Pre-service Physics Teachers' Views on Designing and Developing Physics Digital Stories

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Abstract

The aim of this study is to determine the pre-service physics teachers' views on the effect of designing and developing physics digital stories (DST) on improving their 21st century skills. The study is a qualitative research carried out with 13 pre-service physics teachers, who participated in the course of designing and developing DST, during 6 weeks, at Yuzuncu Yıl University, Turkey, in the spring term of 2013-2014 academic year. Data were collected using semi-structured interviews and were examined by descriptive analysis technique focusing on the themes. The major findings of the study are that they developed their many 21st century skills; such as ICT (information and communication technologies) skills, critical thinking, problem solving; planning, self-control, responsibility, production; communication, cooperation, and collaboration when creating their digital stories. Thus, to design and develop digital stories have a positive effect on pre-service physics teachers' skills, and improve many 21st century skills.

Keywords

Digital storytelling; Educational technology; Critical thinking; 21st century skills.

I. Introduction

Technology and communication is changing both the way we learn and the way we teach. Banaszewski (2005) pointed out that educational technologies have progressively taken place in the education and instruction environment. Considering today's technological means as well as opportunities that individuals have, it is clear that there is a need to use methods in education that enable individuals to construct the knowledge and to use information, and communication technology in the class. One of these methods may be digital storytelling which has been practiced in many educational systems. Numerous studies have shown that DST has become widespread in the classroom setting and in various fields of study and DST has the potential to facilitate teaching and learning in the classroom and the DST generates a number of substantial techno-educational benefits and it appears to be an appropriate and effective method with today's technological development (Xu, Park, & Baek, 2011; Razmi, Pourali, & Nozad, 2014; Yang & Wu, 2012). The reasons why DST is an effective method are that; a) learners take active responsibility for their learning via designing and developing DST (Menezes, 2012), b) DST has the potential to engage students in learner-centered activities (Hayes, 2011), c) learners gained technological skills during the production of DST (Chigona, 2013), according to Robin (2008), d) DST can promote multiple skills; such as digital literacy (communicate with an ever-expanding community, to discuss issues, gather information, and seek help), global literacy (read, interpret, respond, and contextualize messages from a global perspective), technological literacy (use computers and other technology to improve learning, productivity and performance), visual literacy (understand, produce and communicate through visual images) and, information literacy (find, evaluate, and synthesize information). e) DST has the potential to encourage voice/self-expression (Botturi, Bramani & Corbino, 2012), f) DST has the potential to motivate and engage learners (Dogan & Robin 2008; Figg and McCartney, 2010), g) DST encourages deep reflection (Sylvester & Greenidge, 2009) and h) DST can help build the 21st century skills that learner will need to succeed in school and eventually in the modern workforce and it reinforces literacy and 21st century skills (Czarnecki, 2009; Kotluk & Kocakaya, 2015). All over the world, twenty-first century skills have become a key topic on the agendas of educational systems (Niemi & Multisilta, 2016). In this study, we will focus on the effect of designing and developing digital stories on the pre-service teachers' 21st century skills.

a. What is digital storytelling

There is a number of definitions of digital storytelling (DST) in the literature. Dupain and Maguire (2005) defined DST as creating a story by combining multimedia elements like visuals, audio, video, and animation while it was described by Chung (2007) as multimedia presentation of digital components such as text, images, audio and video in computer environment as a whole. However, DST is generally regarded as production of an authentic story about a theme through the use of multimedia sources/ tools (Nguyen, 2011; Robin, 2008; Lambert, 2010). Almost all digital stories are formed by synthesizing elements such as graphics, text, voiceover, video, and music that are relevant to a particular subject (Robin, 2008).

DST is seen as promising to equip students with various skills including critical thinking, information, and technology literacy in learning-instruction environment (Yang & Wu, 2012). Digital stories are short videos created by integrating visual, video background music and written or audible narration with personal story through some basic software and hardware (Microsoft Photo Story, Windows Movie Maker, Wevideo, Web 2.0 etc.) which can be easily used even by the people who have low technology literacy (Wang & Zhan, 2010).

There are seven elements necessary for creating effective and interesting digital stories. These are (Robin &Pierson, 2005):
1. Point of View: Main perspective that author reflects.
2. Dramatic Question: A question that attracts attention and will be answered at the end of story.
3. Emotional Content: Story or content that will inflect viewers.
4. Voice: Narration that helps viewers to personalize the story.
5. Soundtrack: Music or other sounds that support and embellish the story.
6. Economy: Employing enough content without unnecessary components.

7.   Pacing: The rhythm of the story and how slowly or quickly it paces.

b. Process of producing digital stories

The process of creating a digital story is mainly described in six steps (Jakes & Brennan, 2005). In the first step the learner should select a topic for the digital story. Next, the learner should search for image resources for the story such as pictures, photographs, and maps, and audio resources including music, and sound effects, and informational content from web sites, documents. When the learner has gathered all of his resources, learner should begin thinking about the purpose of the story. Is the purpose to inform, convince, provoke, or question? (Xu, Park and Baek, 2011). In the second step, the learner organizes and selects specific audio, images, text, and other content for the story. The learner should import the images and audio into Photo Story. In the third step, the learner can modify the number of images and image order, if necessary. In the fourth step, the storyteller creates, records, and finalizes the story. The learner should decide on the purpose and point of view of the story and write a script that will be used as narration. The learner can record the narration with a computer microphone and import the narration into Photo Story. Finally, the digital story is finalized by saving it as a Windows Media Video (.wmv) file. In the last step, the learner presents the story and receives feedback. The learner can show the story to his colleagues and gather feedback about how the story could be improved, expanded, and used in the classroom. If well received, he can teach colleagues how to create their own digital story (Xu, Park and Baek, 2011).

