Digital Media Academy
TechCamps

Students' Perceptions and Attitudes Toward Digital Media Academy and STEM Fields

by

Xavier J. Monroe
Anthony Muro Villa III
Karla Lomelí
Greses A. Pérez-Jöhnk
Daniel L. Schwartz, PhD
Bryan A. Brown, PhD

November 22, 2019

Stanford
GRADUATE SCHOOL OF
EDUCATION

Executive Summary

The Digital Media Academy mission states that the organization is "committed to providing impactful technology education and working with educational researchers to evaluate and improve their offering." This report summarizes the findings of the implementation study conducted on the Digital Media Academy Tech Camp hosted at Stanford University during the summer of 2019. The study team consisted of four doctoral researchers and two faculty advisors. Utilizing a mixed methodology approach inclusive of surveys and focus groups, the researchers aimed to understand the effects of the summer digital tech camp on students' perceptions and attitudes towards digital media. This document includes over 100 pages of charts, quotes, and findings that the research team has amalgamated into emergent themes the Digital Media Academy team might consider in its deliberation about the future directions of the program.

While we encourage reading and reviewing the entirety of this document, we provide a few salient findings in this executive summary. Descriptively, the findings suggest that students who received a scholarship had a slightly higher shift in their perceptions and attitudes toward digital media technology. Further, findings also suggest that students who received a scholarship started the summer camp with higher positive attitudes towards digital media technology and Science, Technology, Engineering, and Mathematics (STEM). Second, the results also descriptively suggest that students generally had a positive experience at the camp and would most likely pursue similar opportunities in the future. Overall, the scholarship students felt that the camp provided them access to meaningful learning experiences that made use of high quality technology and software.

Additional findings of importance to the Digital Media Academy team concerns the impact of the summer camp on all students' learning, attitudes towards STEM, and overall experience. Findings from the survey suggest that students had an overall positive learning and personal experience with the DMA Tech Camp. There was an increase in students' willingness to attend a summer STEM camp from the initial survey to the final survey. Students further showed a slight increase in their willingness to attend a DMA Tech Camp between the two survey collection periods. The survey data particularly pointed to a positive increase in students attitudes towards digital media and technology. These trends also emerged with students' attitudes towards STEM as students interests and comfort with the topics also increased between data points. The amalgamated results suggest that students' largely had positive experience with DMA that might encourage their continued participation with digital media, technology and STEM learning activities.

Although DMA has hosted this camp for some time, this summer represented the first time that some students received scholarships to attend the summer camp. While the research team made an effort to include as many scholarship status students in our findings, the relatively small sample of scholarship students in relation to the larger student sample makes it difficult to make any definitive statements to compare their learning experience with students who did not receive a scholarship. Nevertheless, these data suggests that students who did receive a scholarship exhibited slightly larger interest in STEM and digital media technology before beginning the program and maintained that level of interest at the end of their camp experience.

To summarize, students appreciated the opportunity to engage with digital media technology and STEM, particularly on the campus of Stanford University. When taken in totality, both the survey and focus groups suggest that students had a positive experience with the camp. This is reflected in markers around students' interest, engagement, abilities and attitudes toward STEM and digital media. The following pages of this document expand upon these highlights.

Table of Contents

Introduction ..... p. 3
Methods ..... p. 3
Setting ..... p. 3
Data Sources ..... p. 3
Table 1. Student focus groups by academy and (number of interviewees, *n*) ..... p. 4
Data Analysis ..... p. 4
Individual Course Findings ..... p. 5
Artificial Intelligence & Machine Learning with Python ..... p. 5
Focus Group Interview Excerpts ..... p. 5
Survey Results ..... p. 5
Python & Electrical Engineering with Take-Home Laptop ..... p. 8
Focus Group Interview Excerpts ..... p. 8
Autonomous Arduino with Take-Home Robot ..... p. 9
Focus Group Interview Excerpts ..... p. 9
Survey Results ..... p. 9
Scholarship Versus Non-Scholarship Survey Results ..... p. 10
Electronic Music Production with Ableton ..... p. 22
Focus Group Interview Excerpts ..... p. 23
3D Modeling & Animation ..... p. 23
Focus Group Interview Excerpts ..... p. 23
Adventures in 3D Printing & Modeling ..... p. 24
Focus Group Interview Excerpts ..... p. 24
Survey Results ..... p. 24
Adventures in Animation ..... p. 26
Focus Group Interview Excerpts ..... p. 26
Survey Results ..... p. 26
Filmmaking Academy ..... p. 28
Focus Group Interview Excerpts ..... p. 28
Survey Results ..... p. 28
Scholarship Versus Non-Scholarship Survey Results ..... p. 28
Overall Findings ..... p. 40
Impacts ..... p. 40
Surprises About Camp and Self ..... p. 41
Selection of Camp or Academy ..... p. 42
Appreciation ..... p. 43
Improvement Recommendations ..... p. 45
Perceptions and Attitudes Toward STEM ..... p. 48
Appendix A. Focus Group Interview Protocol ..... p. 51
Appendix B. Pre-survey ..... p. 52
Appendix C. Post-survey ..... p. 59
Appendix D. Aggregated Survey Results ..... p. 66
Appendix E. Non-Scholarship Versus Scholarship Student Survey Results ..... p. 71
Appendix F. AI & Machine Learning with Python Survey Results ..... p. 80
Appendix G. Autonomous Arduino with Take-Home Robot Survey Results ..... p. 85
Appendix H. Adventures in 3D Printing & Modeling Survey Results ..... p. 90
Appendix I. Adventures in Animation ..... p. 95
Appendix J. List of Academies included in Surveys ..... p. 100

Introduction

Research has revealed that after-school STEM experiences improve students' attitudes towards STEM fields and STEM careers (Mohr-Schroeder et al., 2014; Shahali, Halim, Rasul, Osman, & Zulkifeli, 2017; Tseng, Chang, Lou, & Chen, 2013). Identifying clear learning goals and the content are two fundamental stages in designing effective STEM education programs. Building programs centered around students' early interests and experiences, and engaging them in genuine STEM practices are essential factors in promoting and maintaining students' motivation and engagement with STEM education (National Research Council, 2011). The following report offers data from students that participated in courses offered by Digital Media Academy (DMA) at Stanford University in the summer of 2019. The findings provide suggestions that can inform DMA's future goals and course offerings that can improve DMA's programming.

Methods

Setting

DMA is a network of "Tech Camps" that take place at 11 different universities across the United States. The data from this report draw from the Tech Camp at Stanford University in California. DMA is designed for students between ages 9 to 18, although some summer 2019 courses were offered to ages 7 to 9. Students had the option of taking a one-week or two-week course in different areas. DMA offers 25 different programs along six learning and career pathways: coding and artificial intelligence; robotics and engineering; music production; 3D modeling and design; filmmaking and photography; and game design.

Data Sources

Focus Group Interviews. Eight focus groups were interviewed on the last day of participating in a two-week academy, totalling 48 students. All focus groups were conducted by two researchers. Students were selected by the instructors to be interviewed to offer a variance of experiences and perceptions. For a list of the academies and number of students interviewed within each focus group see Table 1. Students were asked questions based on six main categories: impact of course; surprises from participation and/or about self; selection choice for camp; appreciation; improvement suggestions; and perceptions and attitudes toward STEM after participation. For a list of questions and interview protocol used see Appendix A. The focus groups were done with a semi-structure, allowing some questions to be open to discussion for the whole group, whereas, other questions were asked to be answered by each student. For example, the question "Why did you decide to take a summer course with Digital Media Academy?" was asked of each student to gain the different ways students had decided to take their particular academy.

Surveys. This study used the Instrument to Assess Attitudes Toward Science, Technology, Engineering, and Mathematics (STEM) survey. The Cronbach's alpha for the entire survey is .91, which indicates a high reliability that students' responses will be consistent (Guzey, Harwell, & Moore, 2014). Items were adapted to include "digital" in connection to technology. Pre-surveys were made available for students before the first day of each academy. Post-surveys were made available the last Friday of each academy. The pre-survey and post-survey can be seen in Appendix B and Appendix C, respectively.

Table 1. Student focus groups by academy and (number of interviewees, *n*).

Coding + Artificial Intelligence	Robotics + Engineering	Music Production
● AI & Machine Learning with Python (*n* = 7) ● Python & Electrical Engineering (*n* = 5)	● Autonomous Arduino with Take-Home Robot (*n* = 6)	● Electronic Music Production with Abelton (*n* = 7)
3D Modeling + Design	**Filmmaking + Photography**	**Game Design**
● 3D Modeling & Animation (*n* = 6) ● Adventures in 3D Printing & Modeling (*n* = 4) ● Adventures in Animation (*n* = 7)	● Filmmaking Academy (*n* = 6)	*no focus group*

Data Analysis

Focus Group Interviews. Focus group data were collected with video using a GoPro and two audio recorders. The audio was augmented with video records to improve sound quality. Focus group interviews were transcribed and then coded using NVivo qualitative software. Full quotes from each student were coded with one of six categories that corresponded with the interview protocol: impact of course; surprises from participation and/or about self; selection choice for camp; appreciation; improvement suggestions; and perceptions and attitudes toward STEM after participation. Two researchers coded one interview to first determine interrater agreement. Interrater agreement of 92% was reached with the first interview, and the few disagreements were discussed before then independently coding the remaining interviews. Once the interviews were coded for the main six categories, the researchers sought emergent themes within each category (Glaser & Strauss, 1967). The two researchers then met to discuss emergent themes and come to an agreement.

Surveys. Pre- and post-survey data were merged and cleaned to match participants who took both a pre- and post-survey. A total of 413 matched surveys were included in the final data set. Since only about 20 students took more than one academy, rather than excluding those student responses, we conceptualize each of the 413 matched surveys as a separate instance of participation. For this report, survey results will be first reported by course and then as aggregate results to show differences overall and then between scholarship students and non-scholarship students. Three courses were excluded from the course reports due to small sample size, and one for missing missing survey data: 3D Modeling & Animation Academy; Python & Electrical Engineering with Take-Home Laptop; and Electronic Music Production Academy. All survey data was compiled using STATA. For full survey results from all 413 responses see Appendix D.

Individual Course Findings

Many of the courses had unique findings that were not indicative of the larger emergent themes due to their specialized technology goals or unique structures. The following reports the particular findings from the eight academies associated with the focus group interviews. Direct quotes are anonymized. For five of the eight academies, survey data is also reported.

Artificial Intelligence & Machine Learning with Python

There were 7 students within the focus group interviewed for AI & Machine Learning with Python. There were 27 matched surveys from this academy. For complete survey results from this course, see Appendix F.

Impacts. Many of the impacts of DMA from this academy had to do with learning Python and its larger connections to artificial intelligence outside of gaming.

> I've also became more interested in Python programming, but I also learned about kind of the more applicable uses of AI besides just like the games that we played on the first day.

Students appreciated learning coding of a different language since most students had expressed having learned another programming language before attending the camp.

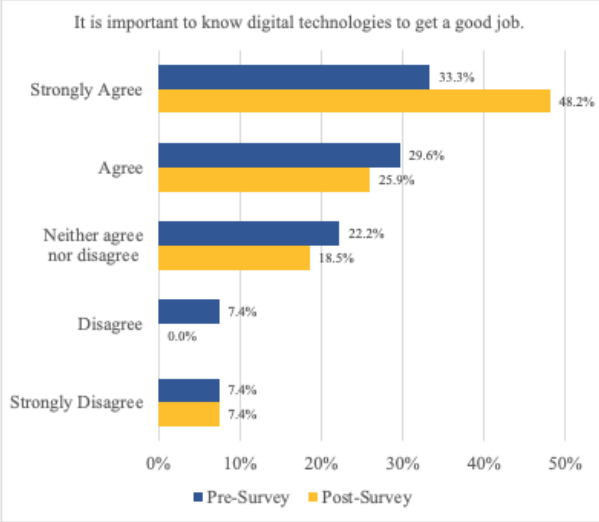
> I mean, I think that also like a lot of people have said that I really got into Python and just learning new languages because I did some JavaScripts. And then we moved to Unity, and I've been doing that in C# for a pretty long time. So it's interesting to see a new language.

Surprises. Students in this course were surprised by the fact that they got to actually code in Python, which is related to what students also noted as having the most impact for the course. Mainly, as the quote below alludes, students were surprised that they got to code with an authentic coding language rather than one that was built (and possibly more accessible) specifically to teach AI.

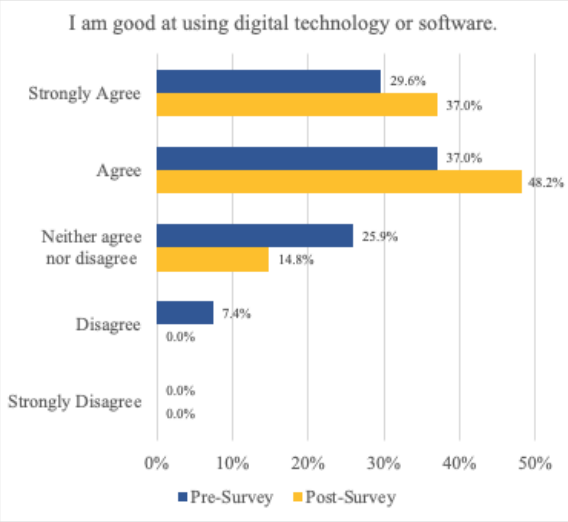
> I was surprised that we were doing, like, actual coding in Python instead of maybe, like, some easier to understand code that was built for AI; because that's sometimes how it works when you're using something complicated like AI.

Survey. The graphs that follow were selected because they showed dramatic shifts in pre- and post-survey attitudes related to digital technology. Most remarkably, Graph 2 shows shifts of students' perceptions of their skills using digital technology or software from 37.0% agree and 29.6% strongly agree (pre-survey) to 48.2% agree and 37.0% strongly agree (post-survey).

