Bringing Egyptology to the Classroom: Virtual Reconstruction of the TT 209 Site

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***Abstract*—In this article we propose the use of virtual reconstructions as a method to improve the learning performance of young students about the methods and techniques used in Archeology. The methodology included in this article follows two different paths depending on the students' abilities when reading or using computers. To test the method, we have developed a virtual reconstruction of the TT 209 archeological site in Luxor. This application allows students to move inside and outside the excavation and get some information on the different activities that were done along the field work. Several questionnaires directly available on the application are included to improve the learning performance. Several preliminary results obtained from an experience with 6 and 13 years old students are also shown.**

Keywords—Virtual Reality, Egyptology.

I. INTRODUCTION

There are some disciplines that can be easily presented in the classroom from an experimental point of view. It is easy to see a scientist showing some chemical reactions to a group of students, or a work group when students represent a Lope de Vega's comedy. However, these practices are much more difficult in other disciplines such as History. The logistical problems of translating students to a real archaeological site make this activity a very restricted one, that can be done only in very specific time windows due to the inherited restrictions of the archaeological activities. This fact is even worse when we focus on Egyptology. This branch of archaeological studies and its specific techniques and characteristics are mainly developed in Egypt itself, where the logistical problems of possible visits highly increase.

Fortunately, the extremely fast development of new technologies opens a new scenario where virtual worlds and multimedia resources can be used as a potential alternative to real visits to archaeological sites where access can be restricted by any reason. The use of computers as an alternative to traditional teaching techniques is much extended nowadays. A clear example is given by MIT as one of the first institution that offered virtual versions of all of its courses [1]. Many advantages have been found in the use of computers in education. One of the most relevant one is the so called gamification, that relies on the argument that computer-games are fun and, therefore introducing game-like features into e-Learning activities would make them more attractive [2,3]. The use of gamification as a potentially motivating e-learning tool is a hot topic nowadays. Several studies have focused, for example, on the dependence of the gamification benefits with the learner profile [4, 5]. The influence of the learner's age has been also found as a factor that may have a strong influence in the positive influence of gamification, being the effect stronger in middle school participants than in adults [6,7]. Another study found a clear difference between effectiveness and engagement in the use of gamification techniques, where effectiveness decreased as engagement increased [8].

In this article we present a gamification methodology, based on the virtual reconstruction of the TT 209 site (figure 1) in Egypt, to recreate in a very immersive way the specific archaeological techniques used in Egyptology.

TT 209 is located in Luxor, in its western necropolis, a worldwide known historical site. The Archaeological Mission of the University of La Laguna has developed four seasons of field work that have excavated the courtyard, the first of the underground chambers, and a mudbrick building of large dimensions on the surface. Through the inscriptions found, it has been possible to identify the name (Nisemro or Ashemro), the titles and the ethnic group of the tomb's proprietor. They have also allowed deducing the chronology of the monument, built at the beginning of the Twenty-fifth Dynasty, a period when Egypt was ruled by a royal family of Nubian origin. The interest of the site is that it is later to the best known phase of the Theban necropolis, the New Kingdom, and, therefore, informs of the cultural transformations in the post-empire Egypt. The architectural and decorative innovations can be seen as tests and adaptations of existing models to resolve the needs of Nubian elites to display prestige goods through a constructive and ritual policy. These novelties are the basis for the later development of Egyptian funerary architecture of the Late Period.

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Fig. 1. TT 209 picture taken during the fourth season of field work on July 2015.

Our methodology relies on the use of gamification as a tool to improve students' motivation and attention, as well as to be used as a virtual substitution of the real experience of being present at the site during the excavation process, which is not realistic in this discipline. It is also worth noting that we are developing a tool that uses real data from an excavation that is being developed at present. By using this tool, students can learn about the most recent Archeological techniques and knowledge. The format of the application allows it to be updated easily in the future to include any new discovery or information.

II. VIRTUAL RECONSTRUCTION OF THE TT209 SITE

A. Data Acquisition

The first step in the development of the virtual reconstruction of the TT 209 site was the data acquisition in the site. This task was performed by a team of computer scientist during the 2015 campaign, which extended from June to August. The subject under study was the Archaeological methodology instead of the history of the site itself. For this reason, the multimedia material obtained in this stage focused on the team instead of the tomb. The only multimedia material needed for the reconstruction is related to the tomb dimensions and materials. Pictures and measures of both the interior and exterior of the site were taken, as well as accurate measurements of the dimensions already taken by the Archaeologists in previous campaigns. The main contents of the application were related to the different activities carried out in the excavation. 10 different jobs were identified: Archaeologists, Restorer, Photographer, Surveyor, 3D reconstruction expert, Coordinator, Cataloguer, Hieroglyphs reader, Computer scientist and Egiptian workers. For the inclusion in the application, a one minute single video of every job was taken, in which the workers explained their activities in the site.