c. Benefits of digital storytelling

In the DST process, certain skills, such as writing, arranging, technology literacy, presenting, problem-solving, evaluating, and collaboration, are improved, and a greater competence in technology through practice and experimentation is gained (Robin, 2008). According to Sadik (2008), DST enables students to personalize learning content, improve collaboration and communication skills and use technology in a meaningful way. Researchers who have implemented or observed students working with DST report high engagement in various types of decision-making (Chung, 2007; Sadik, 2008). Studies show that students develop their technical skills through both planning the stage and the "translation of their ideas and resources to the digital format" (Sadik, 2008). DST puts the technology "in the hands of the learner", allowing students to control how it is used and giving them autonomy. Therefore, DST requires students to synthesize information, tap into their creativity, conduct research, and utilize critical thinking (Hull & Katz, 2006; Ohler, 2008). Gakhar (2007) demonstrated that DST can improve students' writing and critical thinking skills and media literacy. Therefore, DST is a worthy educational endeavor for teachers who are looking for ways to prepare their 21st-century students for their future (Kieler, 2010).

d. Digital storytelling and 21st century skills

Developing students', in-service teachers' and pre-service teachers' 21st century skills, including creativity, critical thinking, problem solving, communication has been a prevailing concern in our globalized and hyper-connected society. One of the key components for pre-service teachers to accomplish this is to take part in today's participatory culture, which involves becoming creators of knowledge rather than being passive consumers of information. The advancement and accessibility of computing technologies has the potential to engage students in this process (Gretter and Yadav, 2016). Many individuals and organizations have proposed lists of skills that they believe to be important for the 21st century (Partnership for 21st century skills [P21], 2009; National Research Council [NRC], 2013). The competencies vary widely, ranging from critical thinking and argumentation to flexibility and empathy. There is a widespread agreement on the need for skills in the areas of communication, collaboration, ICT literacy, and social and/or cultural awareness (Voogt & Roblin, 2013). According to studies (Karakoyun & Kuzu, 2013; Ming et al., 2014; Niemi et al.; 2014; Brenner, 2014; Husband, 2014; Kotluk & Kocakaya, 2015), DST promotes the 21st century learning and skills. Because DST involves the use of technology and interactive media, including audio, images, movies and video, and these processes can help build the 21st century skills (Czarnecki, 2009).

Students are encouraged to become creators, producers, and discussants. Ming et al., (2014) stated that;"*DST allows students to use media to engage an audience and show what they have learned. This requires knowledge of the subject and ability to think in the process of converting their materials into interactive media format. This process is personal and meaningful because they are engaged with it and learned to think about it in a new way. It also involves communication, collaboration and team work as each group of students share their knowledge and know-how with each other. By creating a video as the end product of their work, the participants have to use critical thinking and problem solving skills in order to convey a coherent message. When making the video, the students have to make decisions about which information to include and about how to most effectively format that information to convey their messages. By using digital media to search for materials on an issue meaningful to them and then convey their message to other people through their digital stories, the students are participating in the act of teaching and raising awareness. In order to conduct online research to create a video, the students have to learn how to use software and search on the Web in a variety of ways. This use of technology enables them to gain a better conceptual understanding of the technology that they are using. Thus it can be seen here that the skills they can learn from DST are all skills relevant for the 21st century skills in general*" .

This study introduces the 21st century skills defined by the framework of National Research Council (NRC, 2013). The NRC framework has been used as basic criteria for improving skills in DST process. According to the NRC framework, the 21st century skills, defined by individual and organization, can be organized into three domains: 1. The cognitive domain, 2. The intrapersonal domain, and 3. The interpersonal domain(see Table 1).

COGNITIVE	INTERPERSONAL	INTRAPERSONAL
Analysis	Social influence with others	Adaptability
Decision-making	Responsibility	Integrity
Critical thinking	Assertive communication	Self monitoring
Executive function	Leadership	Continuous learning
Adaptive learning	Empathy	Initiative
Reasoning	Trust	Self evaluation
Active listening	Coordination	Metacognition
Interpretation	Self presentation	Self direction
Problem solving	Teamwork	Flexibility
Communication	Cooperation	Responsibility
Innovation	Collaboration	Planning
Information and communication technology (ICT)	Conflict resolution	Self control
Creativity	Negotiation	Production
	Interpersonal competencies	Self monitoring
	Service orientation	Citizenship

Table 1. The NRC framework for the 21st century skills.
Source: Compiled by author

e. Importance of Study and Research Questions

Robin (2008) proposed that digital storytelling takes advantage of the creative potential of modern communication technologies. Learners are encouraged to become creators, producers and discussants, rather than simply passive audience members. Creating digital stories on the subjects of physics allows pre-service teachers to realize the effect of digital stories on learning these subjects. With respect to the process of its emergence, it appears that DST is not adequately recognized and implemented in physics instruction apart from a few studies. Moreover, it is considered that thanks to the methods, such as DST that can provide individuals with opportunity to engage in physics, individuals could use multimedia tools more effectively and efficiently in physics instruction. It is argued that in physics instruction by means of such methods as DST, which enables pre-service teachers to become active learners and take responsibility of learning tasks, pre-service teachers could take advantage of

multimedia tools and utilize computer and internet more efficiently in learning-instruction environment. Digital storytelling involves the integration of technology and the use of interactive media (which may include digital audio, video, movies, digital comic books and multimedia images. It is similar to traditional storytelling in that it is an exercise in communication and a creative process that requires participants to visualize and use their imaginations. It can help build the 21st century skills that are needed in modern workforce by enabling students gain competence in skills considered as an important part of any curriculum (Ming et al., 2014). There are many studies conducted on DST, from its effect on academic achievement to learning motivation, from studies carried out with pre-school students to higher education students, but there is need to study its effect on pre-service teachers' skills. In response to the above sentences, this study investigated the potential of digital storytelling in enhancing pre-service physics teachers' 21st century skills. It is hoped that an article on the potential benefits of DST to enhance 21st skills in the classroom may encourage more teachers to use DST. Also, stakeholders may gain a better understanding of the benefits of this technological tool in teaching the learners.

