IMPACT OF DIGITAL STORYTELLING IN STUDENTS´ SATISFACTION, MEASURED THROUGH SEEQ QUESTIONNAIRE

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Abstract: *This paper describes the evolution of satisfaction indexes, measured among students attending the course Security of Information taught as part of two fields of studies: Computer Engineering and Telematics Engineering at the University of Extremadura. This degree of satisfaction has been continuously measured by means of a SEEQ questionnaire from the academic year 2012/2013 until the recently completed one, 2017/2018. As a new change, implemented in the last two academic years, the practice of Digital Storytelling has been included as a teaching-learning technique for specific topics. Therefore, this research aims to reflect its influence on the measured indexes and assess whether the introduction of learning technique manages to increase student satisfaction.*

Keywords: Digital Storytelling; SEEQ questionnaire; teaching changes, higher education.

INTRODUCTION

The research experiment detailed in this article is based on the introduction of a practice known as Digital Storytelling for teaching certain concepts or parts of a higher education programme module. Specifically, it has been carried out in the subject of Information Security (Arias Masa, 2018), which is taught simultaneously in the third year of the Degree in Computer Engineering in Information Technology (GIITI, Grado en Ingeniería Informática en Tecnologías de la Información) and in the fourth year of the Degree of Telematics Engineering (GIT, Grado en Ingeniería Telemética) in the University Center of Merida belonging to the University of Extremadura. It is a module with a distribution of 4.5 theoretical credits, 1.5 credits for practical and 0.3 credits of follow-up activities, scheduled tutorials or tutorials known as "ECTS Tutorials" (European Credit Transfer System). The latter correspond to 3

hours face to face sessions for each working group, created at the beginning of course. The process for forming groups will be discussed later.

Though there is enough evidence that Digital Storytelling helps to improve traditional skills development, mainly speaking and writing along with researching, collaborative tasks, technological skills, (Alcantud-Díaz, A, Ricart Vayá, & Gregori-Signes, 2014), (Hung, Hwang, & Huang, 2011), (Benedyk & Furniss, 2011), it is still recommended to collect more data to measure the impact that this practice has on student learning, motivation and engagement (Barrett, 2005).

In fact, there are already several investigations that this research team has developed on the use of Digital Storytelling (DST) in higher education, as detailed in Martin Espada, Mass Arias, Traver Becerra, Contreras Vas & Cube Delgado (2017) or Martin Espada, Arias Mass cube Delgado, et al. (2017). In particular, we want to highlight the study which was published in Arias Masa, Martin Espada, Traver Becerra, Contreras Vas, & Cubo Delgado (2017), where the introduction of DST in the subject syllabus was analyzed. The Digital Story (DS), as the goal of the DST project, was developed on the topic Block Cipher (Block cipher is a key module of the information security programme; it is an algorithm for data ciphering in which a block of plaintext is treated as a whole and used to produce a ciphertext block of equal length). In the study it was concluded that the inclusion of DST practice can help to improve the teaching-learning process in some categories, namely "Enthusiasm", "Organization", "Personal Attitude" and "Testing". This research article aims to go a step further than now we can make a comparison between two measures blocks. One of them collects data from 4 courses where traditional teaching was given, not including any Digital Storytelling practice, facing a block of two courses data in which DST has been used as a learning technique for specific topics of the subject.

1. OBJECTIVES

The main objective raised in Martin Espada, Arias Masa, Traver Becerra, et al. (2017) was to get students to become active participants in the teaching-learning process, being essential parts of it, from the first day of attendance on the course. In this research, the objective is still the same, but it is amplified by finding those specific categories from the SEEQ satisfaction questionnaire which are enhanced when DST is added as a practice.

2. METHODS OF DST PRACTICE ASSESSMENT

While there are numerous definitions of DST, there is little controversy about what it is. In short, it can be defined as storytelling supported by multimedia elements (images, audio, music, text, etc.) and actions (transitions, acceleration, etc.)