Finally, several videos and pictures were additionally taken to include other complementary information in the application, such as questions about the tools used for different members of the expedition or the specific relevant activities that were developed.

B. Virtual Visit Tool

The engine selected for the virtual visit was Unity 5.2.2. The 3D object set including the whole volume of both the interior and exterior of the tomb was developed by Blender 2.69. Some images from the final version of the application are shown in figure 2. In this figure we also show the different

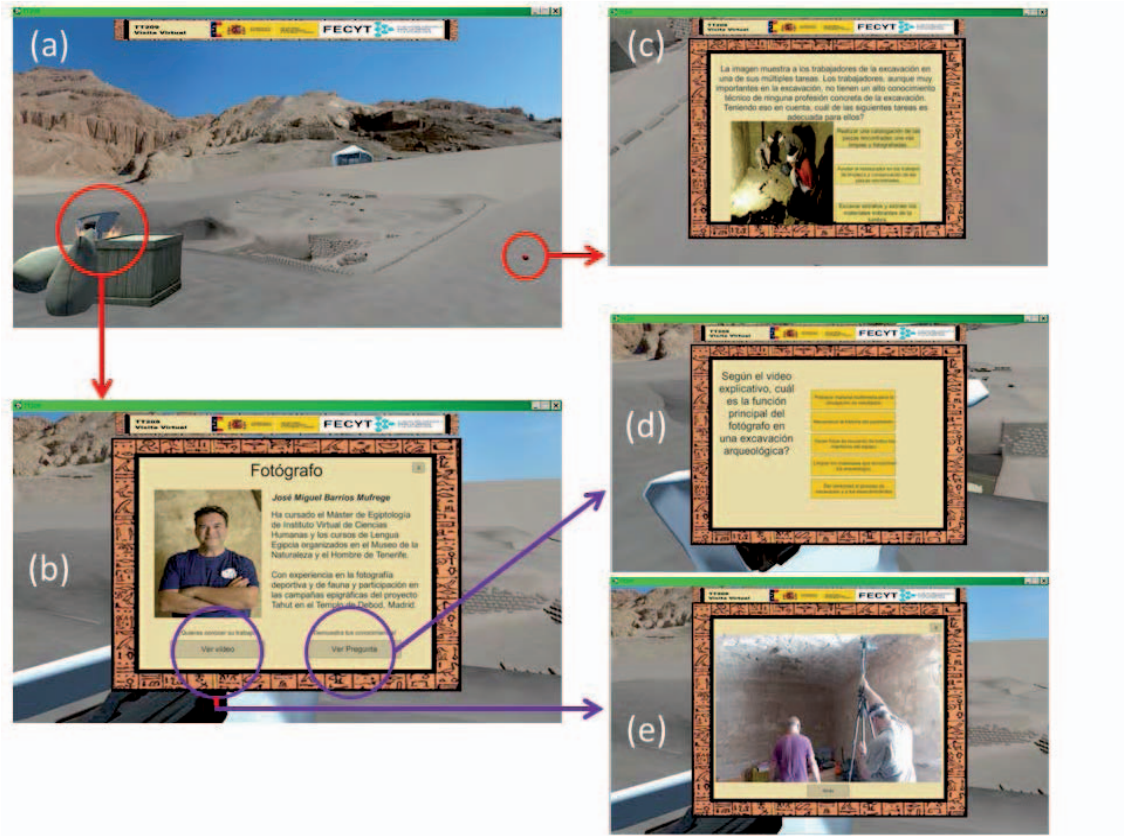

Fig.2. Virtual visit of the TT 209 site. The image shows the different paths that must be followed to get access to the different options offered by the application.

options for students when they are using the application. In figure 2a we can distinguish the exterior of the tomb with several objects on the surface. On the right side we can see some boxes and a chair. This chair is attached to the information of the photographer. If the student moves closer to the chair and push a certain key, a new image is shown on the screen, as shown in figure 2b. In this image we can find some relevant information about the photographer and the option of showing a video made by this member of the expedition or showing a question about his job. The question about his activities can be found in figure 2d. Since these questions are directly related to the video, five possibilities can be answered. In figure 1e we show an image of the video related to the photographer, where he is preparing a photogrammetry system and, at the same time, explaining some details about his work in the audio. Since the question from figure 2d is related to the video from figure 2e, it is recommended that students take a look to the videos before answering the questions. The second possibility that comes from figure 1a is related to several red spheres that can be found in different places of the virtual visit. These spheres are triggers of questions that are not directly related to the videos of the expedition members. Once we are close to the spheres and push the trigger key, a new screen such as the one shown in figure 1c appears on the screen.