The aim of this study is to determine the effect of DST on improving their 21st centuries skills. The main question of the study is the following:

1. What are the views of pre-service teachers of the potential benefits of digital storytelling (DST) to promote their 21st century skills?

II. Material and Method

The qualitative research method was used in collection, analysis and evaluation of the data obtained for this research. Since it was aimed to describe the existing situation as it is, descriptive model was used (Creswell, 2013).

a. The Participants

Participants of this study consist of 13 pre-service physics teachers, all of whom took part in the study, registered to Physics Teacher Education Department of Education Faculty of Yuzuncu Yıl University in the spring term of academic year 2013-2014. They are expected to work as a physics teachers at high school in Turkey next year. This study was applied during the courses of teaching learning methodology and techniques, which is official subject of the department.

A questionnaire were applied to them to learn their knowledge about computer (low), how often they used different technological application (less than twice a week) and DST (never). Due to their responses about computer and internet literacy, they were taught to use Windows Movie Maker, a program for preparing DST, by the same instructor, 6 hours. We can conclude that the pre-service teachers did not have any experience with DST before.

b. What the Pre-service Teachers Did? How the pre-service teachers designed and developed the digital stories?

According to Barrett (2005) digital storytelling facilitates the convergence of four student-centered learning strategies: student engagement, reflection for deep learning, project based learning, and the effective integration of technology into instruction. In this study ''project-based learning'' principals were applied. Applying technology in PBL could support cooperative activities and constructivist approaches in learning (Hung, Hwang and Huang, 2012). Project-Based Learning (PBL) is an innovative approach to learning that teaches a multitude of strategies critical for success in the 21st century. The learners drive their own learning through inquiry, as well as work collaboratively to research and create projects that reflect their knowledge. From gleaning new, viable technology skills, to becoming proficient communicators and advanced problem solvers, students benefit from this approach to instruction (Bell, 2010). Also, ''*Project-Based Learning (PBL) is a learner-driven approach to learning. Learners pursue knowledge by asking questions that have piqued their natural curiosity.*

The genesis of a project is an inquiry. Learners solve problems by designing their own inquiries, planning their learning, organizing their research, and implementing a multitude of learning strategies. ''(Bell, 2010). In this study, project-based digital storytelling was employed to develop 21st century skills for an university physics course. Each pre-service teacher was asked to complete a digital storytelling project via taking pictures with digital cameras, developing the story based on the pictures taken, producing a film based on the pictures by adding subtitles and a background, and presenting the story.

The process followed by pre-service physics teachers are that:

1. In the beginning of the process workshop was given to the pre-service teachers to introduce DST and how to design and develop digital stories. Pre-service teachers were trained to use windows movie maker software (Week 1)

2. It was determined by pre-service teachers and instructors that digital stories would be about unit *''Modern Physics''*. Due to the pre-service teachers are expected to teach 9th-12th grade students at high school in Turkey in future, Modern Physics Unit was chosen as the topic for DST from the 10th grade physics course book by pre-service teachers. The overall objective of this grade is to develop scientific literacy. Scientific literacy means that a person can ask, find, or determine answers to questions derived from curiosity about everyday experiences. It means that a person has the ability to describe, explain, and predict natural phenomena. Scientific literacy entails being able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions. Scientific literacy implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed. A literate citizen should be able to evaluate the quality of scientific information on the basis of its source and the methods used to generate it. Scientific literacy also implies the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately. (National Science Education Standards, page 22 http://www.nap.edu/readingroom/books/nses) The objective of this unit is to make students understand and develop basic concepts, which are a list of topics that are included in high school physics curricula or textbooks, such as what is physics, motion, force, mass, volume, heat, velocity etc., without entering detailed mathematical formulating *(Week 2.)*

3. Pre-service teachers were given a week to search, to read all of the unit from course books, library, internet etc. and choose a sub-topic. At the end of the week, each determined a topic as theme to create digital story and as a result prepared a script on sub-topic, for example, a pre-service teacher chose '' Michelson & Morley Experiment'' topic as theme and prepared a short script which highlights the main idea of the topic.

4. The scripts (on total 13 sub-topics), then, were discussed and evaluated by the instructors (an associate professor at yuzuncu yil university department of physics education and an in-service physics teacher) and the other pre-service teachers in the class. The scripts were revised and the final decision were made. (Week 3).

5. Pre-service teachers were given a week to search for visuals, images, audios and music concerning the script. At the end of the week, the materials were discussed and evaluated by the instructors and the other pre-service teachers in the class whether these materials were in harmony with the scripts and the materials to be used were determined. (Week 4).

6. Using windows movie maker, pre-service teachers created their videos by adding images, visuals, and then background music. Finally, they added their voice, which should be in tune with the script, to video by reading the script. So, they came up with their digital stories by using all the materials. (Week 5).

7. They uploaded their own digital stories to the web environment. (Week 6).

After six-week application, each pre-service teacher created an authentic digital story. A channel named as 'DST-YYU-FİZİK-2014' was created and subscribing this channel, they uploaded their own digital stories and then they evaluated one another's stories. For example, the digital story which was created by a pre-service teacher about '' Michelson & Morley Experiment'' can be viewed from the link '' https://youtu.be/ZhL8Iqastw4 '' The outline of creating digital stories applied by the pre-service teachers is shown in Table 2.