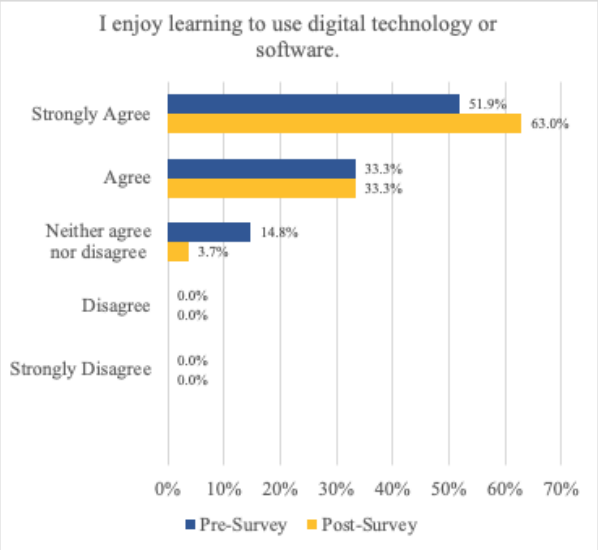
Graph 1. AI & Machine Learning with Python



Graph 2. AI & Machine Learning with Python

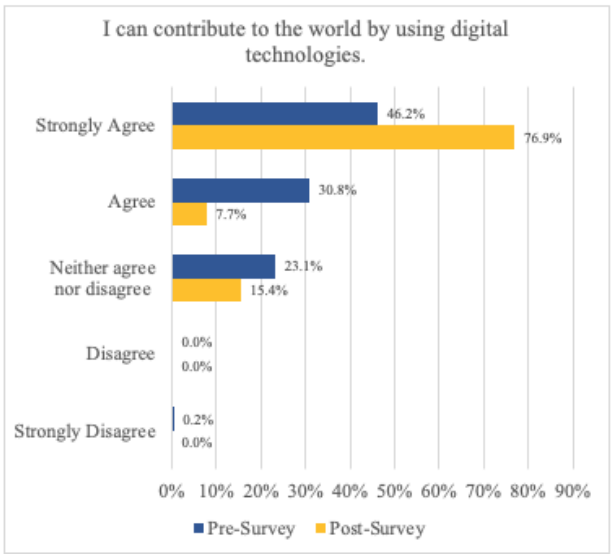


Graph 3. AI & Machine Learning with Python

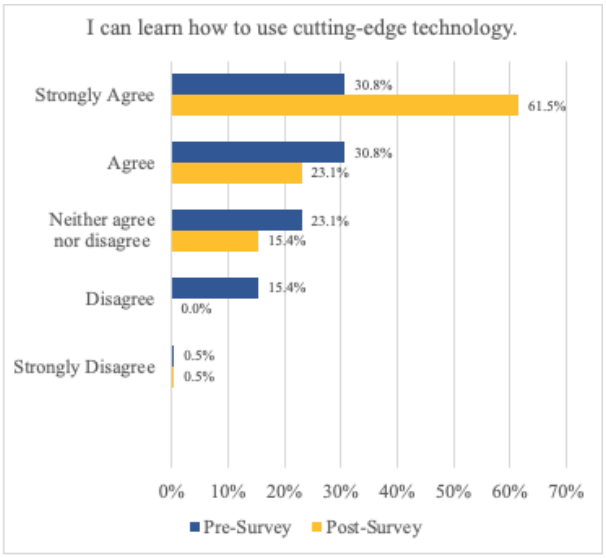


Additionally, students in this academy indicated shifts to strongly agree in two questions concerning contributions and their perceptions of their own learning of digital technology. Graph 4 shows a large jump from with strongly agree from 46.2% (pre-survey) to 76.9% (post-survey) in answering the prompt, “I can contribute to the world by using digital technologies.” Graph 5 also had large shift in strongly agree from 30.8% to 61.5% in answering the prompt, “I can learn how to use cutting-edge technology.”

Graph 4. AI & Machine Learning with Python

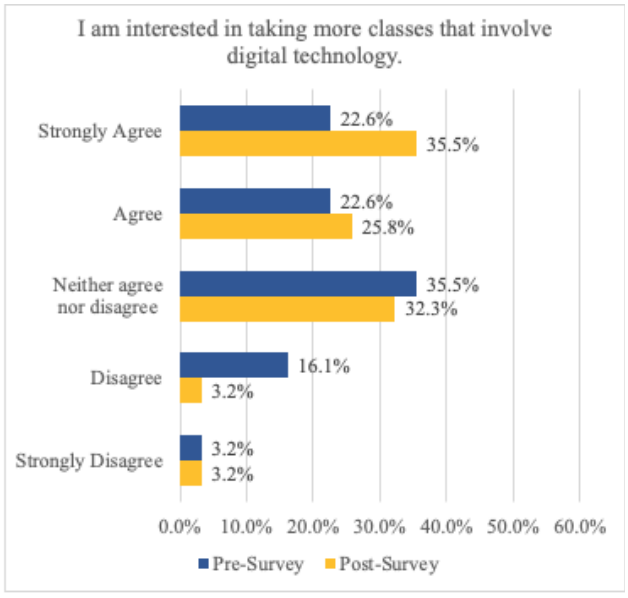


Graph 5. AI & Machine Learning with Python



The graph that follows was selected because they showed dramatic shifts in pre- and post-survey related to interest in taking more classes that involve digital technology. As can be seen in Graph 6, we see a shift in strongly agree of 22.6% (pre-survey) to 35.5% (post-survey) in answering the prompt, "I am interested in taking more classes that involve digital technology." Additionally, we see a small shift in agree from 22.6% (pre-survey) to 25.8% (post-survey). Some of these shifts may have come from large shift in disagree from 16.1% (pre-survey) to 3.2% (post-survey). In connection to the interviews, this may be because there were two different types of technologies introduced and used in connection to electrical engineering (Arduino then Python).

Graph 6. AI & Machine Learning with Python



Python & Electrical Engineering with Take-Home Laptop

There were 5 students within the focus group interviewed for Python & Electrical Engineering with Take-Home Laptop. There were only 2 matched surveys from this academy. Therefore, there are no separate survey data reported here.

Impacts. Similar to the other course with Python, students talked about learning software and coding as having significant impact on their perceptions of the camp. The quote below goes a step further can talks about having exposure to two coding languages in connection to electrical engineering as an advantage because a student can really see the limits and affordances of both.

> For me it's probably the electrical engineering, because last week, this is a continuation of Arduino class which was last week. So I mean, it's really given me more insight about what you really can and can't do the boundaries and limits between both. And coding with both of them was pretty similar but two completely different languages and more knowledge of both.

Autonomous Arduino with Take-Home Robot

There were 6 students within the focus group interviewed for Autonomous Arduino with Take-Home Robot. There were 31 matched surveys from this academy. For complete survey results from this course, see Appendix G. There were also 5 scholarship students and their responses to the surveys are reported here.

Impact. Students in this academy talked about having a robotics team at their own school sites, and how DMA helped them gain knowledge to be a more meaningful participant.

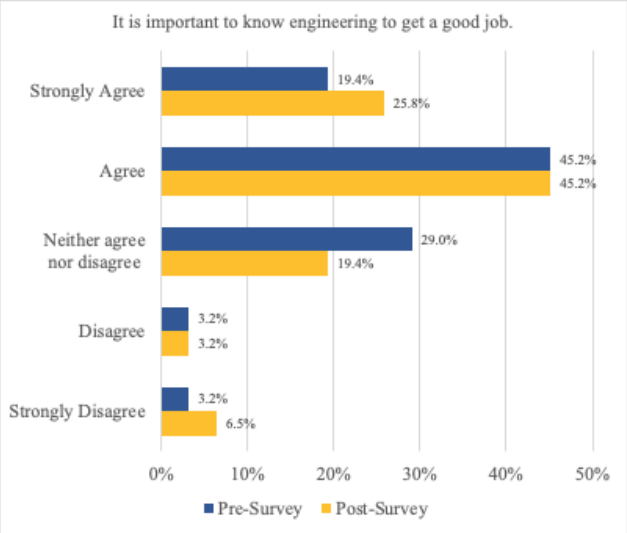
> So, at my school I'm part of a robotic team and just because of how I haven't really had as much experience, I've had trouble getting into it and understanding like the specifics. But I guess courses like these and a few programming courses I've taken with DMA before, over the past three years have helped me to catch up and sort of understand the specifics of how stuff works rather than just the overarching what's the outcome.

Additionally, one student noted that their participation with DMA gave them their first programming experience, which they marked as different from participating in LEGO robotics. The following student was following up on the previous student's comment, alluding to the fact that DMA allows for a chance to do programming that is useful when thinking of joining a robotics team at school.

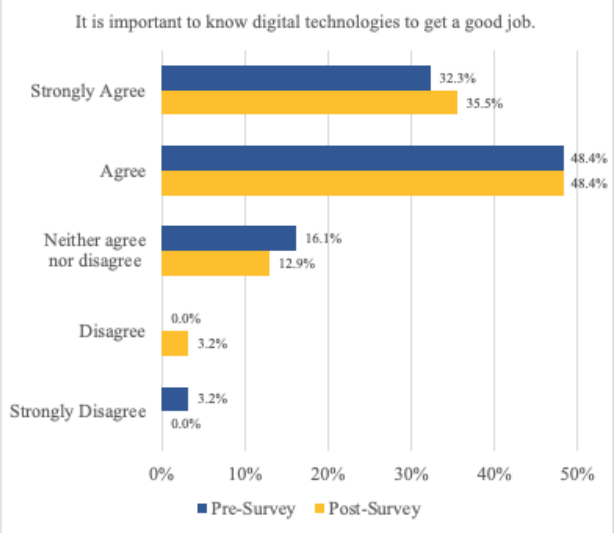
> And I met someone here who is already on that team at my school and I think this is helping too because I've only done LEGO robotics and I don't think that's what they're going to do. So this is my first actual like program your own robotics camp.

Survey. Responses that stood out for this course had to do with the importance of engineering and digital technologies to get a good job. In Graph 7 and Graph 8, We see that students shifted to strongly agree from 19.4% (pre-survey) to 25.8% (post-survey) in answering the prompt, "It is important to know engineering to get a good job." Although not as large of a shift, students reported shifted to strongly agree from 32.3% (pre-survey) to 35.5% (post-survey).

Graph 7. Autonomous Arduino with Take-Home Robot



Graph 8. Autonomous Arduino with Take-Home Robot

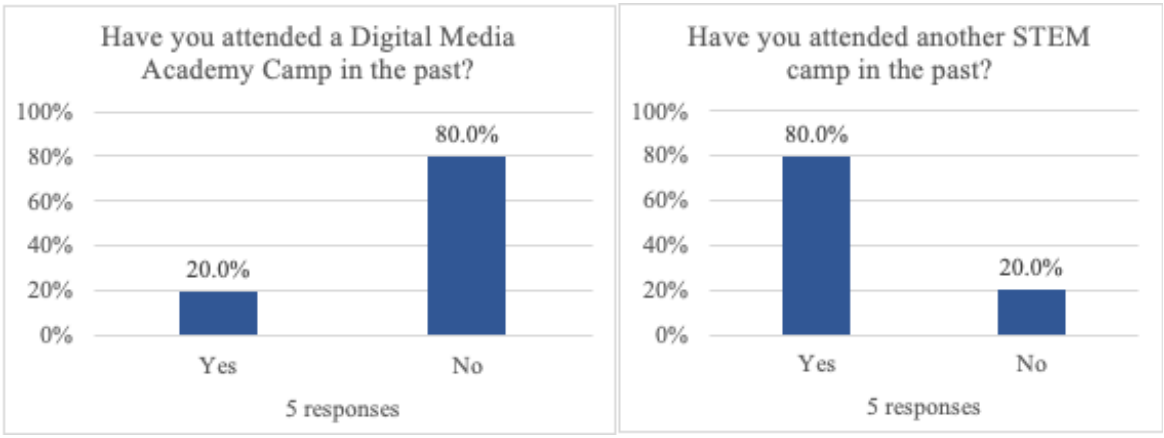


Scholarship Versus Non-Scholarship Student Survey Responses

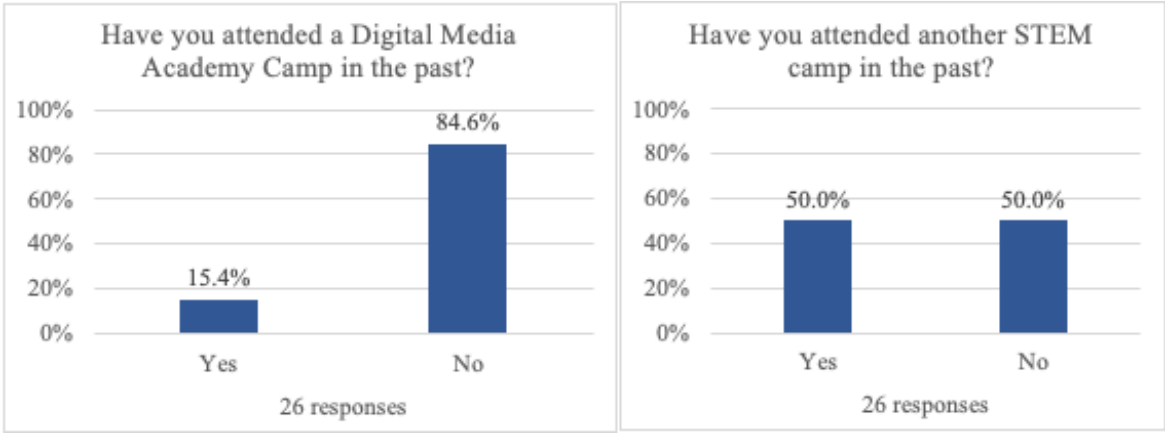
There were 5 Scholarship students out of the 31 students that had matched surveys for Autonomous Arduino with Take-Home Robot. The Scholarship student responses are followed by Non-Scholarship Student responses for each set of survey questions.

Q1. Assent.
Q2. Which Digital Media Academy course are you currently taking?
Q3. What dates are you attending this course?
Q4. Please select Yes or No for each of the below questions.

