

From Story-Telling to Educational Gaming: The Bamiyan Valley Case

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Abstract. Preserving the knowledge of previous generations and passing it to new generations is challenging. This process is usually based on an educational system or in any other kind of face-to-face tradition. However, developing countries usually face a lack of well educated people so that this process is hindered. This is even more problematic for countries having recently struggled through times of war. Hence, we apply a community-centered approach to capturing expert knowledge in non-linear digital stories and repurposing it in the shape of educational games. In particular, we support the vocational training of local employees within a cultural heritage community that aims at preserving Bamiyan Valley in Afghanistan.

Keywords: Technology Enhanced Learning, Knowledge Sharing, Non-Linear Multimedia Story-Telling, Educational Gaming.

1 Introduction

Cultural heritage worldwide faces risk of damage as a result of natural and human impact. This is a particularly serious problem for the preservation of cultural heritage sites in developing and post-conflict countries. In these contexts, local experts are a scarce resource and funds for external expert support are very limited. The situation gets even worse in countries shaken by internal and/or external tensions, which led to an exodus of local experts during the years of political instability. The impact on the human resource sector is devastating. In this regard, Afghanistan, having suffered from internal and external armed conflicts and wars in the past 25 years, is an especially severe case.

Since 2002 the international community has made great effort in rebuilding and recovering severely damaged Afghan cultural heritage. Under the appeals and guidance of the United Nations Scientific and Cultural Organization (UNESCO)¹ as well as the International Council on Monuments and Sites (ICOMOS)², RWTH Aachen Center

¹ <http://whc.unesco.org/en/activities/2/> (last access: 28/05/08)

² <http://www.international.icomos.org/risk/2002/afghanistan2002.htm> (last access: 28/05/08)

for Documentation and Conservation cooperates with international organizations as well as national institutions in the domain of cultural heritage preservation. In this context, capacity-building activities in heritage management for Afghan experts and conservation work on some of the most important monuments in the country such as the UNESCO World Heritage Site Bamiyan are key projects. Activities take place in tight cooperation with national institutions and local experts such as the Society of the Preservation of Afghanistan Cultural Heritage (SPACH)³, the Departments of Archaeology and Historical Monument Preservation of the Afghan Ministry of Information and Culture, the National Research Institute of Cultural Properties Tokyo and with the participation of a new generation of scholars and students from the Kabul University. The creation of a UNESCO Cultural Master Plan for the World Heritage site of Bamiyan⁴ is one of the most important outcomes of the project. However, it remains a difficult and complex task to recruit and coordinate a sufficient number of local and foreign experts to accomplish such an ambitious project. This is a typical example that acts as case study in this work:

“We are trying to specify the exact position of a large piece of debris in one of the giant Buddha caves in Bamiyan. This is a necessary preprocessing step for a potential later relocation of fragments and reconstruction of the giant Buddha itself. As a capacity building measure, experts instruct local heritage officials employed for the project to take photos of a stone fragment with a GPS-enabled camera [6]. But quality of the resulting data tends to be rather poor as the local employees have problems at using the equipment in the pre-defined sequence or they simply forget to reset the GPS bearing settings after a photo has been taken because the overall purpose of this activity is not fully understood for a variety of reasons.”

While educational infrastructures have to be rebuilt across the country, the brain drain of a whole generation also has to be stopped or even inverted. In our vocational training scenario we use educational games to teach adult employees the nature of a conservation project, the nature of data gathering procedures, and the correct use of the equipment. Since the creation of educational games from scratch is expensive and requires highly specialized technical and pedagogical skills, we use a semi-automatic approach in creating educational games from multimedia narratives. Starting point are non-linear stories created in our MPEG-7 [8] based multimedia integrated storytelling environment called MIST [22], which taps the multimedia repository of an online community with the intention of gathering the widespread information about the Afghan cultural heritage [14].