1st week	Inform about the process	Introduce DST procedures, Show the self-made digital story	Introduce Windows Movie Maker
2nd week	Review Modern Physics Unit and choose an interesting topic	Explain reasons for choosing the issues	Content Scanning Related to Selected Issues
3rd week	Arranging Scripts	Discussion of the Scripts In Groups	Scan for images
4th week	Arrange Images	Sharing Views on Script-Images Harmony	Search for Background Music
5th week	Provide Harmony Audio-Music-Content	Installing Background Music and students' Audio to Video	Upload 3-5 minute Digital Story to the Web Environment
6th week	Watch digital stories uploaded in Web Environments	Share reflections and comments for each Video by the students	Provide Feedback by the owners to the criticism of the videos and Making Corrections

Table 2. The Outline of Application in Group
Source: Compiled by author

c. Data Collection Tools

This is a qualitative study that explores pre-service teachers' views of the potential benefits of DST to enhance 21st skills. The data were collected by semi-structured interviews. The interview items were developed by the researchers. The participants were also asked to fill in the semi-structured interview form during the personal interviews in order to avoid data loss in the study. Interviews were audio recorded with the consent from the participants. In the process of analyzing the collected data, the audio-recorded interviews were transcribed verbatim.

d. How were the interview items developed?

The literature concerning the aims of the study was examined. 20 prospective questions to be asked in the interview were determined by researchers. These questions were examined by three associate professor individually. Of these, six questions which were approved by all the three experts were chosen. Moreover, three questions were determined to be added to the interview questions as a result of observations during the process of DST in the class by researchers. To have content validity, after the question writing, firstly three academicians as experts (associate professor at Yuzuncu Yil University department of educational science who teach scientific research methods to doctorate students) were consulted to review the questions and they stated that they found the questions sufficient in number, understandable, and suitable for the objectives. Secondly, as a pilot study, 3 pre-service teachers, who were not participants in the study, were interviewed to determine whether the questions were clear or not. Thirdly, during the interviews after the application completed, the participants were asked some other questions to have explanatory answers when the participant views went beyond the aim of the questions and they were not clear. Finally, nine questions were agreed upon by all the experts and researchers. The questions of the interview were the following:

1. What skills did you develop as a student and pre-service physics teacher by means of the process of creating DST?
2. Do you think the designing and developing DST is beneficial ? Why/Why not?

e. Data Analysis

Thematic Analysis Model (Miles & Huberman, 1994), was used for data analysis of this study. The data were summarized, interpreted and classified according to predefined themes (Creswell, 2013). The data were submitted within three activity; data reduction, data display, and data drawing and conclusions (Miles & Huberman, 1994).

In the presentation of the data, the criteria of intensity, explanatory, diversity and extreme examples were taken into account to classify the views so that it could illustrate the data in great detail and dealt with diverse subjects via interpretations. So, the researcher could associate an analysis of the frequency of a theme with one of the whole content (Boyatzis, 1998).

The following part describes in detail the process of data analysis using the stages of the Miles & Huberman (1994) Model in this study:

1. After collecting the data in this study, the recordings and the information obtained from the semi-structured interview forms on the participants' views were deciphered andencoded and written down via the Microsoft Word. Accordingly, each participant was given a number as the code.

2. The researcher read data, 567 views, several times. Totally 197 views were deleted by three researchers, because they did not reflect the aims.

3. The other 370 views were given ordinal numbers.

4. According to three themes, 1-DST & physics, 2-DST & learning, and 3- DST & 21st skills, 370 views were classified by the researchers individually, in different times (see Figure 1).
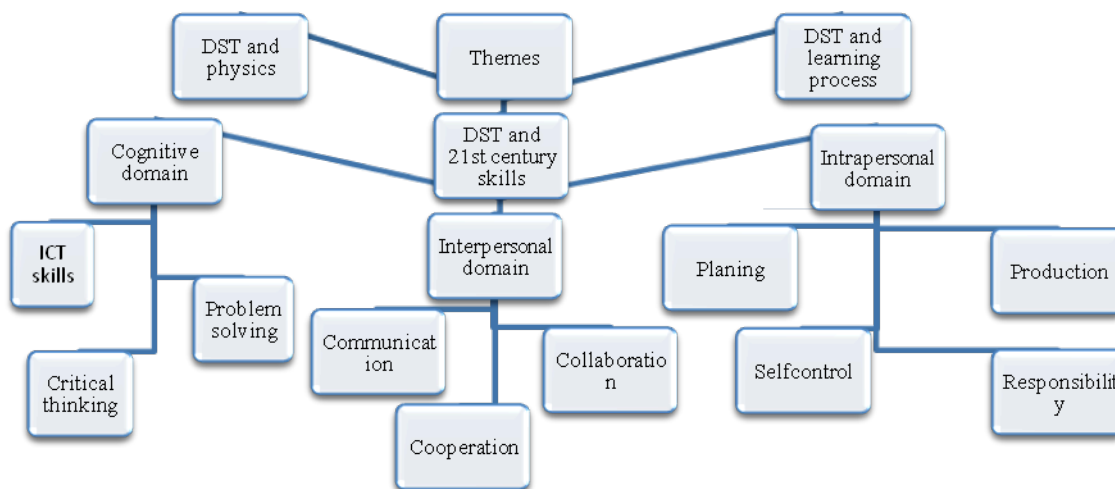

Figure 1. The themes and categories in the study.
Source: Compiled by author

5. The frequencies of the views which were categorized and placed in the themes by the two researchers were examined and it was shown in the table 3. (R; Researcher. T; Theme, T1; Theme 1.)