(Chung, 2007). The possibilities offered by new technologies today make us think in a new language, or rather, in new forms of expression and communication, which is evident in the current boom related to speech and multimedia communication products (PowerPoints cartoons, memes, videos, etc.). Some author (Handler Miller, n.d.) defines as a new genre, quoted by Carmen Gregori-Signes (Signes, 2010).

This research article assesses whether students have perceived this educational change, consisting in introducing DST practice for understanding some complex concepts, and if it implies an improvement of the teaching-learning process, regarding the students' perception from previous courses, in which this learning practice was not used on any of the topics of the same subject.

The use of this practice has been introduced as an experimental activity included in the ECTS Tutorials in the last two courses. To do this, four working groups of four or five members have been formed by selecting students randomly in the first ECTS Tutorial meeting. All groups have developed its digital story based on the same subject, concretely "Block Cipher" in the course 2016-2017 and "AES encryption" (AES stands for Advanced Encryption Standard; it is a particular case of block cipher, symmetric, that is, it uses the same key for ciphering and deciphering, applying four different mathematical functions recursively for doing it; it is the most widely used encryption algorithm) in the last course, in December of 2018. The result of the three months process in both courses was the DS itself, developed independently by each group, and displayed to their classmates.

The process described in this article is part of an extended research project on DST uses in higher education. In fact, various methods have been used to evaluate the development and evolution of students' knowledge, and skills associated with this activity throughout the academic years.

- Methods and techniques based on Pathfinder Associative Networks (Casas, 2002);
- Data collected from students´ entries about the selected topic in open format, clear text without any guided question from the teaching team, in each ECTS tutorial, which has been assessed by qualitative analysis methodology using WebQDA software (WebQDA, 2017);
- The SEEQ questionnaire itself, which is described in this work, whose data have been analyzed with STATA Software Release 15;
- Finally, a satisfaction survey on the practice of Digital Storytelling as a technique for enhancing the teaching-learning process.

In overall view, the research project aimed to get a validation process as complete as possible for this experimental practice in higher education.

3. SEEQ QUESTIONNAIRE

In higher education, it is increasingly common to use students´ opinion collected through surveys to assess teaching process. However, what is not yet widely implemented is the use of this questionnaire data as a tool for assessing and enhancing continuously the teaching process for an extended period of time. Thus, it allows to add small changes to a stable structure and measure its direct effects on survey answers and, therefore, on the teaching-learning process.

In order to analyze satisfaction results, an adaptation of the aforementioned SEEQ questionnaire, created by Hernert Marsh in 1970 and updated in 1982, has been used to analyze teaching, considering a series of factors. Each of them consists of several questions, which are scored on a Likert scale from 1 to 5 (strongly disagree, disagree, disagree or disagree, agree and strongly agree).

The selection of the SEEQ questionnaire stems from the fact that it has the described advantages (Matés & Bouzada, 2010), which are: psychometric properties (Marsh, 1984), its widespread use in universities around the world and the large amount of research material for each item improvement (Matés & Bouzada, 2010).

Table 1.

SEEQ Questionnaire Categories

Category	Name
C1	Learning
C2	Enthusiasm
C3	Organization
C4	Group interaction
C5	Personal attitude
C6	Exams
C7	Bibliography
C8	Overview

Source: Own work

In this adaptation of a SEEQ questionnaire, the research team has used eight categories or dimensions as may be seen in Table 1, for a total of 35 questions. In the first seven categories, a five-point Likert scale is used. In the eighth category, referred to as "Overview", data is collected through open questions, in order to get students' free opinions and let them provide additional information not collected in the previous questions, according to them. The detailed analysis of this latter category is not performed in this work.

The previously adapted SEEQ questionnaire has been applied anonymously through Google Forms web application (Lorca Montoya, Carrera, & Casanovas Catala, 2016). This method allows students to answer when they

desire from the moment when the questionnaire is available and it has the obvious advantage of providing rapid feedback to the teaching team. The questionnaire is available from the time when students have their final grades and their corresponding certificates, until two weeks later approximately. The objective of this extended period is to provoke their reflection as unbiased as possible on the survey questions. It is accessible via direct link from the Moodle virtual classroom, which is used for teaching the programme modules.

