

# <e-Adventure3D>: An Open Source Authoring Environment for 3D Adventure Games in Education

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## ABSTRACT

Computer and videogames are rapidly entering the field of Technology-Enhanced Learning. Among the different approaches and game genres, adventure games have been pointed out as one of the most appropriate choices for education. Enthusiast instructors are looking for tools to develop their own educational games, but there are few tools for the rapid creation of modern adventure games with no programming background, and even fewer have been designed with educational gaming in mind. In this paper we present the <e-Adventure3D> platform, a complete environment for the creation and execution of 3D low-cost adventure games in educational contexts.

## Categories and Subject Descriptors

D.1.7 [Programming Techniques]: Visual programming;

K.3.1 [Computers and Education]: Computer uses in education – *distance learning, computer-managed instruction*;

K.8.0 [Personal Computing]: General – *games*.

## General Terms

Design, Economics, Human Factors.

## Keywords

Game-based learning; adventure games; authoring tools;

## 1. INTRODUCTION

During the last decades there has been a rising trend of academic works that advocate for the use of digital games (or videogames) as an interesting complement to traditional approaches in education. Works such as [1;7;8] identified and studied the properties that make digital games suitable for education. Among their arguments, perhaps the most relevant are the impact that fun and motivation can have on the learning experience [3;6] and how the immersion in the world of the games can be used to analyze

the domain of study [4]. Other authors have discussed which genres are more suitable for education, and most agree that *point-and-click* adventure games are a good choice given their bias towards content instead of action [2;5]. In addition, the interaction in adventure games is usually carried out by the combination of the objects and conversations with characters, which promotes analysis, reflection and problem-solving skills [13].

However, the introduction of this kind of games in the educational system is hindered by some barriers such as an excessive development cost and the difficulty of engaging instructors in the production of the games. An interesting solution for these problems would be the introduction of simple-to-use authoring environments for the creation of the games that could be used by instructors and teachers to produce or adapt low-cost adventure games for their specific learning scenarios.

For these reasons, we created the <e-Adventure3D> platform, an Open Source authoring environment for the creation of low-cost 3D adventure games, specially devised for educational purposes.

## 2. AUTHORING TOOLS FOR GAMES

The idea of giving people without a programming background the chance to develop their videogames is not new. Perhaps the most relevant example from an academic perspective is *Game Maker*, originally developed as a tool for education [11;12]. Other popular projects are those published by *The Game Creators*<sup>1</sup> (*The 3D Game Maker* or *The FPS Creator*). There are also some good tools for the development of adventure games (*Adventure Game Studio*<sup>2</sup>, *Lassie Adventure Studio*<sup>3</sup> and *Adventure Maker*<sup>4</sup> are good examples). However, adventure games are nowadays meeting reduced success because modern trends demand 3D graphics. One of the few initiatives in this direction is the *3D Adventure Studio*<sup>5</sup>.

Analyzing these issues from an educational perspective, all these approaches present diverse shortcomings. On the one hand, most 3D tools are still too complex to be used directly by instructors. Additionally, they were not designed specifically for education. For instance, if instructors want to track and evaluate the learning experience, they must rely on direct observation. The challenge is therefore to provide instructors with simple-to-use authoring tools that come closer to the kind of games demanded by the students,

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<sup>1</sup> <http://www.thegamecreators.com/>

<sup>2</sup> <http://www.adventuregamestudio.co.uk/>

<sup>3</sup> <http://lassie.gmacwill.com/>

<sup>4</sup> <http://www.adventuremaker.com/>

<sup>5</sup> <http://3das.noeska.com/>

with the lowest possible costs and that take into account the specific needs of educational contexts (such as the maintainability of the contents or the possibility of evaluating the activities of the students within the games).

3. THE <E-ADVENTURE3D> PLATFORM

The <e-Adventure3D> platform is our contribution to address those issues. The platform gives instructors the chance to produce good educational games for those students demanding attractive environments similar to the ones presented in current commercial games but without compromising the cost.

The platform includes two main applications. An instructor-oriented authoring tool and a game engine that takes the games produced with the editor and executes them. This application was devised to be rapidly deployed in the machines of the students with no need of installation, as this aspect is one of the identified inconveniences of educational gaming.

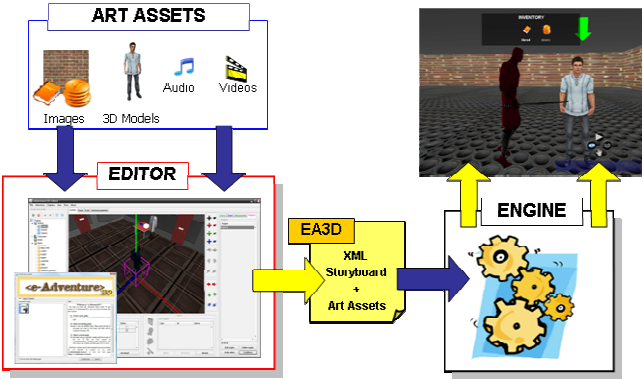


Figure 1. General structure of the <e-Adventure3D> platform.

