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Promoting Science Affinities through a Video Project in a Science, Technology, and Society (STS) Learning Approach

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Abstract

Lack of awareness about the interconnections between Science, Technology, and Society and students' dislike of studying science have led to many environmental and social problems. During the COVID-19 Pandemic, students experienced difficulties accessing educational resources and demanded new programs to support their academic science experiences. This study designed a science outreach program, a video project competition using a science, technology, and society (STS) learning approach and explored its effects on 13 randomly selected students (Grades 4-11). This video project employed three foundational theories—identity formation, attitudes toward science, and growth mindset—to increase students' affinities in science and assess the program's effects. Pre-and post-survey data showed that the video project using the STS approach did not have statistically meaningful effects on the participants who had high achievement in STEM areas. However, their interviews suggested that this study helped to sustain and increase their affinities and science learning even during the Pandemic by involving them in the learning process, understanding Science and Technology in our society, and making decisions for society's future.

Introduction

While the influence of Science and Technology has invaded our everyday lives over the past century, there needs to be more effort to enhance students' understanding of the impact of Science and Technology in our society. Lack of awareness of the interconnections between Science, Technology, and society (Chowdhury, 2016; Kumar & Chubin, 2000) and students' hesitancy toward Science (Peffer, 2020) have led to many environmental and social problems from the community level to the global level, such as natural resource depletion, the loss of biodiversity, environmental pollution, nuclear proliferation, social injustice, and global climate change (Aldeia & Alves, 2019). *In the Next Generation Science Standards* (NGSS Lead States, 2013), the global awareness of the impact of science and technology on our living environment became more and more critical. However, schools were ill-prepared to teach students science in its social context and help them understand and think through the implications of science and technology's social nature and culture (Autieri et al., 2016). Additionally, during COVID-19, students experienced a new learning environment in science classrooms (Hamilton et al., 2020). The COVID-19

Pandemic unexpectedly changed the school environment, transferring from traditional classrooms to online distance learning. The students required new programs to enhance their academic experience inside and outside science classrooms during the COVID-19 Pandemic (Department of Education, 2020).

Integrating science with other subject areas and daily decision-making processes fosters valuable learning opportunities by engaging students in science and society and stimulating students' interests in the global society (Yoon & Ko, 2013). This study created a video competition as a STEM outreach program that provided a unique opportunity for future scientists and engineers to get involved, retain their interest in STEM, and build toward future careers in STEM areas by creating video projects during the COVID-19 Pandemic. The video project helped the students actively participate in the learning process, leading to a deeper and more complex understanding of Science and Technology in our society and how to make the best decisions for the future society.

Conceptual Framework of the Study

The foundational theories for this STEM outreach program are identity formation, self-efficacy, and growth mindset theory. Identity theory explains how students develop long-lasting science identities and mix them with their self-concepts, which increases their possession of science in themselves (Herman, 2011). Self-efficacy theory presents students' confidence in their abilities through mastery, vicarious modeling, and emotional and hands-on experiences (Chowdhury, 2021). Growth Mindset research explains how students become mature and foster mental resilience when they face challenging tasks (Dweck, 2015). Individuals with solid science identities and self-efficacy will be more likely to seek out positive experiences in science, which cultivates their mindsets. This video project was designed to help the students' affinities in science by building science identities and self-efficacy using techniques of growth mindsets in science.

Literature Review

Science, Technology, and Society

As science and technology rapidly grow in 21st-century society, severe environmental and social issues, such as climate change, water pollution, natural resource depletion, and ethical dilemma, have emerged on a global scale. These new threats bring up a challenge in science education of preparing students aware of the impacts of science and technology on our living environment (Amirshokoohi, 2016). Students are expected to have the enormous responsibility of making decisions that impact themselves as well as society. Many of these decisions require understanding the interaction of science and technology and its interface with society. Therefore, schools must have an adequate instructional method that helps students to understand the relationship between science and technology in society and make informed *decisions* about those complex societal and environmental issues.

