

Targeting Creativity Through a Learner-Generated Digital Storytelling Project

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One of the most emphasized skills for social, educational and workplace settings is creativity in the present decade. This study aims to understand whether a collaborative digital storytelling production project improves the creativity of undergraduate students. 109 students engaged in group work and employed a range of digital tools (i.e. wikis, storyboard creation tools, video editing programs) for creating digital stories about the 21st-century problems they think relevant. Students were able to review and comment on each other's scenarios and present their digital stories to their classmates at the end of the project. The adapted version of 'How Creative Are You?' scale (Whetten & Cameron, 2011) was used for measuring the students' creativity scores before and after the implementation. Whereas results indicated that creativity scores were increased by the digital storytelling production project, this effect was not significant. However, observation of the production process revealed some components of creative thinking skills of students.

Keywords: Digital Storytelling, Multimedia, Creativity, 21st Century Skills

INTRODUCTION

Through the economic and social changes, Information and Communications Technology (ICT) served an essential role for people on how to interact with knowledge. While education was required to meet the standards of traditional methods of learning and teaching in response to the industrial period, new advancements in communications technology challenged the system to change the roles of stakeholders in the education system and the teaching and learning practices (Jacobsen, 2001). Further, the rapid pace of

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technology has addressed new forms of activities in education, thus, the use and integration of different types of digital technology in schools have been practiced in many years. However, the debates of their effects on teaching and learning have still been ongoing, as the literature claims, technology should serve ways to utilize the teaching and learning activities rather than the effects of technology itself on education (Robin, 2008). Digital storytelling is one of the many ways in which technology is integrated into educational settings.

Digital storytelling (DST) is a method of encompassing teaching and learning strategies through technology to offer a way of telling stories (Robin, 2008). DST involves an effective aggregation of multimedia elements such as visual, written and audio tools (Robin & McNeil, 2012). Two components are essential to create DST: narration and stories, and digital tools. The stories are placed in the heart of DST where technology plays a role in leveraging the expression of stories. Storytelling is a way of reflecting personal experiences including causality, empathy, communication, and interaction (Boase, 2008) which makes the content more authentic and valuable (Yang & Wu, 2012). As a promising transformative approach, DST holds many advantages in learning activities including 21st century skills of information technology (Yang & Wu, 2012). Therefore, many studies focused on the potential of DST in the educational context. The practices in DST mostly engage with the skills of critical thinking, media and information literacy, social skills, and the outcomes of engagement, motivation, and achievement, thus, there is a lack of evidence on how DST procedures influence students' creativity. Therefore, this study focuses on exploring the effects of DST processes on creativity for delineating the ways in which this type of practice can be used for creative purposes. The detailed account of DST use in this study can guide researchers and practitioners targeting creativity.

LITERATURE REVIEW

DIGITAL STORYTELLING AND 21ST CENTURY SKILLS

Storytelling is not a new practice, rather it is a way of communication and self-expression to convey knowledge and experience that existed through history (Smeda, Dakich, & Sharda, 2014b). Stories are the reflection and apprehension of self-being and they act as channels for people to understand each other (Harris, 2007). Besides the social and cultural functions, storytelling was placed in educational practices when they were used to educate people in 1400s (Gils, 2005). Since these days, the essence of storytelling has held its aims but the transmission and creation of the stories have been transformed by the development in multimedia (Smeda et al., 2014b). Advancements in ICT and multimedia tools shifted the formalization and distribution of storytelling to the form of DST. The idea of DST emerged in the Center for Digital Storytelling (CDG) (former name was San Francisco Digital Media Center) which was founded in 1994 by Joe Lambert and Dana Atchley (Lambert, 2013) to allow people to create their narratives and their personal stories in a meaningful way by using new digital media technology (Robin, 2008). In 1990, DST also took attention in education (Lambert, 2015) where new media platforms and Web 2.0 tools offered new communication and interaction platforms which present different approaches to create digital stories (Wang & Zhan, 2010).

Storytelling is mostly used to reflect personal narratives and lifetime stories; however, historical documentaries and subjects in history, science, math, or different disciplines to inform and instruct the audiences could be applied to digital stories as well (Robin, 2008; Robin & McNeil, 2012). Storytelling is a powerful tool to create meaningful instructional content derived from personal experiences (Harris, 2007). Further, DST offers many advantages such as variation on narrations, personalized and engaging education, dealing

with real-life situations, compelling, active and interactive learning activities (Gils, 2005). Thus, as an educational objective, teachers could employ DST to instruct a subject, to show the procedures of a process, and to inform students about daily experiences, besides, students could use this approach to show their apprehension and reflection of a subject and an experience (Wang & Zhan, 2010). Many studies in the literature focused on different contexts and perspectives which reported diverse results regarding DST practices. Regarding affective results, some studies showed increased student motivation and attainment of attractive experience (Pardo, 2014), and engagement of students on the learning process while creating video and study subjects (Smeda, Dakich, & Sharda, 2014a). Whereas some studies focused on cognitive skills which displayed effective results on comprehension by exercising cognitive and metacognitive skills use (Hung, 2019), increased learning gains on specific subject matter (Grant & Bolin, 2016), and retention of material (Powell & Murray, 2012) while a study emphasized the contradictory results on students' achievements that show no significant improvements (Nam, 2017).

Regarding media, technology, and literacy skills, in a study, students' motivation and engagement were increased and media literacy and technology skills were developed whereas some students struggled to connect the story with the objectives of the subject matter (Sadik, 2008). DST had a positive impact on students' language skills and increased their motivation (Liu, Tai, & Liu, 2018), fostered the students' visual memory capacity and writing skills (Sarica & Usluel, 2016), and enhanced the language learning and skills through multilingual DST context (Anderson, Chung, & Macleroy, 2018). From the social aspect, a longitudinal study investigated the effects of collaborative DST platforms combined with social media platforms improved students' collaborative and social experience and their learning performance through engaging with social support (C.-C. Liu, Yang, & Chao, 2019). DST also enabled engagement in collaborative activities, communication, and interaction activities among students in online learning environment (Nam, 2017) and served as a facilitator for collaboration and social interaction among students (Rubino, Barberis, & Malnati, 2018).