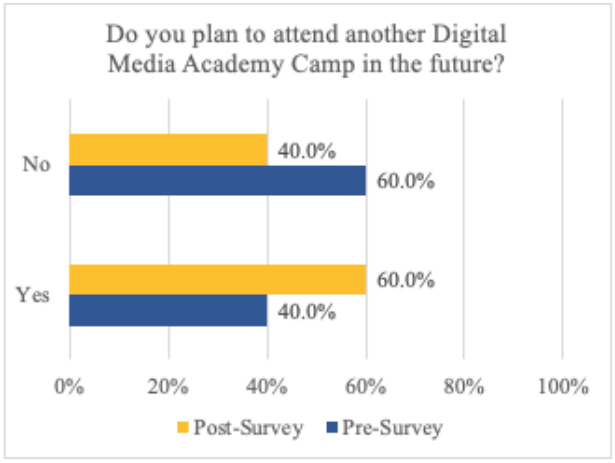
Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=5)

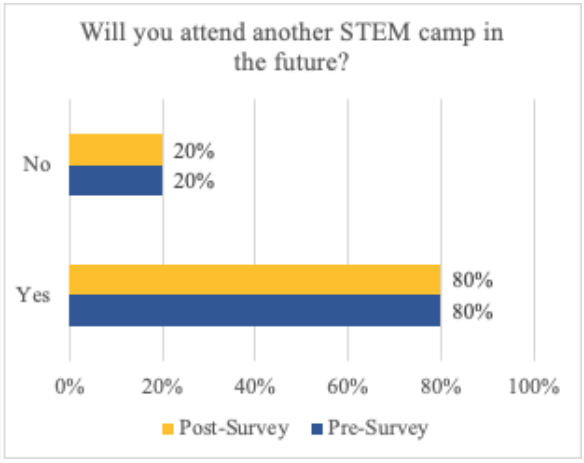


Non-Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=26)

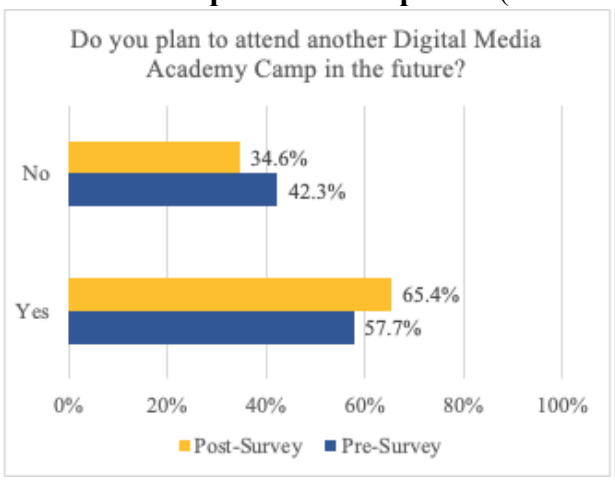


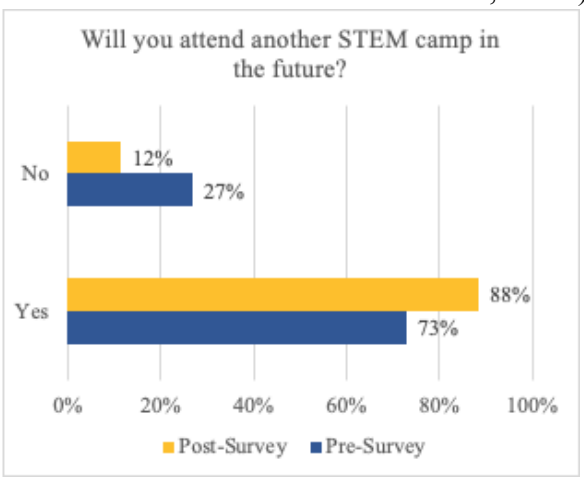
Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=5)



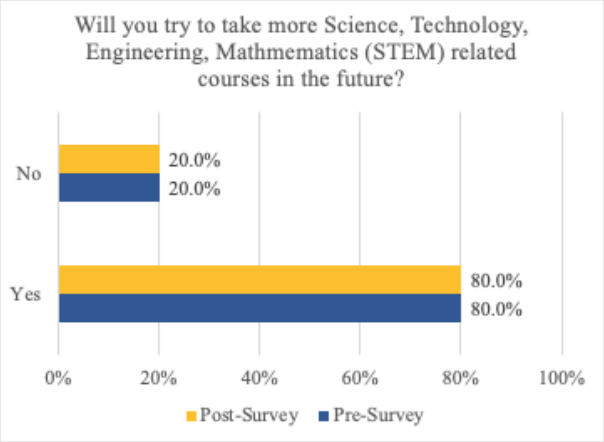


Non-Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=26)

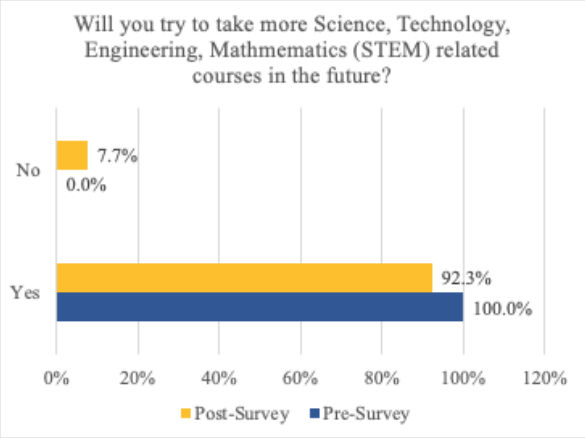




Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=5)

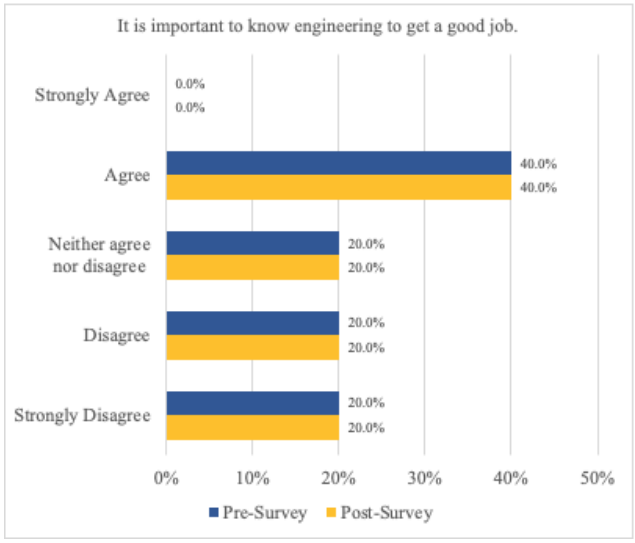


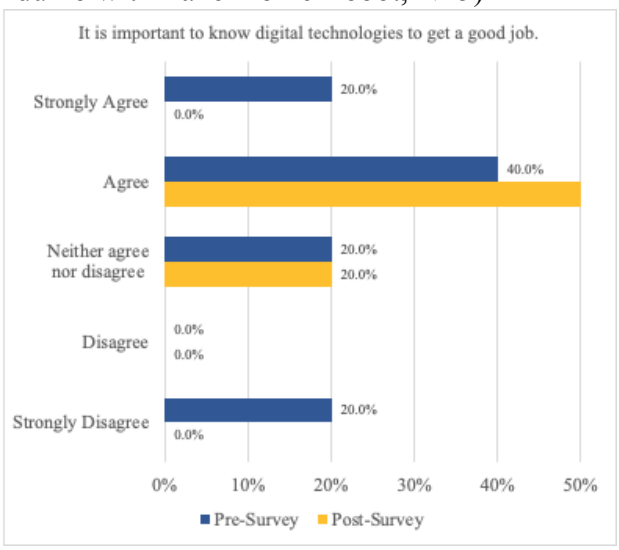
Non-Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=26)



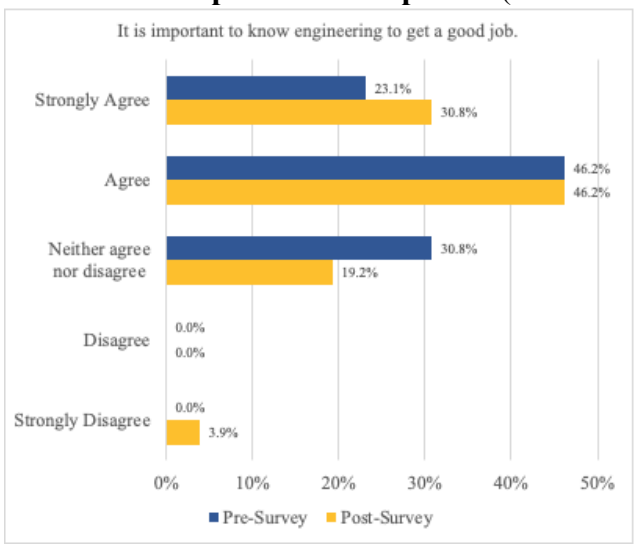
Q5. In the next part, we want to know how much you agree with each statement.
You will select from: *strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree.*
Q6. STEM Personal and Social Implications.

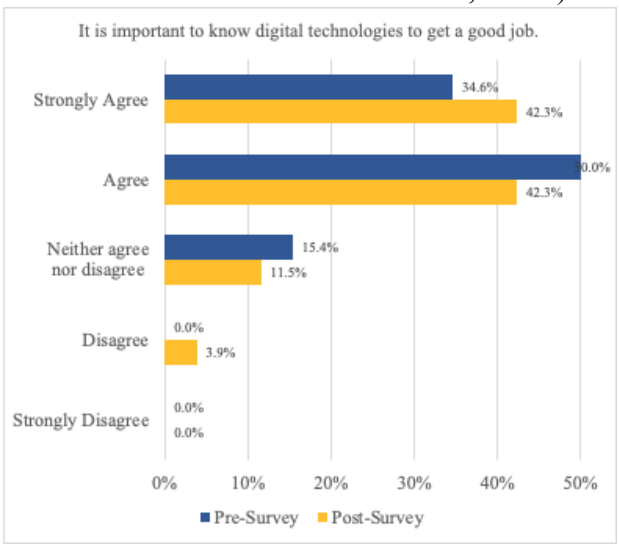
Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=5)



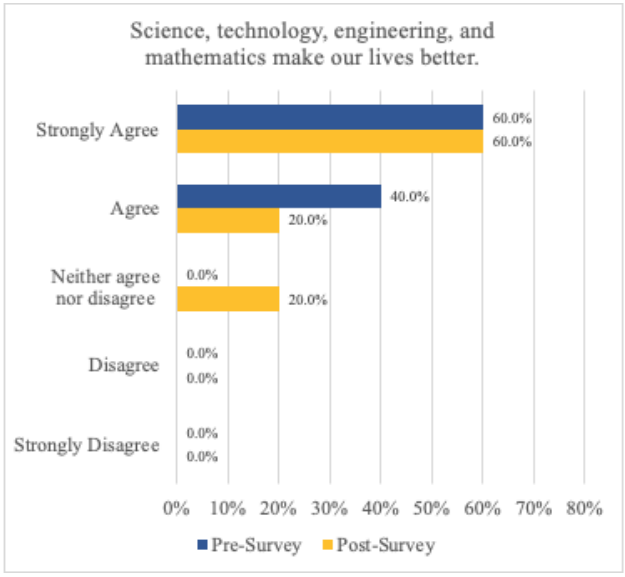


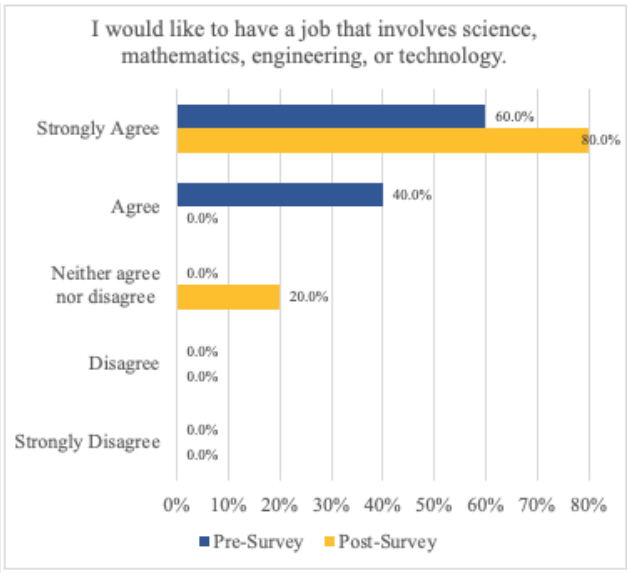
Non-Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=26)



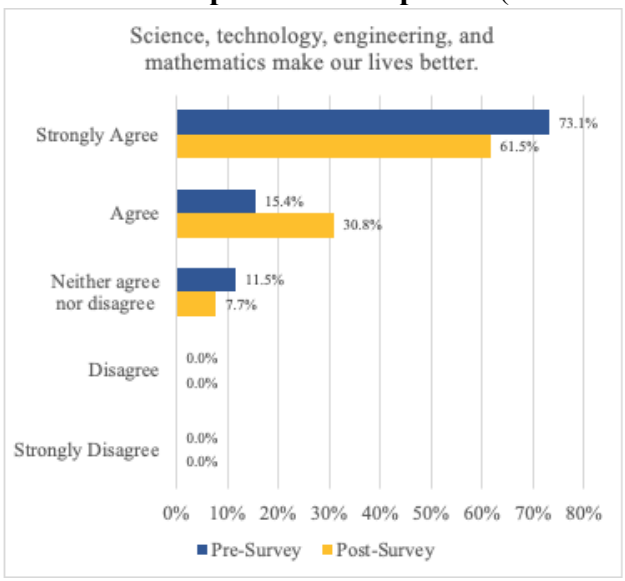


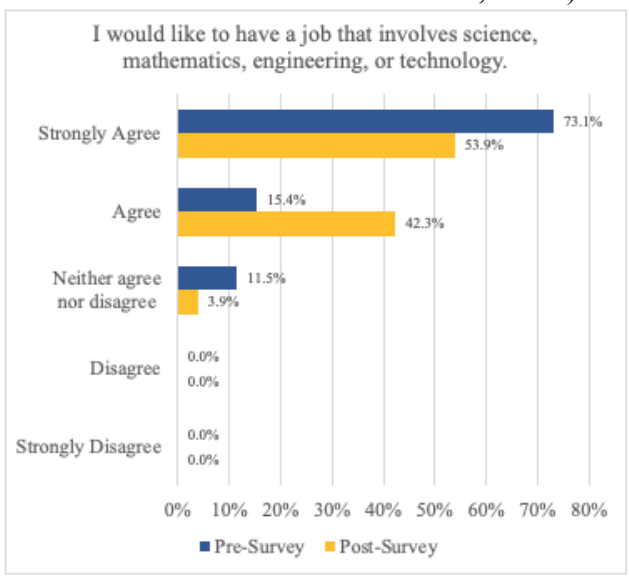
Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=5)





