Integration of Media Design Processes in Science, Technology, Engineering, and Mathematics (STEM) Education

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Abstract

Problem Statement: Science, technology, engineering and mathematics (STEM) education aims at improving students' knowledge and skills in science and math, and thus their attitudes and career choices in these areas. The ultimate goal in STEM education is to create scientifically literate individuals who can survive in the global economy. The identification of new learning outcomes, curriculum programs, and teaching practices needs to be clarified by the STEM education community. Media design processes are a potential teaching method in STEM education that requires learners to design digital media artifacts using a variety of technological tools.

Purpose of the Study: This study investigates the impact of science, technology, engineering, and mathematics (STEM) integrated media design processes on 8th grade students' attitudes toward science and technology classes, as well as their views about these design processes in after-school science activities. In addition, it demonstrates the opinions of the classroom teacher regarding the integration of media design processes in science classes.

Method: Using an action research design, 21 secondary students from a public school participated in this 14-week study. The quantitative data that was collected from the student attitude survey for science and technology classes was analyzed using the Wilcoxon signed-rank test,

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while the qualitative data (student artifacts, PSA forms, semi-structured interviews, and field notes) was analyzed through open coding and thematic analysis respectively.

Findings and Results: The findings indicated that STEM-integrated media design processes positively impacted the participating students' attitudes toward science and media design activities. In addition, students were more motivated and engaged in the media design processes, which improved their learning of science content and participation in class discussions.

Conclusion and Recommendations: The literature in STEM education calls for new curricular activities and teaching practices as well as the integration of art in STEM. In addition, the visual technology industry in this century creates a job market for the STEM-literate people who are able to apply their knowledge of STEM fields in visual technologies and art. In response to these demands, the positive outcomes of media design processes used in this study offer an encouraging premise in meeting the objectives of STEM education.

Keywords: science, technology, engineering, and mathematics (STEM) education, media design, public service announcements (PSAs), action research, after-school activities

Introduction

Throughout history, countries have authorized reports with similar educational goals to identify solutions for improving students' scientific knowledge and skills. These reform documents have also addressed national concerns for competition among countries in a globalized world (Zollman, 2012). STEM education is the most recent science reform that aims at improving students' knowledge and skills in science and math, thus their attitudes and career choices toward the fields of science, technology, engineering, and mathematics (National Academy of Engineering [NAE], 2009; National Academy of Sciences [NAS], 2006). Recently, there have been efforts to highlight the urgent need for preparing Turkish students with STEM competencies (Aydeniz et al., 2015; TUSIAD, 2014).

The ultimate goal of STEM education is to create scientifically literate individuals who can survive the conditions of a global economy. STEM integration is usually defined by merging the disciplines of science, technology, engineering, and mathematics in order to (1) deepen students' understanding of these disciplines through fostering conceptual understanding, (2) broaden their understanding of these disciplines with the use of socially and culturally relevant STEM contexts, and (3) increase students' interest in STEM disciplines for their career choices (Roehrig, Moore, Wang, & Park, 2012).

Bybee (2013) highlighted that the identification of new learning outcomes, curriculum programs, and teaching practices needs to be clarified by the STEM

educational community. Media design processes are one potential teaching practice in STEM education that require learners to design digital media artifacts by using a variety of technology tools (Liu, 2003). Media design helps students learn complex concepts and apply these concepts in a meaningful way (Lambert & McCombs, 1998). In addition, it helps students improve their problem solving, analysis, creative thinking, and social skills (Bates, 2000) as well as their conceptual knowledge (Newstetter, 2000) and motivation and engagement in learning processes (Karahan & Roehrig, 2014).

Current technologies can create different paths for the integration of media design processes in education. Public service announcements, digital storytelling, and animations are examples of media design usage in education. Public service announcements (PSAs) have been used in education to make students aware of social and environmental issues (Lester, Ma, Lee, & Lambert, 2006). In this study, students created PSAs for the purpose of informing people about specific science concepts and strengthening the relationship between their school and community. Based on Bybee's (2013) suggestions for extending the range of STEM activities, the potential of visual arts in STEM career options and the processes that are common in both engineering and media design were reviewed and integrated into science and STEM learning. Some of the similarities between engineering and media design processes in the context of STEM include using real world contexts, following design stages, introducing design constraints, and using team work and cooperative learning skills throughout the design processes.

In this study, we investigated the impact of STEM-integrated media design processes on 8th grade students' attitudes toward science and technology classes. In addition, the science teacher and her students' views about designing media products in after-school science activities were included. The specific research questions that guided this study were:

- Is there a significant difference between 8th grade students' science and technology attitude scores on pre- and post-surveys implemented before and after STEM-integrated media design processes?