An <e-Adventure3D> game is a self-contained zip file that contains the art assets files (3D models, audio tracks, images and textures, video files, etc.) and the storyboard of the game, which is represented using an XML-based language. This grants the possibility of tweaking the games even without the editor.

3.1 Creation of the Games: The Editor

The graphical editor allows instructors to edit all the elements of the games, but it is especially helpful for the edition of the most complex aspects such as the geometry for model placement/modification. In addition, given that the target audience is “amateur” developers, the editor creates multiple options by default. However, all the elements are fully configurable and editable, thus balancing expressivity and simplicity. As instructors do not usually have programming knowledge, game-making skills or even sometimes 3D geometry notions the editor was devised to make all these complex tasks completely transparent.

Finally, the editor contributes to improve the performance of the games acting as a transparent multimedia format converter. When an art asset file is selected to be part of the game, the editor converts it automatically to the formats supported by the engine, trying in all the cases to improve the runtime efficiency.

3.2 Executing the Games: The Engine

The engine processes the EA3D file and executes the game. Regarding its design, it was devised to simplify the delivering of

the games to the students in educational contexts (tackled by the choice of Java technologies, which allows the games to be launched on the web), and the need to produce good-looking 3D adventure games without requiring top-tier computers.

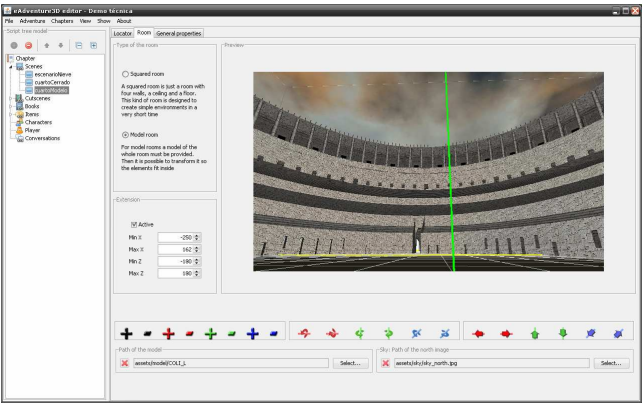


Figure 2. Edition of a scene with the game editor.

Finally, the engine was devised to make the games as intuitive as possible. <e-Adventure3D> games can be controlled with “standard” gamepads (4 buttons, 2 or more triggers and 2 thumb sticks), or a keyboard. When the player moves around, the game highlights the elements that are reachable from the current position and maps the gamepad buttons to the available interactions with those elements.

4. FEATURES OF <E-ADVENTURE3D>

This section summarizes the most important elements and characteristics of the platform.

4.1 Scenes

The narration in <e-Adventure3D> games is structured in interactive scenarios where the action takes place. However, it is not the purpose of the platform to provide a complex, fully-featured tool for the creation of scenarios, but to simplify the game development process. Therefore the platform supports two predefined environments: open environments and rooms.

It is very easy to personalize those environments by just changing some parameters, which allows users to obtain scenes completely different one from the other with low effort. First, open environments are defined by a terrain surrounded by a sky. The terrain has a size (width and depth), a texture and a roughness setting selected by the user. When the user selects a type of roughness the editor generates randomly a terrain according to some predefined parameters, and the process can be repeated as many times as desired. The sky is defined as a 6-image skybox.

Secondly, rooms can be closed rooms or model-based rooms (from a 3D model). Standard rooms are compounded of four parallel walls, a ceiling and a floor with their respective textures. Users can redefine the size (width, height and depth) and the default textures. Model rooms are automatically generated from a pre-existing 3D model which is selected by the author along with the delimitation of the interactive area wherein the player can move. This allows authors to easily define realistic scenes without developing a fully-featured scenario creation tool.

The last aspect to be described in the configuration of a scene is the definition of cameras and lights. Those elements are important

not only due to their impact in the appearance of the games, but also because they can be used to guide the student. The platform allows two kinds of cameras: static and third person cameras. Cameras are edited by just dragging and dropping the mouse. During all the process the values given to the parameters of the camera are completely transparent to the user.