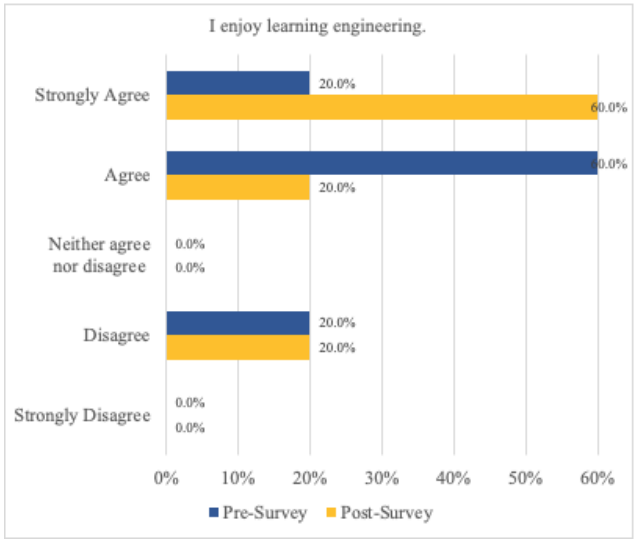
Non-Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=26)

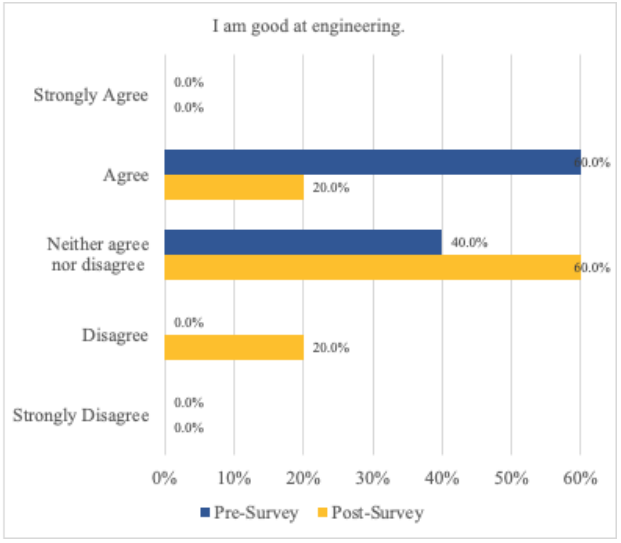




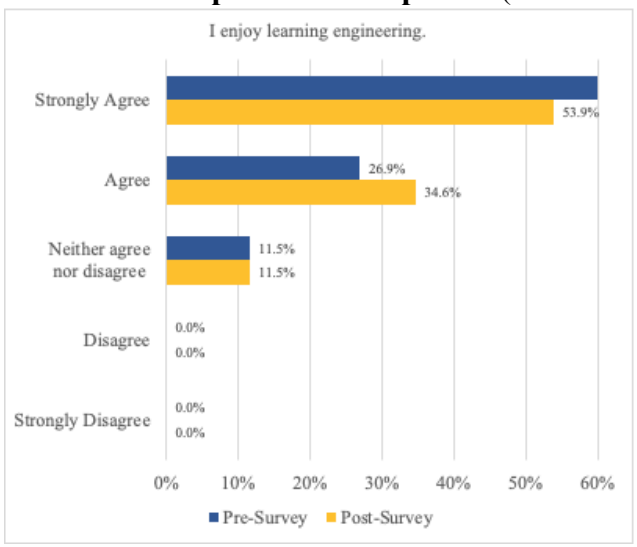
Q7. Engineering & Technology.

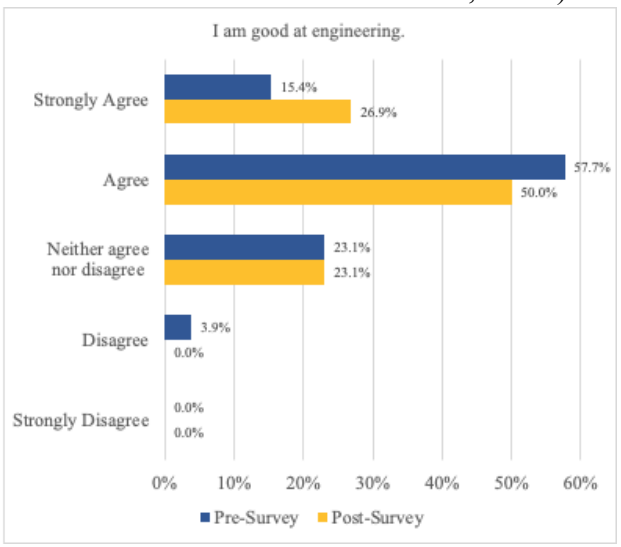
Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=5)



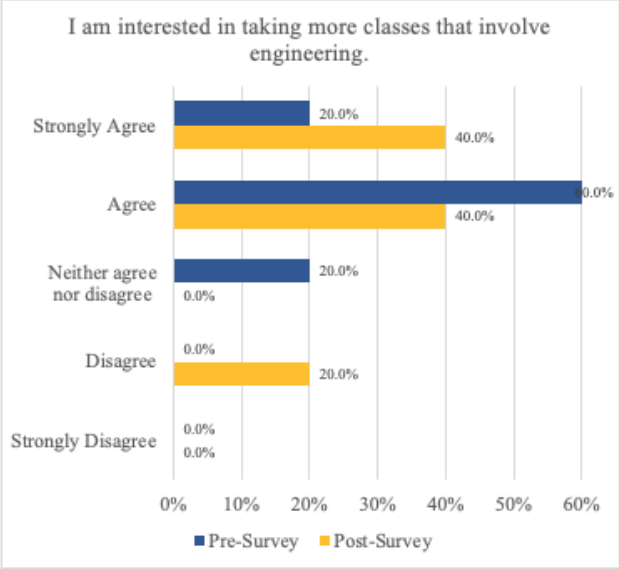


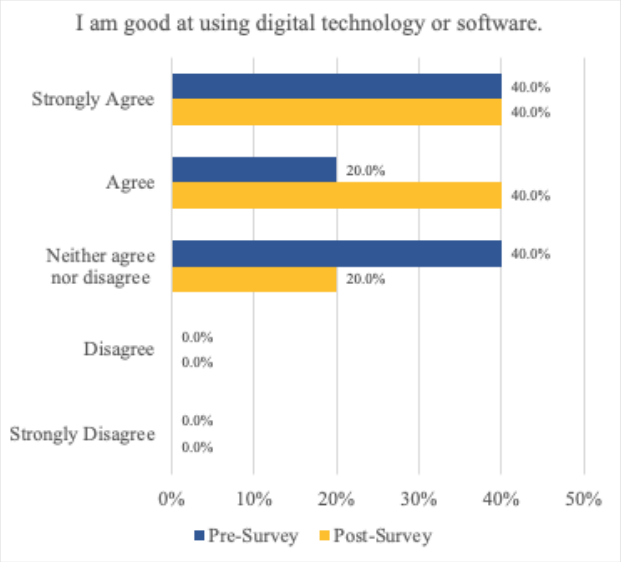
Non-Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=26)



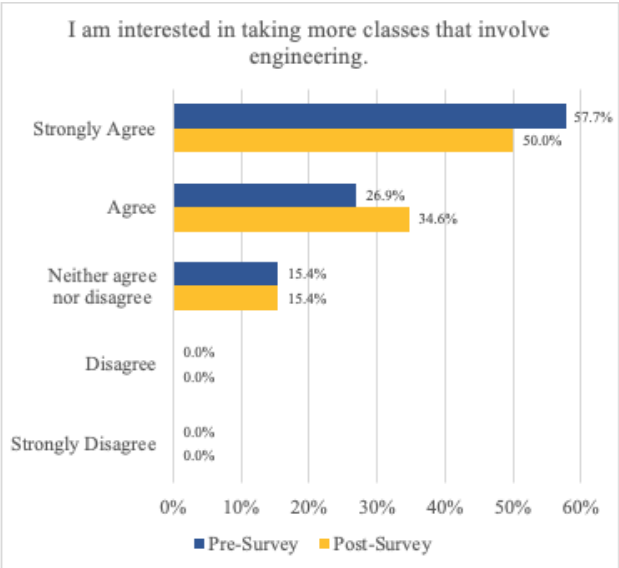


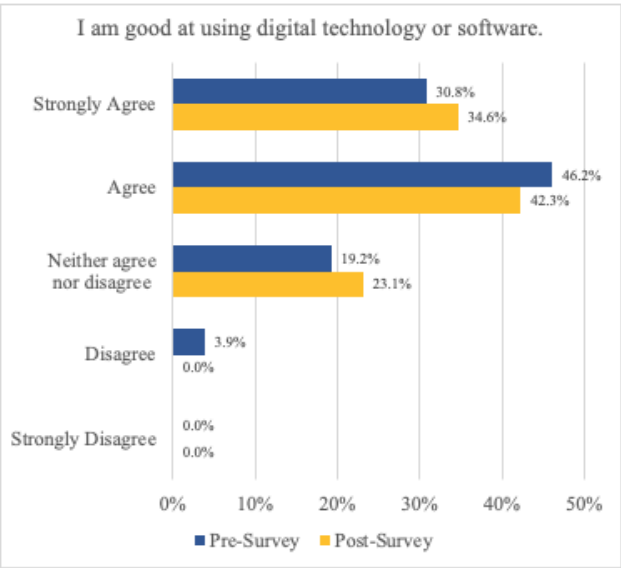
Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=5)



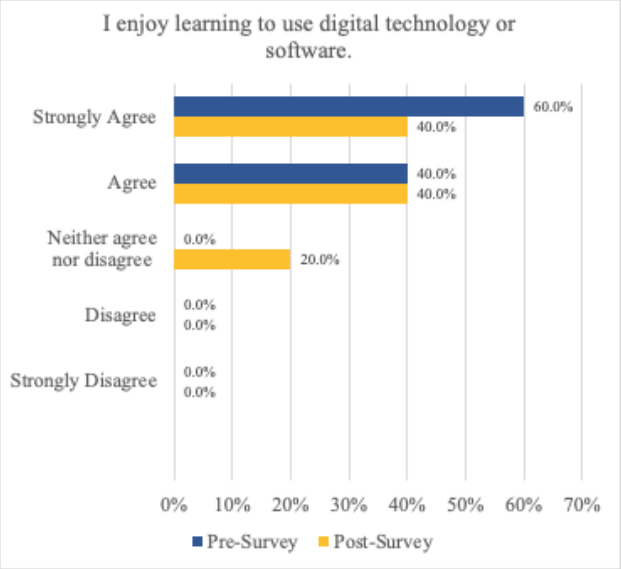


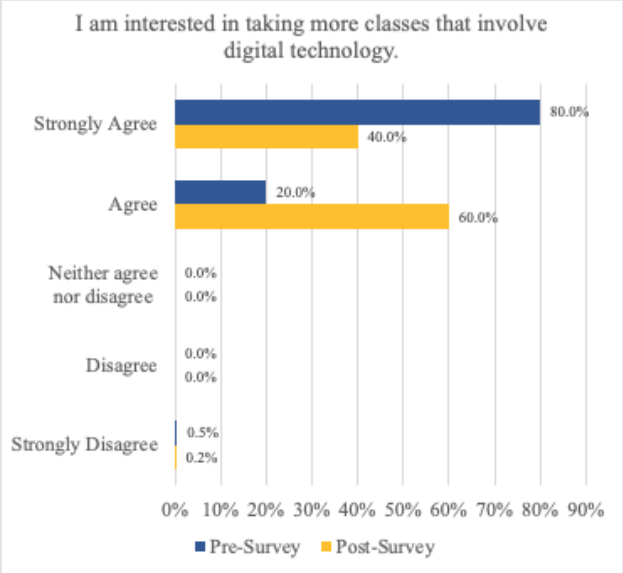
Non-Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=26)



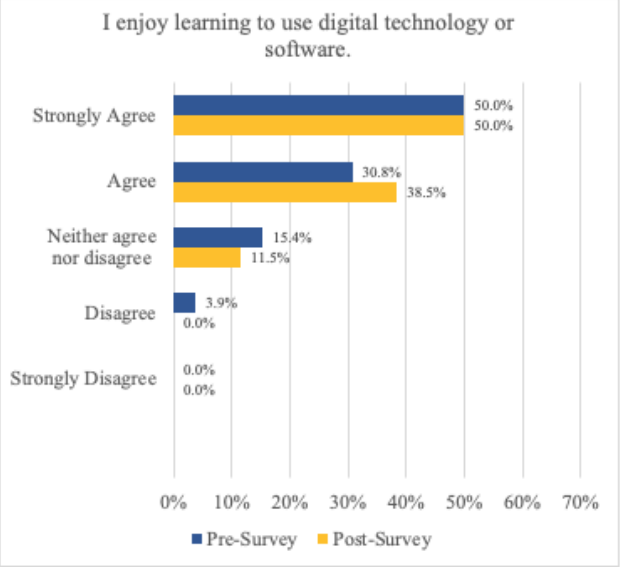


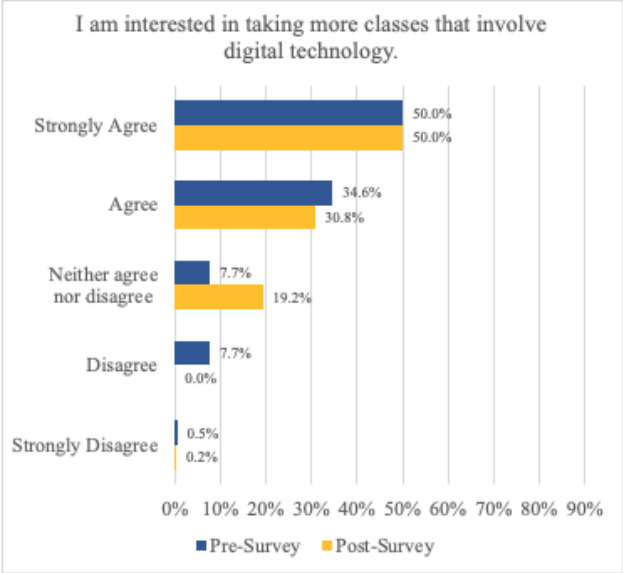
Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=5)