- What are the participating students' opinions about the use of STEM-integrated media design activities in science classes?

- What are the classroom teacher's opinions about the integration of media design activities in science classes?

Methods

Research Design

This study employed an action research design in which one of the researchers planned and implemented the study in the fall and spring semesters of the 2013-2014 academic year. Mills (2003) described action research as a type of research where a teacher or school principal investigates teaching practices, learning outcomes, or

administrative actions in a systematic way. A 14-week action plan was designed based on Sagor's (2005) four-stage process for action research. These four stages involve clarifying vision, articulating theories, implementing action and collecting data, and reflecting and planning informed action.

Table 1.

Action Plan

Week	Content
Week I	• Deciding on the study sample • Organizing a meeting for informing participating students about media design processes and PSAs • Implementing a pre-survey to determine participant students' attitudes toward science and technology class
Week II	• Assigning design groups for PSA projects • Distributing PSA directions for a cell division and genetics unit
Week III	• Writing PSA scenarios about the cell division and genetics unit
Week IV	• Designing PSAs regarding the cell division and genetics unit
Week V	• Presenting and peer-evaluating the PSAs about the cell division and genetics unit
Week VI	• Distributing PSA directions for a force and motion unit
Week VII	• Writing PSA scenarios about the force and motion unit
Week VIII	• Designing PSAs about the force and motion unit
Week IX	• Presenting and peer-evaluating the PSAs about the force and motion unit
Week X	• Distributing PSA directions for a structure of matter unit
Week XI	• Writing PSA scenarios about the structure of matter unit
Week XII	• Designing PSAs about the structure of matter unit
Week XIII	• Presenting and peer-evaluating the PSAs about the structure of matter unit
Week XIV	• Conducting semi-structured interviews with the participating students • Conducting a semi-structured interview with the science teacher • Implementing a post-survey to determine the participant students' attitudes toward science and technology class

Student groups designed their PSAs on the subject of cell division and genetics and force and motion units in the fall semester, while the structure of matter was the

unit they used in the spring semester. After designing their PSAs, the groups presented their projects to receive feedback from their peers and the teacher. The last week of the study was dedicated to data collection.

Research Sample

Data was collected from a convenience sample of 21 8th graders (16 girls, 5 boys). The study site was a public school located in a low socio-economic community in Turkey. The first week of the study was dedicated to determining the students who volunteered to participate in the study. The participants were allowed to decide their own groups as the groups worked together during after-school hours to design their PSA projects.

Research Instruments and Procedures

Six main tools were used to collect the data of the study: student attitude survey for science and technology class, student designed media artifacts, PSA forms, semi-structured student interviews, semi-structured teacher interview, and field notes. Each data collection tool is described in detail below.

Student Attitude Survey for Science and Technology Class. In this study, the student attitude survey for science and technology class developed by Nuhoglu (2008) was used. The original survey includes eleven items for measuring student attitudes toward science and technology class and nine items to determine their attitudes toward the activities in the class. Since PSA design was the focus of this study, we specifically focused on the term PSA in the survey, instead of a more general term such as activity. The Cronbach Alpha reliability coefficient value was .72 for the pre-survey and .75 for the post-survey.

Student Media Artifacts. During the academic year, participants designed their media projects on the topics of cell division and genetics, force and motion, and the structure of matter. Following the constructionist design steps, which are planning, designing, testing, redesigning, and presenting (Harel, 1991; Kafai, 2005), the students designed their projects by using the elements of popular culture in which they live. In the planning phase, the design teams researched the focus of their projects and wrote the scenarios that guided their projects. While conducting research about the scientific concepts they wanted to address in their projects, they also discussed how to integrate them in their projects in a way that could be easily understood by their audience. They also completed their media design forms in this phase. The following phase, designing, was dedicated to filming their videos based on the scenarios they wrote and manipulating these multimedia materials by using a particular design software. In the testing phase, the design teams viewed their projects in order to decide if there was any need for improvement. Next, in the redesigning phase, they made changes in their projects based on what they determined needed improvement. Lastly, they presented their media projects in the classroom with follow-up discussions led by the teacher.

Media Design Forms. The design teams filled out media design forms before they started designing their projects in order to plan and structure them. The media

design forms included the driving questions, which asked them to describe the audience they targeted, the message they wanted to convey in their projects, the processes they planned to follow in designing their projects, and the timeline they created for their work. The answers provided on these forms gave the researchers an idea about the experiences they had during the design process.