DIGITAL STORYTELLING AND CREATIVITY

Creativity is one of the most ambiguous concepts in the social sciences. It was defined in terms of various characteristics and categories. Nevertheless, it is possible to mention that there are some ideas that are agreed-upon by different definitions of creativity. Some of them are novelty, relevance, and effectiveness (Cropley, 1999). Relevance is determined regarding the problem being handled while effectiveness requires providing a genuine solution to this problem. Starko (2017) named these last two characteristics as 'appropriateness' and argues that what is appropriate is determined by the cultural context. In all cases, these characteristics usefully exclude every far-fetched idea from being considered creative.

Creative products can either be physical products or new ways of using symbols within a field. They are the results of a purposeful effort to "make something better, more meaningful, or more beautiful" (Starko, 2017). Fostering creativity with systemic interventions is a humanistic endeavour in its own right (Runco et al., 2011). While creativity can be regarded as a social phenomenon facilitated and inhibited by others, an individual perspective may refer to ways of thinking, personal traits, and motivation. In parallel with these aspects, enhancing creativity can bring benefits in both individual and societal scales. Despite the popular remarks made about supporting creativity, there are no clear-cut guidelines towards this aim. One reason for this is the multi-faceted nature of creativity that involves a combination of cognitive, affective, motivational, personal, and social factors.

Some studies focused on the differences of creativity in different domains. Furnham, Batey, Booth, Patel and Lozinskaya (2011)'s study applied different measures of creativity to Arts and Science majors and reported that the Arts students achieved higher scores on self-rated creativity and creative achievements than science majors, but no differences were found on divergent thinking fluency between arts and science majors. Another study included diverse majors to examine the self-reported creativity, the Arts students' self-reported creativity scores outperformed other majors' scores (Humanities, Biological Sciences, Business, Education, Physical Sciences, Pre-professional, and Social Sciences) (Miller & Smith, 2017). Cheung, Rudowicz, Yue and Kwan (2003) reported a significant decline of students' creativity scores over years of study in every major whereas they pointed to higher scores of verbal creativities considering arts and humanities and social science students than science and technology major students.

There are also some studies focusing on gender differences on creativity, but the results are contradictory considering the diverse measures of creativity. Sokic, Qureshi and Khawaja (2021)'s study assessed gender differences on creativity and creative behavior. This study reported that there is a small significant difference between the creative behavior scores of females and males in favour of females but no significant difference between females and males' scores on creativity were found. Dong and Zhu (2021)'s study examined the gender differences in creative design education in which they found higher scores on creative characteristics (novelty, affective and elaboration) in favour of females but no significant differences between the scores of females and males' design principles were reported. While a study associated gender creativity with social role theories and cultural aspects (Hora, Badura, Lemoine & Grijalva, 2021), another study put a different perspective on gender difference studies which argues for following a person and certain situation approach rather than the studies focusing on main-effect differences (Kimmelmeier & Walton, 2016). This study showed that specific goals and conditions could affect the creative performance of females and males in different contexts.

Regarding the DST practices, the multi-faceted nature of creativity is evident in studies addressing how it is influenced by DST practices. Erişti (2016) used a participatory design approach for focusing on the creativity of elementary school students and DST practices. Students actively draw the illustrations used in their digital stories. She concluded that both motivation and creativity were positively affected by active and authentic experience. However, involving a more objective measure could provide a clearer picture of the issue. For example, Coppi (2016) did not find a significant difference in creativity using quantitative measures using the game-based unit with DST. Schmoelz (2018) focused on student interactions during digital story creation to understand the co-creativity process. Co-creativity is a term that attempts to emphasize creativity in both individual and social dimensions. Employing interviews and observations they tried to illustrate the co-creative flow emerging in digital story production.

Creativity is an important element for 21st century skills (Davies, Newton & Newton, 2018), thus new practices could focus on the activities which highlight the relation between technology and creativity (Henriksen, 2016). Therefore, this study aimed at designing a series of well-thought instructional activities through digital technologies for addressing different dimensions of creativity within the context of an undergraduate course.

PURPOSE AND RESEARCH QUESTIONS OF THE STUDY

The purpose of this study was to evaluate and observe the effects of the collaborative digital storytelling production processes on creativity. The research questions of the study were written as:

1. Is there a significant difference between the students' pre and post creativity scores?
2. Is the level of creativity proportions independent of gender, age group, department, number of books read in a month, hours of internet usage in a day, and playing an instrument the same for pre-test scores?
3. Is the level of creativity proportions independent of gender, age group, department, number of books read in a month, hours of internet usage in a day, and playing an instrument the same for post-test scores?
4. Are the differences between students' pre and post creativity scores different among the four departments (Elementary, Arts Education, Social Sciences and Turkish Education)?
5. How do the students' creativity change over time in terms of cognitive skills?

METHODS

RESEARCH DESIGN

In this study, quasi-experimental research was performed to address the research questions. Experimental research is a way of testing the cause-and-effect relationships of independent and dependent variables (Fraenkel, Wallen & Hyun, 2012) through the manipulation of independent variables. In this study, the type of instruction (digital storytelling) was defined as the independent variable whereas the level of creativity was entitled as the dependent variable.

As a form of quasi-experimental design, one-group pre- and post-test design (Fraenkel, Wallen & Hyun, 2012) was followed in this study. This design is selected because the unequal numbers of students in each of the four departments and pre-formed groups of departments led the researchers to the present design. Therefore, rather than one group, students from several departments were selected to amplify the results of the study. Additionally, researchers did not prefer to use traditional methods (in this case, the type of instruction used) to the control group because this instruction was given for only one semester. This treatment period took six weeks to implement, and the teachers of each department applied the same procedure and provided the same guidance to minimize the practitioner's effect.