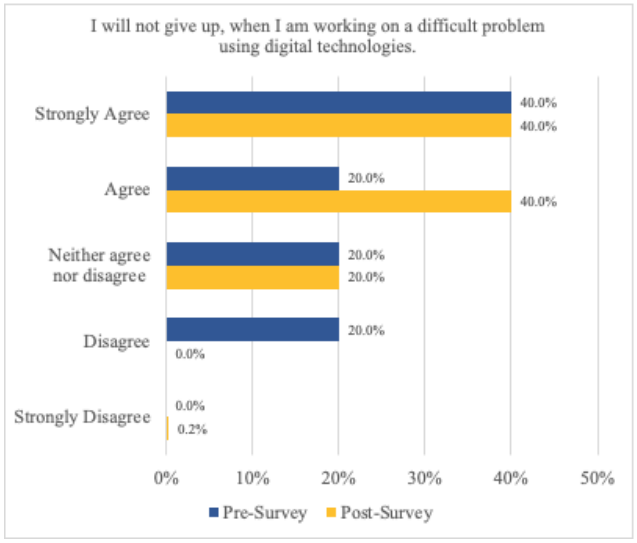
Non-Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=26)

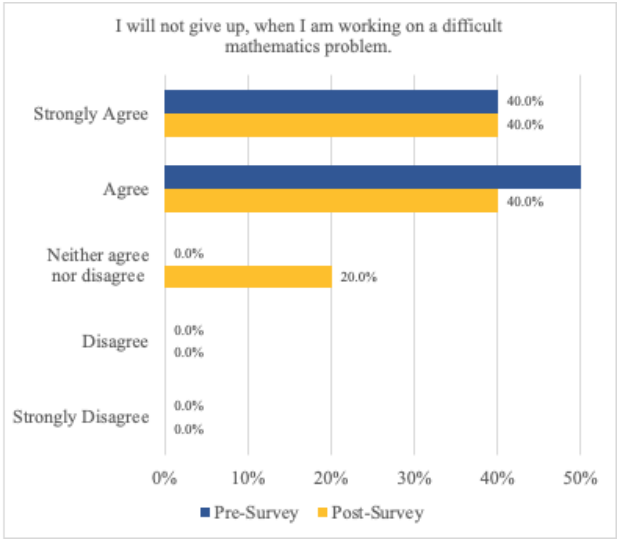




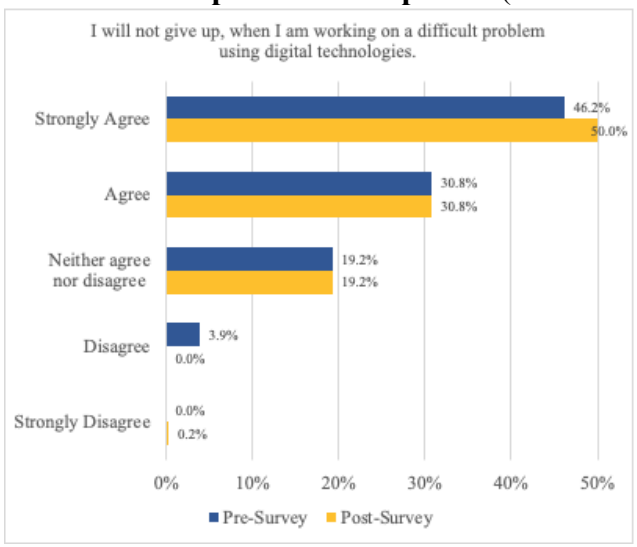
Q8. Persistence and Creativity.

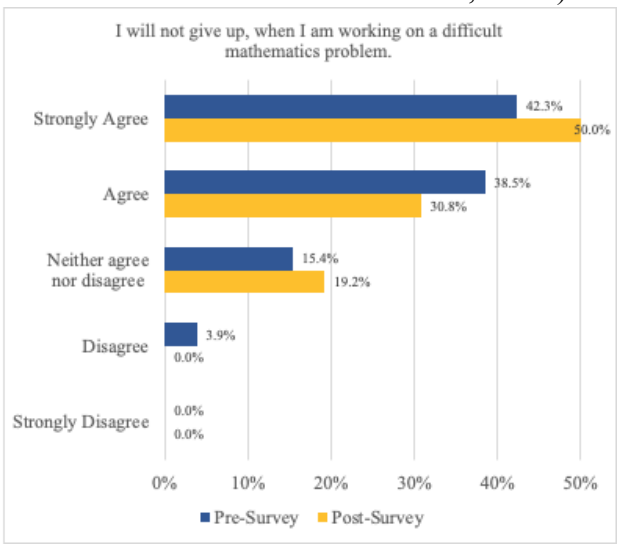
Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=5)



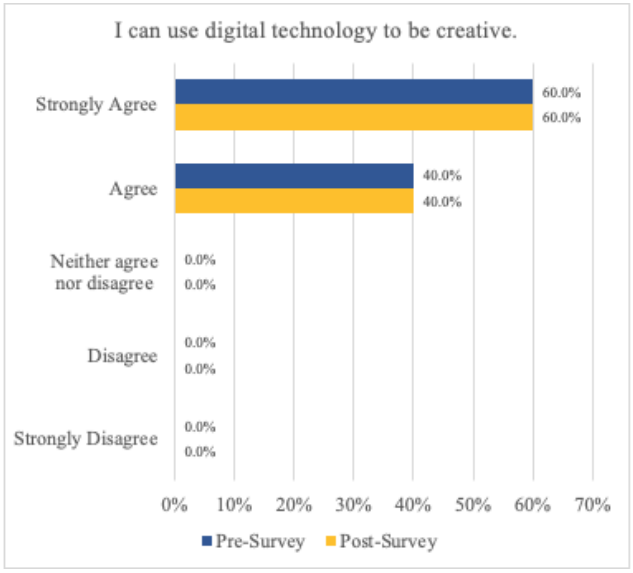


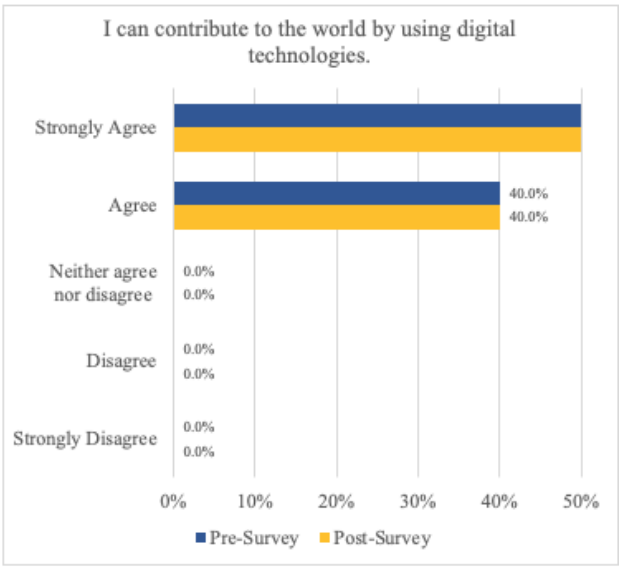
Non-Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=26)



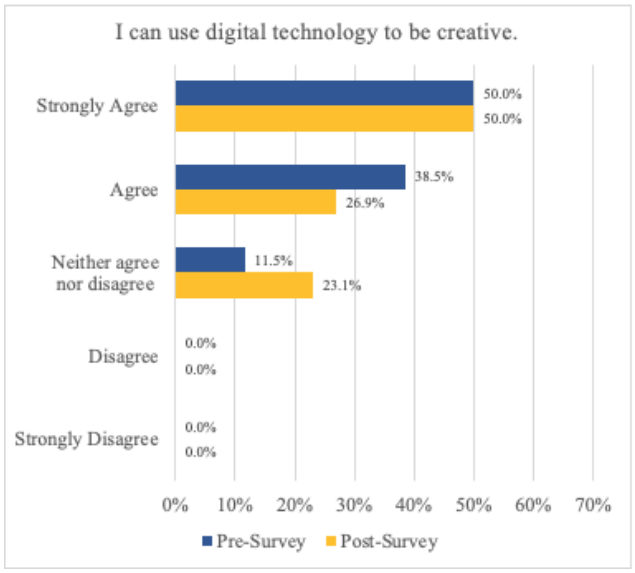


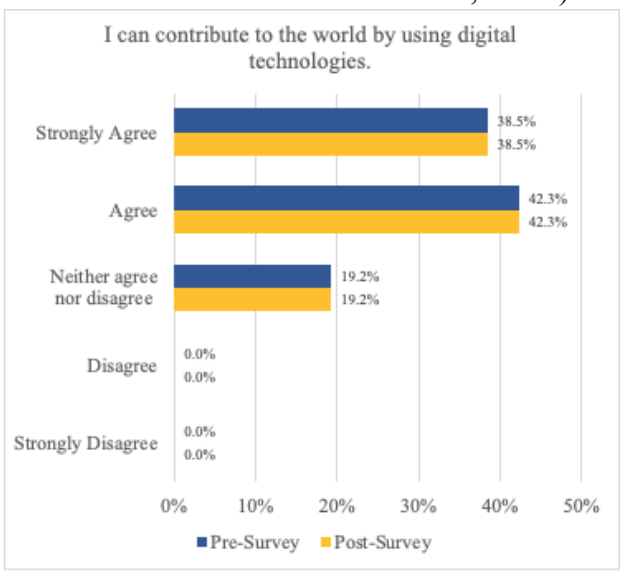
Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=5)



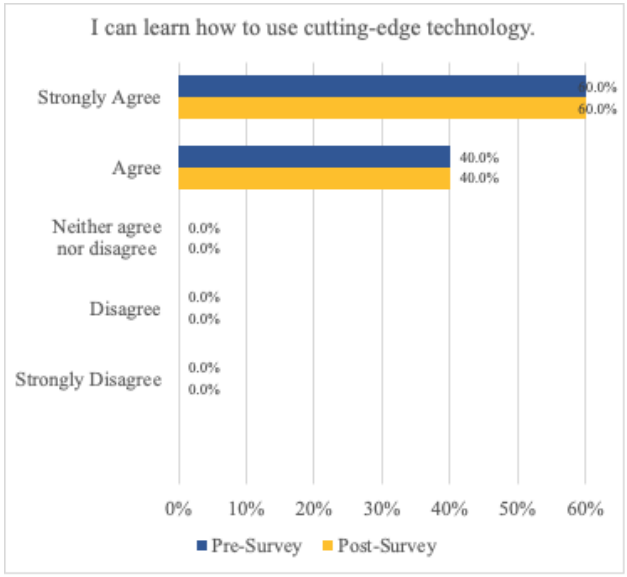


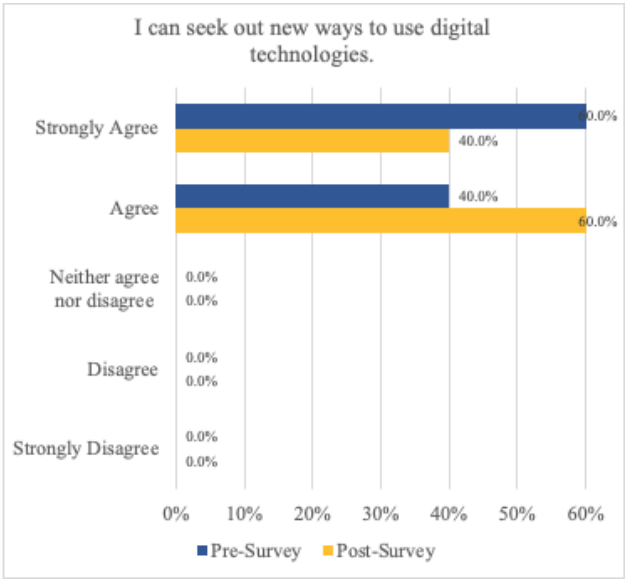
Non-Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=26)



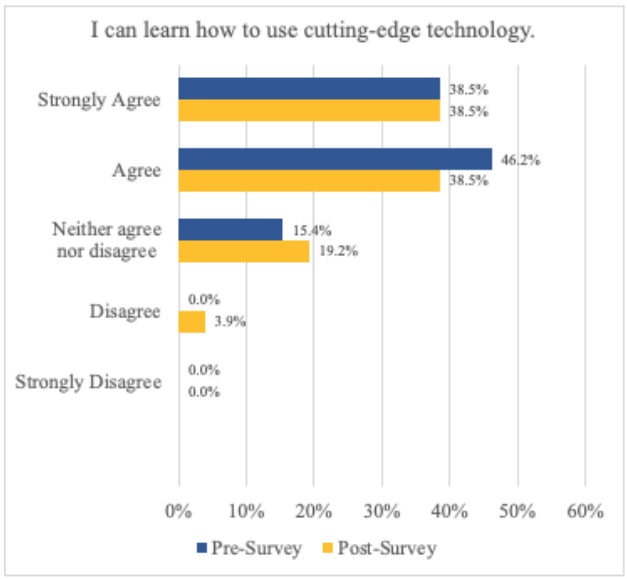


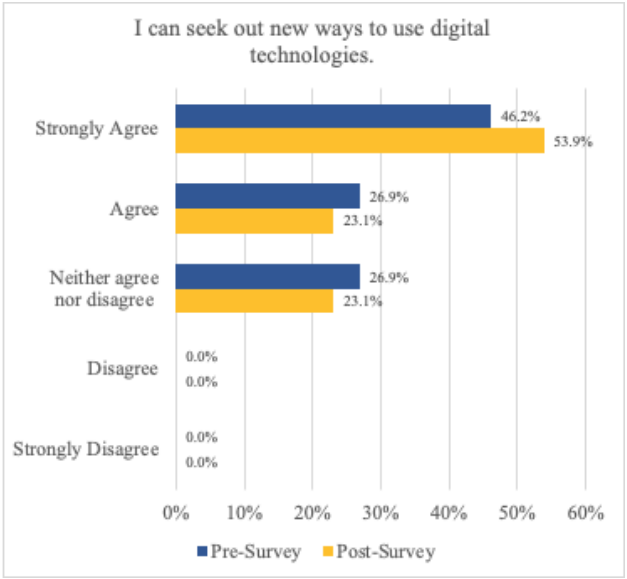
Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=5)