Semi-Structured Interviews. Two different semi-structured interview protocols were used to conduct interviews with both the teacher and her students. In the semi-structured student interview, eight open-ended questions addressed the experiences in the media design processes. These included the challenges faced, the way in which those challenges were handled, the impact of media design processes on their conceptual learning, the advantages and disadvantages of media design activities, and their opinions about integrating media design activities in different subjects. The semi-structured interview protocol for the teacher involved four open-ended questions to reveal the strategies she used in the media design processes, the challenges she faced in design processes and the ways in which she handled those challenges, her opinions about integrating media design processes in her science classes, and the modifications she planned to do in case she would use media design activities in her future classes.

Field Notes. Through out the academic year, the teacher took notes about her experiences and those of the participant students based on her observations in the media design processes. These field notes provided a reflective balance with the statements of the students. This data was particularly used for triangulation purposes.

Data Analysis

The quantitative data collected from the student attitude survey for the science and technology class was analyzed by using the Wilcoxon signed-rank test on Statistical Package for the Social Sciences (SPSS) 15.0 program because the sample size was smaller than 30 and differences in scores did not show a normal distribution. The method of qualitative data analysis in this study involved the following steps: (1) open coding (Strauss & Corbin,1990), (2) identification of patterns and categories (LeCompte&Preissle,1993), and (3) building themes and models for cross-case analysis (Miles & Huberman, 1994). The open coding process attempted to organize data sources by looking at the words that frequently emerged. After gathering all the open codes, main ideas emerged as patterns. The researchers used these main ideas to identify the patterns that represented participants' opinions about the media design processes. Lastly, the researchers examined all the patterns in the categories to determine themes. Based on the themes that emerged, the relationship model was built.

Results

I. The Impact on Participant Students' Attitudes toward Science and Technology Class

A student attitude survey for the science and technology class was implemented before and after the media design activities. Averaging across participant, the mean to the pre-test score was less than that of the post-test score. The means and standard deviations of these scores are given in Table 2.

Table 2.

Wilcoxon Signed-rank Test Results

Pre- and Post-test	N	Mean Rank	Sum of Ranks	Z	p
Negative Ranks	4	8.50	34	2.84	.004*
Positive Ranks	17	11.59	197.00		
Ties	0				

*Based on negative ranks

The differences as shown in Table 2 were analyzed by using the Wilcoxon signed-rank test. The results are presented in Table 3 below.

Table 3.

Attitude Scores to Pre and Post Survey

	Mean	Standard Deviation
Pre-survey	27.09	5.84
Post-survey	30.90	2.14

As seen in Table 3, there was a statistically significant difference between the participant students' pre- and post-test scores on the attitude survey that was implemented before and after their participation in STEM-based media design activities (T=34, Z = -2.84, *p* = 0.004). In order to find the degree of difference between the pre- and post-test survey scores, which is also called the effect size, the eta-square coefficient (η^2) was calculated and found to be .62. The eta-square coefficient (η^2) value between 0-1 shows the variance rate of the independent variable in dependent variables. The value of ".01" is generally considered low; ".06" medium and ".14" high impact (Cohen, 1988 cited in Pallant, 2005, p. 201). Therefore, it was concluded that the use of PSA design activities in science and technology class had a significant impact on students' attitude scores.

II. Participant Students' Opinions about the Use of PSA Design Activities in Science and Technology Classes

The themes emerged based on the open coding processes of the data are shown in Table 4. The model in Figure 1 was created through eliciting the relationships among these codes by using axial coding. These themes are presented with the direct quotes from the students.

Table 4.

The Frequency Table of Codes

Codes	Number of students in which the code was observed	Frequency of codes
Learning science content	19	67
Revisiting content and strengthening learning	17	51
Team work	20	43
Differences from other science activities	17	41
Role of teacher	21	41
Having fun while learning	15	39
Social skills	18	33
Constraints and challenges	19	32
Impact on academic success	18	31
Use of resources	21	28
Correcting misconceptions	14	25
Self-awareness	11	15
Problem-solving skills	12	15
Increased active participation	10	14
Deciding criteria	7	8
Creativity	6	7
Understanding the role of science in the real world	2	5