In this paper, Section 2 highlights the interrelation between (non-)linear storytelling and educational gaming in technology-enhanced learning (TEL) for vocational training [7]. Then we present the related work with an emphasis on multimedia capableness, interoperability and community support in Section 3. In Section 4, we introduce our methodology of creating educational games from expert knowledge captured in non-linear multimedia stories. Section 5 explains how our approach connects

³ <http://www.spach.info/> (last access: 28/05/08)

⁴ <http://www.bamiyan-development.org/projects/cultural-master-plan> (last access: 28/05/08)

non-linear story-telling and educational gaming in the case of Bamiyan Valley. Finally, conclusions and future work are presented in Section 6.

2 TEL for Vocational Training: Story-Telling and Educational Gaming Revisited

When making TEL productive for vocational training, a usual question arises: What are the main differences between guiding children in their learning processes and guiding adults? Knowles developed a theory called andragogy (mentioned by Barbara Kieslinger in her blog⁵) that specified fundamental aspects to be covered in adult learning [12, 13]. He figured out that adults – unlike children – are self-directed and expect to take responsibility for decisions. Moreover, adults prefer the instructor to behave as a facilitator instead of a lecturer. As a result, he postulated four principles to be incorporated in the process of adult learning [12, 13]:

- 1) Motivation: Adults need to know why they need to learn something
- 2) Experience: Adults need to learn experientially
- 3) Orientation: Adults approach learning as problem-solving
- 4) Readiness: Adults learn best when the topic is of immediate value

Table 1. Andragogical similarities between story-telling and educational gaming

Andragogy	Story-Telling	Educational Gaming
Motivation	Reliving real life tasks	Preparation for real life tasks
Experience	Non-linear exploration of story paths	Non-linear navigation through a virtual world
Orientation	Complex story graph	Interleaved sub-problems
Readiness	Problem solving by other members' experiences	Understanding of real life problems by reproduction

Table 1 depicts the andragogical similarities between story-telling and educational gaming. From the respective facets contained in story-telling as well as in educational gaming, it can be seen that both approaches emulate real life processes either within complex story graphs or as interleaved sub-problems. This is consistent with the main conclusion that can be drawn from the previous four assumptions for TEL in vocational training: TEL in vocational training requires learning to focus more on the process and less on the contents.

However, educational games require highly specialized technical and pedagogical skills to cover adequately complex learning topics. This difficulty can lead to a trivialization of the final games produced, which in turn can lead to a de-motivation problem. Indeed, as pointed out by Hamalainen [7], while the integration of learning and

⁵ <http://barbarakieslinger.zsi.at/index.php/2008/01/16/what-happened-to-andragogy/> (last access: 28/05/08)

gaming provides great opportunities, it also addresses severe motivational challenges (particularly in vocational training). As pointed out by Weinberger [25], an important source of de-motivation is the creation of excessively obvious tasks by designers during scripting.

In turn, non-linear digital stories are an ideal starting point for the creation of educational games, since each story addresses a known problem, so that the story recipient may gain benefit from other users' experiences. The results are real-life stories that set up the basis for non-trivialized educational videogames. In order to connect both aspects, we take a closer look at related work in the next section and will point out what (if possible at all) is needed to connect these approaches.

3 Related Work

There are very different approaches to group-based story-telling and educational gaming. In this overview, we focus on initiatives to foster knowledge sharing in communities of practice. We will also point out whether and to what extent these approaches cover both aspects in andragogical motivation: Reliving real life tasks from stories and preparation issues in educational gaming.

3.1 Related Work on Story-Telling

An application of group story-telling in knowledge management is *TellStory* [20]. It is a collaborative, web-based application that allows a group of users to jointly create a text-based story. A decisive deficit of *TellStory* is that it is text-based only and does not support the usage of multimedia.

StoryMapper is an approach to group-based story creation [1]. The collaboration process is guided by user roles (i.e. teller, organizer, associator/indexer and listener). For visual representation *StoryMapper* supports the use of conceptual maps and arbitrary media can be attached to the conceptual map nodes. Thus, *StoryMapper* is capable of modeling expert experiences within stories.

An approach towards group story-telling for team awareness and entertainment is *PhotoStory* [24]. Group members may create stories jointly, which consist of pictures and their subtitles. The system is based on BSCW [11] and supports community collaboration and knowledge exchange according to the BSCW methodology. However, its current implementation only supports photos.