PROCEDURE OF THE DIGITAL STORYTELLING

In the treatment process, we followed the 12-steps guideline which helped the researchers to form and implement DST procedures (Robin, 2016). Unifying some steps in the guideline, we devised seven steps to display each action in the process. Figure 1 displayed each step, procedure, and the teachers' assistance through the process.

This study was designed from the reflections of a previous semester study which revealed 'thought-provoking', 'challenging' perceptions of students about the production of DST. Furthermore, real-life and ill-defined problems were mentioned as a motivational factor. Therefore, in the current study, the digital story-making efforts were limited to the broad theme of the 21st century problems which allowed the students to concentrate on a relevant task. The creative DST project was a six-week unit that involved instructor demonstrations as well as student self-exploration with digital technologies and ideas. Students formed groups of 2-3 to create their stories. In the following section, the underlying steps of the process are explained in detail.

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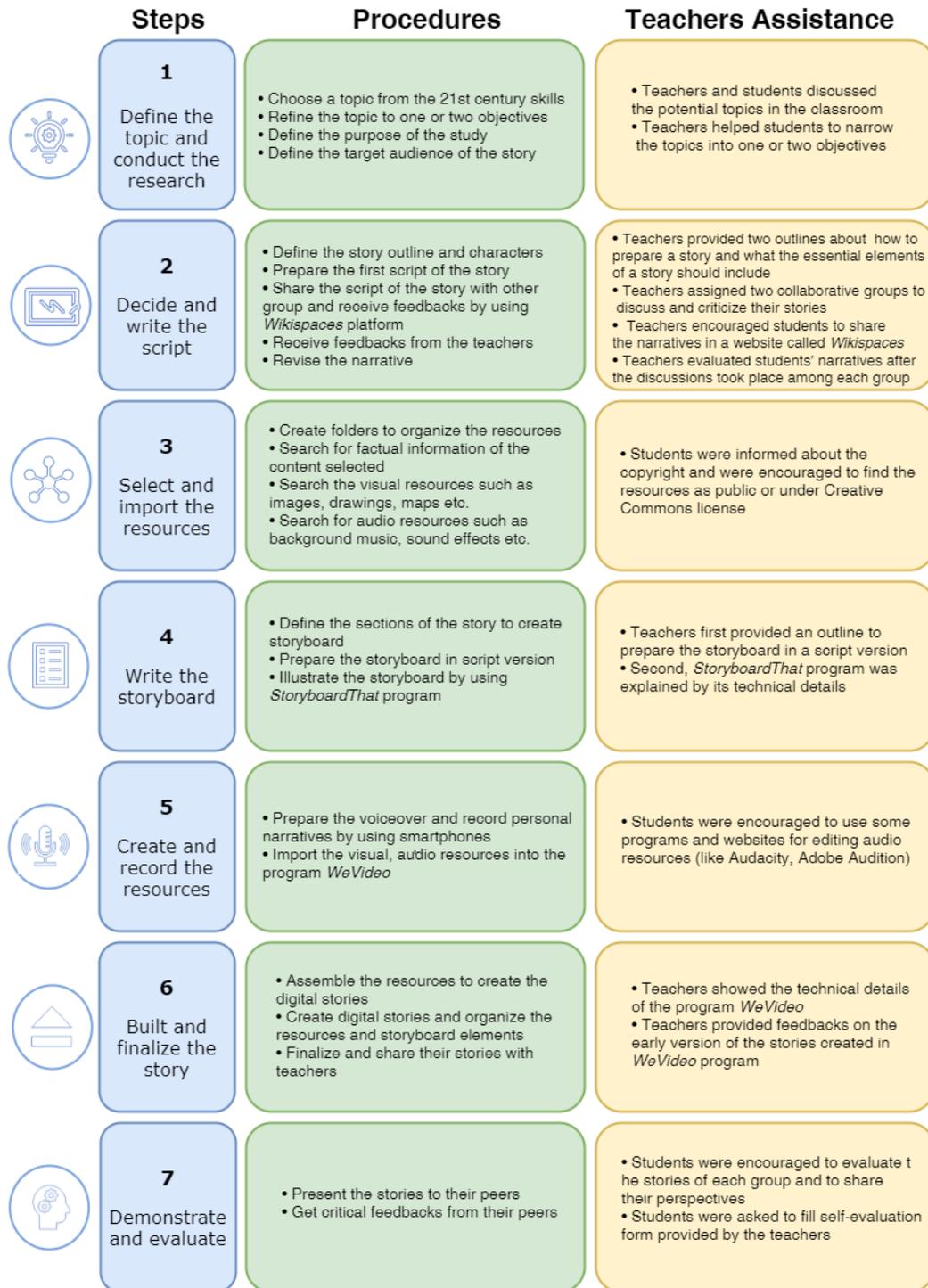


Figure 1. DST process through six weeks period

Define The Topic And Conduct The Research. The first task given to the students was to choose a 21st century problem to focus on their digital story. Next, students were assisted to conduct research on the content, visual and aural resources to shape their story to tell.

Decide And Write The Scripts. Second task expected from groups was to prepare their first scripts and write on the platform Wikispaces. Each group was guided to share their

work and evaluate the stories of another group (Figure 2). Thus, the wiki platform enabled students to work jointly on their project, read and comment on the narrations of the others.