Themes	T1	T2	T3										Non clas.	Tot
			Cognitive			Interpersonal			Intrapersonal					
Researchers			ICT skills	Critical think.	Problem solve.	Communication	Collaboration	Cooperation	Planning	Selfcontrol	Responsibility	Production		
Researcher 1	96	114	24	14	12	15	16	19	12	13	14	7	14	370
Researcher 2	84	101	38	15	16	11	15	18	14	17	10	15	16	370

Table 3. The frequencies of classified-non classified views by the researchers.
Source: Compiled by author

6. Number of agreement and disagreement on the views, classified by two researchers' were examined and shown in the table 4.

		T1	T 2	T 3	No theme	Total
Number of agreements		79	96	140	10	325
Number of disagreements	R1	17	18	6	4	45
	R2	5	5	29	6	45

Table 4. The frequencies of agreement and disagreement on views.
Source: Compiled by author

7. The views were examined whether they were positive or not and it was shown in the table 5.

	Theme 1	Theme 2	Theme 3
Positive	10	9	13
Negative	3	4	0

Table 5. The frequencies of the pre-service teachers' positive-negative views
Source: Compiled by author

8. Miles and Huberman's (1994) formula (reliability= number of agreements / agreements + disagreements) was calculated for assessing interview inter coder reliability on the each themes, and it was found to be 78 % for first theme, 80 % for second theme, and 80 % for third theme.

9. Finally, the researchers selected exemplary samples from the data to represent the themes related to each survey questions in the results section.

10. In the study, to provide internal reliability, consistency between opinions was examined while to provide external reliability, as Miles and Huberman (1994) offered, encoded recordings were encoded again by two researchers and they were analyzed and they confirmed the validity of the themes in the early and late stages of data analysis.

III. Results

According to the pre-service teachers, the DST project was enriching. As a result, they believed DST might be an appropriate tool which could be used in the classroom as it has the potential to motivate and engage learners, promote ICT skills, critical thinking, collaboration, communication, problem solving, planning, self-control, responsibility, and productivity, or acquire 21st century skills. The results of the data collected are presented under the themes that follow.

DST and the 21st century skills

The feedback from the pre-service teachers on the questions about the 21st century skills can be summarized as follows: "ICT skills", "Critical thinking and problem solving", "Communication, cooperation, collaboration", and "Planning, self-control, responsibility and production".

a. ICT Skills (Cognitive Domain)

Nine pre-service teachers indicated that DST improved their ICT skills. Pre-service teachers stated that they improved their own computer skills and their ability to do research on the internet. Also, they got knowledge about physics in the DST process. For example, A1 stated: "I have learned to use a few computer-related programs. I learned what I did not know about certain topics using a combination of different programs and I learned to create new work with them. I started to use the Internet more actively". A4 claimed: "As a student my computer skills improved. I learned how to use some programs, such as a movie maker and format factory. I learned some shortcuts. Moreover, I learned to conduct research on the internet and to download programs. I already had information about the photoelectric effect and Franck Hertz experiment in physics, but after preparing a video, my knowledge extended".

b. Critical Thinking and Problem Solving (Cognitive Domain)

Nine pre-service teachers indicated a promotion of their own critical thinking and problem-solving competence in the process of DST. The pre-service teachers stated that they evaluated the videos they had prepared, compared them, taking into account the perspective of others and paying attention to the content's adaptation to video or audio-visual-music. Although they encountered a large number of problems in the process, they managed to solve them. For instance, A2 claimed: "How beautiful our own work is, the criticism has made us more conscious. It allows us to evaluate ourselves". A7 stated: "I had trouble while recording a voice. I had to repeat it several times. I could not find some issues-related pictures and animations ".

c. Communication, Cooperation, and Collaboration (Interpersonal Domain)

Twelve pre-service teachers indicated promotion of their own communication-cooperation-collaboration competence in the process of digital storytelling. They stated that they got help from their friends when they had problems about DST: they were in contact with each other in the process and constantly asked each other something. They benefited from each other's experience and research,

and they stated that they tried to use tone and the Turkish language effectively while composing video sound in the DST process. For example, A4 stated: "Skills, such as team work and social leadership, were in the foreground. Social relationships developed with group work". A9 asserted: "In the beginning, I did not know how to use this program. I had a bit of fear that I would not be able to finish it. However, I learned and did it with the help of my friends. It allowed us to create something collectively as a group".

d. Planning, Self-control, Responsibility, and Production (Intrapersonal Domain)

Eight pre-service teachers indicated promotion of their own planning, self-control, responsibility, and production competence in the process of DST. They stated that they were nervous about the process, but with each stage of the process they made significant progress with the plan: they managed the whole process, corrected the mistakes they made, took responsibility for the process, were active in the process and were happy at the end of it as they completed the story which they produced. For instance, A4 indicated: "Constructing the story, presenting it in a certain order, using different websites and resources, combining information and creating a meaningful framework (story) required good planning, regulation and responsibility ". A13 stated: "I started with curiosity and chose the subject that interested me. I did my research, downloaded pictures, prepared my text and did the last part of the soundtrack with music. I grew more confident in every step".

IV. Discussion

In this study, project-based digital storytelling was employed to develop 13 pre-service physics teachers' 21st century skills at a university physics courses. Each pre-service teachers was asked to complete a digital storytelling project via taking pictures with digital cameras, developing the story based on the pictures taken, producing a film based on the pictures by adding subtitles and a background, and presenting the story.

In the process of DST, pre-service teachers came up with a topic about the Modern Physics and they researched, explored and learned about this topic. Afterwards they wrote a script using the information gathered from media, books, newspapers, etc. and created an authentic story. After gathering text, images, audio and graphics, they blended their own story with these multimedia elements and finally, created a short video that could be viewed in web or computer environment. Digital stories were viewed and evaluated by pre-service teachers themselves. From the beginning to the end of the process, they edited, used material and worked actively. DST encouraged them to become active constructors instead of being passive recipients of direct knowledge, and developed their research skills. As the findings revealed that the pre-service teachers had a favorable opinion of using DST in physics instruction, this process involving worthy and authentic learning tasks may contribute to their some skills, learning and motivation. The findings of this study supported the findings obtained by Yang and Wu (2012), Wang and Zhan (2010), and Niemi et al. (2014). Matthews-DeNatale (2008) stated that the use of Digital Physics Stories for physics course makes the physics course more visual, fun, interesting and joyful, thus, increases interest and achievement by relating the course with daily life, provides permanent learning and has a positive effect on students' engagement and motivation to the course.