An approach to retrospective story-telling with digital photos is *iTell* [15]. In this aspect, *iTell* is in line with the intention of story-telling to support learning by sharing expertise within communities. *iTell* supports a 4-ary creation process (brainstorming, organization, writing and media association) including photos as well as voice recordings to be associated with linear text-based stories.

Collaborative audio-based storytelling is an approach focused on audio and its text-based metadata [10]. The system is also suitable for modeling non-linear media dependencies. However, *collaborative audio-based storytelling* does not support any other media and application of the stories for educational gaming is not considered.

An interactive environment for emergent story-telling is *StoryWriter* [23]. The idea is to create text-based and illustrated stories. The authors of stories are guided by rules

that e.g. manage the interaction between characters. But *StoryWriter* is neither web-based nor collaborative.

In addition, there are several story-telling platforms especially for cultural heritage management such as the *CIPHER* project [5] and the *Instory* project [3]. Both of them focus on helping tourists explore cultural heritage sites using linear multimedia.

3.2 Related Work on Educational Games

Regarding the development of educational games, the field is very broad, as there are many different approaches to game development. These can range from writing them from scratch (using general-purpose languages such as C++) to GUI-based authoring tools that don't require any programming knowledge. Given the nature of this application, we will focus the discussion on such authoring tools.

Many game-authoring tools are actually non-educational commercial products targeted to amateur game developers willing to develop their own games without programming knowledge. This is the case of tools such as *The FPS Creator* and *The 3D Game Maker*, both developed by The Game Creators⁶. On the other hand, *Mission Maker* (distributed by Immersive Education⁷) was developed with educational purposes, but it is still a commercial product.

The Game Maker [19], on the other hand, is an academic project consisting on a GUI-based authoring environment that also supports a scripting language to extend the functionality of the tool. It has been used in several academic research projects related to educational gaming [2]. However, it was not specifically designed for the kind of game design that we are pursuing.

In this sense, the *Alice*⁸ project, developed by Carnegie Mellon University, was originally designed to be a first contact with Object Oriented Programming, but its spin-off project, *Storytelling Alice* would fit the game design we are seeking. Unfortunately, its focus on being a tool to learn computer programming suggests that it may not be ideal for the integration with our previously existing tools.

3.3 Conclusion

In the previous overview we have introduced several approaches towards story-telling and educational gaming. As we have pointed out, current approaches are not suitable for combining community support with a comprehensive methodological support to connect the reliving real life tasks from stories and the preparation issues in educational gaming. Thus, next section introduces our approach to connect the structural properties of the story-telling with a specific gaming engine.

4 Creating Educational Games from Non-linear Digital Stories

As mentioned in the previous chapter there is no approach that exploits the expertise of non-linear digital stories for a latter usage in educational gaming. In order to tap

⁶ <http://www.thegamecreators.com/> (last access: 28/05/08)

⁷ <http://www.immersiveeducation.com/missionmaker/> (last access: 28/05/08)

⁸ <http://www.alice.org/> (last access: 28/05/08)

the vast repository of community-generated knowledge for vocational training contained in non-linear digital stories, we propose an efficient way of creating and converting these stories into educational games. This is the rationale behind the connection of the structural approach of the story-telling environment MIST (developed at RWTH Aachen University, Germany) with the <e-Adventure> educational game platform (developed at Complutense University of Madrid, Spain) via an XML-based interchange format.

