Rafael Martín Espada
PhD Professor
Director General of Telecommunications and Information Society Board
University of Extremadura (UEx), Spain
rmmartin@unex.es

Juan Arias Masa
PhD Professor in the Telematic Engineering Department
University Centre, University of Extremadura, in Mérida, Spain
jarias@unex.es

Sixto Cubo Delgado
PhD Professor in the Education Studies Department
Education Faculty of the University of Extremadura in Badajoz, Spain
sixto@unex.es

Gemma Delicado Puerto
PhD Professor in the English Department
Teacher Training Faculty of the University of Extremadura in Caceres, Spain
gdelpue@unex.es

Prudencia Gutiérrez Esteban
PhD Professor in the Education Studies Department
Education Faculty of the University of Extremadura in Badajoz, Spain
pruden@unex.es

Laura Alonso-Díaz
PhD Professor in the Education Studies Department
Teacher Training Faculty of the University of Extremadura in Caceres, Spain
laulonso@unex.es

Rocío Yuste Tosina
PhD Professor in the Education Studies Department
Teacher Training Faculty of the University of Extremadura in Caceres, Spain
rocioyuste@unex.es

A WAY TO MEASURE COMPLEX CONCEPTS RELATIONSHIPS WHEN USING DIGITAL STORYTELLING

Abstract. In recent years the concept of digital narrative or Digital Storytelling has become one of the most effective techniques for educational systems. This, although being a classic theme, has recently been revitalized with the ease of making digital stories with current technologies, mainly by the profusion of tools accessible on the Internet under the Cloud Computing paradigm and the high integration of them, for their design, creation, publication and other actions that these well-known new technologies allow and, even more important, the communicative power that the multimedia elements provide to a classic story. Although there have been several and important efforts to structure the production of digital stories, analyzing the key points that the digital multimedia formats provide to the narrative and focusing on those emotional aspects or the research and synthesis skills that students develop, there are not any concrete systematized experience on how to use Digital Storytelling in classrooms to develop and teach specific topics in classrooms. And if they exist, a coherent and homogenous measurement method for assessing the specific contribution to student skills development is missing as digital stories are supposed to do. This research project aimed to explore the use of Digital Storytelling with in educational environments, designing and implementing digital stories about a specific topic concerning the Information Security subject, taught in the 3rd year Degree in Telecommunication and Computer Science Engineering, developing an assessment of the map of knowledge that the students owns about the selected topic before, during and after creating their digital stories. To do so, we have used qualitative data analysis techniques and Pathfinder networks to measure the similarity grade o distance between technical concepts, previously graded by the students in a continuous scale. Thus, the project is aimed to provide a way of measuring one of the

skills likely developed by Digital Storytelling, according to the opinion of a great number of experts.

Keywords: digital storytelling; education; science network; digital stories; complex concepts relationships

Digital Storytelling for educational purposes. Although there are many definitions of what a digital story is, there is little controversy about what Digital Storytelling is (Clarke & Adam, 2011); (Fasi, 2011). In short, Digital Storytelling can be defined as storytelling with the support of multimedia elements (images, audio, music, text, etc.) and their actions involved (transitions, accelerations, etc.) (Chung, 2007). The possibilities offered today by new technologies make us think of a new language or rather new forms of expression and communication, supported on the current boom of products related to expression and multimedia communication (animated powerpoints, gifs, flash, videos, etc ...). Some authors define it as a new genre (Handler- Miller (2008) cited by (Signes, 2010) (Malita & Martin, 2010) (Kordaki & Psomos, 2015).

As said before, It is already known that it is not a new technique. Not surprisingly, the Digital Storytelling Center was created 20 years ago by Lambert and his colleagues, foreseeing the importance of this technique, although in recent times the tools for multimedia elements management, online sharing and processing in the cloud, in addition to the increasingly simplicity provided for the usability of these tools, allow non-computer users to make excellent digital stories (Robin, 2008).

Lambert has already established the criteria for developing digital stories, developed in a widely used cookbook (Lambert, 2007), slightly modified by (Robin & Pierson, 2005) though new theories, methods, etc. appears very often in a very dynamic world that moves parallel to the growth of market, such as marketing, advertising, education, etc. (Sakka & Zualkernan, 2005) (Price, Strodtman, Brough, & Lonn, 2015).

Despite the countless literature about the benefits of using Digital Storytelling in education, the measured experience yields surprisingly very low implementation data. Among many reasons are the ambiguity of the term, which causes some technical teachers feel uncomfortable with it, lack of constructive alignment and few resources and technological support (Clarke & Adam, 2011). Some experts also argue that they need more training and support in how to create and use Digital Storytelling than in specific technological issues. (Yuksel, Robin, & McNeil, 2011).