Besides, students are reluctant to learn science and demand a new learning environment where they can engage in science and accomplish scientific literacy within society (Peffer, 2020). Many high school students defined *science* as a complex subject and showed low enrollment in science courses (Heitin, 2016). This is of great concern because the students who do not have experiences in science in high school can affect how well the students adjust to science-related majors during college and how many students accommodate their lives in 21st-century society by understanding science and technology in society. Therefore, it is urgent to introduce a new instructional design with more relevant approaches to the students who make our future society.

Science, Technology, and Society (STS) is one of the most effective instructional strategies to promote science learning in a socially contextualized environment. Students investigate issues in a manner that supports real-world connections between the classroom and society (Yoon & Ko, 2013). The STS interdisciplinary approach is beneficial for learning science content within a realistic, student-derived context and increasing their interest in Science (Primastuti & Atun, 2018).

Studies (Amirshokoohi, 2016; Lee, 2007) have shown a positive relationship between STS-based instruction and student creativity and motivation. In such studies, students demonstrated growth in process skills, applications of science processes and concepts to new situations, and improved attitudes toward science and self-efficacy. The STS interdisciplinary approach presents an understanding of scientific knowledge and skills and process skills in a personal/social context, which empowers students who are literate in Science and Technology to make informed decisions and take responsible actions for society.

Distance Learning during COVID-19

The COVID-19 Pandemic has been a particular time for students because their learning has relied mainly on the online setting. The COVID-19 Pandemic has resulted in high growth in distance learning with the sudden shift away from classrooms in many parts of the world (Li & Lalani, 2020). Schools are closed, and learning is undertaken remotely and on digital platforms. Distance learning has benefited time management and resource access (Koller et al., 2013; Lorenzetti, 2013). Without the usual constraints of time and space, students could learn at their own pace, going back and rereading, skimming, or researching more as they liked. They could access educational resources worldwide if they had a broadband connection. Compared with students in traditional classrooms, students in online settings had better learning outcomes and improved their motivations to learn by writing, sharing, answering, and discussing with freedom (Feeley & Parris, 2012). In determining the outcomes of distance learning, research showed that types of online learning activities, varied materials, formative assessments, and the levels of students' active engagement played critical roles (Blitz, 2013; Tsai et al., 2015; Wang et al., 2006). For example, students performed better with additional online tools and varied materials in a course, including textbooks, media-enhanced PowerPoint slides, video lectures, interactive and individualized practice problems, and repeatable, low-stakes practice questions (Brown & Liedholm, 2004).

To get the full benefit of distance education, there needs to be a *collaborative effort* to design a structured learning environment that does not merely duplicate a physical classroom but also goes beyond. The online learning environment needs to promote *inclusion* and *personalization* (Li & Lalani, 2020). It is necessary to use an educational strategy that creates inclusive communities and approaches each student online, which makes them feel comfortable and respected and empathically inspired to learn more in the online setting.

Benefits of Video Project in Distance Education

The student-generated video project is an effective learning strategy to support inclusion and personalization by increasing individual engagement and motivation towards learning about communities in society and understanding the scientific process, especially in an online setting (Stanley & Zhang, 2018). The student-generated video project includes mostly 1) researching the project topic, background, and its solutions, 2) designing how to film for audience delivery by utilizing technology, and 3) making presentations to teach lessons through the video. The video project enables students to experience not only individually but also collectively the scientific process by actively interacting with and researching their communities and collaborating to create visual and audio presentations about the project topics (Bolliger et al., 2010; Guertin, 2010; Kay, 2012). The adoption of the student-generated video project resulted in increased learning in not only science but also related disciplines like engineering, technology, and environmental science (Alon & Herath, 2014; Alpay & Gulati, 2010; Armstrong et al., 2009; Bolliger & Armier, 2013; Oruset al., 2016). The video project helped students engage in and learn science concepts mainly concentrated around what they produced in their videos, thus improving their performance in science and helping them pursue careers in STEM fields (Stanley & Zhang, 2018).

Purpose of the Study

This case study sought to explore how a student-generated video project using an STS approach could help to retain students (Grades 4-11) in science during the COVID-19 Pandemic. The study focused on 13 individual students and their video projects and analyzed the effects of video production on the student's motivation and affinities for science. The study was conducted based on the following research questions:

(1) Does the online video project help students to increase their science identities?
(2) Does the online video project improve students' interest in science?
(3) Does the online video project promote students' science efficacy?
(4) Does the online video project positively develop students' attitudes toward science?