As shown in Table 4, the most frequently observed codes in the student data were *learning science content, revisiting content and strengthening learning,* and *teamwork,* whereas the least frequent codes were *deciding criteria, creativity,* and *understanding*

the role of science in the real world. Using axial coding and thematic analysis processes, the model presented the relationships among the codes and is shown below (Figure 1). In this model, each color represents a group with similar themes, while the one-way and two-way arrows between themes show the relationships among the themes they connect. Additionally, the sizes of the themes in the model represent the frequencies of these themes.
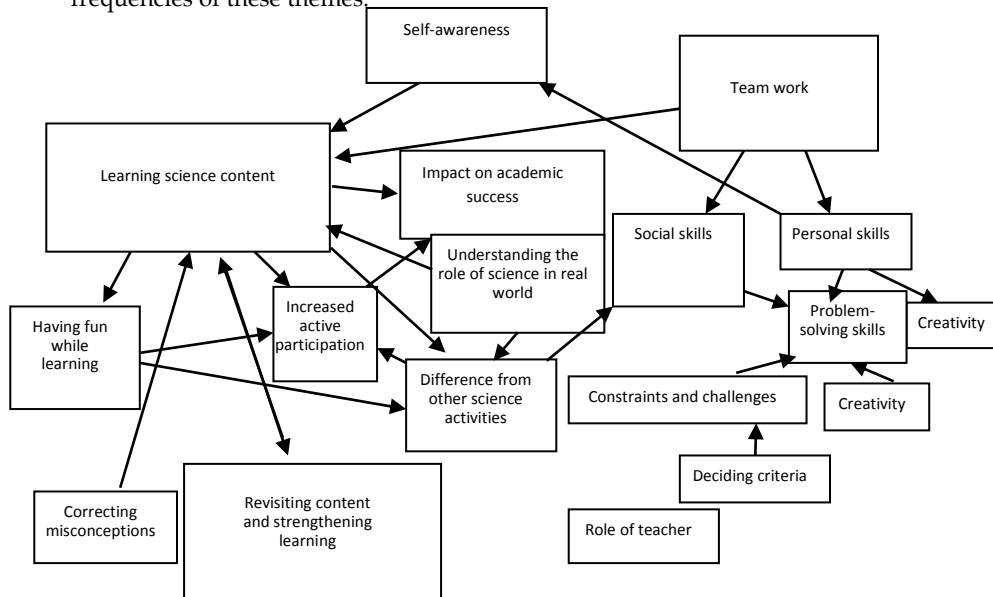

Figure 1. The Relationship Model between Themes based on Open and Axial Coding

In the qualitative analysis model (see Figure 1), the themes of *learning science content, correcting misconceptions, revisiting content and strengthening learning,* and *understanding the role of science in real world* were the most dominant themes in the first group of themes. In addition, *having fun while learning, increased active participation,* and *difference from other science activities* were the dominant themes in another group of themes. The connection arrows between the themes in this group shows that there was a relationship between the themes of *having fun while learning* and *increased active participation*, thus indicating a difference of PSA design activities from other science activities.

The data analysis showed that the most frequently repeated code was *learning science content,* which was commonly associated with the codes *correcting misconceptions, revisiting content and strengthening learning,* and *understanding the role of science in real world.* Almost all participants (n=19) stated that PSA design activities positively impacted their learning of science content. In addition, they highlighted the role of after-school PSA design activities on revisiting the content they learned in

class, as well as on learning the content they were not able to previously. Hence, they believed that PSA design activities directly impacted their academic success.

Designing PSA projects in science classes has many benefits, because if students could not understand the topic in the class, they understood the topic better when they watched the PSAs. For instance, I could not understand cell division, but I got it when I watched the PSAs. (Student 7)

I used to have a hard time while taking tests. I used to answer the questions without knowing the concepts and the meaning of the words. But, while correcting our misconceptions through PSAs, we strengthened our understanding of these true concepts. (Student 8)

For instance, we sometimes misunderstand something in the class or learned something wrong, but my friends corrected me several times while working on our PSA projects. It helped us understand science and conceptualize the science units better. (Student 13)

I don't think there were any disadvantages, but several benefits of using PSAs in science classes. For example, it helped us for the central exam a lot as well as our participation in science classes. (Student 17)

In addition to learning science, students also highlighted the positive impact of PSA design activities on their participation in science classes. While designing PSAs, students were able to spend more time on learning science and in understanding the points they missed in the class due to the limited class time. Factors, such as following an extensive curriculum in a limited time and crowded classroom, that cause teachers to be unable to help individual students enough, were balanced by designing PSA projects after school hours. This gave students the opportunity to learn science in an extended timeframe, thus allowing for more active participation in science classes.