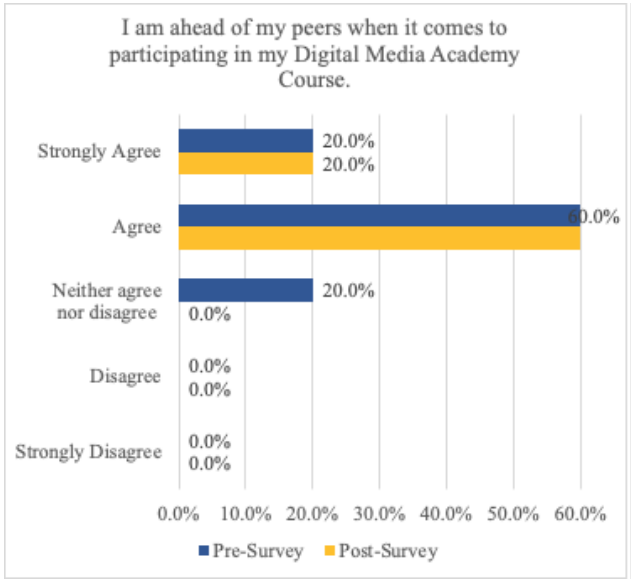


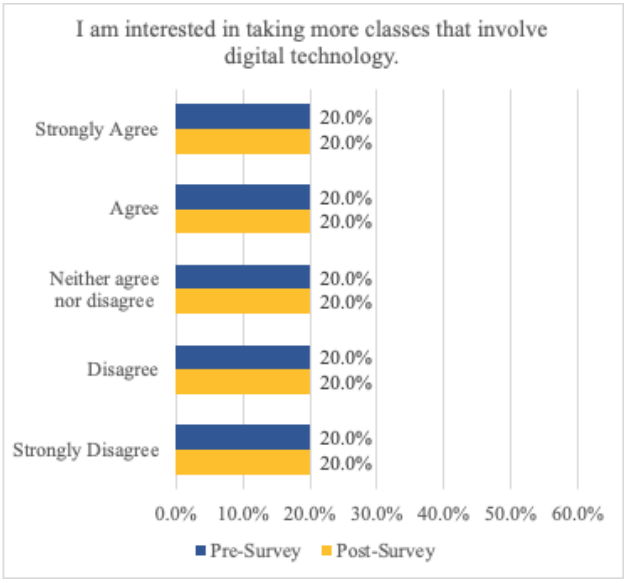
Non-Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=26)



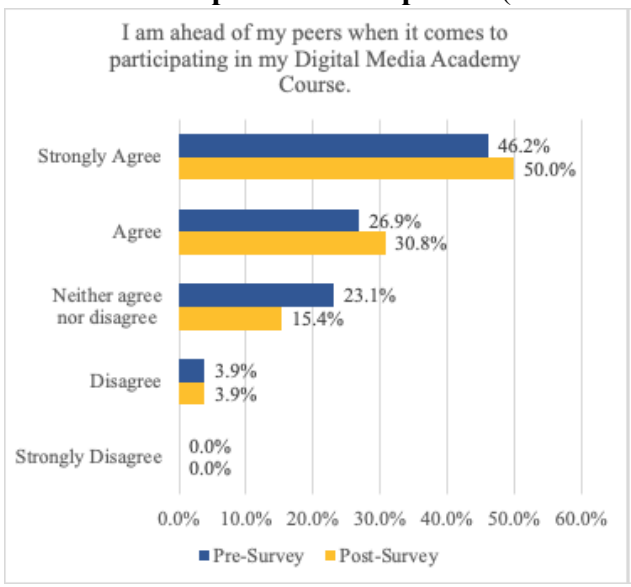


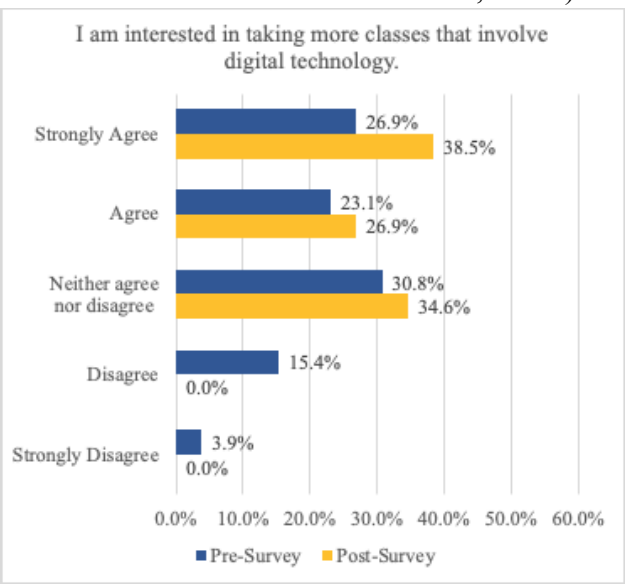
Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=5)





Non-Scholarship Student Responses (Autonomous Arduino with Take-Home Robot, N=26)





Electronic Music Production with Ableton

There were 7 students within the focus group interviewed for Electronic Music Production with Abelton. There were no matched surveys from this academy. Therefore, there are no separate survey data reported here.

Impact. Some students discussed having exposure to other music production software before attending DMA. Students talked about Ableton giving them more abilities to do music.

> I used Logic before this and then I came here and now I feel like Ableton actually has some stuff that the other software I used didn't. So, now I feel like I have the ability to do more stuff with music.

Students also talked about how even coming into the camp with a less knowledge of music production software, DMA allowed them to still produce a "super good song."

> You could have been a beginner coming into this camp and not have known anything, and you probably could've made a song that… sounded super good, yeah.

Appreciation. Although every focus group discussed appreciating collaboration, this focus group talked about it in a different way. Students in this group talked about collaborating on music both in and outside of class. Students talked about each person in the class bringing different skills to the song and how it mimicked the music industry. In talking about the course, one student expressed the collaboration in the following way:

> I think it kind of gives us the experience of the music industry because I know a lot of these people work together even though they're part of making different songs, they work together and give each other's feedback. So it's not like one person try to be better than this person or like... but also help each other out of the way. Like, we will write songs and then some people would sing songs or use samples of their songs, something like that. So I think it's all like one big company where they all work together in the way to make songs.

3D Modeling & Animation

There were 6 students within the focus group interviewed for 3D Modeling & Animation. There was only one matched surveys from this academy. Therefore, there are no separate survey data reported here.

Impact. One student stood out in this focus group because the student had attended a similar camp in Pennsylvania. Rather than staying with that camp, the student decided to come to the one at Stanford University. The student mainly thought that the quality and amount of content taught at DMA was remarkably better than at the previous camp.

> Two years ago, I tried the same course in Pennsylvania, and I didn't really learn anything, probably at all in two weeks. And what we learned last week and this week was like amazing so, yeah.

One other difference in this focus group compared to others was how the students talked differently about each week of the academy. Students seemed to appreciate the week of Modeling more than the week of Animation. Mainly, they felt that modeling had more of a variety of skills taught as compared to animation. Although multiple students brought this up, one exchange sums up what most of the students said:

> Student: Well, since we did two weeks, the first week was modeling and the second week was animation, I really liked the animation. But I really liked the modeling I think a little better.
> Researcher: Why did you say that? Why was the modeling better?
> Student: I felt over the weeks or over the days we had in that, we could learn a lot more than in animation. But I love animation, I loved how we learned how to do it, but I feel like we could have learned a lot more spread out across the week because it just like we learned how to cut frames and frames, but I felt like we could do a lot more, I don't know.

Appreciation & Improvements. Another unique idea that came out of this focus group was the idea of learning space. The students in this academy had their own classroom in Munger, which was separate from the Stern Hall space where most of the other courses were being taught. Students brought up several benefits to having this space such as comfort, proximity to Munger Market and Tressider, and noise level. This was tied to what students also felt could be an improvement for DMA, which was about the learning space of the other participants in Stern Hall. In other words, this group of students were aware of the difference in experience they had.

> Well, this isn't really only to our class, but all the other classes are in one massive hall.
>
> And without air conditioning and with all those computers.
>
> But even just being like everyone in one room, it's super loud. I think if we took the same class in Stern, I think it would be kind of a different experience.
>
> Okay, I just have one thing to say. I think it's sad that they never, like I'm pretty sure most of the other classes in Stern they don't mention Tresidder. So all of the other kids are going to the cafeteria with "Oh yeah."

Adventures in 3D Printing & Modeling

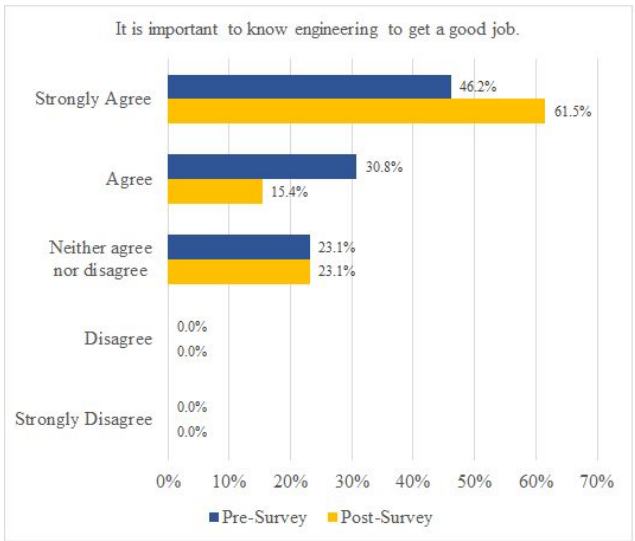
There were 4 students within the focus group interviewed for Adventures in 3D Printing & Modeling. There were 13 matched surveys from this academy. For complete survey results from this course, see Appendix H.

Impact & Appreciation. Students talked about how the Adventures in 3D Printing & Modeling course gave them the opportunities to make errors and try things again. All the students talked about the mistakes they made in the first time their printed something overnight, and the adjustments they had to make. This was mixed with an appreciation to be able to learn from these mistakes.

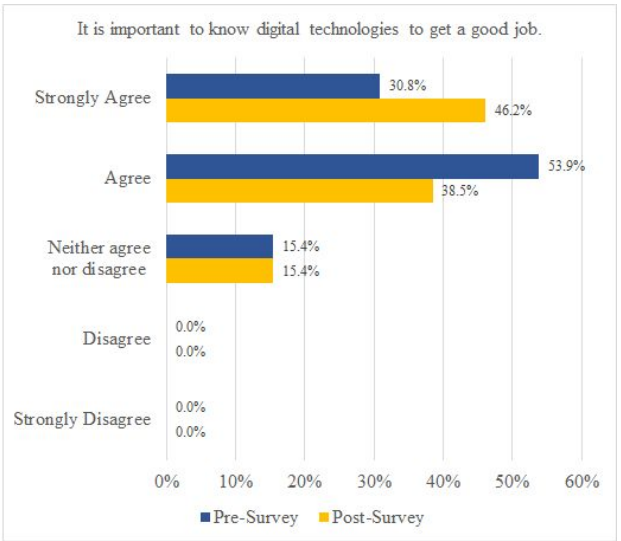
> Yeah. When I came here, because we print overnight, so when I came here in the morning on Tuesday, my heart, I had this thing that said love and it was like a star. But the letters were way too small so they would just sticks and it was too thick so it was really hard to put on as a keychain and my then I had to do it another time.
>
> And it was really hard because some of them it was just like a square even if it was supposed to be some kind of design. So I had to do it over and over again. It took time but it did work.

Survey. This group had some interesting shifts about what is needed to get a good job and their perceptions of being able to use digital technologies. For Graph 9, the shift was mainly from agree to strongly agree between pre- and post-survey. In answering the prompt, "It is important to know engineering to get a job, strongly agree shifted from 46.2% (pre-survey) to 61.5% (post-survey). Similarly, in Graph 10, students shifted to strongly agree from 30.8%(pre-survey) to 46.2% (post-survey) in answering the prompt, "It is important to know digital technologies to get a good job."

Graph 9. Adventures in 3D Printing & Modeling

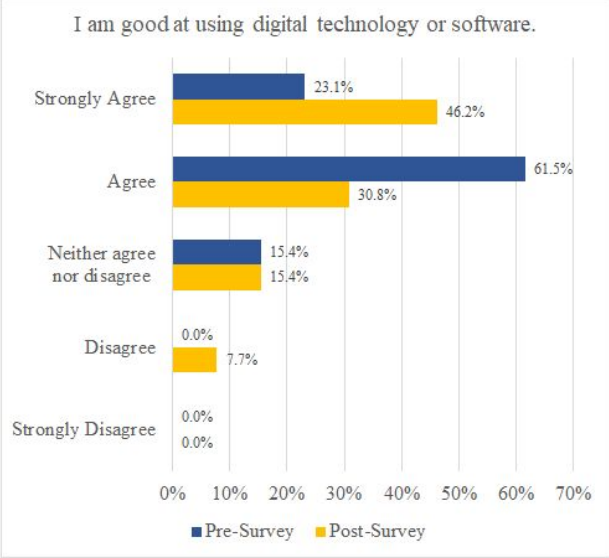


Graph 10. Adventures in 3D Printing & Modeling

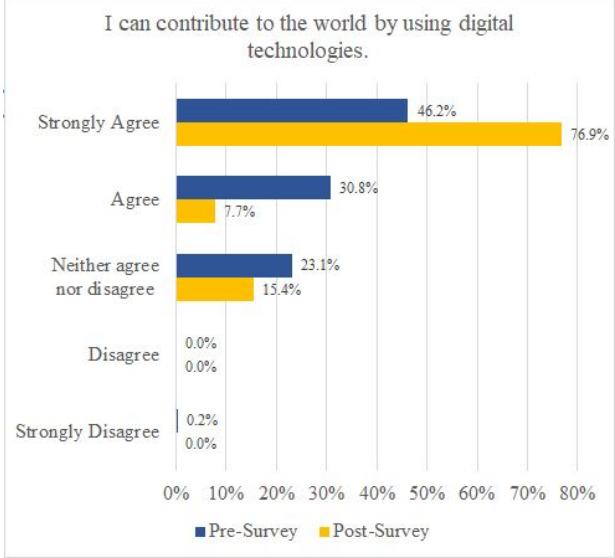


Additionally, students seemed to shift to strongly agree with questions around the perceptions of their own skills with digital technology or software. In Graph 11, students shifted to strongly agree from 23.1% (pre-survey) to 46.2% (post-survey) in answering the prompt, "I am good at using digital technology or software." For the prompt, "I can contribute to the world by using digital technologies," students shifted to strongly agree from 46.2% (pre-survey) to 76.9% (post-survey). When it came to learning potential, students shifted to strongly agree from 30.8% (pre-survey) to 61.5% (post-survey). These shifts indicate that students seemed more confident about their abilities to use and learn technology after participating in this academy.