Methods

Project Procedure

The Video Project is a STEM outreach program run by a science and engineering organization, targeting middle to high school students. The goal of the program was to encourage the students to maintain and pursue STEM education and careers during the COVID-19 Pandemic. The project procedures:

Step 1. Design. The project team, composed of two researchers and four judges, designed an online STEM outreach program with the video project in the STS approach and survey questions based on the previous research studies. The survey (see Appendix B) combined questions about science identity, personal interest, self-concept of ability, and attitude toward science tests.

Step 2. Implement. The project team announced a competition for creating video projects through the organization's homepage, social media, local newspapers, and group emails. The announcement included the awards, primary directions for creating the video project, the rubric, an informed consent form, and a pre-survey. The survey was administered to 200 students (Grades 4-11) using QuestionPro who registered for the national video project competition. The video project was to deliver the topic of "saving the world through science and technology" to people around the world through student-created video clips. The videos needed to last less than two minutes.

Step 3. Assessment. Over 100 video submissions were made during the project for six months. The video judges evaluated the video projects based on the rubric. The winners were announced through the homepage, social media, and local newspapers. Only 13 out of 24 award winners completed the post-survey through the submission site and participated in interviews at the end of the project (Appendix C).

Step 4. Dissemination. The organization's website provided the video project information and made the winners' videos available for broader dissemination.

Participants

The participants in this study were 13 middle and high school students across the United States. The video competition was announced through a website, and the students created their videos based on a rubric provided on the website. They were asked to create video projects (less than two minutes long) with the topic of "Saving the World through Science and Technology." The students were divided into four groups: Group 1 was Grades 4-5, Group 2 was Grades 6-7, Group 3 was Grades 8-9, and Group 4 was Grades 10-11. Each of Groups 1 to 4 had three places: one student for the first place, two students for the second place, and three students for the third place. There were over 100 video submissions (about 25 submissions from each Group), and four project judges, who were professional scientists and engineers, evaluated the submitted video projects based on the rubrics (see Appendix A). All competition participants were Korean Americans, and their parents (their fathers, mothers, or both) were presently working in STEM fields. The 13 study participants who were award winners and had high academic performances in STEM areas completed the pre- and post-surveys. At the end of the study, they had an interview.

Data Collection and Analysis

Data collected for this case study include both quantitative and qualitative measures. Each instrument was intended to provide information about how the video project impacted participants' learning of science and their affinity for Science during COVID-19. Visual inspection of the histograms suggested that our data were parametric, therefore, matched paired t-tests were used to compare the pre-and post-surveys with the same participants.

Quantitative Data

Participants were administered a pre-survey at the beginning of the project and a post-survey of science affinities at the end of the project. The affinities survey was modified from Project Little Scientists (Todd, 2016) and included four scale measures: science interest, self-concept of ability, science attitudes, and science identities. The survey with all scale measures can be found in Appendix B. Information about each measure is detailed below.

(1) Science Interest. The scale used to measure participants' interest in science was taken from the Colorado Learning about Science Survey (CLASS) (Adams et al., 2006). Reliability was assessed using test-retest reliability. Correlations between responses ranged from .88 to .99. Test-retest reliability for the adapted scales ranged from .86 to .99 (Semsar et al., 2011). Each item is in the form of a 5-point ordinal scale question ("strongly disagree" to "strongly agree").

(2) Self-Concept of Ability. Participants' science efficacy was measured using a self-concept of ability (Eccles, Adler, & Meece, 1984). Each scale consists of three items on a 5-point ordinal scale ("not at all good" to "very good"). Cronbach's alphas for the scale of self-concept of ability have ranged from.80 to .95 (Else-Quest et al., 2013). Cronbach's alpha for the scale of task value was reported at .81 (Else-Quest et al., 2013).