This questionnaire has been conducted on an ongoing basis since the academic year 2012/13, when the subject of Information Security was given for the first time as a module in the undergraduate degrees in Telematics Engineering and in Computer Science Engineering, jointly taught. The basic goal of this permanent survey is to keep a record of assessment data. Also, and more important, it is aimed to compare students' perceptions about the teaching process during each academic year with the previous ones. Therefore, it can be seen how the methodological changes that are gradually implemented affect students' opinions, mainly in relation to the ECTS activities. Some results have already been published in various forums (Morze, Makhachashvili & Zhyltsov, 2016).

In this paper, teaching improvement is analyzed in detail, collecting overall students' opinions after introducing the use of DST practice (Robin, 2008) in ECTS activities and content summaries, which have been introduced gradually by the teaching staff in each lesson. In this research work, two academic years implementing both described changes are analyzed. Therefore, at the moment of writing this paper, the sample space contains more than 100 answers collected over different academic courses. Thus, in this study it can be compared data from the 2012/13, 2013/14, 2014/15 and 2015/16 academic years, when DST practice was not yet implemented in ECTS tutorials to data collected from students in the 2016/17 and 2017/18 courses, in which DST practice has been definitely introduced.

The results of the SEEQ questionnaire application to analyze teaching improvement when implementation of DST practice takes place, with data collected from 2016/17 course students were published in the conference "12th Iberian Conference on Information Systems and Technologies" (Mass Arias et al., 2017). Then, they were subsequently confirmed for publishing in the "Journal on Advances in Theoretical and Applied Informatics" (Martin Espada, Mass Arias, Becerra Traver, et al., 2017).

With the data collected from this academic year, from students who have taken the 2017-18 course, we can have more data to gain more reliability, as it will be discussed in the following sections.

4. ANALYSIS OF RESULTS

For the analysis of results we have used the software STATA © Release 15 (LLC & StataCorp, 2018), which allows ease and effective analysis of data. Besides, it permits to develop small programs or scripts in order to be reused for similar analysis in the future, when additional data may be added.

A first glimpse of the results shown in Figure 1 is enough to see how data are segmented into two groups of students: students who have done digital Storytelling practice and students who have not. In all categories, it can be seen that there is an increase in the average. Nevertheless, in order to determine whether such increases are significant or not, further statistical analysis must be done.

Variable	Grupos	Obs	Mean	Std. Dev.	Min	Max
C1_Aprendi~e	Without DST	67	3.794.776	.8811208	1	5
C1_Aprendi~e	With DST	33	4.098.485	.7498422	2	5
C2_Entusia~o	Without DST	62	3.552.419	1.020.424	1	5
C2_Entusia~o	With DST	33	4	.7629097	1.75	5
C3_Organiz~n	Without DST	66	3.363.636	.927343	1	5
C3_Organiz~n	With DST	33	3.909.091	.7202923	2.5	5
C4_Interac~o	Without DST	65	3.934.615	.85041	1	5
C4_Interac~o	With DST	33	4.234.848	.6432929	2.25	5
C5_Actitud~l	Without DST	60	3.935.417	.9038793	1	5
C5_Actitud~l	With DST	33	4.367.424	.5153308	3	5
C6_Examenes	Without DST	66	3.878.788	.9032446	1	5
C6_Examenes	With DST	33	4.383.838	.4648865	3.333.333	5
C7_Bibliog~a	Without DST	65	3.376.923	1.082.643	1	5
C7_Bibliog~a	With DST	33	3.909.091	.7337249	3	5

Figure 1. T test for independent samples in groups without DST courses and courses with DST

Source: Own work

First, the **null hypothesis (H_0)** is defined, which represents the claim that implementing Digital Storytelling practice in ECTS tutorial does not improve the teaching-learning process. And the **alternative hypothesis (H_1)** is then defined as well stating that there is some degree of relationship or reliance when Digital Storytelling practice is implemented as a task of the syllabus with an effective improvement in the teaching-learning process (Hurtado & Silvente, 2012). Then tests of homogeneity of variance and normality are performed, prior to a detailed

statistical test. According to Mercado, Macías, & Bernardi (2012), assumptions to make parametric comparisons of k means are:

1. The samples must be selected randomly and independently of k populations
2. Distributions inside the population of the random variables whose means are compared are normal in each of the groups.
3. Standard deviations of the variable in each of the populations are equal to each other.

