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DIGITAL STORYTELLING AS A TEACHING METHOD IN ADULT EDUCATION - THE CORRELATION BETWEEN ITS EFFECTIVENESS AND WORKING MEMORY

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Abstract:
In recent years, technology has been growing rapidly. The impact that Information and Communication Technology (ICT) and associated teaching tools have on the learning process is already significant, and this is expected to grow further in the future. Digital Storytelling (DST) is a combination of interaction and learning at the same time and it could prove to be an excellent teaching method at the disposal of the educator. The present study is an attempt to examine the impact of the method in adult education, providing that the learners are the creators of digital stories. In addition, the current research is an attempt to examine the relationship between learners' Working Memory and the impact of DST on their learning performance. The research has been conducted in a public vocational training institute. The findings revealed that DST is an effective learning tool in adult education that can improve learners' performance. In addition, the findings suggest that the method is more effective in learners which have higher working memory rates than others.

Keywords: digital storytelling, adult education, cognitive functions, working memory, skills development

1. Introduction

1.1 Adult Education and ICT

The exponential growth of technology has brought incredible changes to many sectors in our life so that technological innovation can provoke the evolution of society (Fernback, 1997). In addition, technology plays such a significant role in children's daily lives that

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Prensky calls modern children "*digital natives*" (Prensky, 2001). Digital literacy in the modern school curriculum is necessary for students' skills development, because it will be a fundamental requirement for them later in life, especially for employment. But it is a crucial element in adults' life as well. This is the reason why ICT plays an essential role both in children and adult education. The use of new technologies in education, has been necessary and have given educators the opportunity to enhance students' knowledge and motivation for learning.

In the last decades, there has been a tendency to separate adult and young people's education. Adults have a very different style of learning than young students, and this is the reason why in adult education a different teaching approach is needed. Adult learners have unique characteristics and needs, which make them a very special audience and adult education an independent scientific field (Hiemstra & Sisco, 1990). Adults have a tendency to be involved in a more active way in the learning process (Kokkos, 2005). They cannot be passive learners, on the contrary, they are able to use their experiences and be responsible for themselves in learning (Polson, 1993). From this point of view, new technologies can have a positive impact on adult education and DST can be an innovative teaching approach, with positive effects, especially when adults are the creators of digital stories.

1.2 Digital Storytelling as an Active Learning Method

Narration has always been a great learning tool and its beginning is lost in the mists of time. Digital storytelling is a new kind of narration, a short form of digital production that allows sharing stories and experiences with others. The value of this educational tool is widely recognized and in the last decade, it is used in school and seems to have a high impact on adult education as well (Robin, 2008).

There are many types of digital storytelling: personal narratives, stories with special characters describing their experiences, historical documentaries, and many other kinds of digital stories with the aim to inform or entertain people by presenting or analyzing a subject. Lambert suggests that seven elements have to exist in a successful digital story (Lambert, 2002). Creator's clear point of view that reveals their perspective, a dramatic question to capture people's interest and emotional content, making the story come alive. The gift of voice is a critical factor to help the audience to understand the story, and the power of the soundtrack is an essential element too. On the other hand, the economy of content that gives the audience enough information to understand the story, and the appropriate pace for the story are also influential components for a successful result.

According to Clark & Rossiter (2008) when learners are creators of their narratives their experiences are reflected in their creation. The authors suggest that we learn through our stories' creation. In this way, we can "make meaning of our experience". This is because DST creation is based on the existence of an appropriate learning environment. The pedagogical approach of DST has elements of behaviorism too because behavioral patterns are based on motivation for learning and the existence of an appropriate learning

environment (Jung & Orey, 2008). In addition, "Discovery Learning" models that present the importance of learning through action in order to rearrange and transform the learning object are related to DST creation (Bruner, 1961). Thus, DST is a great learning tool that enhances learning motivation and improves collaboration. Students can develop their creativity through digital stories construction (Ohler, 2008). Furthermore, DST is a suitable pedagogical approach to trigger the development of additional skills such as research skills, through the process of collection and analysis of information, writing skills through script construction, organization skills through the need of project management. Problem-solving, presentation and assessment skills can also be improved (Robin, 2011). Last but not least, creators of Digital Stories, develop technological skills through the use of respective tools. In conclusion, while people create stories, they can build new knowledge, through interaction between them and the learning object (Kokkos, 2005). All the above support our hypothesis that Digital Stories' construction can be an enhancing learning factor in adult education (Knowles, 1980).