(3) Science Attitudes. Participants' science attitudes were measured using the Attitudes Toward Science in School Assessment (Germann, 1988). This instrument measures students' attitudes toward science with particular emphasis on studying science in schools. The original respondents were 7th and 8th-grade students. Reliability was high (α= .94) in the study sample. This scale consists of 14 items on a 5-point ordinal scale ("strongly disagree" to "strongly agree").

(4) Science Identity. The science identity test incorporated modifications to the existing instrument that was used for the study of Carlone and Johnson (2007). The composite reliability (CR) that is used to assess the reliability value of the science identity test was 0.7. The four items that represent the significant components of identity—experience, confidence and competence, and feedback—were used in this project. A 5-point ordinal scale was used in place of the original four-point scale employed in this study. These items were summed to create a scale score of science identity.

Qualitative Data

Qualitative data were collected after project winners who took the pre-and post-survey answered the interview questions. The qualitative interview questions from a study by Todd (2016) were modified (see Appendix C) for this project to measure insights into participants' scientific affinities (science identity, personal interests, self-efficacy, and attitudes toward science). Qualitative data were analyzed using deductive coding based on the study by Todd (2016). Codes were then grouped into themes using content analysis.

Timelines of the Project

The research activities outlined in Figure 1 were carried out between March 2020 and August 2020.

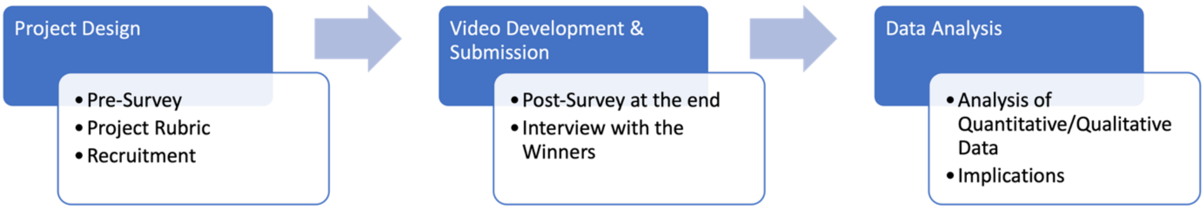

Figure 1. Project Timeline

Researchers worked closely together to design the project and collect data after the project. Participants took the pre-survey when they registered, and the post-survey was the exact measure of the pre-survey when they submitted their videos. The data was entered/transcribed, and analyzed, and project implications were discussed at the end of the project.

Results

Matched Paired t-tests

The randomly selected 13 video winners had the pre-and post-test before and after the project. To see the effects of the project on the 13 participants, matched paired-sample t-tests were run to determine whether there were statistically significant differences between the pre-and post-test scores on the four scales of science affinities (i.e., science identity, personal interest, self-concept ability, and attitudes towards science). None of the t-tests were statistically significant, $p > .05$. The post-test scores, on average, were higher than the pre-test scores. Specifically for science identity, the post-test ($M = 3.81$, $SD = 0.53$) was not statistically significantly higher than the pre-test ($M = 3.65$, $SD = 0.53$); $t\ (12) = -0.76$, $p = 0.46$. For personal interest, the post-test ($M = 4.14$, $SD = 0.61$) was also not statistically significantly higher than the pre-test ($M = 3.87$, $SD = 0.51$); $t\ (12) = -1.16$, $p = 0.27$. For self-concept of ability, the post-test ($M = 3.98$, $SD = 0.38$) was also not statistically significantly more significant than the pre-test ($M = 3.94$, $SD = 0.38$); $t\ (12) = -1.16$, $p = 0.27$. Finally, there was no difference between the post-test score ($M = 4.25$, $SD = 0.83$) and the pre-test score ($M = 4.16$, $SD = 0.35$) for the attitudes toward the science scale; $t\ (12) = -0.34$, $p = 0.74$. Table 1 shows the results of the four matched paired t-tests.