Firstly, in the process of DST, the pre-service teachers evaluated the videos they had prepared and compared them, taking into account the perspective of others and paying attention to the content's adaptation to video and audio-visual-music. Although they faced a number of question, they managed to find solutions to them. As used in this study, DST can develop critical thinking and problem solving skills (cognitive domain). This finding is in line with the Dreon, Kerper and Landis, (2011); Hung, Hwang and Huang, (2012); and Yang and Wu, (2012) who reported that the production of DST enhance such skills for learners.

Secondly, in the process of DST, despite their nervousness at the beginning of the process, when they managed to complete the whole process, corrected the mistakes they made, took responsibility for the process, they were satisfied with the story which they produced. As it seen in this study, DST can

improve their planning, self-control, responsibility and production (Intrapersonal Domain) skills. As Robin, (2008); Xu, Park and Baek, (2011) stated that DST has the potential to promote the acquisition of such skills.

Thirdly, according to pre-service teachers, lack of technological resources and their ICT competences make difficult to create DST for them to integrate DST into their teaching. But in the process of DST, they stated that the pre-service teachers improved their computer skills and their ability to do research on the internet. In addition to that, they obtained information about physics in the DST process. As they said, the DST can broaden their ICT skills (information and communication literacy-cognitive domain). This findings supported the findings obtained by Sadik, (2008) and Doğan, (2012).

Finally, according to pre-service teachers, in the process of DST, they cooperated and helped each other when they had problems about designing digital stories. The communication and cooperation were necessary. They benefited from each other's experience and knowledge. They tried to use the language and over voicing effectively. In the light of these findings, DST can enhance communication, collaboration and responsibility (Interpersonal Domain) skills. These findings are similar with the findings of the study which carried out by Gyabak and Godina, (2011).

V. Conclusions

Because, this study is limited to results obtained from 13 pre-service physics teacher' views about the effect of designing and developing digital stories on their 21st century skills, the findings cannot be generalized. But, based on the interview results and our observations as researchers who taken an active role in the process, we can say that while the pre-service teachers were designing and developing their own digital stories, they enjoyed and worked actively together. Learning activities such as searching for knowledge, using various information sources and evaluating their own digital stories were highlighted as encouraging experiences by them.

As a conclusion, after doing this study, we believe that digital storytelling is a valuable learning experience for pre-service teacher to develop 21st skills, such as ICT skills, critical thinking, collaboration, communication, problem solving, planning, self-control, responsibility, and productivity. (Robin; 2008;, 2013; Niemi, et al., 2014; Karakoyun & Kuzu, 2013; Ming et al., 2014; Kotluk & Kocakaya, 2015).Also, as used in this study, the designing and developing DST can positively affect the pre-service teachers' skills. The current study can help teachers and researchers by providing awareness of one digital storytelling application. Further work can be designed with a larger sample to provide additional results. As a recommendation for further study, pre-service teachers could be tracked in their classrooms during in-service practice to ascertain the benefits of DST in a classroom setting. Because of the changes in educational realm today, pre-service physics teachers should incorporate new tools, and technologies into their classroom in order to improve many 21st skills. Designing and developing digital stories can be regarded a possible tool to accomplish these goals.

Notes

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References

Andrée, M. (2005). *Ways of using 'Everyday Life' in the science classroom*. (Eds. K. Boersma, M. Goedhart, O. De Jong ve H. Eijkelhof). Research and the Quality of Science Education, Springer Netherlands, 107-116. Retrieved March 10, 2014 from http://link.springer.com/chapter/10.1007%2F1-4020-3673-6_9

Banaszewski, T. M. (2005). *Digital storytelling: Supporting digital literacy in grades 4-12*. (Unpublished doctoral dissertation). Georgia Institute of Technology, Atlanta, USA. Retrieved March 15, 2014 from, https://smartech.gatech.edu/bitstream/handle/1853/6966/banaszewski_thomas_m_200505_mast.pdf

Barrett, H. C. (2005). Researching and evaluating digital storytelling as a deep learning tool.Retrieved September 30, 2016, from http://electronicportfolios.com/portfolios/SITEStorytelling2006.pdf

Bell, S. (2010). Project-based learning for the 21st century: Skills for the future. *The Clearing House*,*83*(2), 39-43. . Retrieved September, 30, 2016, from http://www.huso.buu.ac.th/file/2559/ActiveLearning/Document/10.ProjBL%20of%2021st%20cent%20skills.pdf

Brenner, K. (2014). Digital stories: A 21st century communication tool for the english language classroom. *English Teaching Forum*, Number 1. Retrieved February 29, 2015, from, http://americanenglish.state.gov/files/ae/resource_files/52_1_5_brenner.pdf

Botturi, L., Bramani, C. & Corbino, S. (2012). Finding your voice through digital storytelling. *TechTrends*, 56(3): 10-11. Retrieved September 29, 2016 from, http://search.proquest.com/openview/11e51bd8f29b47bbb25f655ec41cfc95/1?pq-origsite=gscholar

Boyatzis, R.E. (1998). *Transforming qualitative information: Thematic analysis and code development*. Thousand Oaks, London, & New Delhi: Sage

Creswell, J. W. (2013). *Qualitative inquiry and research design. Choosing among five approaches* (3rd edition.). Thousand Oaks, CA: Sage