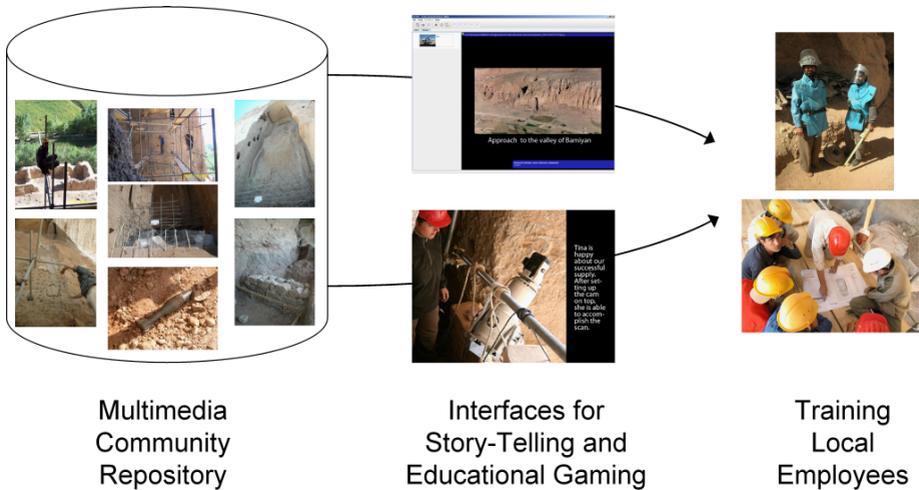


Fig. 1. Interconnecting story-telling and educational gaming for vocational training

4.1 Using MIST to Compose Non-linear Digital Stories

The first pillar of this approach is the story-telling environment MIST [22]. In order to help experts and instructors in creating useful stories (from a structural point of view), the MOD paradigm is applied (cf. [21] for details). The basis are multimedia contents that might either be re-used from our geographic information system ACIS or newly added at time of creation. Thus, the story designer might take benefit of the vast pool of already existing data in the community repository.

The MIST editor allows a temporal composition of multimedia contents. The story author can now create paths covering different aspects along the contents. Thus, the problems addressed depend on the path selected and lead consequently to different results in a story. Figure 2 shows the editor consisting of three main elements: Storyboard (on the left), problem hierarchy (upper right side) and media preview (lower right side). The storyboard is a graphical representation of stories according to MOD paradigm, which prescribes the decomposition into dedicated (potentially repeating) begin, middle, and end sequences.

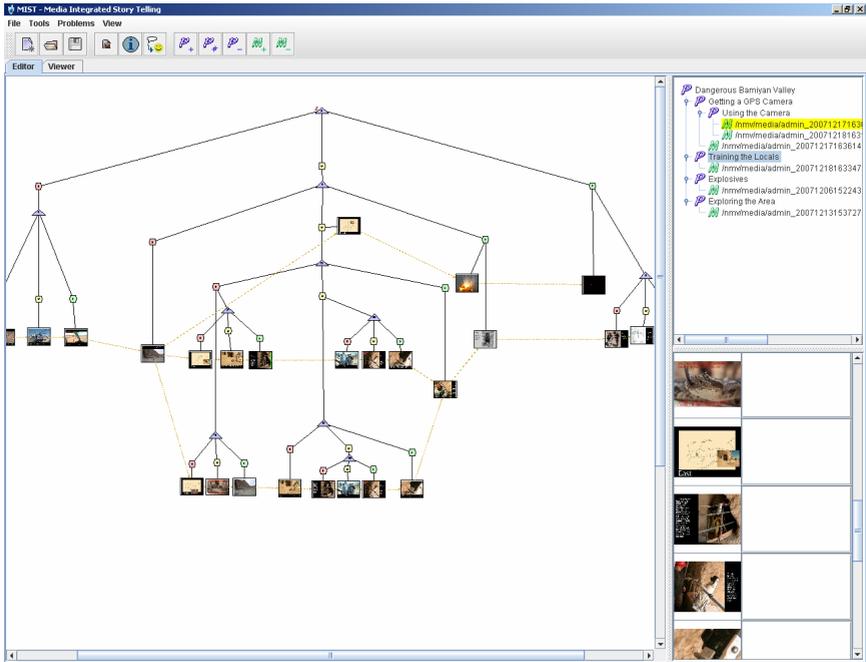


Fig. 2. Expert knowledge captured in a non-linear multimedia story

4.2 Using <e-Adventure> to Transform Non-linear Digital Stories into Educational Games

The other pillar is the <e-Adventure> platform, a complete solution for the development, execution and integration of educational games in Virtual Learning Environments [17]. The games are created using the <e-Adventure> editor, which is a GUI-based authoring environment for *point and click* adventure games. The games created with the editor bundle a description of the game content using the descriptive markup of the <e-Adventure> XML language [18] and all the media assets required for the game. These bundles are executed by the <e-Adventure> game engine, which can run stand-alone or being deployed through Virtual Learning Environments [4].