1.3 Cognitive Functions and Working Memory

The brain is undeniably the most important and complex organ of the human body. It is the biggest part of our nervous system, completely responsible for the coordination of the other organs and their proper function. Due to the existence of the brain, basic automatic functions are performed, such as heartbeat, breathing, digestion and blood pressure. In addition, it controls the human ability to think, feel, see, hear, remember, walk, talk and other crucial capacities.

Cognitive functions are considered particularly important for both, automatic and voluntary reactions. These functions are mental processes that involve operations such as attention, perception, thinking, memory, problem solving and language. Memory is an extremely important faculty due to its significance for encoding, storing, retaining and retrieving information. There are several types of memory according to the criteria which are used. The main types are the explicit and implicit memory. Explicit memory refers to the recalling of prior events, a deliberate attempt of retrieving some information from the past. Implicit memory refers to the unconscious recall process that usually helps us to complete a task. It is almost impossible to describe this kind of memories as certain events although they can influence our behavior (Dew & Cabeza, 2011). The main stages of memory according to the information retention time are the Sensory Register, the Short-term Memory and the Long-term Memory (Atkinson & Shiffrin, 1968).

The term Working Memory was introduced in the 60s, by Miller, Gallanter and Pribram (1960) in their book "Plans and the Structure of Behavior" in an attempt to compare the human brain to a computer. At first, there was a general belief that Working Memory and Short-term Memory were identical. Baddeley (1999) defined Working Memory as the mental ability to store information temporarily and process it, at the same time. Baddeley and Hitch (1974) proposed the most common model of Working Memory which is focused on short-term memory. This model is based on the existence of a Central Executive system and its subsystems. The central executive acts as a control center that

controls the data flow from and to its subsystems. The first subsystem is the Phonological Loop, which stores verbal information for a very short period of time, about 2 seconds. The second subsystem is the Visuospatial Sketchpad which temporally retains object and spatial information that is used for spatial orientation. Baddeley introduced the fourth subsystem into his model, the Episodic Buffer which is the link between the Central Executive and the Short-term Memory (Baddeley, 2000). Through the Episodic Buffer, the scattered information can become coherent.

All research findings focused on the connection of working memory and academic performance indicate that working memory is an essential factor that influences the learning process. Thus, Working Memory is a critical factor that affects the learning ability because of its importance in a variety of activities. It can have a significant impact on reading comprehension, mental arithmetic and problem-solving ability. As a result, learners' low working memory has a negative impact on their academic progress (Gathercole et al., 2006). Even simple tasks and activities are difficult to be completed, and a student who has poor working memory capacity is likely to fail (Alloway, 2006). Thus, learning ability in adult education can be affected by Working Memory deficits (Alloway & Gregory, 2013).

The pedagogical value of DST as a learning tool has been widely studied, but not extensively in the field of adult education. The correlation between the effectiveness of DST and the participants' Working Memory remains unexplored. Considering all the above, we propose the following hypotheses:

Hypothesis 1. Digital Storytelling can be beneficial in adult education

Hypothesis 2. There is a connection between the effectiveness of DST and the participants' Working Memory so that the participants who have lower rates in Working Memory measurements benefit more.

The Hypothesis 2 represents a great challenge due to the lack of relevant studies, so further research is required. A comparative study has been conducted to answer the above questions and the results showed that DST is in fact positively associated with participants' learning performance in adult education. Thus, the hypothesis that DST is an effective learning tool for adults is supported. But results showed that lower rates of working memory significantly reduced the strength of the aforementioned positive impact.

2. Materials and Methods

2.1 Participants

The study involved 32 adult participants (age range: 19-56 years, 12 male, 20 female), trainees in a public vocational training institute in Viotia, a rural area in Central Greece. The participants were post-secondary adult students, split randomly into two groups. The first group of 15 was the experimental group and they were taught using Digital Storytelling methods. They were creators of the stories as well. That group was sub-divided into four sub-groups. Each sub-group of students worked together to create parts

of the project. After that, they cooperated to create the final digital stories. The remaining 17 research participants formed the control group that was taught the same subject using traditional methodologies. The control group was used as a comparison reference between the juxtaposed results of the tests, so that relative performances can be measured.