In this study, the first point is always true as samples are independent. It must be remembered that all data correspond to different courses and different students, gathered in one group with students' opinions from courses where Digital Storytelling practice was not implemented and the other group with the rest of students' opinions who developed digital stories as ECTS tutorial tasks, as described before.

For the second condition, we can use different tests to prove the normality of sample data. As we are using STATA© Software, we can use various methods to determine whether or not a distribution is normal, namely:

- *Swilk.* This command performs the Shapiro-Wilk test of normality, which gives information about the degree of agreement between the normal distribution plot and the expected straight line. This test is appropriate for a sample size between 7 and 2000.
- *Sfrancia*. This command performs Shapiro-Francia W test, which is also intended for a sample size between 5 and 5000.
- *Ksmirnov.* It performs the Kolmogorov-Smirnov test, which is a non-parametric one that determines the goodness of fit between two probability distributions.
- *Sktest.* This test is based on the kurtosis (curvature) and the skewness (lack of symmetry) of the variable.

For the third assumption, it should be checked homoscedasticity (same variance). It can be done by applying the Levene test or any of its variants.

4.1. Normality test

As previously mentioned, Shapiro-Wilk test can be applied to assess the normality of samples. When using STATA© Software, the command is *swilk variable* where the null hypothesis H_0 is: *The variable has a normal distribution*. The results by categories obtained are shown in Figure 2, where two categories have been underlined and printed in bold text. They are Organization and Bibliography, whose z value is greater than 0.05 (It must be said that Prob>z is one of STATA's strange shorthand habits; it can be found in the output from numerous commands;

it does not mean that a probability is larger than z, but (in the line for C1_Aprendi~e) that - if the null-hypothesis of normality is true - the probability of z being 4.339 or more extreme, is < 0.00001), whereby the null hypothesis of normality in these two cases is rejected and therefore data not follow a normal distribution. Unlike, the null hypothesis H_0 is accepted for all other categories, as they follow a normal distribution.

```
                Shapiro-Wilk W test for normal data
Variable |  Obs  W  V  z  Prob>z
C1_Aprendi~e | 100 0.91438 7.069 4.339 0.00001
C2_Entusia~o | 95 0.93605 5.059 3.586 0.00017
C3_Organiz~n | 99 0.98285 1.404 0.753 0.22574
C4_Interac~o | 98 0.92477 6.108 4.010 0.00003
C5_Actitud~l | 93 0.84678 11.909 5.474 0.00000
C6_Examenes | 99 0.87967 9.852 5.072 0.00000
C7_Bibliog~a | 98 0.98406 1.294 0.571 0.28413
```

Figure 2. Screen capture for execution of Shapiro-Wilk normality Test with STATA® Software

Source: Own work

4.2. Homogeneity of Variances

The assumption of equality of variance, also known as homoscedasticity assumption, considers that the variance is constant (unchanged) for each value of a given factor, i.e., different groups. In our case, the groups are the set of students who have completed the DST activities and the rest, arranged in a group with those cases who learned mainly on master-class basis, in which the teacher explains topics in a traditional way.

Table 2.

Summary of equality of variances for each category according to the test

Category	Name	H0: Equal Variances	Significance value of sdtest
C1	Learning	**It is accepted**	0.3188
C2	Enthusiasm	**It is accepted**	0.757
C3	Organization	**It is accepted**	0.1191
C4	Group interaction	**It is accepted**	0.0862
C5	Personal attitude	It is rejected	0.0009
C6	exams	It is rejected	0,001
C7	Bibliography	It is rejected	0.0180
C8	Overview	It is accepted	0.3188

Source: Own work

It is aimed to compare means in independent samples from populations with unknown variances. Therefore, before comparing means, it is necessary to make a variance or standard deviation comparison, and this can be done with the command sdtest variable1, by (variable group) (In STATA software, sdtest is the command for variance-comparison test). For this case, the null hypothesis is "The variances are equal." The results of this command are summarized in Table 2.