Table 1. Results of the Matched Paired T-tests

Science Affinity		N	Mean	SD	t	p
Science identity	Pre-test	13	3.65	0.53	-0.76	0.46
	Post-test	13	3.81	0.53		
Personal Interest	Pre-test	13	3.87	0.51	-1.16	0.27
	Post-test	13	4.14	0.61		
Self-concept ability	Pre-test	13	3.94	0.38	-1.16	0.27
	Post-test	13	3.98	0.38		
Attitude toward Science	Pre-test	13	4.16	0.35	-0.34	0.74
	Post-test	13	4.25	0.83		

Interview

The 13 award winners who completed the post-survey had the interview (see Appendix C). The interview was with six questions and the interview responses were categorized based on scientific affinities (shown in Table 2). The interview responses demonstrated that the students positively improved their personal interest and attitudes towards science, built confidence in their self-concept of their abilities, and achieved their science identities after they went through the challenges of exploring the STS issues and creating the video project. All the interviewees responded that they believed they were good at science after they completed the video projects, along with being good at technological skills and STS interdisciplinary knowledge. They described being interested in science and skilled as scientists. They also revealed that their belief in their science abilities, known as science efficacy, and their attitudes toward science had improved through the process of researching and designing the video projects using an interdisciplinary approach and documenting them with technological skills. Table 2 shows the responses that were selected, mostly related to the interview categories.

Table 2. Selected Responses to the Interview

Category	Responses
Science Identity (What will be your future career?)	• Participant 1: I want to become an inventor so that I can help the world and create machines everyone will use in their everyday life. This project helped me get an idea of what to invent and what problems to solve. • Participant 3: This project will affect my career because it helped me discover that if I put my effort into researching and making educational projects, it would help me learn more about the topic but also help me learn other efficient ways to gather and use important information. • Participant 4: I'm interested in a career that combines both Technology and the arts. This project was a good experience for me to understand how STEM and videography can come together and make something great. • Participant 6: I did not choose my future career yet, but I would say it might be in the science field. Also, if it were, my video would affect my future career as a first step into science. • Participant 8: I am still not certain what exactly I want to pursue, but I have had a consistent passion for science, and I do not predict that to be changing any time soon. • Participant 10: I think I would be a good scientist. A good scientist is someone who can conclude something within the experiment. Not the outcome or result or solution but a comment, remark, or observation that leads to questions. Questioning, I think, is the most important in being a scientist. IF a scientist does not have any questions, where are the answers? • Participant 13: I would call myself a scientist because I think everything leads or is related to science. I think I would love the different experiments I would do during my journey as a scientist. There are so many different outcomes: some may be obvious and some may be completely bizarre. I definitely want to become a scientist or an engineer. But the challenges that I may come across are frustration from not getting things correct or not being able to solve a phenomenon that cannot be explained.
Personal Interest (Why did you get involved in this project?	• Participant 2: I got involved in this project because I wanted to help the world through Technology and fix problems such as air pollution, water pollution, and other types of pollutants.

	• Participant 5: I decided to get involved in this project because the concept seemed interesting, and I felt like it would be a very useful opportunity for me to learn through. • Participant 7: The opportunity to create a video was what first interested me. After further research, being able to tie together STEM and filmography led to my involvement in this project. • Participant 9: I was interested in science and went to the math competition, but it was canceled so instead I did this project. There were also prizes and it was a competition. This looked like a challenge, and I like them. • Participant 11: As my state was already well into lockdown due to COVID-19, this project was a welcome diversion from the mind-numbing repetition that came with shelter-in-place. I was also excited by creating a video project.
Attitudes toward Science (What challenged you the most in developing your video project?)	• Participant 2: What challenged me most throughout my video project was having to screen record multiple times when something messed up and having to make the stop motion animation. • Participant 3: I think that the process of planning out how my video should be was the most difficult for me since I had to keep everything short and not over or underexplain. Furthermore, there were many times where I felt like the transitions from one topic to another were very choppy and I had to do some editing before I was satisfied with the video plan. • Participant 5: Explaining both the addressed problem and a completely new concept (RoboFish) as the solution was difficult to do in just two minutes. I had to be sure to incorporate only necessary information while making sure the video didn't seem too rushed or incomplete. • Participant 8: I'd probably say making all of the pictures and voice recordings because sometimes I pronounced a word wrong, or a picture was not explained enough. • Participant 10: The biggest challenge was definitely the deadline. I found out about the competition a week before it was due, and this led to a near-frantic seven days of storyboarding, shooting, recording dialogue, and editing. Stop-motion takes a very long time to film, as 30 pictures only equates to 1 second in the film. Figuring out a way to create a finished product by the deadline both challenged and excited me. • Participant 12: I think it is an honor and also very fun to be a scientist. Also, science is known throughout all countries, states, and cities all around the world along with mathematics. Which is why I enjoy both topics. They serve as a worldwide" language" that everyone can understand.