It seems that there is a certain consensus about the fact that use of Digital Storytelling develops many of the needed skills of the education of our century, based on a postmodernist proposal (Fasi, 2011); indeed, in a constructivist perspective of teaching-learning. According to this view, Digital Storytelling combines a set of skills and abilities that students must improve, which can be differentiated and powered in terms of the topic to be taught every time (Signes, 2010). It should be clarified at this point that researches and studies that have been carried out are mostly based on questionnaires and surveys that measure students and teachers perceptions about the use of digital storytelling in their classrooms. However, there is not empirical measurement of the level of improvement in these specific skills regarding traditional teaching and the different magnitudes, in order to modify the digital story creation project for succeeding in our goals; this fact may be an explanation for described mismatch between perceptions and real implementation of

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Digital Storytelling in education (Karakoyuna & Kuzub, 2013) (Clarke & Adam, 2011) (Yuksel, Robin, & McNeil, 2011).

The project purpose aims to focus on a very specific area that is expected to be developed by a Digital Storytelling activity, which is the improvement of the understanding of complex concepts through reflection and critical thinking (Sadik, 2008) and try to measure the level of improvement in the understanding some complex concepts such as those related to encryption systems in the field of information security engineering.

Content analysis and pathfinder networks. So far, countless pilot projects have been made to measure the results of Digital Storytelling in education, but the vast majority of them have been made on very specific subjects and with qualitative measurement by means of questionnaires, surveys or variable ratings grouped into different categories (Yuksel, Robin, & McNeil, 2011) (Clarke & Adam, 2011) (Karakoyuna & Kuzub, 2013).

Our project aimed to measure the outcomes of Digital Storytelling concerning complex concepts is based on the theory of nuclear concepts (Luengo & Casas, 2004), originally developed to analyze underthe cognitive theory of significant learning the problem of understanding the concept of the angle by students in maths classroom.

The theory of nuclear concepts is based on the fact that knowledge is not structured sequentially, in a linear organization, but as a network structure of concepts that form the cognitive structure. This structure will be determined by the geographic organization of concepts, concepts themselves and the least-cost routes (Rodríguez, 2016).

One way of representing the cognitive structure is through PathFinder networks, which, after applying various statistical algorithms, determine the nuclear concepts, discriminating them from the rest, and the minimum or more significant distance links, allowing an approximate representation of the student's cognitive structure (Contreras, Luengo, Arias, J, & Casas, 2015).

Students set the concept similarity in a simple scale, in order to be able to build the correlation concepts matrices according to the selection. Through the software Goluca (Casas, Luengo, & Godinho, 2011) the network diagram of concepts is drawn, applying the proper simplification algorithms (of minimum path). Subsequently, comparison of the student cognitive structure regarding the named Science Network (Arias Masa, 2008) is carried out.

Digital Storytelling in our project. Before going further with project details, it must be clarified that the use of Digital Storytelling in education can be implemented in a double way: as a transmission tool for introducing content, for topic discussion and, based on the characteristics already described of these multimedia works, for focusing on a better understanding of complex or complicated concepts; or as a tool for students to perform certain tasks of communication or transmission of learning results, which requires them to develop intense information search skills, summarizing and synthesis of relevant concepts, building comprehensive learning products (Robin B. , 2008), intensive practice with software tools and finally , social review of their works within their environment.

This second use of Digital Storytelling is the one that seems most relevant to our purposes, since it implies a greater student commitment to learning, improves self-esteem, links research activity or information search with critical thinking (Malita & Martin, 2010), which will surely improve the concepts relationship.

Some caution has been taken in our experience due to the fact that these Digital Storytelling projects are time consuming (Clarke & Adam, 2011). Actually, the student syllabus are already work loaded with many activities and tasks must be developed within a tutorial period set to a maximum of 10 additional hours. For this reason, the pilot project has been structured giving the students freedom to choose the easiest and well-known tool and the genre that they would like to create their digital stories.

Pilot project. This project has been implemented in the subject of Information Security (Information, 2016), which is taught in the third year Degree in Computer Science Engineering: Information Technologies (GIITI) and in the fourth year of the Degree of Telecommunication Engineering (GIT) of the University Center in Mérida of the University of Extremadura. This subject is formed with a distribution of 4.5 theoretical credits, 1.5 practical and 0.3 of follow-up activities, programmed tutorials or "ECTS" tutorials (European Credit Transfer System), which are calculated as 3 working hours for each working group. In this project, the size of the work groups has been set to a range between 2 and 5 students, with mostly students groups of 3 members.