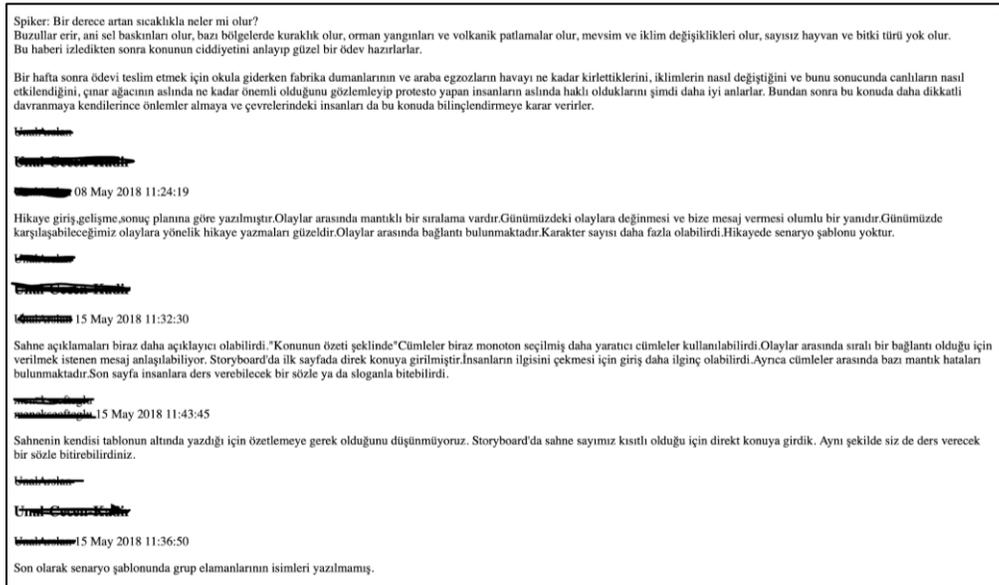


Figure 2. Screenshot of discussions among groups in Wikispaces

Select And Import The Resources. After finishing the narrations, groups commenced to an initial search for visual and aural resources. This task also involved a useful categorization and storage of resources.

Write The Storyboard. The groups prepared storyboards which involve the main ideas in their story. This mid-product was required for early planning for the story making. Groups prepared their storyboard by following two phases. First, they created them by filling in the template prepared by the teachers (Figure 3) which enabled students to organize their stories by considering the flow and the structure of the events as well as the technical issues (visual effects and interaction of audio and visual components) which the video-editing program (WeVideo) entails.

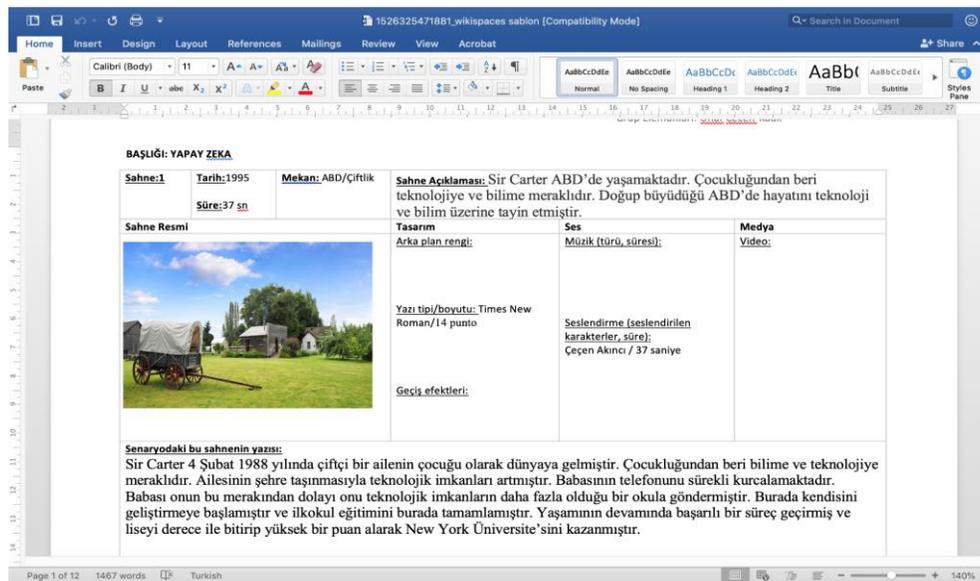


Figure 3. Screenshot of storyboard template created by the outline

Second, they adapted their storyboard by using StoryboardThat platform to visualize the process (Figure 4).

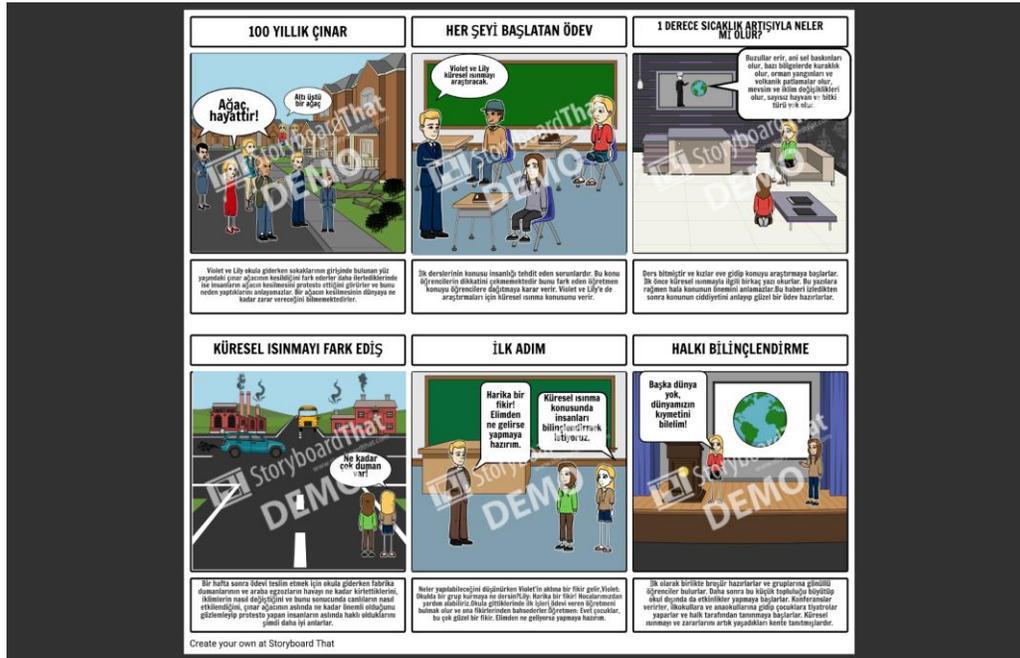


Figure 4. Screenshot of storyboard visuals created in StoryboardThat platform

Create And Record The Stories. In this task, students were expected to edit their narratives and record the voiceovers with different programs provided (like Audacity) to edit their voiceovers.