Self-concept of Ability (What were you most proud of, personally and professionally through this video project? What did you achieve through this video project, especially in the STEM area?)	• Participant 1: I was most proud of being able to find all the different kinds of software used to create my video. • Participant 3: What I achieved most throughout this video project was knowing more about air pollution and being able to think of an idea that can help the world be a better place. • Participant 4: I was very proud of myself when I completed the video project because before I created my video, I was unsure of how it would turn out and I thought that the video I would make wouldn't be as good as I wanted it to be. However, when I finished the video, I was joyful because I thought that the video turned out well and reflected the amount of time that I put into it. • Participant 5: I learned about what formic acid is and I got to educate myself more about greenhouse gases and other alternative solutions there are to reduce emissions. In addition, the video project allowed me to research and gather information on my own and then use that information to create an educational video explaining how formic acid can help reduce carbon emissions. • Participant 6: I learned much more about the science behind water pollution and how it is affecting the planet, as well as the mechanics behind a trash eating RoboFish. I also became more comfortable using video editing technology and software. • Participant 7: I achieved going more deeply into virology and achieved my first successful video. I also achieved doing my first competition and having a great experience. • Participant 8: I had created two LEGO stop-motion videos in the past, but as other extracurriculars got in the way, I ended up abandoning it as a hobby. Returning to stop-motion animation was quite enjoyable, and just rediscovering the magic of a long-lost hobby was something that I was proud of. • Participant 10: The video was actually relatively difficult to make—I had found out about the competition only a week before the due date, so I was on a tight schedule. While my videos in the past had taken a few months to complete, I was able to write, film, and edit a video in just one week, which is a technical achievement I am very proud of—I would have not thought it possible before this competition. • Participant 11: I think the most STEM-related insight I gained came from the writing stage, when I was trying to think of a topic that I could discuss within the small limit of two minutes. By reflecting on why Science and Technology were important to humanity, I was able to achieve a clearer understanding of why I personally valued science as a field. The love of exploration, discovery, and understanding inherent in science appeal to me greatly, and I think that realizing that made it easier for me to explain to myself why I want to pursue a

	STEM-related career. • Participant 13: Winning second place in the competition made me feel more like a scientist. It boosted my confidence with science and made me more engaged with science. I think that not being able to comprehend the information in the recent competition had discouraged me. I thought that maybe I wasn't smart enough but nevertheless I decided that I would research more at home and learned that I will be learning more when I start high school this fall, which has me pretty excited for high school.

Discussion and Implications

The purpose of the study was to examine the effects of a video project using an STS learning approach on the middle to high school students' science affinities to support and retain these students in science during the COVID-19 Pandemic. This study explored thirteen participants' science identities, interests, self-concepts, and attitudes. The pre-and post-survey scores showed that this project did not have statistically significant effects on the participants. However, the interview responses that revealed the participants' insights showed that the video project effectively helped to sustain or increase the students' science affinities and their science learning after participating in the video project.

This study aimed to help the students improve their learning in science by enhancing their affection for science, thus forming their science identities. The primary factor for science identity formation through the video project was experiencing the whole scientific process of bringing up the issues of Science and Technology within society, researching solutions to problems, making their best decisions for society, designing the videos with technological skills, and sharing the video products with the public. The video project provided the students at least an opportunity to develop their science motivation, engagement, attitudes, and literacy, thus shaping their scientific integrity and fostering their mindsets.