As the rest of subjects in the GIT and GIITI degrees, Information Security is aimed to teach and develop a set of skills that are not only specific of the subject itself but also transversal to the rest of subjects. In particular, the tasks assigned to each ECTS activity group aim to develop the following transversal skills:

- Communicate effectively (oral and written expression and comprehension), knowledge, procedures, results and ideas related to ICT, with special emphasis on writting technical documentation
- Take the initiative and problem-solving skills, providing effective solutions to problems raised even in situations of lack of information and / or temporary restrictions and / or resources.

It should be noted that this experience has been made by selecting a specific topic by the instructors, not easy to understand, such as Block Cipher. This particular choice is a great challenge because one of the main points that are defined in the correct development of Digital Storytelling is the selection of an attractive topic, one about you want to tell something, according to (Robin B. , The educational uses of digital storytelling, 2006). In fact, for our project purposes of testing the applicability of Digital Storytelling to any specific topic we must test specific topics for teaching and learning, within the classification proposed by (Robin B., 2008).

Therefore, the original idea supporting this experience is to analyze and note the processes of using of Digital Storytelling in the educational field as a task within the instructional dynamics, within the framework of the teaching-learning process, so that students can develop specific and transversal skills previously programmed and, also, being applicable to any subject and in any educational field.

Moreover, this project was aimed to measure the development variables that would allow to design and propose a more ambitious, multidisciplinary and multicultural study later, with a broad scope of reserarch that allowed to draw definitive conclusions.

Three meetings were held with the students, all groups together. In the first meeting they were introduced to the Digital Storytelling tool, the way to approach it, what was expected of them and a guide for their development based on the Lambert 7 elements for creating Digital Stories (Lambert, 2007). At the second meeting, after lecturing on the same subject in theory classes, they were invited to perform the analysis of concept association via web, as well as deliver the idea and script of the ongoing Digital Story . In the third meeting, we were able to watch all the works altogether and in the end, they took the tests for concepts relationship again.

Although the ECTS tutorials have an impact on the overall assessment of the subject, as an additional task done by the students, it was decided that the tests and the final quality of the Digital Stories would not be evaluable for the final score, so that students would be discharged from an extrinsic motivation that could have corrupted the project results or pressured too much the students when doing a task that takes too much time over from their busy schedules.

Measurement. Pathfinder networks Process. The process of taking data using the

Pathfinder associative networks (RAP, here in after), which can be obtained in (Casas L. M., 2002), was carried out in the first ECTS tutorial period. Students were questioned for the following concepts:

- Chained blocks
- Initiation vector
- Block feedback
- Error propagation from one block to another
- Flow Encryption
- Independent blocks

The Science Network calculated as described in (Arias Masa, 2008) is shown in Figure 1. Comparisons will be done between each student network and such Science Network, before and after the completion of the work on Digital Storytelling tool.

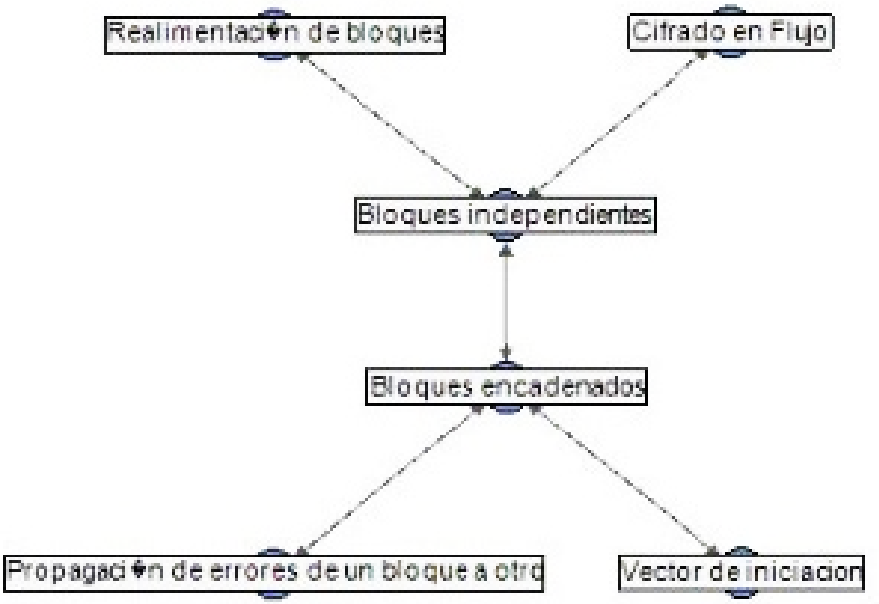

Fig. 1 Science Network.

Once RAP has been obtained and eliminated those networks of students with negative coherence as described in (Arias Masa, 2008), we obtain the similarity indexes of the networks of each student before and after the creation process of the Digital Story, whose comparison we can see in the graph of Figure 2. There we can see how for mostly all students there is a significant increase of similarity once they have finished the digital storytelling tasks, with the exception of students 3 and 10, where we can see in the first case that there is a deep decrease. This deviation should be studied carefully for understanding which is the reason for that. However, in the case of student 10 there is a very small decrease.