C. *Methodology*

The TT 209 Virtual Visit is going to be used by students on divers levels, which have many different knowledge and abilities because of their age. Depending on that factor, students may be able to use computers easily or not. The youngest ones will not be even able to read since we are fixing a lower limit around four years old. Since we have very different scenarios, we must adapt our methodology to the final conditions and characteristics of the targets. In figure 3 we show the two main methods that we propose in this article.

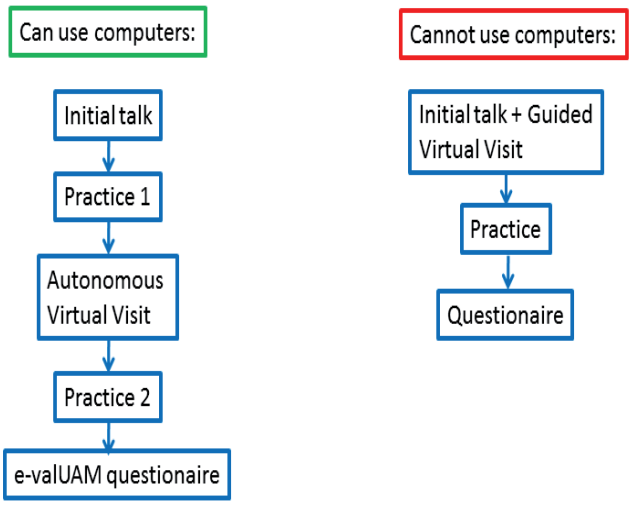

Fig. 3. Methodology proposed for students with correct reading skills and an efficient use of computers (left) and for students that are no able to read or use computers correctly (right).

The strategy that we propose for students with good reading and computer skills starts with an oral presentation in which the main characteristics of the excavation and related jobs are shown. In this presentation the TT 209 Virtual Visit is not at the beginning. If needed, it can be briefly explained in order to improve the students' efficiency when using it, but it must be clearly stated that this kind of students will be practicing with the application later autonomously. After the initial talk, a first exercise is proposed to the students (Practice 1 in figure 3). This exercise is placed here as a control group and will measure the different students' performance before and after using the application. It is also adequate as a reminder of the knowledge acquired in the first talk. After these two steps are done, students start using the application. It is supposed that students will be accessing to the different questions and videos proposed in the application and acquiring a better and wider sight of the Archeological excavation processes. A second exercise, that will have a similar format than the previous one is presented right after using the application. The format suggested here is an open question where students must propose an Archeological methodology against a typical situation found in the site. The texts obtained in both Practice 1 and Practice 2 can be treated by emotion detection procedures [9] to measure the motivation found in students both when using the application and when they did not use it yet. This second exercise (Practice 2 in figure 3) can be proposed to the students after the virtual visit or at the same time. Last step in this methodology is an e-valUAM test [10] where all the questions asked by the applications are asked again to the students. This tests works as a control point that measures the knowledge acquired during the process.

Students that are not able to use computers or read require a different methodology, which is restricted mainly by the limitations of autonomous use of the TT 209 Virtual Visit and the e-valUAM tests. In this case, we propose an initial talk composed by both the talk used with the older students and also a guide virtual visit where the students are able to see all the features of the application and also ask questions to the speaker about anything they see along the visit. Since these students are watching the presentation and virtual visit at the same time, it is not possible to measure the different motivation or interest after and before the visit. In this case, we propose a role playing game (Practice in figure 3) where students assume the role of the different members of the excavation and try to solve a problem (similar to Practice 1 and 2) where they have to interact in the correct way. The format of the final questionnaire here depends on the students' abilities.

III. PRELIMINARY EXPERIENCE

The first experience involved two groups of students from very different ages. The first one was composed by a set of 20 students from the second course of primary school. These students are 6-7 years old. The second group involved 24 high school students who were, in average, 13 years old.

Let us start analyzing some results from the first group. These 20 students followed the methodology proposed in figure 3 for students that cannot use computers. Although some of them could do it, we decided to apply this procedure since they did not have yet formal knowledge about computers and

we could not be sure about their skills in this matter. During the practice stage, all the students selected a job from the list explained in section II. Only the coordinator was removed from the list since his job was already done by the teachers when preparing the activity. The questionnaire was composed by the 4 following questions:

1) What was your task in the excavation?