In our approach, the expert knowledge captured in the non-linear multimedia story using MIST is transformed into an <e-Adventure> game skeleton. The first step is to export the story to the domain-specific markup language used in the <e-Adventure> platform. The mapping between the non-linear stories created with MIST and educational games processable by <e-Adventure> is described in Table 2. As a result from the conversion process, a basic skeleton for an educational game is obtained. The MOD structure of the story is used to specify a basic set of transitions for the further creation of the educational game. In addition, the media contained in the non-linear story are set as background images of each scene.

In the next step, the dedicated editor of the <e-Adventure> platform is used to refine the raw educational game derived from the non-linear story. Even though the

editor was designed for the creation of educational games from scratch, it can take the output of the exportation process as a basic game. Then, the users can leverage the editor to refine and improve the automatically generated game skeleton and turn it into a fully featured educational adventure game.

Table 2. Transformation rules from non-linear stories into educational games

<i>MIST</i>	<i><e-Adventure></i>	<i>Remarks</i>
<pre><mediaNode type="*" id="{id}"> {URI/{scene}} </mediaNode></pre>	<pre><scene start="no" id="scene{id}"> <resources> <asset type="background"> uri="assets/background/{scene}" </asset> <name>scene{id}</name> <exits> ... </exits> </resources> </scene></pre>	<ul style="list-style-type: none"> • Scene ID gets the prefix <i>scene</i>. • Content of <i><exits></i> defined by <i><successorRel></i> as shown below.
<pre><successorRel> <relation> id="1" source="2" target="1" </relation> <relation> id="2" source="1" target="1" </relation> </successorRel></pre>	<pre><exits> <exit x="0" y="0" height="100" width="100"> <next-scene idTarget="scene2" /> </exit> <exit x="100" y="0" height="100" width="10"> <next-scene idTarget="scene3" /> </exit> </exits></pre>	<ul style="list-style-type: none"> • Successor represented as exits starting in the top left corner. • Relation (source, target) means that source is a predecessor of target. The exits here (scene 2 and scene 3) belong to scene 1.

5 The Bamiyan Valley Case-Study

The approach outlined in the previous section has been used in the development of educational games for the specific training context of the UNESCO Cultural Master Plan for the World Heritage site of Bamiyan as described in Section 1. In order to raise awareness on cultural heritage preservation among local communities and to facilitate cooperation among international experts and local authorities responsible for site management, architects at RWTH Aachen Center for Documentation and Conservation created stories to be repurposed as educational games. These stories target non-professional or non-skilled locals involved in preservation and monitoring work, who require career training in working procedures to be done during on-site preservation work. The stories were automatically transformed into adventure game skeletons usable by the *<e-Adventure>* platform as described in Section 4. These skeletons could not be considered distributable educational games yet, but the narrative portion of the games was already created. Then, using the *<e-Adventure>* graphical editor, these skeletons were manually refined and turned into executable educational games.

Figure 3 shows the *<e-Adventure>* editor displaying a scene automatically generated from one of the non-linear stories. This particular game deals with the task of using a GPS-enabled camera to take photos of a stone fragment in one of Buddha caves in Bamiyan. Using the editor, additional resources (such as a GPS camera), characters and transitions between scenes (so-called exists) as well as (educational) dialogue between characters can be defined. In addition, back links – which do not exist in non-linear stories – can be inserted at this stage. The result of the process is the “Bamiyan Valley Educational Game”. Figure 4 contains two screenshots of the resulting point & click adventure being executed by the *<e-Adventure>* engine.