Based on the statistical analyses with the thirteen award winners, the video project using the interdisciplinary learning approach did not contribute to positively supporting their science interests and attitudes, building their abilities, and achieving their identities in science. Like these participants, high achievers in STEM areas may render the statistics meaningless due to smaller learning gains (Li, 2014). However, the raw survey cores and the interview results suggested that the best practice for advancing science engagement and identities in future scientists and engineers during the COVID-19 Pandemic was the hands-on science activity of the online video project and the STS interdisciplinary approach to enhancing their understanding of scientific principles. The student-generated video project promoted student interactions and cognitive engagement (Kay, 2012; Zhu, 2006), which inspired students to learn more and understand science conceptions better through visual and audio multimedia presentations. The STS learning approach to the students' research about the project topics enabled them to *grasp* the interdependence of Science, Technology, and society and become empowered to make informed and responsible decisions; and to act upon those decisions (van Eijck & Roth, 2013; Yager, Choi, Yager, & Akcay, 2009), which is the major contributing factor in the development of more positive attitudes toward learning and teaching science (Maypole & Davies, 2001). Studies regarding the benefits of STS instruction for student learning have shown improvements in students' achievement, decision-making, attitudes toward Science, creativity, questioning abilities, and process skills such as hypothesizing, investigating, and evaluating (Maypole & Davies, 2001; Yager & Akcay, 2008; Yager et al., 2008; Yager et al., 2009).

With limited access to science resources during the Pandemic, this study built valuable insight for educators and administrators in science regarding how to retain better and support students' interests and attitudes toward science to form a science identity. Educational organizations have recognized the benefits of the student-generated multimedia project using an STS interdisciplinary approach. This study attempted to bridge science affinities and scientific literacy by allowing the students to interact with video projects and STS issues online. The students could achieve their science identity with access to proper resources and gain knowledge and skills in science based on their research experiences, which allowed further development of interest and competence in and identification with science and enhanced academic competitiveness in science.

Limitations and Recommendations for Future Research

While the findings of this case study provide meaningful insights regarding future scientists' and engineers' science affinities and their learning during COVID-19, limitations must be acknowledged. First, the generalizability of our findings is limited since data were collected only from 13 students. This small number of participants for the quantitative findings should be considered when interpreting the findings and may not have provided enough power to find statistically significant results.

Also, the representativeness of the students is limited because all our participants were Korean American students who were award winners with advanced achievements in STEM areas. Given that there are diverse students other than Korean Americans in the United States (e.g., Black, Caucasian, Latino, Native Americans, and other Asians), the limited representation of one ethnic population with high performers in STEM areas should be considered. Also, the statistical data from the high performers may not produce meaningful results. Therefore, we recommend further investigations examining various student populations' experiences with video projects that use more ethnically and racially diverse groups of participants with low achievement in STEM areas as well as larger sample sizes to increase the generalizability of the findings.

Next, our study was limited to examining students' experiences at only one-time points during COVID-19. Future research may seek to engage in longitudinal studies to understand changes in students' experiences with the video project during and after the Pandemic, including how students adjusted to the online learning environment of the Pandemic and how students' experiences change after the Pandemic is over and they return to typical face-to-face learning environments.

Lastly, our study did not capture students' experiences without the video project during COVID-19, which could have provided a comparative perspective. Thus, we recommend further analysis exploring students' experiences of an online video project compared to their peers without the video project to capture differences and similarities in experiences between these two groups.

Practical Implications

This case study demonstrated that meaningful interactions with student-generated multimedia projects provide multiple benefits to students. Thus, educators and administrators should design and offer special programs in science education to help students stay motivated to learn science and develop their knowledge and skills. Considering that COVID-19 limited diverse learning opportunities in science education, our findings show that online interactive programs in science can be a practical and helpful resource for students with limited access to science education during uncertain times such as the Pandemic.

In addition, we recommend that K-12 districts offer educational workshops and training to enlighten educators and administrators about the need for the student-generated multimedia project and STS interdisciplinary approaches in science education. Considering the increased need for particular instructional strategies in science education in COVID-19 settings related to student academic success and school adjustment, educators need to be aware of the importance of the student-generated multimedia project and STS interdisciplinary approaches to science.

Conclusion

This study contributes to the field of science education by providing the insight that an online video project using an STS interdisciplinary approach successfully helped future scientists and engineers to increase and retain their interest in and positive attitude toward science, thus forming a science identity. It is necessary to create online enhancement programs specially designed to enable students to interact with STS issues and multimedia skills that can provide proper research experiences in science and help students go through the scientific process to encourage them to learn more and retain their interest in science.