2) What is the porpoise of an Archeological site?

3) Write down three jobs (different than yours) related to Archeology and explain their activities.

4) What do you like the most about Archeology?

Students had to answer these 4 questions at home right after the activity. We could collect 13/20 questionnaires, were two of them were discarded because it was detected that the students may have received some help by adults. From the final 11 questionnaires, we obtained the following results:

1) 9/11 students wrote down correctly the details about their own job in the simulation. These data correlate with the results obtained in the classroom right after the game, where the teacher asked all the students about their activities. 18/20 correctly identified and explained the basic details of their work.

2) 8/11 students gave correct answers to the second question with correct and reasonable details about the motivations of Archeology.

3) Cataloguers and Hieroglyphs Readers were cited once. Archaeologists, Restorers and Computer Scientists were cited twice. Surveyors were cited 3 times. Egyptian workers were cited 4 times. Coordinators were cited 5 times and Photographers were cited 8 times. Also, other jobs not related to the excavation were also cited such as miners, mechanics and builders. It is very interesting the 5 citations to the coordinators since this job were not included in the activity. Apparently, this is a job that is highly enjoyed by young students. The most cited job was photographer, probably because it is one of the most familiar activities in their life. Another interesting fact is that Egyptian worker, apparently one of the most exhausting activities, is cited 4 times. We assume that this was one of the funniest activities along the game. The last fact that must be taken into account is that Hieroglyph Readers were cited only once. However, this was the activity that the students wanted the most at the beginning of the activity. It is worth noting that students that played that role could not mention it in this third question.

4) 5/11 students claimed that the most interesting activity was the one that they performed, even when they had to play a role different than their favorite at the beginning. 2/11 students claimed that the most interesting activity was the use of the virtual visit during the previous talk.

Let us now analyze the second group (high school students). We applied the methodology from the left side of figure 3. To measure the influence of the virtual visit on the students' motivation, we made three different groups of 8 students who followed different paths. The first 8 students (group 1) first used the TT 209 virtual visit application, then the e-valUAM test and finally the "practice 2" exercise. The second group of 8 students (group 2) made first the "practice 2" exercise, then the e-valUAM test and finally the TT 209 visit. The final 8 students group (group 3) made first the e-valUAM test, then the "practice 2" exercise and finally the T 209 visit. In other words, groups 2 and 3 were evaluated before using the virtual visit and group 1 used the application before making any questionnaire.

The first conclusion that we found in this study is that the use of the virtual visit is a very exciting activity for the students that focus all their attention. We concluded that by measuring the difference performance between "practice 1" (right after the initial talk) and "practice 2" (being done in the computer laboratory at the same time than the virtual visit). In general, the answers from the first exercise were longer and included a higher amount of significant information. This is a very important result since it demonstrates that the interest of the students in the virtual visit can be an obstacle for their performance in other tasks. We suggest separating the virtual visit to any other learning activity to avoid any interference.

A second conclusion is related to the increasing in their knowledge due to the use of the virtual visit. In this first preliminary results, we have measured an average score of 7.05 in the e-valUAM questionnaire from group 1 (who used the virtual visit before) and an average score of 6.51 from groups 2 and 3 (who used the virtual visit after finishing the questionnaire). There is an increasing that, however, can be more significant if we also take into account the measurements of the motivation from "practice 2". When we compare students' performance in this task, we find that group 1 had a much smaller motivation. These two results again points to the fact that students had a huge expectation about using the virtual visit tool. Once they finished, their knowledge increased but their motivation fell. This reduced motivation could affect also their performance in e-valUAM, so we may expect higher differences in the e-valUAM scores when they are not influenced by the different motivation.

IV. CONCLUSIONS

We have presented the virtual visit of an Archeological site in Egypt and a methodology to use it as an e-learning tool for young students between 4 and 18 years old. The methodology strongly depends on the age of the students and suggests two different paths depending on their reading abilities and their computer skills. We have also described a preliminary experience where the two paths of the methodology were applied. The methodology used for youngest students gave us information about their interests in the different jobs performed in the excavation, as well as a high interest and motivation when the virtual visit was shown during the first talk. The methodology used for older students showed that the expectation of using the application can interfere in their performance when developing other activities that can be perceived as less interesting. To avoid this effect, we propose to use the virtual visit in an independent session, in order to avoid any possible distraction.

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