Chigona, A. (2013). Using multimedia technology to build a community of practice: Preservice teachers' and digital storytelling in South Africa. *International Journal of Education and Development using Information and Communication Technology*, 9(3), 17-27. Retrieved September 29, 2016 from http://files.eric.ed.gov/fulltext/EJ1071388.pdf

Chung, S. K. (2007). Art education technology: Digital storytelling. *Art Education*, 60 (2), 17-22. Retrieved August, 2014, from, http://www.udel.edu/present/aaron/digitalstory/Readings/Art%20Ed%20Tech%20digital%20storytelling.pdf

Czarnecki, K. (2009). Chapter 3: How Digital Storytelling Builds 21st Century Skills. *Library technology reports,* 45(7), 5-8. Retrieved September 29, 2016 from https://journals.ala.org/ltr/article/view/4438

Dogan, B. (2012). Educational uses of Digital Storytelling in K-12: Research results of Digital Storytelling contest (DISTCO) 2012. P. Resta (Ed.), *Proceedings of Society for Information Technology & Teacher Education International Conference* 2012. Chesapeake, VA: AACE. Retrived Februrary 15, 2015 from http://www.editlib.org/p/39770

Dogan, B. & Robin, B. R. (2008). Implementation of digital storytelling in the classroom by teachers trained in a digital storytelling workshop. Retrieved May 10, 2014 from http://faculty.coe.uh.edu/brobin/homepage/site2008_briefpaper-Dogan_Robin_final.pdf

Dreon, O., Kerper, R. M. & Landis, J. (2011). Digital Storytelling: A tool for teaching and learning in the YouTube Generation. *Middle School Journey*, 5 (42), 4-9. Retrieved June 15, 2014, from, http://files.eric.ed.gov/fulltext/EJ934075.pdf

Dupain, M. & Maguire, L. (2005). Digital storybook projects 101: How to create and implement digital storytelling into your curriculum. *21st Annual Conference on Distance Teaching and Learning*. Retrieved June 6, 2014 from, http://www.uwex.edu/disted/conference/resource_library/proceedings/05_2012.pdf

Figg, C. & McCartney, R. (2010). Impacting academic achievement with student learners teaching digital storytelling to others: The ATTTCSE digital video project. *Contemporary Issues in Technology & Teacher Education*, 10(1), 38-79. Retrieved September 28, 2016, http://www.citejournal.org/vol10/iss1/languagearts/article3.cfm

Gakhar, S. (2007).The influence of digital storytelling experience on pre-service teacher education students' attitudes and intentions, *Masters Abstracts International*, 46(1). Retrieved July 21, 2014, from, http://lib.dr.iastate.edu/rtd/15051/

Gretter, S. & Yadav, A. (2016). Computational Thinking and Media & Information Literacy: An Integrated Approach to Teaching Twenty-First Century Skills. *TechTrends.* 60 (5), 510–516 Retrieved September 30, 2016, from http://link.springer.com/article/10.1007/s11528-016-0098-4

Gyabak, K. & Godina, H. (2011). Digital storytelling in Bhutan: A Qualitative Examination of New Media Tools Used to Bridge the Digital Divide in a Rural Community School. *Computers & Education*, 57 (4), 2236-2243.

Hayes, C. (2011). "Nihon to Watashi: Japan and myself"-Digital stories to enhance student centered Japanese language learning. *Electronic Journal of Foreign Language Teaching*,8(1), 291-299. Retrieved September 28, 2016, from, http://e-flt.nus.edu.sg/v8s12011/hayes.pdf

Hull, G. A. & Katz, M. L. (2006). Crafting an agentive self: Case studies of digital storytelling. *Research in the Teaching of English*, 41 (1), 43-81. Retrieved October 21, from, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.472.370&rep=rep1&type=pdf

Hung, C. M., Hwang, G. J. & Huang, I. (2012). A project-based digital storytelling approach for improving students' learning motivation, problem-solving competence and learning achievement. *Educational Technology & Society,* 15 (4), 368–379. Retrieved September 11, 2014, from, http://www.ifets.info/journals/15_4/31.pdf

Husband, T. (2014). Developing 21st century skills in teacher education thorough digital storytelling. *Selected scholarship on teaching and learning at Illinois State University*, Volume 2. Retrieved May 1, 2015 from http://sotl.illinoisstate.edu/downloads/gauisus/HusbandVolume2.pdf

Jakes, D.S. & Brennan, J. (2005). Capturing stories, capturing lives: An Introduction to digital storytelling. Retrieved October 29, 2014, from, http://bookstoread.com/etp/earle.pdf

Karakoyun, F. & Kuzu, A. (2013). Examining Digital Storytelling In Terms of the 21st Century Skills Development. Retrieved September 8, 2014, from, http://cdtl.nus.edu.sg/tel2013/abstracts/Track%204-Technologies%20&%20Strategies%20for%20the%2021st%20Century%20Digital%20Learner/4-FeritKarakoyun.pdf

Kajder, S. B. ve Swenson, J.A. (2004). Digital Images in the Language Arts Classroom [Electronic version]. *Learning and Leading with Technology*, 31(8), 18-19. Retrieved December 11, 2014, from, http://files.eric.ed.gov/fulltext/EJ695775.pdf

Kieler, L. (2010). A reflection: Trials in using digital storytelling effectively with the gifted. Retrieved 5 May, 2014, from, http://eric.ed.gov/?id=EJ893806. v33 n3 p48-52 Sum 2010

Kotluk, N. & Kocakaya, S. (2015). Digital storytelling for developing 21st century skills: From high school students' point of view. *Journal of Research in Education and Teaching,(JRET)* May, 2015 (4) No:2 Article No: 36 http://www.jret.org/FileUpload/ks281142/File/36c.nihat_kotluk..pdf

Lambert, J. (2010*). Digital storytelling cookbook and traveling companion*. Berkeley, CA: Digital Diner Press

Matthews-DeNatale, G. (2008). *Digital Storytelling: Tips and resources*. Boston: Simmons College. Retrieved January 16, 2015, from http://net.educause.edu/ir/library/pdf/eli08167b.pdf

Menezes, H. (2012). Using digital storytelling to improve literacy skills. Paper presented at the International Conference on Cognition and exploratory learning in digital age 2012 (19-21). Madrid, Spain. Retrieved September , 2016, from http://files.eric.ed.gov/fulltext/ED542821.pdf

Miles, M. B., & Huberman, A. M. (1994).Qualitative data analysis: An expanded sourcebook(2nd ed.). Thousand Oaks, CA: Sage.

