergencies such as

identifying causes of a forest fire. Furthermore, by changing some of the strategy rules, the game can serve to train them to identify the safest place in the room when a hurricane strikes.

CONCLUSION

The model presented seeks to organize and formalize the necessary elements to create an educational experience that facilitates the training and learning of children about emergency situations. The model allows the definition of a learner profile, the description of the main features of emergency risk and provides a set of elements to define a game experience that takes into account those requirements.

Currently editor tools to facilitate educators describing the educational experience requirements using the model elements are being developed. Work is also being carried out to develop a game engine able to interpret the definition of the game proposed by an expert based on the definition provided by the educator.

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