In other classes, we spend very limited time on the topics. However, while designing PSAs, we have more than enough time to focus on each topic. Science classes are important, but PSA activities help us understand better. (Student 2)

We did not have enough time to have a voice all the time, but we cooperated very well and said what we wanted to say in PSA activities. We learned something we did not know all the time, and we learned the concepts we were confused about with the help of our teacher and friends. (Student 6)

Sometimes, we could not understand in the class because it is too crowded. But, watching PSAs helped us due to the fact that they gave real examples from our own lives. (Student 12)

We learned science and participated in the class discussions more. For example, I did not know adaptation, but then I learned it from the PSAs and I participated in discussions about it in the class more. (Student 16)

In addition to the positive impact of media design activities on their academic achievement, the participant students also highlighted the role of media design activities on improving their personal and social skills. They stated that they worked

as a team in designing their projects and solving the problems they faced during the media design processes. The students added that they positively impacted each other's learning. As it is strongly emphasized in cooperative learning studies, students highlighted the interactions with their peers more than their teacher's role throughout the learning process. It was observed that media design processes positively impacted participant students' opinions and motivation about group work.

> *In our social life outside of school, it was helpful for us. Each of us has responsibilities and we need to complete our tasks. Thus, it helps our social life. (Student 8)*

> *Unity and solidarity. I mean we helped each other and learned from each other. (Student 18)*

> *I had an open personality before, but it has become more and more after this semester. I love sharing and group work more now. (Student 11)*

> *I get along with my friends better now. For instance, we work harder in a group. (Student 2)*

> *There are many benefits of working as a group for us because all of us will be doing group work in the future. If we had worked individually, it would not have been as good. We could not have gotten as much support as we got. It is always better to work in groups. (Student 15)*

The students also mentioned that they had a fun experience while learning science throughout the processes of media design. When they compared media design activities with other in-class science activities, they highlighted that they both learned the content and had fun. It is important to note that students' statements showed a direct connection between the fun part of media design activities and its positive impact on their learning. Thus, it was concluded that students considered media design activities as an enjoyable learning experience that had a direct relationship with in-class science activities instead of considering those activities just a fun game.

> *We were learning science while having fun, and I got many benefits out of it. While designing PSAs, I was able to learn the concepts that I could not learn before. (Student 2)*

> *I think PSAs are better because we do activities and leave it in the class, but we both learn and have fun in media design activities. That is why it sticks in our mind easily. The similarity is that we learn in both, but we have fun in media design. (Student 4)*

> *There is no negative point, I think, because we do these activities and have fun. As I said, it helps us learn science and gives us a different kind of activity. (Student 13)*

In addition to the interview data, the participants also filled out PSA forms where they brainstormed about the focus of their projects, their audience, concepts, and the message of their project. For instance, the group that focused on mitosis in their PSA projects wrote in their form that "*we want to learn mitosis very well, and our message will be the fact that it is responsible for the growth of our body and wound healing.*" In the interviews, students stated that filling out the PSA forms helped them to review the

basic content they learned in the class. Similarly, the interview and fields notes from the classroom teacher indicated that students examined and reviewed their scientific knowledge while designing PSAs.

III.   Classroom Teacher's Opinions about the Integration of Media Design Processes in Science Classes

The data derived from the teacher interview and field notes were categorized under three titles: constraints and challenges, benefits of the integration of media design processes, and suggestions for future implementation. In regard to the constraints and challenges category, the teacher stated that students had a difficult time structuring their groups and finding a time to meet after school hours. In order to help her students, the teacher organized meetings with the design groups to figure out the best way for students in groups to work together. In addition, the teacher stated that after school media design activities took a significant length of time for both the instructor and students. She added that her students specifically wanted her to be present in the environment while they wrote their scenarios that required a strong scientific frame. However, students did not want their teacher to join them while recording their videos, giving the reason that her presence made them anxious.

The teacher also addressed several benefits of media design activities, such as helping students learn the science content and noticing their misconceptions and correcting them. Especially in the processes of writing scenarios and shooting videos, group members helped each other question their scientific knowledge and improve each other's understanding of science. Also, the discussions about the PSA projects in class improved students' conceptual understanding, according to the teacher. She observed in the written exams that her students answered the questions by addressing specific aspects from the PSA projects.

> *I used to think that the strategies I used in my classes were perfect. However, I realized that even the students with high academic success had misconceptions that were revealed in media design activities. For example, we did an experiment with a turnsole paper for acids and bases. But, while observing my students in the media design activity, I realized that Student 2 did not learn it well enough. She learned it better after designing a PSA about it. (Teacher Interview)*

> *In our conversations, students told me that they benefited from the media design activities in the written exams. They understood the content better and corrected their mistakes. (Teacher Field Notes)*

Lastly, the classroom teacher stated that she wanted to integrate media design activities in her classes in the future because she thought that it would support her students' learning and understanding of science. She also added that the parents of her students were happy with these after-school activities and enjoyed the artifacts their kids created. Based on her experiences, she suggested that the stages of scenario writing and video shooting should be conducted of the same day in order to help students focus on the content more intensely. Considering the experiences in science class, she noted that students asked to design PSA projects in different subjects, such

as math and English. Hence, media design processes could be integrated into different subjects in which students struggle academically.