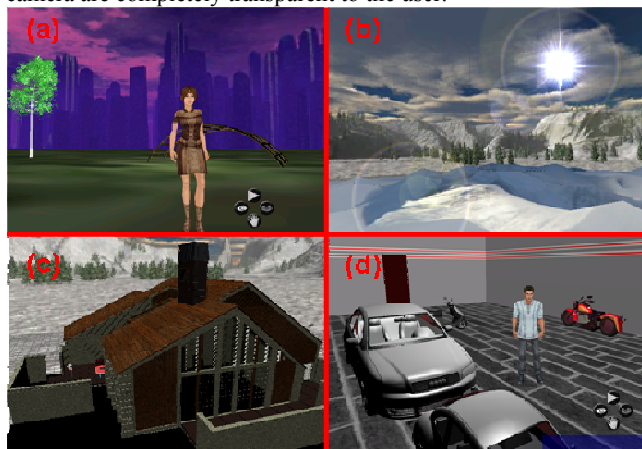


Figure 3. Different scenes: open environments (a, b), a room from a 3D model (c) and a closed room (d).

## 4.2 Interactive Elements

As it is usual in adventure games, scenes can be populated with interactive elements. In <e-Adventure3D> those interactive elements are objects, characters and regions. Following the same pattern that classical adventures such as *Escape From Monkey Island* or *Grim Fandango*, the player can interact with them by carrying out some actions with objects and talking to characters.

The first step to define objects and characters is to select the resource files used in rendering the elements. For objects and characters a 3D model file representing the element must be compulsory selected. Optionally a texture file and the icon image which will represent the object on the inventory can be defined.

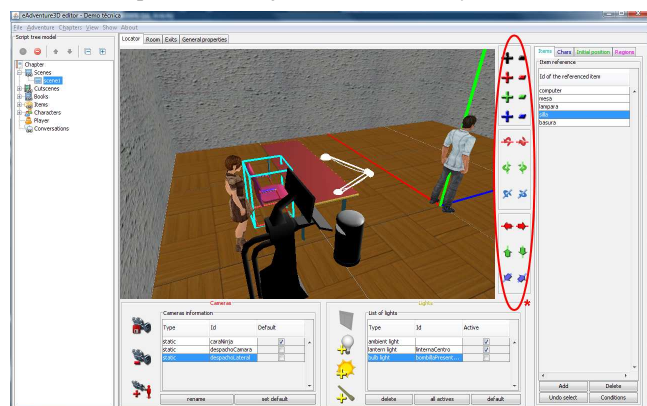


Figure 4. The authors can place and transform elements easily using the transformations bar.

Once the 3D model for an element is loaded with the editor, authors are ready to place it on a scene. As it is usual in 3D games, models may need to be scaled, rotated and/or translated to fit correctly in the scene. With the editor those actions are performed in a graphical and simple way.

Besides, characters accept additional parameters such as the animation ranges of the model (which can be used to improve the realism of the movements and gestures of the character), and two vectors to indicate the orientation of the character's spine and face. In combination, these vectors give the engine the information required for the orientation of the character.

Additionally, the characters can engage in interactive conversations that can be graph-shaped if cycles are needed or tree-shaped otherwise. The editor includes a graphical facility to create these structures easily.

Other sources of interaction are the regions, portions of space which can be defined to trigger automatically some effects when they are entered or exited by the player. This kind of interaction is very interesting as, for instance, we can trigger camera changes when the player moves near a specific area. In addition, regions can also be configured as non-transitable and be used to restrict the movement of the player within an area.

## 4.3 Adding narrative flow: Flags, conditions and effects

With all the elements described so far it is possible to make the skeleton of a good adventure game. But the key difference between a good educational adventure and a bad one is the story that is told. Thus <e-Adventure3D> supports a simple but effective mechanism to support the narrative flow based on flags.

The set of flags determines the game state in each moment. Those flags are indicators which can be "active" or "inactive" at any moment, as traffic lights can be green or red. Flags can be used to block or unblock certain actions or elements in a moment through the definition of conditions on them. The course of the games can be changed by triggering effects to activate or deactivate flags.

In addition, other effects are supported to enhance the appeal of the games. For instance, there are effects to put or remove objects into the inventory or the scene, to provoke automatic movement of characters, to play sounds, change animation frames or cameras, turn on/off lights, etc.

## 4.4 Education-specific elements

The <e-Adventure3D> platform is devised to maximize the learning value of the games. Building on that idea, in-game books can be defined in <e-Adventure3D> to provide learners with huge amounts of information or just as a reference guide.



Figure 5. An in-game book in <e-Adventure3D>

Instructors can define the contents of the books using the editor, which supports basic constructs such as images, titles, bulleted lists, etc. However, it is also possible to link the contents of the book to an HTML document, either as a local file or URL.

Another educational feature of <e-Adventure3D> is the explicit support for in-game assessment. The editor allows the instructor to define different types of assessment rules following the patterns for educational game design proposed in [9]. With these rules, the instructor can track the activity of the student within the game, associate game states with specific marks for the student or compute the grade depending on the choices made by the student during the play session. The results of this evaluation are gathered by the engine, which creates an assessment report. This report can be formatted as an HTML document for the instructor or sent as an XML fragment to an online Learning Management System (LMS) for automated processing.