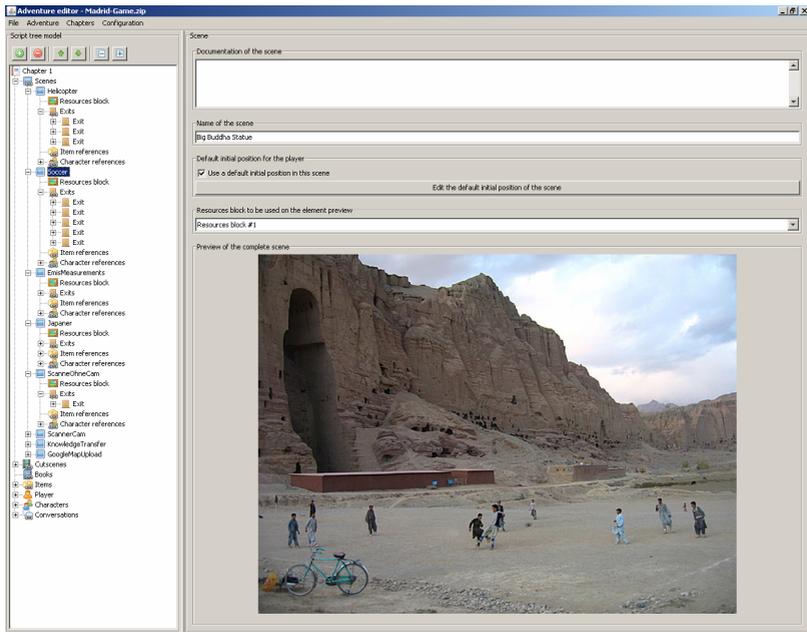


Fig. 3. Refining a game skeleton derived from a non-linear story in the <e-Adventure> editor

The designed game was introduced to a group of trainees from Bamiyan during a capacity building course at RWTH Aachen University within the UNESCO project for the preservation of the Bamiyan site. All participants of the course are employees of the local public administration in Bamiyan and selected in order to be trained on the long term preservation goals for Bamiyan as defined in the UNESCO Cultural Master Plan. The game was widely accepted and tried out with enthusiasm. It led to a truly collaborative experience in which some participants explained to others the “correct” answers to reach the game ending. The use of real-life imagery led to enhanced attention on behalf of the users to the assigned training tasks. It is planned to use the game in preparation of future conservation and monitoring tasks on site.



Fig. 4. Screenshots of the “Bamiyan Valley Educational Game”

6 Conclusions and Future Work

The process described in this work proposes a collaboration model between domain experts (cultural heritage experts in our case study) and game developers (instructors in this case, since <e-Adventure> is an instructor-oriented environment). The expert knowledge is captured in the shape of non-linear stories. This a collaborative process that uses specialized story-telling tools (such as MIST) to compose the stories using contents gathered and annotated collaboratively in ACIS for cultural heritage management in Afghanistan. The challenge was therefore to make this expert knowledge available for vocational training in educational games. Our mapping rules now make stories for technology enhanced learning by educational adventure games based on the <e-Adventure> platform. The XML bindings supported by both platforms facilitate this process, allowing a semi-automatic transformation process composed of an automated step (turning the story into a game skeleton) and a manual refinement process that fine-tunes this skeleton converting it into a game.

This approach reduces the cost of the game development process enormously. Tasks such as writing the narrative flow of the game, creating and/or gathering the art assets, and then creating and connecting scenes with content are usually the most demanding stages of the development process. This approach covers these aspects, leveraging the functionality of the ACIS platform for collaborative asset gathering and maintenance, using MIST to facilitate the creation of the non-linear stories and, finally, transforming these stories into basic game skeletons that include the different scenes already interconnected and populated with content.

Most game-based learning experiences also find problems when it comes to interweave content and fun. In adventure games, both aspects are actually connected through the narrative flow of the game [9]. Therefore, the quality of the final game (both in terms of educational value and appeal) depends heavily on the quality of the underlying story. Compared to other educational game authoring approaches, the creation of the storyline using specialized tools like MIST offers additional support for the creative process.

After the development of the case study we intend to apply the same approach in other fields like medical training, where <e-Adventure> has been used successfully as a standalone tool [16]. Additionally, we also envision non-educational applications of the approach: Commercial games often find difficulties when it comes to convert interesting storylines into functioning games without losing value in the process. The authoring approach supported by MIST facilitates the procedure of writing and maintaining the stories which can be transformed into games semi-automatically then. Whether this approach can be applied for the development of purely entertainment-driven adventure games is an interesting line for future research and development.

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