2.2 Procedure

The teaching subject was "Marketing". All the trainees had no prior knowledge of the subject. Both groups were taught through different didactic interventions. In the experimental group, two units of the subject were taught through DST methods and two Digital Stories were made by students, during the didactic intervention. The time required to complete the task was 12 teaching hours. The same two units of Marketing were taught to the control group, through traditional methodologies in 8 teaching hours. The measurement tools to investigate the knowledge of research participants were exploratory tests with questions, at the beginning and at the end of the teaching process. A researcher's observation diary was a useful tool too, as it contains important notes about students' behavior in both groups.

2.3 Measures

In order to answer to the second research question (H1), the Working Memory of all students had been measured before they took part in the study using the "Digit Span Test" which is a subtest of both the Wechsler Adult Intelligence Scale (WAIS) and the Wechsler Memory Scales (WMS). Digit spans (*"Forward digit recall test"* and *"Backwards digit recall test"*), are widely used as capacity measures of immediate verbal memory (Gathercole et al., 2004). In each test, the trainees singly hear a sequence of verbal digits. The first test concerns the ability to forward repeating the digits in the same order that they are presented, and is a verbal short memory measure that is associated with the phonological loop in Baddeley's working memory model. The second test concerns the ability to repeat the digits in the reserve order that they are presented and corresponds to the central executive in the same model (Alloway & Gathercole, 2006). Each student completed individually both tests, in a quiet room in the public school.

2.4 Statistical Analysis

The mean and standard deviation (SD) were used to describe quantitative variables. Absolute Value (N) and relative frequency (%) were used to describe qualitative variables. To compare proportions, Pearson's x^2 test and Fisher's exact test were used. To compare quantitative variables between the groups, we use Student's t-test. Dispersion analysis for repeated measures (ANOVA) was used to examine score differences between the rates of both groups. The Statistical Package for the Social Sciences (SPSS), version 22.0 was used.

3. Results and Discussion

The sample group comprises 7 females (46.7%) and 8 males (53.3%). The second group participants are predominantly females, 13 (76.5%), and only 4 males (23.5%). Findings have shown that sex differences do not affect working memory performance (Alloway et al., 2004). The average age of the population is 31.7 years (SD=10.1 years) for the first group and 39.3 years (SD= 13.2 years) for the second group. The majority of both group participants are high school graduates. Only 3 (20%) for the sample group and 1(5.6%) for the second group, are university graduates.

3.1 Working Memory

Both groups population scores in the tests involved in working memory did not have a significant difference. The experimental group had Digit Span Forward mean score 5.3 and mean rate 17.9. The same group had Digit Span Backward mean score 3. 9 and mean rate 9.9. On the other hand, according to the test results in the control group, the Digit Span Forward Recall's mean score was 5.1 and the mean rate was 17.1. The Digit Span Backward Recall's mean score was 3.5 and the mean rate was 8.2. Thus, both groups were almost equivalent because their population had almost similar measurements in working memory tests.

Table 1: Working Memory Measurements

Working memory rates	Groups				P Student's t-test
	Traditional methods		DST		
	Mean	SD	Mean	SD	
Forward Digit Recall (span)	5.1	.9	5.3	1.3	0.588
Forward Digit Recall (rates)	17.1	4.3	17.9	7.1	0.671
Backward Digit Recall (span)	3.5	.8	3.9	1.0	0.164
Backward Digit Recall (rates)	8.2	4.1	9.9	5.2	0.308

3.2 Knowledge Measurements

Two units of Marketing were taught to students of both groups. In order to investigate the students' obtained knowledge, they were given two tests per unit, a test before teaching and the same test after the teaching, to measure the difference of knowledge. The results of the two tests showed that before teaching both groups had a similar level of knowledge, so it was considered to be almost equivalents. After the teaching of the first unit both groups had a rise of the knowledge but the group of Digital Story makers-experimental group -had a bigger difference in their knowledge level. In the case of the second unit, the performance of both groups had a significant but almost equal rise, after the teaching. The results of the knowledge tests are shown in the following correlation table.