Ming, T.S., Sim, L.T, Mahmud, N., Kee, L.L., Zabidi, N.A. & Ismail, K. (2014). Enhancing 21st century learning skills via digital storytelling: Voices of Malaysian teachers and undergraduates. *Procedia-Social and Behavioral Sciences*, 118, 489-494. Retrieved January 14, 2015, from http://www.sciencedirect.com/science/article/pii/S1877042814015973

National Research Council, NRC. (2013). Education for life and work: Developing transferable knowledge and skills in the 21st Century. Retrieved March 10, 2015, from http://sites.nationalacademies.org/cs/groups/dbassesite/documents/webpage/dbasse_084153.pdf.

Niemi, H., Harju, V., Vivitsou, M., Viitanen, K., Multisilta, J., & Kuokkanen, A. (2014). Digital Storytelling for 21stCentury Skills in Virtual Learning Environments*. Creative Education*, 2014. Retrieved Februrary 21, 2015 from http://www.scirp.org/journal/PaperInformation.aspx?PaperID=46248

Niemi, H. & Multisilta, J. (2016) Digital storytelling promoting twenty first century skills and student engagement, *Technology, Pedagogy and Education*, 25:4,451-468, Retrieved September 30, 2016, http://dx.doi.org/10.1080/1475939X.2015.1074610

Nguyen, A. T. (2011). *Negotiations and challenges in creating a digital story: The experience of graduate students*. Dissertation (Ed. D.), University of Houston. Retrieved March 8, 2015, from https://repositories.tdl.org/uh-ir/bitstream/handle/10657/276/NGUYEN-.pdf?sequence=2

Ohler, J. (2008). *Digital storytelling in the classroom: New media pathways to literacy, learning, and creativity.* Thousand Oaks, CA: Corwin Press

Partnership for 21st Century Skills. (2009). A state leader's action guide to 21st century skills: A new vision for education. Tucson, AZ: Partnership for 21st Century Skills. Retrieved April 10, 2014, from, http://www.p21.org/storage/documents/stateleaders071906.pdf

Razmi, M. Pourali, S. & Nozad, S. (2014). Digital Storytelling in EFL Classroom (Oral Presentation of the Story): A Pathway to Improve Oral Production. *Procedia Social and Behavioral Sciences, 98, 1541-1544.*Retrieved April, 15, 2015, from http://www.sciencedirect.com/science/article/pii/S1877042814026676

Robin, B. (2008). *The effective uses of digital storytelling as a teaching and learning tool.* Handbook of research on teaching literacy through the communicative and visual arts. New York. Lawrence Erlbaum Associates.

Robin, B. & Pierson, M. (2005). A multilevel approach to using digital storytelling in the classroom. In C. Crawford et al. (Eds.), Proceedings of Society for Information Technology & Teacher Education International Conference, Chesapeake, VA: AACE. Retrieved April, 10, 2014 from http://digitalstorytelling.coe.uh.edu/archive/multilevel-approach.pdf

Sadik, A. (2008). Digital storytelling: A meaningful technology-integrated approach for engaged student learning. *Educational Technology Research and Development*, *56*(4), 487-506. Retrieved April, 10, 2014 from http://www.u.arizona.edu/~chawk/Annotated%20Bibliography%20%20Digital%20Storytelling.pdf

Sylvester, R. & Greenidge, W. (2009). Digital storytelling: Extending the potential for struggling writers. *The Reading Teacher*, 63(4), 284-295. Retrieved September, 30, 2016, from http://www.u.arizona.edu/~amjaadm/summary2.pdf

Voogt, J. & Roblin, N.,P. (2013). 21st century skills. Discussion paper. University of Twente Faculty of Behavioral Sciences Department of Curriculum Design and Educational Innovation. Retrieved February 9, 2015, from, http://www.kennisnet.nl/fileadmin/contentelementen/kennisnet/Bestanden_Feddo/21st-Century-Skills.pdf

Wang, S., & Zhan, H. (2010). Enhancing teaching and learning with digital storytelling. *International Journal of Information and Communication Technology Education (IJICTE)*, 6 (2), 76-87.

Werby, O. (2012). Using Digital Storytelling to Advance Scientific Comprehension and Retention in a Middle School Science Course. *International Journal of Computer Information Systems and Industrial Management Applications.* 4, 018-026. Retrieved April, 20, 2015, from, http://www.mirlabs.net/ijcisim/regular_papers_2012/Paper3.pdf

Xu, Y., Park, H. & Baek, Y. (2011). A new approach toward digital storytelling: An activity focused on writing self-efficacy in a virtual learning environment. *Educational Technology and Society*,14 (4), 181-191. Retrieved April, 20, 2015, from, http://www.ifets.info/journals/14_4/16.pdf

Yang, Y. T. C. & Wu, W. C. I. (2012). Digital storytelling for enhancing student academic achievement, critical thinking, and learning motivation: A year-long experimental study. *Computers & Education*, *59* (2), 339-352

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