## 5. CONCLUSIONS AND FUTURE WORK

In this work we have commented how videogames have gained acceptance as a valuable medium for education. Among them, the use of *point-and-click* adventure games is usually identified in the literature as a relevant approach. However, in some cases the acceptance of these games by students is hindered because they are far behind the current state of the art in commercial videogames. Nonetheless, top-tier videogames are too costly to be affordable in education. The challenge then is how to achieve a balance between modern videogame trends and low-cost educational games. We advocate for authoring tools for the creation of 3D videogames (especially focused on the adventure genre) at an affordable cost to address this issue. Following that idea, the <e-Adventure3D> platform provides two applications: an instructor-oriented authoring tool and a game engine designed with educational settings in mind.

So far, the platform has been tested developing two complete adventure games. Both games show good results in terms of the appearance of the games, not so far from commercial 3D adventures such as *Escape From Monkey Island* or *Grim Fandango*. While it is true that these games are somewhat old, they represent an acceptable balance between technical quality and development costs.

This balance is achieved because the toolset reduces the existing gap between the cost of 3D adventures and 2D point-and-click games. It is true that the cost of producing the art assets will be higher as 3D models are very costly. However, small endeavors may find enough material among the numerous free resources available online, while bigger projects with in-house artists will still benefit from this instructor-centered approach [10].

<e-Adventure3D> also includes some education-specific features that increase its applicability. The Java-based implementation of the game engine facilitates the delivery of the games to the students, via web through a Learning Management System. Some of the features of the engine, such as in-game assessments and the support for adaptive learning patterns also improve its educational value [9].

In the near future, the platform needs to be tested more thoroughly by final users (instructors) in order to improve its usability and appropriateness for educational settings. It is also important to note that having an editor that facilitates the technical aspects of

3D adventure game development does not automatically guarantee that anyone can produce a good game in terms of educational content and fun.

## 6. ACKNOWLEDGMENTS

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## 7. REFERENCES

- [1] Aldrich, C. 2005. Learning by Doing: A Comprehensive Guide to Simulations, Computer Games, and Pedagogy in e-Learning and Other Educational Experiences. San Francisco, CA: Pfeiffer.
- [2] Amory, A. 2001. Building an Educational Adventure Game: Theory, Design and Lessons. Journal of Interactive Learning Research, 12(2/3), 249-263.
- [3] Garris, R., Ahlers, R., & Driskell, J. E. 2002. Games, Motivation and Learning: A Research and Practice Model. Simulation & Gaming, 33(4), 441-467.
- [4] Gee, J. P. 2003. What video games have to teach us about learning and literacy. New York: Palgrave Macmillan.
- [5] Ju, E., & Wagner, C. 1997. Personal computer adventure games: Their structure, principles and applicability for training. The Database for Advances in Information Systems, 28(2), 78-92.
- [6] Malone, T. W., & Lepper, M. R. 1987. Making learning fun: A taxonomy of intrinsic motivations for learning. In R. E. Snow & M. J. Farr (Eds.), Aptitude, learning and instruction III: Cognitive and affective process analysis (pp. 223-253). Hillsdale, NJ: Lawrence Erlbaum.
- [7] McFarlane, A., Sparrowhawk, A., & Heald, Y. (2002). Report on the educational use of games: TEEM: Teachers Evaluating Educational Multimedia.
- [8] Mitchell, A., & Savill-Smith, C. 2004. The Use of Computer and Videogames for Learning: A Review of the Literature. Trowbridge, Wiltshire: Learning and Skills Development Agency.
- [9] Moreno-Ger, P., Burgos, D., Sierra, J. L., & Fernández-Manjón, B. 2008. Educational Game Design for Online Education. Computers in Human Behavior, 24(6), 2530-2540. DOI = <http://dx.doi.org/10.1016/j.chb.2008.03.012>
- [10] Moreno-Ger, P., Martínez-Ortiz, I., Sierra, J. L., & Fernández-Manjón, B. 2008. A Content-Centric Development Process Model. IEEE Computer, 41(3), 24-30.
- [11] Overmars, M. 2004. Teaching Computer Science through Game Design. IEEE Computer, 37(4), 81-83.
- [12] Robertson, J., & Good, J. 2005. Story creation in virtual game worlds. Communications of the ACM, 48(1), 61-65.
- [13] Van Eck, R. 2007. Building Artificially Intelligent Learning Games. In D. Gibson, C. Aldrich & M. Prensky (Eds.), Games and Simulations in Online Learning. Hershey, PA: Information Science Publishing.