Discussion and Conclusion

In this 14-week action research, the participant students created PSAs based on media design principles by using technology tools with which they had access in their daily lives. The findings indicated that the integration of media design activities positively impacted the participant students' attitudes toward science and media design activities. In a European Union (EU) funded project called ENGINEER, Cavas, Bulut, Holbrook and Rannikmae (2013) found similar results in that the use of materials designed based on the integration of engineering design processes with five stages (ask, imagine, plan, create, and redesign) increased the interests, skills, and attitudes of female students.

In contrast to the studies showing that students get bored in science classes (Delpech, 2002; Williams, Stanisstreet, Spall Boyes, & Dickson, 2003), this study showed that the participants enjoyed the media design processes while learning the science content and participating in the in-class discussions (Karahan & Roehrig, 2014; Bruckman & Resnick, 1995). Students asked to use similar kinds of experiences in subjects they academically struggled with, such as math. Similarly, the classroom teacher also noted that media design activities (writing scenarios, shooting videos, and presenting end products) helped students learn science content and correct their misconceptions (Newstetter, 2000; Lambert & McCombs, 1998; Papert, 1991). In addition, she believed that there were several benefits of using media design activities in science classes. Media design activities in which students worked in groups resulted in strengthened communication among group members and positive attitudes toward teamwork. These findings were consistent with Bates' (2000) study, which found that media design processes helped students take responsibility in groups and obtain social skills. Similarly, Marulcu and Sungur (2012) and Sungur Gul and Marulcu (2014) found that engineering design based lessons improved students' psychomotor, creative, and social thinking skills as well as created a socially enriched learning environment.

This study has the potential to present teachers alternative ways to integrate technology in science classes and to cope with the challenges they face in those classes. Moreover, it has the potential to improve students' STEM literacy skills that (1) conceptualize STEM disciplines through learning, inquiry, and design, and (2) create interest in STEM-related problems, such as constructive and reflective individuals. Considering the impact of STEM-based activities on students' career choices in STEM-related fields, this study addresses one of the goals of the National Science Curriculum in Turkey, which is "raising awareness about the fields of science" (Ministry of National Education [MNE], 2013). Use of engineering design processes in K-12 schools helps students understand science and math relationships, improve their STEM literacy, and raise consciousness about STEM career options (Katehi, Pearson, & Peder, 2009 cited in Sungur Gul & Marulcu, 2014).

Bybee (2013) highlighted that the identification of new learning outcomes, curriculum programs, and teaching practices needs to be clarified by the STEM educational community. Thus, media design processes as one of the project-based learning strategies are strong alternatives in STEM activities. Specifically, the student artifacts in the context of social or environmental problems can be shared via social networking sites, thus creating a strong student voice and strengthening the ties between school and society. The findings showed that media design activities can be used in the subjects that students struggle with such as math and English. STEM-based media design activities require participants to use only the technology tools most students have access to in their daily lives; therefore, it is a good way for transitioning to the adaptation of STEM reform in our country.

Recommendations

The visual technology industry has moved from computer graphics to digital video, which is a positive stimulator to the global economy. As per the report by the Creative Industries in the U.S., there are approximately 2.99 million people employed in jobs related to visual arts (Platz, 2007). Most of these employees not only need developed art skills, but also need the ability to apply the concepts taught in the STEM approach. STEM activities designed based on media design principles have the potential to meet the STEM-literate employment in visual technology industry.

For most people, STEM specifically addresses job opportunities and innovations in engineering fields. However, the visual technology industry in this century creates a job market for STEM-literate people who are able apply their knowledge of STEM fields to visual technologies and art. There have been several efforts to integrate art in STEM reform in different parts of the world (Robelen, 2011). This study has the potential to integrate the fields of art and STEM due to the technical and technological features of media design processes as well as the commonalities between media design and engineering design processes.

Despite the fact that STEM career options grow three times faster than others, the number of female students choosing STEM fields still stays significantly lower than male students (Milgram, 2011). To illustrate, female students choosing engineering fields in college were only 18% in the U.S. in 2010, and this number was as low as 0% in some specific engineering fields (Gibbons, 2011). The fact that male and female students have different interests and learning styles significantly impacts their interests and career choices in STEM disciplines (Margolis & Fisher, 2001). Therefore, research in STEM particularly aims at motivating female students' to choose STEM fields. Milgram (2011) suggested that the best way to solve the gender gap issue in STEM fields is to design STEM activities that can attract more female students to participate. This study, in which most participants were female, showed that media design activities significantly increased their participant students' attitude scores in science and media design activities. Hence, media design activities in the context of STEM have the potential to increase the attitudes of female students toward STEM fields.