Consequently, within the scope of this experiment, we can see that using Digital Storytelling tools in classroom student improves the associative relationship of very complex concepts.

In the showed comparison of the average networks of students before and after the instruction compared to the science network (see the columns of "All") we can also see that there is a slight increase of similarity, precisely as it is the average network it has shifted from 0.22 to 0.28 which on average is a very good result as explained in (Arias Masa, 2008).

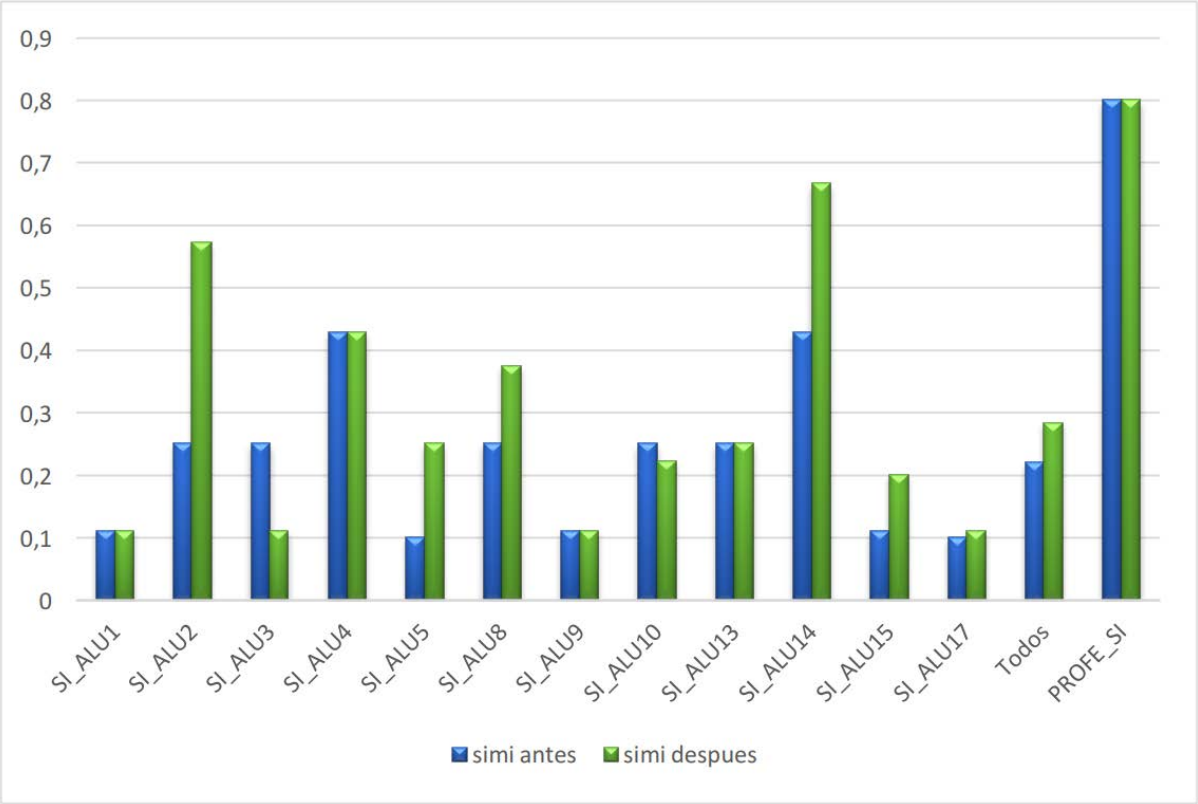

Fig. 2 Comparison of similarity of the middle networks before and after each student

Finally, in the column "Profe_SI", we see that the similarity is maintained, being also very high regarding to the science network, although it is not identical, because on one side we can set the science network and as a close approximation we can set the network calculates from teacher´s data.

Conclusion. As it has been verified in the results of this first experience, the students have worked creating Digital Stories and, with these tasks, they have managed to improve the association of concepts in a natural way, without any specific preparation for the tests that they were demanded to do.

Although this experience focuses exclusively on the assimilation of complex concepts, it is proposed to experimentally measure the improvement in the different skills that are considered strengthened by the use of Digital Storytelling. This research would provide concrete methods and action guide to carry out the experiences in the classrooms in a way much more oriented to the objectives that are pursued.

Finally, we propose an improvement in the experience with the measurement of knowledge by means of quantitative and qualitative measurements on the content analysis of the free texts that the students can develop in the tests, so that there is no researchers influence when selecting concepts to be related.

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