Build And Execute The Story. This task involved the final version of the students' projects. The students completed their products in which the resources (collected pictures, videos, and music) were integrated into the WeVideo program by adding their voiceovers to create their digital stories.

Demonstrate And Evaluate. In the last task, students were expected to present their stories to their classmates. Students were also encouraged to give critical feedback to other groups' projects and to fill in a self-evaluation form to personally reflect on their experiences.

PARTICIPANTS

109 students aged 18-25 from four departments in the Faculty of Education of a state university in Turkey participated in this study. Participants were freshmen students who enrolled in the Computer II class during the spring semester of 2017-2018. Participants were not randomly selected, rather they were naturally formed groups (Creswell, 2014) who were pre-defined at the beginning of the study. This study did not consist of a control group, rather one group received the treatment. Four departments were convenient and all of them were sub-groups which formed one group for this study. The number of participants were 38 (Elementary), 14 (Arts Education), 16 (Social Sciences) and 41 (Turkish Education).

The sub-groups shared similar characteristics in terms of age and grade level. However, each department requires specific personal characteristics and abilities. Thus, different departments helped to vary the sample where the comparison between treatment and control group was not used in this study.

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Female	48	80.0	30	75.0	7	87.5	0	0	4.13	0.23
Male	12	20.0	10	25.0	1	12.5	1	100.0		
Age Group										
<20	15	25.0	12	30.0	2	25.0	0	0	3.52	0.74
20-25	44	73.3	26	65.0	5	62.5	1	100.0		
>25	1	1.7	2	5.0	1	12.5	0	0		
Department										
Art Education	5	8.3	8	20.0	1	12.5	0	0	5.34	0.80
Elementary Education	23	38.3	13	32.5	2	25.0	0	0		
Turkish Education	23	38.3	13	32.5	4	50.0	1	100.0		
Social Sciences Education	9	15.0	6	15	1	12.5	0	0		
No. of reading books/month										
None	4	6.7	3	7.5	2	25.0	0	0	6.77	0.66
1-2	46	76.7	29	72.5	3	37.5	1	100.0		
3-4	8	13.3	6	75.0	2	25.0	0	0		
>4	2	3.3	2	5.0	1	12.5	0	0		
Hours of Internet use/day										
<1	4	6.7	1	2.5	0	0	0	0	6.45	0.69
1-3	21	35.0	9	22.5	3	37.5	0	0		
3-6	25	41.7	18	45	4	50.0	1	100.0		
>6	10	16.7	12	30	1	12.5	0	0		
Playing an instrument										
Yes	2	3.3	2	5.0	0	0	0	0	0.56	0.90
No	58	96.7	38	95.0	8	100.0	1	100.0		

Table 2 shows the frequencies and percentages associated with gender, age group, department, number of reading books in a month, hours of internet usage in a day and status of playing an instrument regarding post-levels of creativity. The number of females decreased in the third level of creativity while the males increased, and vice versa at the bottom. On the third level, the number of students younger than 20 years and between 20-25 increased. There was an increase in the number of Turkish Education students at the second level whereas a decrease in the third level. In the second level of creativity, 1-2 and 3-4 number of reading books in a month increased.

Table 2. Descriptive Statistics of Study For Bottom, Third, Second And Top-Level In Post-Test

Post-test	Bottom		Third		Second		Top		χ^2	p
	N	%	N	%	N	%	N	%		
Gender										
Female	44	77.2	33	82.5	8	72.7	0	0	4.21	0.23
Male	13	22.8	7	17.5	3	27.3	1	100.0		
Age Group										
<20	17	29.8	9	22.5	3	27.3	0	0	1.64	0.94
20-25	38	66.7	29	72.5	8	72.7	1	100.0		

Post-test	Bottom		Third		Second		Top		χ^2	<i>p</i>
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
>25	2	3.5	2	5.0	0	0	0	0		
Department										
Art Education	5	8.8	8	20.0	1	9.1	0	0		
Elementary Education	23	40.4	13	32.5	2	18.2	0	0		
Turkish Education	23	40.4	10	25.0	7	63.6	1	100.0	11.9	0.21
Social Sciences Education	9	10.5	9	22.5	1	9.1	0	0		
No. of reading books/month										
None	5	8.8	3	7.5	2	18.2	0	0		
1-2	41	71.9	28	70.0	7	63.6	1	100.0	3.32	0.95
3-4	9	15.8	8	20.0	1	9.1	0	0		
>4	2	3.5	1	2.5	1	9.1	0	0		
Hours of Internet use/day										
<1	1	1.8	1	2.5	0	0	0	0		
1-3	21	36.8	14	35.0	3	27.3	0	0	7.68	0.56
3-6	19	33.3	17	42.5	7	63.6	0	0		
>6	16	28.1	8	20.0	1	9.1	1	100.0		
Playing an instrument										
Yes	1	1.8	6	15.0	0	0	0	0		
No	56	98.2	34	85.0	1	100.	1	100.0	7.78	0.05
					1	0				

A paired-samples t-test was conducted to evaluate whether students have higher creativity scores in post-test than pre-test. The results showed that the mean creativity in the pre-test ($M = 44.61$, $SD = 7.93$) was not significantly different from the mean creativity in the post-test ($M = 46.02$, $SD = 7.91$), $t(108) = -1.78$, $p = 0.07$ (Table 3). Moreover, the mean difference was -1.41. The standardized effect size index, d , was 0.17, a small value.

Table 3. Creativity Score in Pre-Test and Post-Test

Creativity Scale	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>p</i>	<i>Cohen's d</i>
Pretest-Posttest	-1.41	8.27	108	-1.78	0.07	0.17

RESULTS FOR RESEARCH QUESTION TWO.

Is the level of creativity proportions independent of gender, age group, department, number of books read in a month, hours of internet usage in a day, and playing an instrument the same for pre-test scores?