Summary of equality of variances for each category according to the test

Based on these results, it would be possible to make a comparison of means bearing in mind those categories where the standard deviations are equal or different. For STATA© Software, in the first case, when standard deviation is equal, *the ttest variable1, by (variable group)* command is executed. In the second case, where the variance is not the same, the *ttest variable1, by (variable group) unequal* command must be run. A summary of results after executing these commands for the seven categories under consideration can be seen in Table 3. In it, output of these commands are summarized and it can be seen when the null hypothesis of the equal means is accepted and when is rejected.

Table 3.

Summary of equality means for each category

Category	Name	H_0: Equal Variances	Significance value of sdtest
C1	**Learning**	**It is accepted**	0.09
C2	Enthusiasm	It is rejected	0.02
C3	Organization	It is rejected	0,003
C4	**Group interaction**	**It is accepted**	0.07
C5	Personal attitude	It is rejected	0.0042
C6	exams	It is rejected	0.0004
C7	Bibliography	It is rejected	0.0007

Source: Own work

In the Table 3, it has been underlined the cases where acceptance of the null hypothesis of equal means, particularly for C1 and C4 (Learning and Group Interaction) categories. It indicates that, although there is an increase in means from the group of students that had done DST practices for learning, it cannot be concluded that this improvement is directly related to these practical activities. However, besides this test, it is also necessary that the samples meet the requirement of normality, discussed in the next section.

4.3. Non-parametric tests

Since there are data sets that do not follow normal distributions, as determined by Saphiro-Wilk test, and some categories do not meet the assumption of equal

variances, nonparametric tests must be applied. In this case, "U" test of Mann-Whitney, which was proposed by Wilcoxon in 1945 (Wilcoxon, 1945) should be applied. In this test, the null hypothesis states that the mathematical expectations of both populations are equal. Sample size can be different. It does not require any other assumption about the sample distribution and therefore it can be used with discrete or ordinal variables, like the rest of non-parametric tests.

Using STATA© software, the *ranksum* command is used, and output for the seven categories under study are summarized and shown in Figure 3. A summary of the Z-values output of each category is also shown.

```
H0: C1_Apr ~ e (ConDST == No) = C1_Apr ~ e (ConDST == Si)
 z = 1,720 Prob> | z | = 0.0854
H0: C2_Ent ~ o (== ConDST No) = C2_Ent ~ o (ConDST == Si)
 z = 2067 Prob> | z | = 0.0387
H0: C3_Org ~ n (ConDST == No) = C3_Org ~ n (ConDST == Si)
 z = 2774 Prob> | z | = 0.0055
H0: C4_Int ~ o (== ConDST No) = C4_Int ~ o (ConDST == Si)
 z = 1646 Prob> | z | = 0.0998
H0: C5_Act ~ l (ConDST == No) = C5_Act ~ l (ConDST == Si)
 z = 2336 Prob> | z | = 0.0195
H0: C6_Exa ~ s (ConDST == No) = C6_Exa ~ s (ConDST == Si)
 z = 2691 Prob> | z | = 0.0071
H0: C7_Bib ~ a (ConDST == No) = C7_Bib ~ a (ConDST == Si)
 z = 2364 Prob> | z | = 0.0181
```

Figure 3. Screen capture for summary of equality of variance for each category

Source: Own work

When the Z-value is less than -1.95 or greater than 1.95, and consequently when the absolute value | z | is less than 0.05, the null hypothesis H_0 is rejected, and hence the alternative hypothesis is accepted. Therefore, we can indicate that the mean increase in categories C2, C3, C5, C6 and C7 are statistically significant, due to the introduction of DST practice in the teaching-learning process of the subject. It must be said that those categories are the same as the ones that met the value condition for homogeneity of variance as shown in Figure 2. Then it could not be concluded that this evidence was true according to the normality test and therefore the non-parametric test has been performed.