Table 2: Score results of Test 1 and Test 2, before and after the lesson

		Test 1						P[2]	P[3]
		Before		After		Change			
		mean	SD	mean	SD	mean	SD		
Group	Traditional method	52.9	17.6	72.4	13.5	19.4	14.3	<0.001	*0.057*
	DST	56.0	19.2	85.3	20.0	29.3	13.9	<0.001	
P[1]		0.642		0.037					
		Test 2						P[2]	P[3]
		Before		After		Change			
		mean	SD	Mean	SD	mean	SD		
Group	Traditional method	42.9	18.6	60.0	11.7	17.1	15.7	<0.001	0.174
	DST	44.0	15.0	68.7	18.5	24.7	15.1	<0.001	
P[1]		0.862		0.119					

[1]Difference between the groups, [2]Difference between the measurements, [3]Repeated measures ANOVA

3.3 The relationship between the students' working memory and their performance

In order to find the relationship between working memory and the improvement of the tests' scores, Pearson correlation coefficients were calculated, between measurements of working memory and the changes of the test scores. In the first test-first unit-the findings showed that there was no significant correlation between working memory and the rise of test results in both groups. The second test results-second unit- showed that in the traditional taught group there was no significant correlation between working memory and trainees' performance. On the contrary, in the DST method group, there was a relationship, between the high score in working memory tests and knowledge improvement. Thus, those who have benefited more were the trainees whose working memory measurements were high. More precisely, the higher was the measurement of working memory the higher the performance was. The test results are shown in the following correlation table.

After the teaching of the first unit both groups had a rise of the knowledge but the group of Digital Story makers-experimental group -had a bigger difference in their knowledge level. In the case of the second unit, the performance of both groups had a significant but almost equal rise, after the teaching. The results of the knowledge tests are shown in the following correlation table.

Table 3: Correlation table. Working Memory and score improvement

		Test 1 variance		Test 2 variance	
		Traditional method	DST	Traditional method	DST
Forward Digit Recall (span)	R	0.16	0.43	0.07	0.73
	P	0.544	0.106	0.779	0.002
Forward Digit Recall (rates)	R	0.18	0.42	0.10	0.73
	P	0.480	0.117	0.689	0.002
Backward Digit Recall (span)	R	0.19	0.40	-0.08	0.76
	P	0.468	0.144	0.755	0.001
Backward Digit Recall (rates)	R	0.20	0.39	-0.09	0.74
	P	0.432	0.152	0.744	0.002

4. Recommendation

There were some restrictions in the study, as well. Firstly, the sample of the research was small, limiting the generalizability of its findings. In addition, the time of the teaching hours was limited, and only two units of the subject were taught in the class. Moreover, the two measures which have been used, "*Forward digit recall test" and "Backwards digit recall test"* were used to assess the phonologic loop and the central executive of Baddeley's system, but other measures could be valuable to the researcher in order to have a more complete view of the participants' working memory.

Thus, future research should be conducted on a bigger sample of adult trainees. In addition, more teaching time would be helpful in a future attempt to study the specific issue. Last but not least, the research participants' Working Memory should be measured further. Thus, further study of the subject is required and the aforementioned factors have to be improved. Finally, a similar research could carry out, not only to adult trainees but to other levels of education, as well.

5. Conclusion

The present study showed that DST is effective as a teaching method in adult education when the people being taught are the creators of the story. The increased level of trainees' performance proves that the DST method can be a successful tool, at the educator's disposal. Regarding the Hypothesis 2 - if there is a connection between the effectiveness of DST and the participants' working memory so that the participants who have lower rates in Working Memory measurements benefit more than the others- the current study showed that there is no significant correlation between the research participants' Working Memory and the effectiveness of DST method, especially to those who had the lower scores in working memory measurements. On the contrary, those participants who had higher scores, had a bigger increase in their performance. Thus, the Hypothesis 2, is not supported.

Conflict of Interest Statement
The authors declare no conflicts of interests.

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