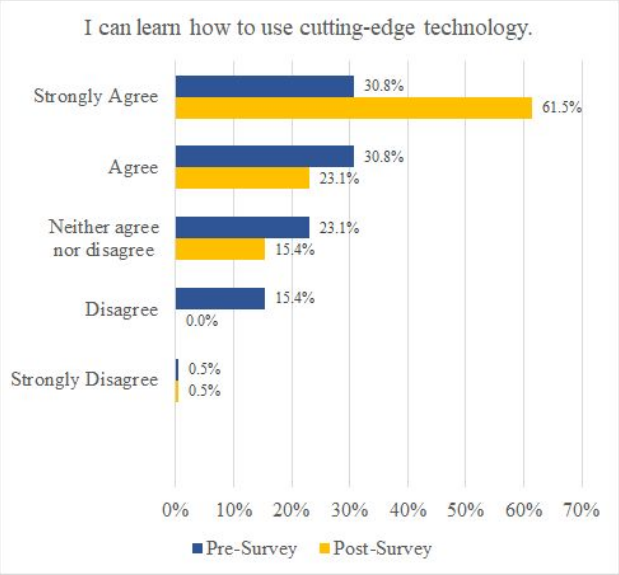
Graph 11. Adventures in 3D Printing & Modeling



Graph 12. Adventures in 3D Printing & Modeling



Graph 13. Adventures in 3D Printing & Modeling



Adventures in Animation

There were 7 students within the focus group interviewed for Adventures in 3D Printing & Modeling. This group of students ranges between ages 7 to 9. There were 32 matched surveys from this academy. For complete survey results from this course, see Appendix I.

Impact. Although multiple focus groups talked about making friends at the camp, this focus group stood out from the rest. The students here all claimed to make "best friends" at this camp although they had all come from different schools. In particular, one student agreed with other students in this assertion, and added that he had attended other technology camps with already established friends, but that this was the first time he had attended a camp alone.

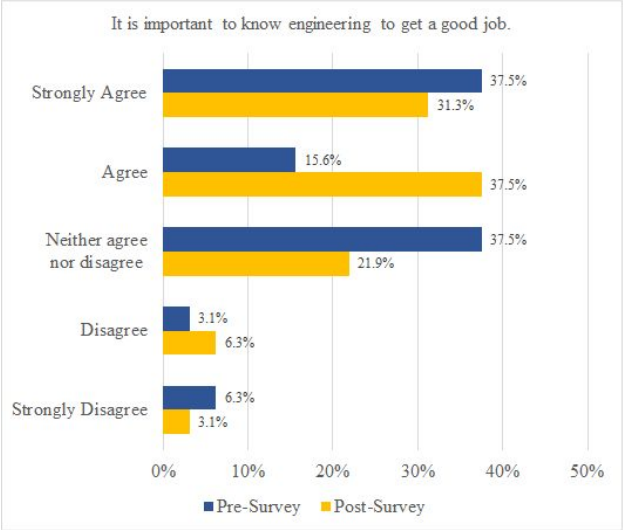
Student:	I actually can really agree with both of you because whenever I go to like we're all aware of iD Tech, right?
Researcher:	Yes.
Student:	Whenever I go to those camps and those are really good and even the Digital Media Academy camp too, I usually go with a friend and I make like one or two new ones, and I was actually supposed to go with a friend with this one but I feel like by not going with a friend, I've actually made more friends.

Additionally, students said that this academy allowed them to be creative, which they noted was different from their school sites. Although *freedom* was a reoccuring theme from all the focus groups, this course seemed to incorporate drawing. Each student shared an experience where they were not allowed to draw in class or after a test. Students talked about how the academy encouraged drawing alongside the technology. Below is an exchange between multiple, distinct students.

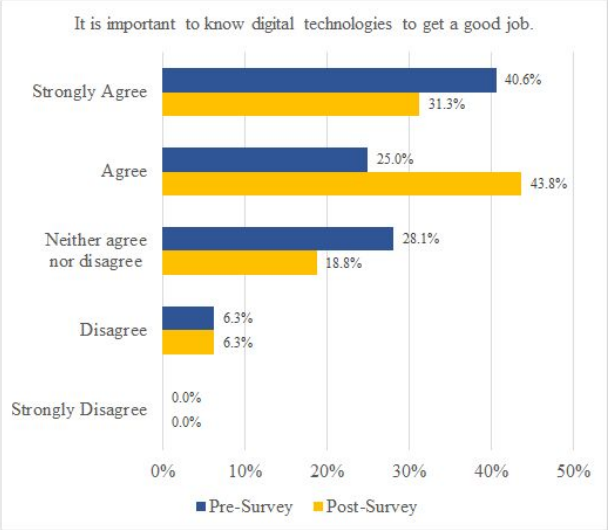
Student 1:	I just want to animate in my free time now.
Student 2:	Yeah, just want to animate in my free time.
Student 3:	Yeah, I don't know, animation is fun.
Student 4:	Yeah, it's fun. At my school, they won't allow us to draw in class.
Student 5:	Yeah, that's the class that I kind of get but like, yeah.

Survey. Different from some of the other academies that were surveyed, this academy seemed to lower their perception of how important it is to know engineering or digital technology to get a good job. Both Graph 14 and Graph 15 show a shift to agree from both strongly agree and neither agree nor disagree.

Graph 14. Adventures in Animation



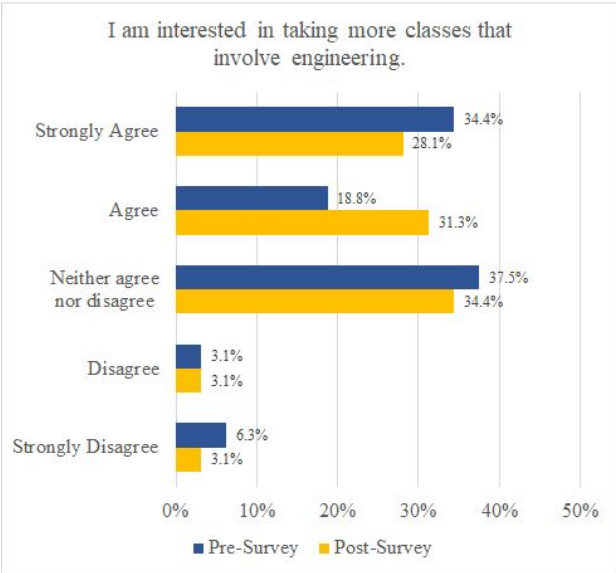
Graph 15. Adventures in Animation



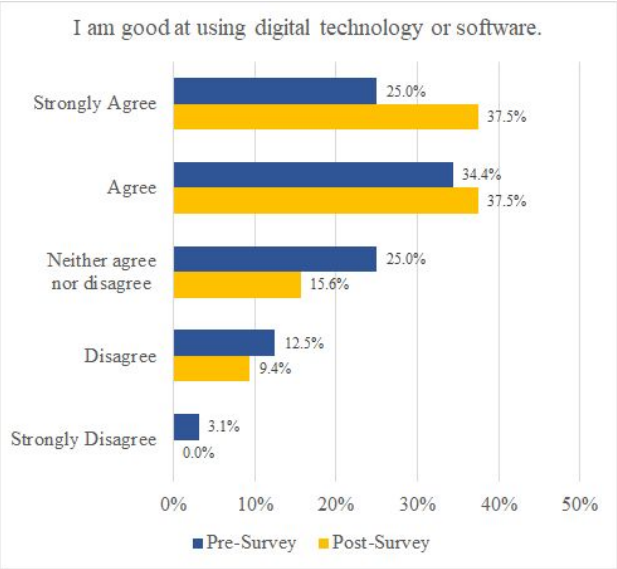
Similarly, the same shift from strongly agree to agree occured with the prompt, “I am interested in taking more classes that involve engineering.”

However, students seemed to have a gain in personal competence with digital technology. Graph 17 shows that students increased in both strongly agree and agree for the prompt, “I am good at using digital technology or software.” This was not expressed as an impact in the focus group interview, but seems to validate that students felt some gain in competence with the software.

Graph 16. Adventures in Animation



Graph 17. Adventures in Animation



Filmmaking Academy

There were 6 students within the focus group interviewed for Adventures in 3D Printing & Modeling. There were 40 matched surveys from this academy.

Impact. Students from this focus group interview expressed an appreciation for the variance in activities from the academy. Students talked about being able to try different things and gain a variety of skills. Aside from this, there were not many unique points from this focus group.

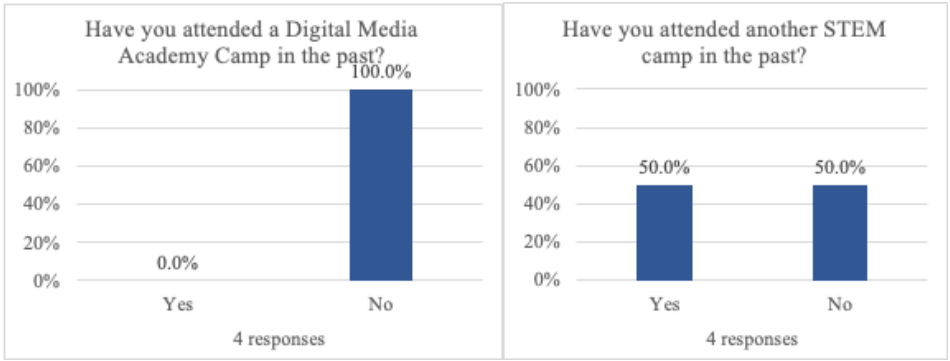
> I think that was different. We never did like the same project. They always introduce us to new and different things every project. So we experimented with all these different kinds of things. So we learn more about what we liked and what we were better at.

Scholarship Versus Non-Scholarship Student Survey Responses

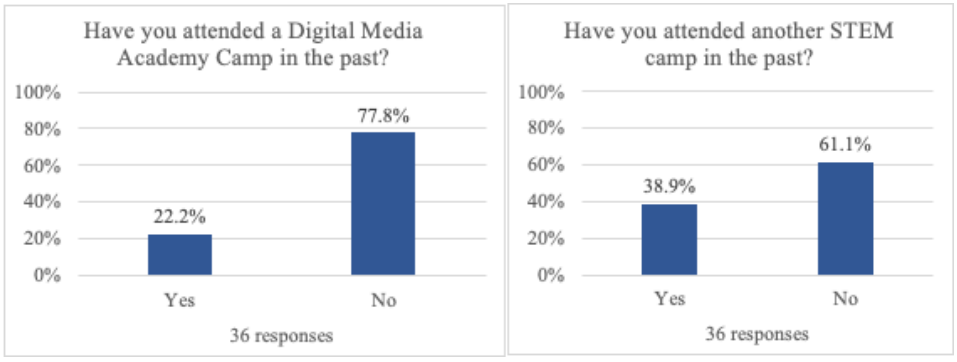
There were 4 Scholarship students out of the 40 students that had matched surveys for Filmmaking Academy. The Scholarship student responses are followed by Non-Scholarship Student responses for each set of survey questions.

Q1. Assent.
Q2. Which Digital Media Academy course are you currently taking?
Q3. What dates are you attending this course?
Q4. Please select Yes or No for each of the below questions.

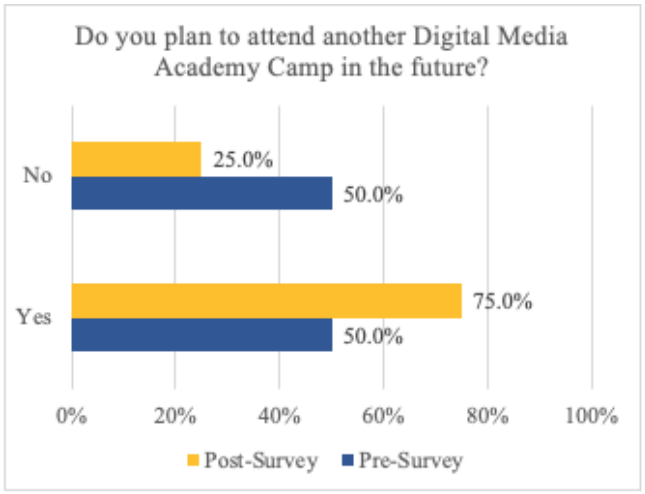
Scholarship Student Responses (Filmmaking Academy, N=4)

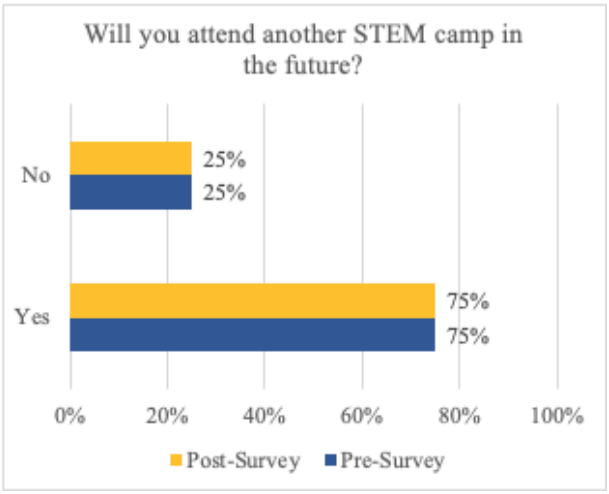


Non-Scholarship Student Responses (Filmmaking Academy, N=36)

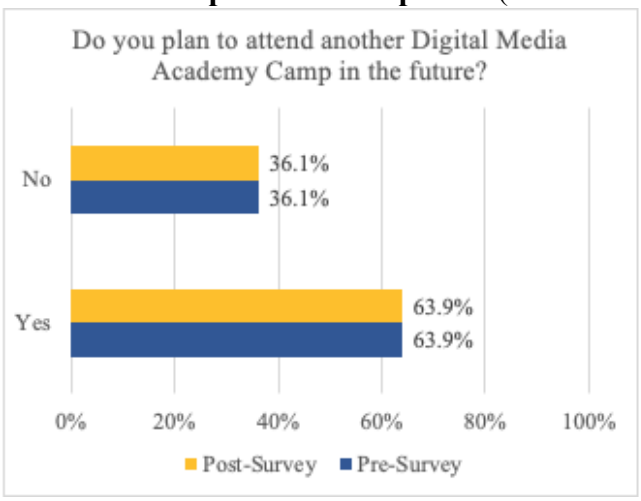


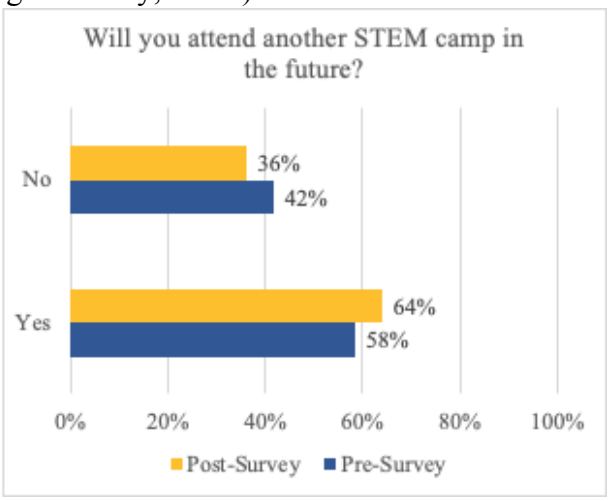
Scholarship Student Responses (Filmmaking Academy, N=4)