Table 4.

Summary of results from 2016-17 and 2017-18 courses surveys

Category	Name	course 2016-17 no improvement	course 2017-18 no improvement
C1	Learning		

C2	Enthusiasm	Yes	Yes
C3	Organization	Yes	Yes
C4	Group interaction		
C5	Personal attitude	Yes	Yes
C6	Exams	Yes	Yes
C7	Bibliography		Yes

Source: Own work

If the results of this research study are compared to the results of the previous one (Martin Espada, Mass Arias, Becerra Traver, et al., 2017), it turns out they are exactly the same, but with the addition of the category "Bibliography", as shown in Table 4. Besides, mean increase is statistically significant for those answers to the SEEQ questionnaire questions from students who have worked on some Digital Storytelling projects, as in the 2016-17 and 2017-18 academic years. All this is shown in Figure 4, where it can be seen that the most valued categories are Personal and Testing Attitude.

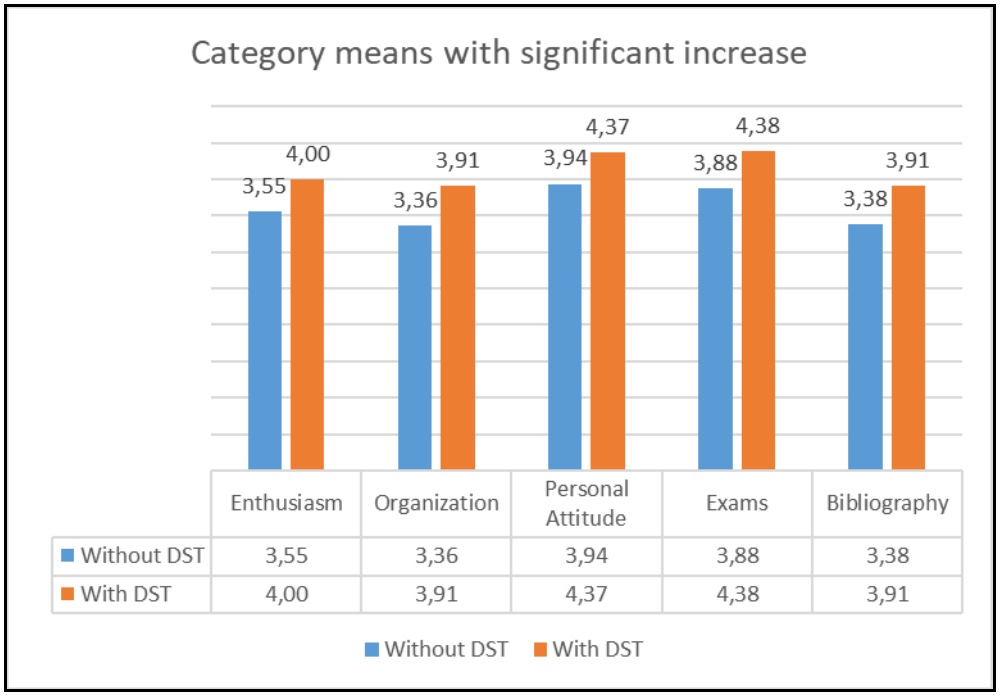

Figure 4. Means comparison, by categories: students working on DST projects versus the rest

Source: Own work

In addition, when plotted in a graph (see Figure 5) the absolute value of increase for those categories on which it can be considered as statistically significant, it can be seen that categories "Organization" and "Bibliography" have the highest increase. This cannot be a surprise because, on the one hand the category "Bibliography" was not included among categories in the last year study, thus it is easy to have a statistically significant increase related to the results from previous courses. In addition, this increase can be directly related to DST practice, as bibliography must be fully updated and organized to execute each phase of such projects.