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Fen, Teknoloji, Mühendislik ve Matematik (FeTeMM) Eğitimine Medya Tasarım Süreçlerinin Entegrasyonu

Özet

Problem Durumu: Geçmişten günümüze eğitimle alakalı birçok reform hareketi mikro ölçekte öğrencilerin bilimsel bilgi ve becerilerini geliştirmenin yanı sıra makro düzeyde ülkelerin küresel rekabette sağlam bir yer edinmesini amaçlamaktadır. Bu amaçla hayata geçirilen küresel eğitim reformlarından en güncel olan Fen, Teknoloji, Mühendislik ve Matematik (FeTeMM) eğitimi, ilk ve ortaöğretim seviyesindeki fen ve matematik eğitimi standartlarının yükseltilmesi ve buna bağlı olarak öğrencilerin fen, teknoloji, mühendislik ve matematik alanlarına yöneliminin sağlanması amaçlamaktadır. Bu şekilde bireylerin yükselen küresel ekonomik koşullarda rekabet içerisinde kalabilecekleri düşünülmektedir. Fen eğitimi literatürü FeTeMM destekli öğretim yöntemleri ve öğrenim kazanımlarının FeTeMM araştırmacıları tarafından tanımlanması ve çeşitlendirilmesinin gerekliliğine dikkat çekmektedir. FeTeMM eğitimi Fen, Matematik, Mühendislik ve Teknoloji disiplinlerinin entegrasyonu yoluyla (1) öğrencilerin bu disiplinlerin içeriklerinin kavramsallaştırılması, (2) sosyal ve kültüre dayalı FeTeMM bağlamları yoluyla öğrencilerin FeTeMM disiplinlerini anlayışlarının genişletilmesi ve (3) öğrencilerin FeTeMM disiplinlerine ve bu disiplinler altındaki kariyer seçeneklerine olan ilgisini arttırılmasını amaçlamaktadır. Bu doğrultuda projeye dayalı öğrenmenin bir türü olarak medya tasarım süreçleri, teknolojik araç ve gereçleri kullanımı yoluyla öğrencilerin belirli bir kitleyi hedefleyerek dijital medya ürünleri tasarlamalarını hedeflemektedir. Medya tasarımına dayalı öğrenme süreçleri bireylerin karmaşık kavramsal bilgileri anlamlı yollardan öğrenmesi ve kullanmasına fırsat tanımaktadır. Bunun yanı sıra öğrencilerin problem çözme, analiz etme, yaratıcı düşünme ve iletişim becerilerinin gelişmesini, araştırma-sorgulamaya dayalı öğrenme yoluyla kavramsal bilgilerinin artmasını, ve öğrenme süreçlerinde aktif rol almalarını sağlamaktadır.

Araştırmanın Amacı: Bu araştırmada medya tasarım süreçlerinin FeTeMM eğitimine entegrasyonu ile hazırlanan okul dışı etkinliklerinin, ilköğretim 8.sınıf öğrencilerinin fen dersine ve fen spotu etkinliklerine yönelik tutumları ve ders sorumlusu öğretmen ve öğrencilerin fen öğretim sürecinde medya tasarım süreçlerini kullanarak fen spotu hazırlamaya yönelik düşüncelerinin belirlenmesi amaçlanmıştır.

Araştırmanın Yöntemi: Nitel araştırma metodolojisinin desenlerinden biri olan eylem araştırması yöntemiyle 14 hafta sürecinde gerçekleştirilen araştırmanın çalışma grubunu 2013-2014 eğitim-öğretim yılında sosyo-ekonomik düzeyi düşük bir devlet

okulunda 8.sınıfta öğrenim gören 21 öğrenci (16 kız, 5 erkek) oluşturmaktadır. Araştırmanın verileri, "fen ve teknoloji dersi tutum ölçeği", "öğrenciler tarafından oluşturulan medya ürünleri", fen spotu hazırlama formları", "yarı yapılandırılmış görüşme formları" ve ders sorumlusu fen bilimleri öğretmeni tarafından oluşturulan "araştırmacı notları" aracılığıyla toplanmıştır. Araştırmada tutum ölçeğinden elde edilen nicel veriler Wilcoxon işaretli sıralar testi ile değerlendirilmiştir. Nitel verilerin analizi ise içerik analizi, açık kodlama ve aksiyal kodlama yöntemleriyle gerçekleştirilmiştir.