In Table 1, chi-square results of pre-creativity scores in terms of proportions of gender, age group, department, number of reading books in a month, hours of Internet usage in a day and playing an instrument indicated nonsignificant results. Chi-square test was conducted to assess whether female's creativity scores proportions are equal to male's creativity scores proportions. The results of the test were not significant ($\chi^2(3) = 4.13$, $p = 0.23$). Moreover, chi-square results showed that the proportion of age group (< 20), the proportion of age group (20-25) and the proportion of age group (> 25) were approximately

the same value ($\chi^2(6) = 3.52, p = 0.74$). Regarding the department, the test results indicated that the proportions of each department did not differ significantly ($\chi^2(9) = 5.34, p = 0.8$). Considering the number of reading books/month, chi-square results showed that the proportion of no readers, the proportion of 1-2 hours of readers, the proportion of 3-4 hours readers and the proportion of more than 4 hours of readers were approximately the same value ($\chi^2(9) = 6.77, p = 0.66$). Regarding the number of hours of Internet usage, chi-square results indicated that the test is nonsignificant, and the sample proportions are similar to each other ($\chi^2(9) = 6.45, p = 0.9$). The proportion of playing an instrument was approximately the same value with the proportion of not playing an instrument ($\chi^2(3) = 0.56, p = 0.90$). Therefore, the level of creativity of pre-scores did not indicate a significant relationship with gender, age, department, number of reading books, the number of hours of Internet usage and playing an instrument respectively.

RESULTS FOR RESEARCH QUESTION THREE.

Is the level of creativity proportions independent of gender, age group, department, number of books read in a month, hours of internet usage in a day, and playing an instrument the same for post-test scores?

In Table 2, chi-square results of post-creativity scores in terms of proportions of gender, age group, department, number of reading books in a month, hours of Internet usage in a day and playing an instrument indicated nonsignificant results. Chi-square test was conducted to assess whether female's creativity scores proportions are equal to male's creativity scores proportions. The results of the test were not significant ($\chi^2(3) = 4.21, p = 0.23$). Furthermore, chi-square results showed that the proportion of age group (< 20), the proportion of age group (20-25) and the proportion of age group (> 25) were approximately the same value ($\chi^2(6) = 1.64, p = 0.94$). Considering the department, the test results indicated that the proportions of each department did not differ significantly ($\chi^2(9) = 11.9, p = 0.21$). Regarding the number of reading books/month, chi-square results showed that the proportion of no readers, the proportion of 1-2 hours of readers, the proportion of 3-4 hours readers and the proportion of more than 4 hours of readers were approximately the same value ($\chi^2(9) = 3.32, p = 0.95$). Also, the number of hours of Internet usage, chi-square results indicated that the test is nonsignificant, and the sample proportions are similar to each other ($\chi^2(9) = 7.68, p = 0.56$). The proportion of playing an instrument was approximately the same value with the proportion of not playing an instrument ($\chi^2(3) = 7.78, p = 0.05$). Therefore, the level of creativity of post-scores did not indicate a significant relationship with gender, age, department, number of reading books, the number of hours of Internet usage and playing an instrument respectively.

RESULTS FOR RESEARCH QUESTION FOUR.

Are the differences between students' pre and post creativity scores different among the four departments (elementary, arts education, social sciences and Turkish education)?

A one-way ANOVA was conducted to evaluate the relationship between the department and the difference between pre-test and post-test of creativity scores. The independent variable, the department included 4 sections: Art, Elementary, Turkish, and Social Science. The dependent variable was the difference between pre-test and post-test of creativity score. All assumptions for ANOVA were met and regarding Levene's test result, p was found as 0.47 and variance had homogeneity. The ANOVA was not significant, $F(3, 105) = 0.51, p = 0.68$. The strength of the relationship between the department and the difference in the creativity score, as assessed by eta square, was not strong. From the data in Table 4, it is apparent that the difference of creativity score has the highest value in the department of Social Science.

Table 4. Relationship Between Departments in Terms Of Pre And Post Creativity Score

Department	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>	η^2
Art	0.14	8.16			
Elementary	0.84	7.05	0.51	0.68	0.01
Turkish	1.56	9.13			
Social Science	3.50	9.11			

RESULTS FOR RESEARCH QUESTION FIVE.

How do the students' creativity change over time in terms of cognitive skills?

The researchers employed a template to focus on the creativity patterns on students' works by following the issues of context-based creativity assessment (Henriksen, 2016). To enrich the assessment process, we applied key cognitive skills of creative thinking such as perceiving (observing & imaging), patterning (recognizing & forming), abstracting, embodied thinking (kinesthetics & empathizing), modelling, transformational play and synthesizing (Mishra, Koehler, & Henriksen, 2011) to reveal the creativity patterns (Table 5).

Table 5. Cognitive Skills Observed During DST Production Process

Behavioral	Students' behavior on the classroom activities were evaluated. Most students were eager to develop their stories; however, they were more motivated during the video production process than the storyboard process. They were challenged to create new stories and reform their content knowledge. In this process, they mostly failed to associate their personal stories with the content and created characters detached from stories (modelling).
Process & Product	<p>Process</p> <p>Students were evaluated based on their writing, story development and technical abilities over video production. Most students were seen to struggle with scriptwriting. Furthermore, their comprehension of the content was enough to develop a story; however, characters and dimensions were mostly the mimics of the stories which they encountered in their daily life (perceiving/abstracting). Students were encouraged to reflect on other groups' stories through discussion board but most preferred to write simple advice to their peers. Conversely, students were able to select the visuals and audial resources to enhance the flow (patterning) and they were mostly successful in determining the sections of the story and how to meaningfully order them (patterning).</p> <p>Product</p> <p>The final product was also evaluated based on the presentation of the digital videos. The flow of the stories was enough to grasp the aim of the content; however, the stories did not comprehensively display an intimate connection with the content to foster the students' interconnections with the knowledge (embodied thinking).</p>

Individual Group	Individual	Students were evaluated individually; however, the scores of the process and the product were determined mostly by the group performance. Some students were observed to take little responsibility for the project. Also, it was hard to target personal creativity while the students were encouraged to work collaboratively.
	Group	Collaboration and interaction among students were observed in the process which fostered different ideas to create digital stories. However, the students mostly tended to share the responsibilities in the development process which decreased their awareness and participation of each process in the production.
Domain-Specific & General		We aimed to select a topic between domain-specific and domain-general. Students successfully generated ideas to provide knowledge about the content; however, they mostly chose the subjects that they could explain better rather than the content that they felt personal interest and empathy about (embodied thinking).