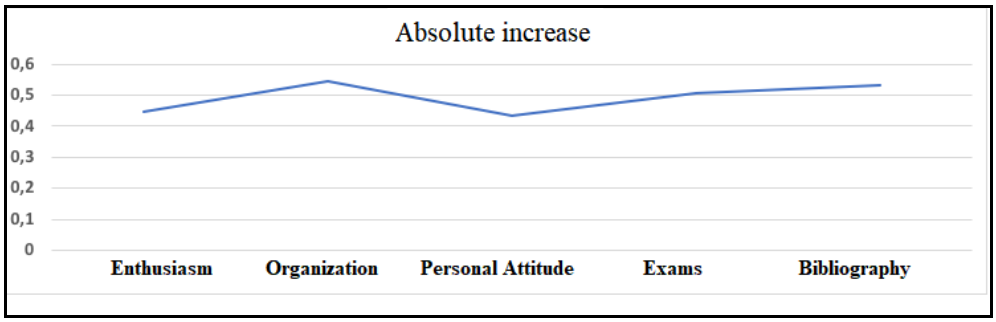

Figure 5. Absolute values of increase for each category
Source: Own work

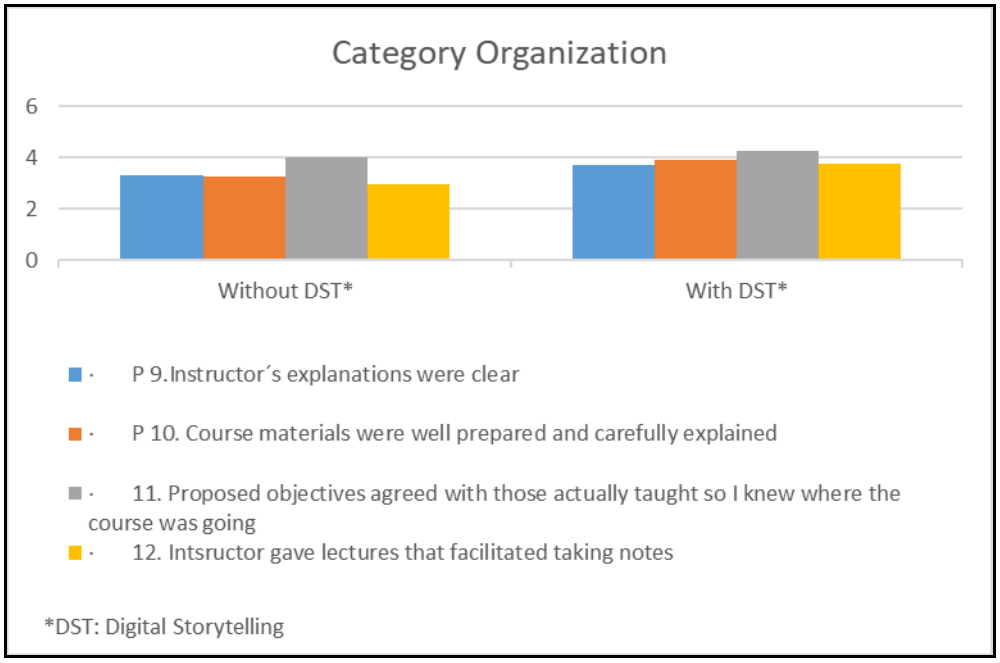

Figure 6. Report on the means of the questions answers that form the category "Organization"
Source: Own work

The other category that also has greater increase is that one named “Organization”. This category is also obtained from the SEEQ questionnaire questions and values for answers are represented in the Figure 6. In it, absolute value and its increase are shown for each of the four questions that are grouped under this category, both for the group of students who have developed DST projects (33 students) as for the rest (67 students). In this figure, it can be seen that the question number 11, asking on whether the objectives are met, is assigned the highest score. It can be said that the teaching staff is very pleased, as scores approximating to 5 and compliance is very important, since it is somewhat expected.