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Appendix A. Video Project Rubric

ACTIVITY	TOPIC	CREATIVITY	QUALITY	LENGTH	FINAL SCORE
Exemplary	4 points The video was accurately and comprehensively related to the topic. Appropriate citations were available.	6 points The video is presented in an extremely unique, original, and creative way. It catches the viewers' attention and holds their interest.	8 points The video is well-planned and produced with care and attention to detail. The transitions are smooth and the materials are easy to comprehend. Both the spoken voice and music or other sound effects are clear, interesting, and appropriate for the topic and the audience.	2 points The video is between 1 and 2 minutes in length	
Proficient	3 points Some aspects of the topic were evident in the video, or were shown in the video, but not clearly. Some citations may have been missing or may have been inaccurate or irrelevant.	4 points The video is presented in a basic way that tries to capture the viewers' attention.	5 points The information in the video has a general order and flow. The material is presented in a basic manner. Either the spoken voice or music or other sound effects are not clear, interesting, or appropriate for the topic and audience.		
Partially Proficient	2 points The topic was noticeably absent from the video and not readily apparent.	2 points The video is not presented originally or creatively. The information is	3 points The information in the video is not organized in any manner and lacks a low of conversation. Transitions between		

ACTIVITY	TOPIC	CREATIVITY	QUALITY	LENGTH	FINAL SCORE
	Citations were inaccurate and/or irrelevant.	read to the viewers and fails to present the information in an interesting format.	scenes and presenters need improvement. Both the spoken voice and music or other sound effects are unclear, uninteresting, or inappropriate for the topic and audience.		
Incomplete	0 points There was no apparent connection between the topic and the finished video. There were no citations.	0 points There is no effort to present information and capture the viewers' attention. The video is ineffective.	0 points The video is made with no attempt at producing a quality project.	0 points The video is shorter than 1 or longer than 2 minutes in length.	
POINTS					

Appendix B. Survey Test Questions

Science Identity		Strongly Disagree (1)		Disagree (2)		Neutral (3)		Agree (4)		Strongly Agree (5)	
		Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Q1	My teachers encourage me to do science.										
Q2	My family and friends encourage me to do science.										
Q3	I am good at science.										
Q4	I think of myself as a scientist.										
Science Interest											
Q5	I think about the science I experience in everyday life.										
Q6	I am not satisfied until I understand why something works the way it does.										
Q7	I study science to learn knowledge that will be useful in my life outside of school.										
Q8	I enjoy solving science problems.										
Q9	Learning Science changes my ideas about how the world works.										
Q10	Reasoning skills used to understand science can be useful in my everyday life.										
Self-Concept of Ability											
Q11	How good at science are you?										
Q12	If you were to rank all the students in your science class from the worst to the best in science, where would you put yourself?										

Science Identity		Strongly Disagree (1)		Disagree (2)		Neutral (3)		Agree (4)		Strongly Agree (5)	
		Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Q13	Compared to most of your other school subjects, how good are you at science?										
Attitudes Toward Science											
Q14	Science is fun										
Q15	I do not like science and it bothers me to have to study it.										
Q16	During science class, I usually am interested in learning science more.										
Q17	If I knew I would never get to science class again, I would feel sad.										
Q18	Science is interesting to me and I enjoy it.										
Q19	Science makes me feel uncomfortable, restless, irritable, and impatient.										
Q20	Science is fascinating and fun.										
Q21	The feeling that I have towards science is a good feeling.										
Q22	When I hear the word science, I have a feeling of dislike.										
Q23	Science is a topic which I enjoy studying.										
Q24	I feel at ease with science and I like it very much. I feel a definite positive reaction to science.										
Q25	Science is boring.										

Appendix C. Interview Questions for My Video Story Project

1. Please tell me your story in the video.
2. Why did you get involved in this project?
3. What were you most proud of, personally and professionally through this video project?
4. What did you achieve through this video project, especially in the STEM area?
5. What challenged you the most in developing your video project?
6. What will be your future career? Will this project affect your future career?