DISCUSSION AND CONCLUSION

In this study, the effect of the digital story-making process on undergraduate students' creativity scores was examined. It was discussed in different studies that digital stories can increase creativity (Catala, Theune, Gijlers, & Heylen, 2017; Daskolia, Makri, & Kynigos, 2014). Also, it is stated that the processes of writing and visualizing the story could increase creativity (Akyeampong, 2018). In the current research regarding the first research question, the creativity levels of students increased; however, this increase was not statistically significant. Some explanations could elucidate the results of this study. First, most applications in this study might refer to the strategies of creative teaching rather than teaching for creativity. DST practices allow a flexible environment to employ teaching for creativity and hold benefits of enabling students to design, produce and implement the ideas, but this study might provide better strategies to assist students in self-monitoring and critical thinking abilities rather than creativity. Second, intrinsic interest is essential for facilitating creativity (Runco, 2003). In this study, the students tended to select the topics that are easily expressed and agreed upon rather than intrinsically connected to their lives, thus topic selection might have suppressed their creativity. Third, some classroom activities such as competition and evaluation could hinder creativity (de Souza Fleith, 2000), therefore the formal construction of the course might have undermined the risk-taking, freedom and flexibility features of creativity. Furthermore, while social interaction was defined as a beneficial element to foster creativity, creativity is a personal construction process where collaboration could impede the personal reflections (Runco, 2003). When the students engaged in teamwork, some tasks may have remained repetitive, and free riders may have hindered co-creative interaction in activities (Maiden & Perry, 2011; Pfaff & Huddleston, 2003). Long (2011) reported a limitation about not enabling students to share their work with classmates in her report on enhancing students' reflective ability through DST. The present study provided ample time and opportunity for viewing other groups' works and writing reviews for their story scenarios. This process facilitated students' reflections on their self and peers' story development through discussion board, but students mostly tended to write shallow reflections on their peers' stories. Therefore, several rounds of in-class discussion sessions may utilize the comprehensive development

of stories and detailed guidelines may be provided for how to effectively discuss and improve the reflections for cultivating creativity. Furthermore, instructors may offer alternative online platforms to monitor students' discussion process.

Students in different fields are expected to execute diverse skills considering creativity. On the other hand, some studies reported that some disciplines like the Arts, humanities and social sciences displayed more creative patterns than science and business disciplines (Cheung, Rudowicz, Yue & Kwan, 2003). Our study did not find any significant difference between the four departments based on their creativity; however, interestingly, social science students made greater progress than the other three departments in creativity scores. On the contrary to the literature, the Arts Education students did not show a significant difference on their creativity score. The possible explanation could be that the result could be inflated by the scarce number of the Arts Education students. Furthermore, although the students are in different departments, they are the students of the Faculty of Education as the common field. It is possible that the difference will become more pronounced if it is carried out with different faculties. Also, the method and the intervention applied in this study may have not aligned with the discipline's curriculum and students' learning experiences. Gender also did not yield significant results considering the difference between female and male's creativity scores. Former studies reported contradictory results on gender creativity which were affected by different aspects of research designs, creativity types, and social and cultural norms (Nakano, Oliveira & Zaia, 2021). Therefore, the results did not indicate a gender gap on creativity scores but the limited number of males in this study should be taken into consideration.

Besides the quantitative results, DST was found to be effective in facilitating students' perceiving and patterning skills and some level of embodied thinking and abstracting. Creativity was a construction of new knowledge and problem-solving skills (Newton & Newton, 2010; Runco, 2003), DST helped to comprehend the knowledge to transform that into a story. Moreover, the storyboard and video production process facilitated the students' thinking process to express their ideas. Furthermore, Gresham (2014) argued that through the DST project, students both developed and illustrated their digital literacy skills. Likewise, we observed that students in this project improved their digital competencies by using various web-based tools such as wiki and a 2-D storyboard maker, using search engines and video-editing effectively. For teacher candidates in all branches, these were some of the core competencies addressed for the course which involved the DST project. Effective integration of technology in primary and elementary education levels is only possible if teacher education addresses these skills during undergraduate programs. However, in this study, we have found that the students had difficulty to employ the creative skills while writing their stories. The study of Duman and Göcen (2015) displayed a contradictory result which reported a significant improvement in the creative writing abilities of students instructed through DST compared to students instructed through PowerPoint presentations. Thus, the researchers could focus on how to elaborate the writing process and could use some digital platforms which guided students in this process. Other supportive courses for developing effective writing skills and for engaging students in creativity-focused activities may improve their intellectual knowledge. Furthermore, in this context, modelling, transformational play, and synthesizing skills were not observed. Thus, different strategies could be developed to integrate them into the DST process. While some studies claimed no significant outcomes, most studies showed significant positive outcomes of DST which could be explained by the novelty effect of technology and the drawer effect which refers to the tendency to publish significant results (Wu & Chen, 2020). On the other hand, reporting statistically nonsignificant results are important to direct teachers and researchers (Moalosi, 2013); therefore, this study aimed to highlight the DST process of undergraduate students including the application of creativity scale and the

conduct of detailed observation. Future studies can be carried out over a longer period; besides, qualitative data can be used to get ideas about creativity levels. Furthermore, the current trends among young people embrace several social networking platforms such as YouTube, Instagram, TikTok etc. To address this trend, future story-making studies could employ such digital media tools to create more personal, thought-provoking stories through using more familiar platforms.