Finally, both categories, which do not achieve a statistically meaningful increase of means, are “Learning” and “Interaction with the group” when comparing students´ opinions, grouped as mentioned above (depending on their learning process). Both show an increase of means, although not statistically significant. However, it can be proved that there is still an increase in the values for each question that is asked, as shown in Figure 7. In there, it can be seen that both categories present mean values near the value 4. As working on 5 points Likert scale, it can be considered a very good score for engineering degree.

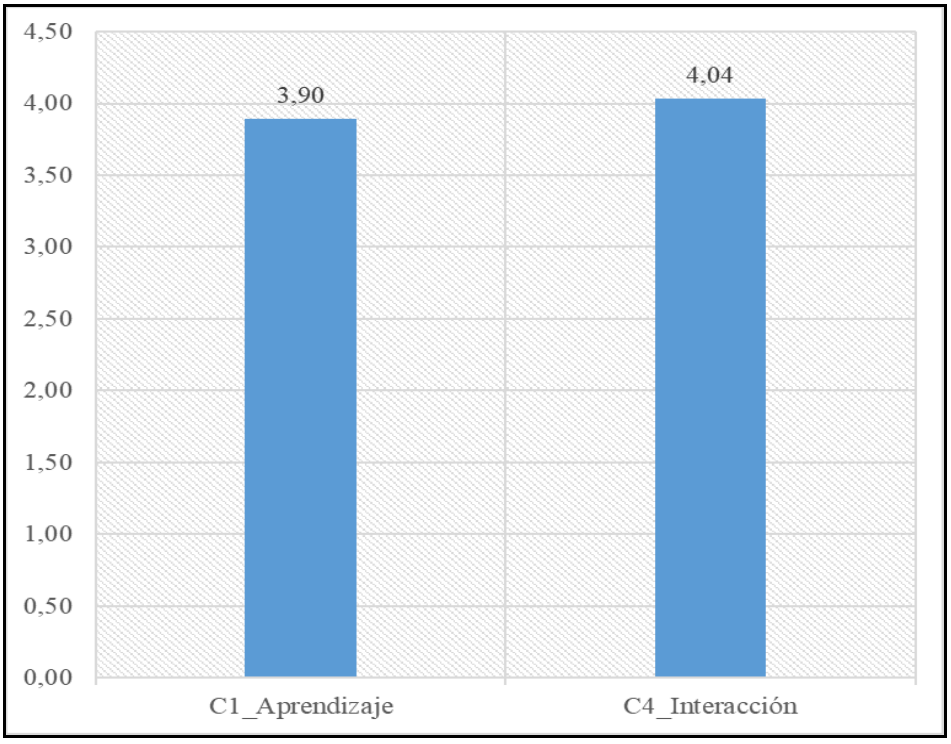

Figure 7. Report on the value of means for questions that form the category “Learning” and “Personal interaction”
Source: Own work

CONCLUSIONS

In this paper, students' opinions from 2016/17 and 2017/18 academic years have been assessed, compared to students' opinions from previous years, starting in the 2012/13 course. The study has been carried out in the programme for Information Security (Arias Masa, Juan, 2017) through the previously validated SEEQ questionnaire (Matés & Bouzada, 2010). Then, the random means of each category have been statistically analyzed, distinguishing those categories where one can indicate a significant mean increase for the last two academic years, concluding that the reason for it can be the incorporation of Digital Storytelling practice as a methodological change in the teaching-learning process.

On the other hand, the introduction of these activities has been tested as a pilot research project within the IRNet (IRNet, 2017) which some collaborative authors of this document belong. From the results of this experience, several additional tests based on DST practice have been currently launched in various engineering programmes, namely Interconnect Systems, and Computer Networks, with the aim of measuring the learning impact of such activities in higher education.

Accordingly, as shown in Figure 4 and Figure 7, all means of the measured categories are above the central value, and in most cases around the value 4. The SEEQ questionnaire displays this good trend in the teacher's attitude in general and this encourages the teaching team to keep moving this way in the forthcoming academic years.

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Our thanks go to all students who have completed the programme on Information Security at the University of Extremadura, and devoted part of his time to answer the questionnaire assessment of the subject once they had finished the whole process of learning.

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