Araştırmanın Bulguları: Araştırmada fen spotu etkinliklerinden sonra, öğrencilerin fen ve teknoloji dersine yönelik tutum puanlarında artış meydana geldiği tespit edilmiştir ($T = 34$, $p = 0,004$, $z = -2,842$). Araştırmada ön test ve son test puanları arasındaki anlamlı çıkan farkın derecesini başka bir deyişle etki büyüklüğünü belirlemek için eta kare (η^2) katsayısı hesaplanarak .62 olarak bulunmuştur. Bu doğrultuda fen derslerinde fen spotu kullanma öğrencilerin tutum puanlarındaki artışta yüksek düzeyde etki büyüklüğüne sahip olduğu ortaya çıkmıştır.

Araştırmanın Sonuçları ve Önerileri: Nitel verilerin analizi sonucu en çok tekrarlanan kodlar *fen konularını öğrenme, öğrenilen konuların tekrar edilmesi yoluyla akılda kalıcılığın sağlanması ve grup çalışması*, en az tekrarlanana kodlar *kriterler belirleme, yaratıcılık ve fenin günlük hayattaki rolünü kavrama* şeklinde olmuştur. Araştırmaya katılan öğrencilerin fen spotu hazırlama sürecinde eğlenerek öğrendiklerini ve yaptıkları çalışmadan keyif aldıkları sonucu ortaya çıkmıştır. Ayrıca öğrenciler fen spotu hazırlamanın konu ile ilgili kavramları daha kolay anlamalarını sağladığını belirterek, zorlandıklarını düşündükleri matematik ve İngilizce, Türkçe, sosyal bilgiler derslerinde de konu ile ilgili medya tasarlamak istediklerini vurgulamışlardır. Ders sorumlusu fen bilimleri öğretmeni ise okul dışı zamanda gerçekleşen fen spotu etkinliklerinin öğretmen için zaman alıcı olmasına rağmen öğrencilerin kavramsal öğrenmelerine, grup çalışma becerilerine katkısından dolayı fen spotu etkinliklerinin kullanımını faydalı görmektedir.

Görsel teknoloji endüstrilerinin bilgisayar grafiklerinden dijital videolara doğru yönelmesi küresel ekonominin pozitif hızlandırıcılarındandır. Medya tasarım süreçlerine dayalı geliştirilecek FeTeMM aktiviteleri görsel ve medya sanatlarında ihtiyaç duyulan FeTeMM okuryazarı istihdamını karşılama noktasında önemli bir potansiyel göstermektedir. Görsel teknolojiler içinde bulunduğumuz çağımızda en az mühendislik dalları kadar ihtiyaç duyulan fen, matematik ve teknoloji alanlarından FeTeMM yoluyla edinilen becerilerin görsel teknolojilere ve sanatlara aktarımı yoluyla bu alanlarda çalışabilecek ya da bu alanlara ilgi duyabilecek gençler yetiştirilebilir. Bu doğrultuda da dünyanın çeşitli bölgelerinde FeTeMM eğitimine sanat boyutu eklenmeye çalışılmaktadır. Bu araştırmada kullanılan fen spotlarının hazırlanmasında kullanılan medya tasarım süreçlerinin içerdiği teknik ve teknolojik özellikler yoluyla, sanat ve FeTeMM arasındaki uyuşmazlık daha uyumlu hale getirilebilir.

FeTeMM destekli öğretim yöntemleri ve öğrenim kazanımlarının FeTeMM araştırmacıları tarafından tanımlanması ve çeşitlendirilmesinin gerekliliğine dikkat çekilmektedir. Bu doğrultuda projeye dayalı öğrenmenin bir türü olarak medya tasarım süreçleri, FeTeMM içerisinde güçlü bir alternatif olarak yer almalıdır. Gerçekleştirilen bu araştırmanın fen bilimleri derslerinde teknoloji kullanımı konusuna ilgi duyan öğretmen ve fen eğitimcilere alternatif uygulama örnekleri sunma ve süreçte karşılaşabilecekleri olası zorluklara yönelik önerilerde bulunma açısından katkı sağlayacağı düşünülmektedir. Ayrıca çevre konuları gibi toplumsal duyarlılığı arttırabilecek alanlarda hazırlanan fen spotlarının sosyal ağlarda paylaşımı yoluyla bu ürünlerin etki alanlarının genişletilmesi ve okul-toplum ilişkisinin arttırılması sağlanabilir.

Anahtar Kelimeler: Fen, Teknoloji, Mühendislik ve Matematik (FeTeMM) Eğitimi, Medya Tasarımı, Fen Spotu, Eylem Araştırması, Okul Sonrası Etkinlikler