This study has limitations on the number of departments selected and the number of students participated in this study. Also, the number of male students was significantly lower comparing with the number of female students. Future studies targeting creativity of university students may involve a more diverse and larger population.

CONFLICT OF INTEREST

There is no actual or potential conflict of interest in relation to this article.

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APPENDIX A

How Creative Are You?©

How creative are you? The following test helps you determine if you have the personality traits, attitudes, values, motivations, and interests that characterize creativity. It is based on several years' study of attributes possessed by men and women in a variety of fields and occupations who think and act creatively or each statement, write in the appropriate letter:

A Agree

B Undecided or Don't Know

C Disagree

Be as frank as possible. Try not to second-guess how a creative person might respond. Turn to the end of the chapter to find the answer key and an interpretation of your scores.

- _____ 1. I always work with a great deal of certainty that I am following the correct procedure for solving a particular problem.
- _____ 2. It would be a waste of time for me to ask questions if I had no hope of obtaining answers.
- _____ 3. I concentrate harder on whatever interests me than do most people.
- _____ 4. I feel that a logical step-by-step method is best for solving problems.
- _____ 5. In groups I occasionally voice opinions that seem to turn some people off.
- _____ 6. I spend a great deal of time thinking about what others think of me.
- _____ 7. It is more important for me to do what I believe to be right than to try to win the approval of others.
- _____ 8. People who seem uncertain about things lose my respect.
- _____ 9. More than other people, I need to have things interesting and exciting.
- _____ 10. I know how to keep my inner impulses in check.
- _____ 11. I am able to stick with difficult problems over extended periods of time.
- _____ 12. On occasion I get overly enthusiastic.
- _____ 13. I often get my best ideas when doing nothing in particular.
- _____ 14. I rely on intuitive hunches and the feeling of "rightness" or "wrongness" when moving toward the solution of a problem.
- _____ 15. When problem solving, I work faster when analyzing the problem and slower when synthesizing the information I have gathered.
- _____ 16. I sometimes get a kick out of breaking the rules and doing things I am not supposed to do.
- _____ 17. I like hobbies that involve collecting things.
- _____ 18. Daydreaming has provided the impetus for many of my more important projects.
- _____ 19. I like people who are objective and rational.
- _____ 20. If I had to choose from two occupations other than the one I now have, I would rather be a physician than an explorer.
- _____ 21. I can get along more easily with people if they belong to about the same social and business class as myself.
- _____ 22. I have a high degree of aesthetic sensitivity.
- _____ 23. I am driven to achieve high status and power in life.

- _____ 24. I like people who are sure of their conclusions.
- _____ 25. Inspiration has nothing to do with the successful solution of problems.
- _____ 26. When I am in an argument, my greatest pleasure would be for the person who disagrees with me to become a friend, even at the price of sacrificing my point of view.
- _____ 27. I am much more interested in coming up with new ideas than in trying to sell them to others.
- _____ 28. I would enjoy spending an entire day alone, just “chewing the mental cud.”
- _____ 29. I tend to avoid situations in which I might feel inferior.
- _____ 30. In evaluating information, the source is more important to me than the content.
- _____ 31. I resent things being uncertain and unpredictable.
- _____ 32. I like people who follow the rule “business before pleasure.”
- _____ 33. Self-respect is much more important than the respect of others.
- _____ 34. I feel that people who strive for perfection are unwise.
- _____ 35. I prefer to work with others in a team effort rather than solo.
- _____ 36. I like work in which I must influence others.
- _____ 37. Many problems that I encounter in life cannot be resolved in terms of right or wrong solutions.
- _____ 38. It is important for me to have a place for everything and everything in its place.
- _____ 39. Writers who use strange and unusual words merely want to show off.
- _____ 40. Below is a list of terms that describe people. Choose 10 words that best characterize you.

energetic	persuasive	observant
fashionable	self-confident	persevering
original	cautious	habit-bound
resourceful	egotistical	independent
stern	predictable	formal
informal	dedicated	forward-
factual	open-minded	looking
inhibited	enthusiastic	tactful
poised	acquisitive	innovative
alert	curious	practical
unemotional	clear-thinking	organized
dynamic	self-	understanding
courageous	demanding	polished
perceptive	efficient	helpful
thorough	quick	good-natured
realistic	impulsive	determined
absent-	modest	involved
minded	flexible	sociable
well-liked	restless	retiring

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APPENDIX B

How Creative Are You?© Scoring Key

Circle and add up the values assigned to each item below.

ITEM	AGREE	DON'T KNOW	DISAGREE	ITEM	AGREE	DON'T KNOW	DISAGREE
1	0	1	2	21	0	1	2
2	0	1	2	22	3	0	1
3	4	1	0	23	0	1	2
4	-2	0	3	24	-1	0	2
5	2	1	0	25	0	1	3
6	-1	0	3	26	-1	0	2
7	3	0	-1	27	2	1	0
8	0	1	2	28	2	0	-1
9	3	0	-1	29	0	1	2
10	1	0	3	30	-2	0	3
11	4	1	0	31	0	1	2
12	3	0	-1	32	0	1	2
13	2	1	0	33	3	0	-1
14	4	0	-2	34	-1	0	2
15	-1	0	2	35	0	1	2
16	2	1	0	36	1	2	3
17	0	1	2	37	2	1	0
18	3	0	-1	38	0	2	2
19	0	1	2	39	-1	0	2
20	0	1	2				

40. These words have values of 2:

energetic perceptive
 resourceful innovative
 original self-demanding
 enthusiastic persevering
 dynamic dedicated
 flexible courageous
 observant curious
 independent involved

These words have values of 1:

self-confident informal
 thorough alert
 forward-looking open-minded
 restless

The remaining words have a value of 0.

The maximum possible score = 116.

The minimum possible score = -18

Total Score_____

Comparison Data (N = 5,000 students)

Mean score: 55.99

Top quartile: 65 or above

Second quartile: 55–64

Third quartile: 47–54

Bottom quartile: 46 or below

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