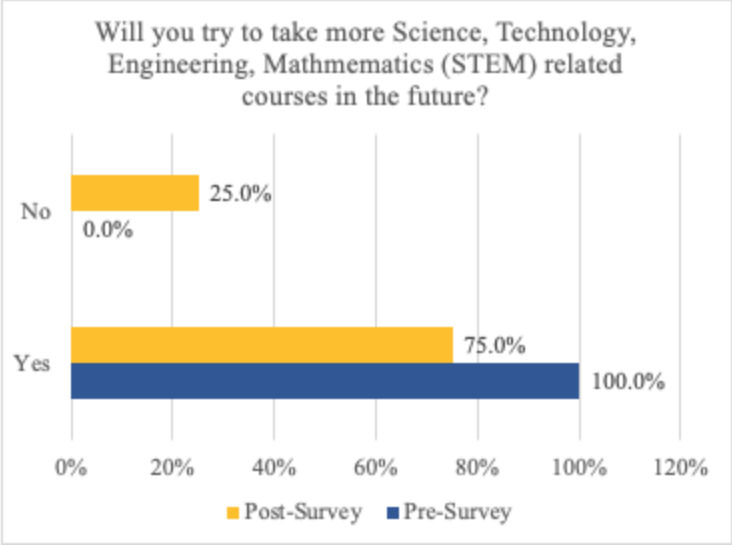


Non-Scholarship Student Responses (Filmmaking Academy, N=36)

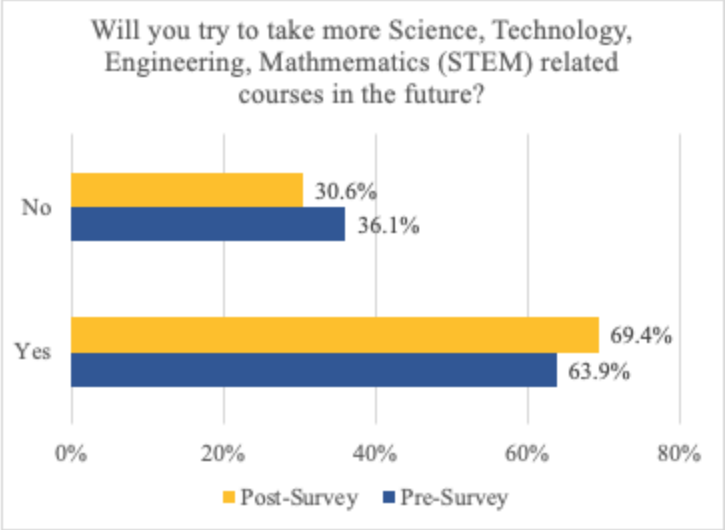




Scholarship Student Responses (Filmmaking Academy, N=4)

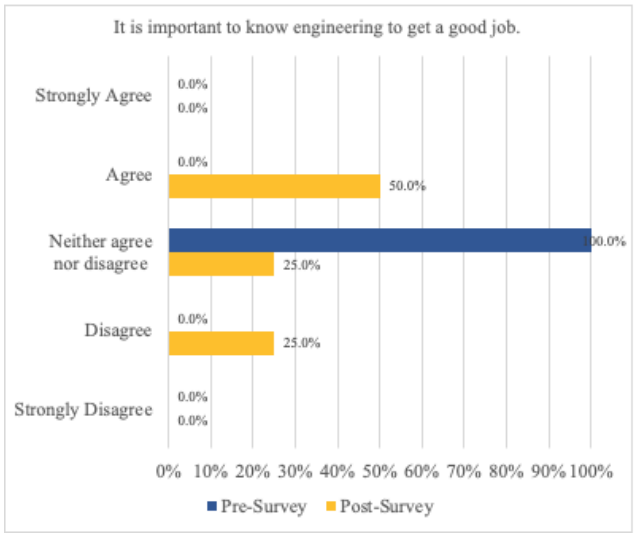


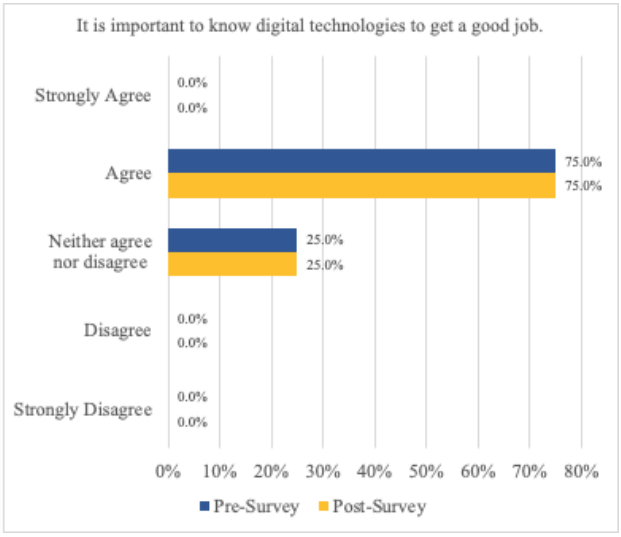
Non-Scholarship Student Responses (Filmmaking Academy, N=36)



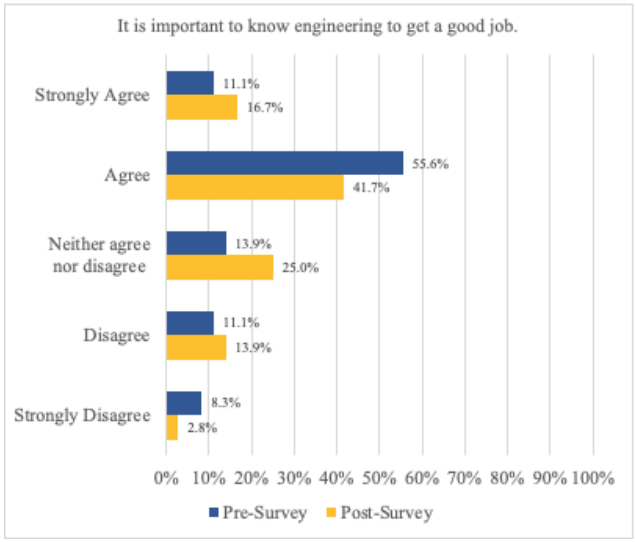
Q5. In the next part, we want to know how much you agree with each statement.
You will select from: *strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree.*
Q6. STEM Personal and Social Implications.

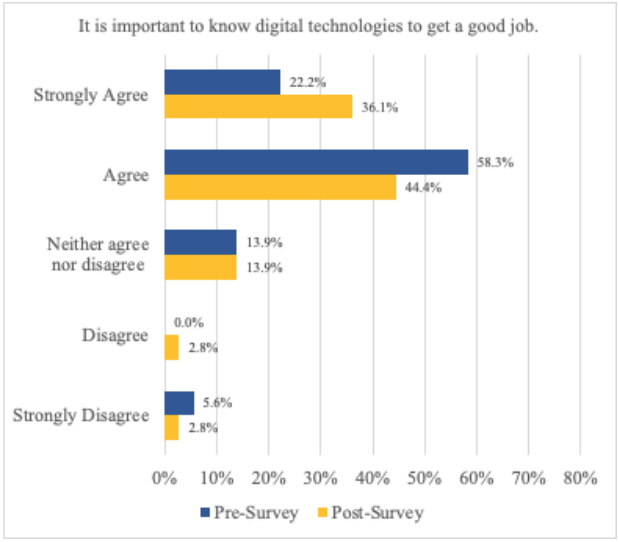
Scholarship Student Responses(Filmmaking Academy, N=4)



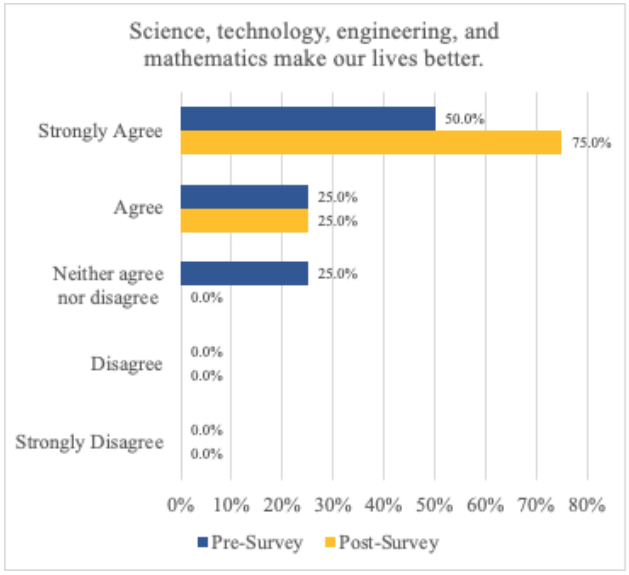


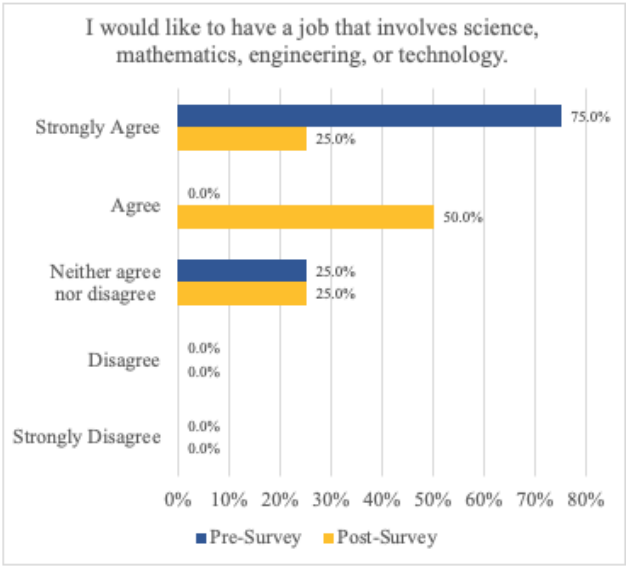
Non-Scholarship Student Responses (Filmmaking Academy, N=36)



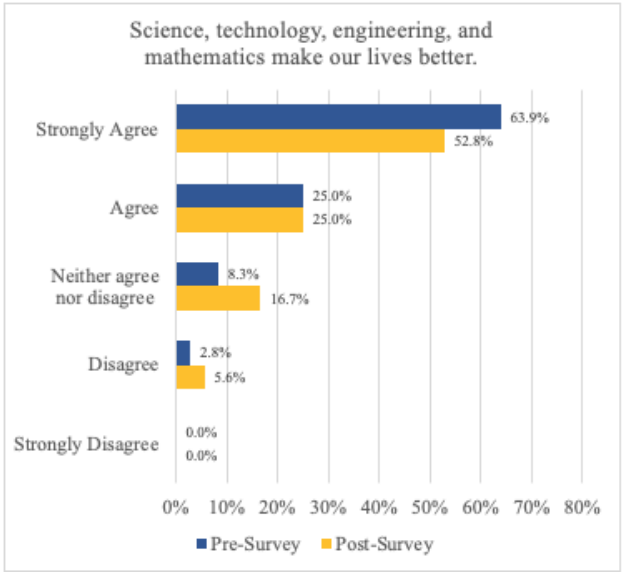


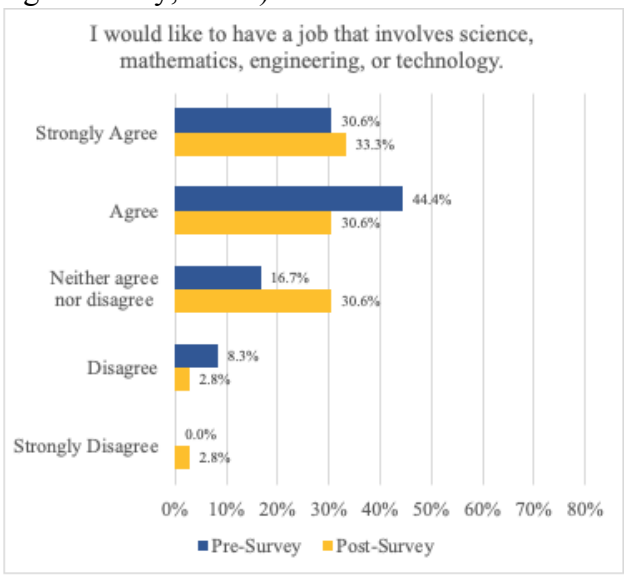
Scholarship Student Responses (Filmmaking Academy, N=4)





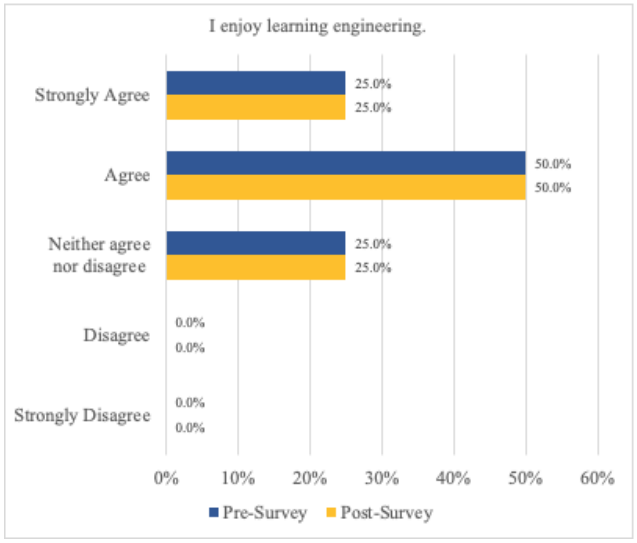
Non-Scholarship Student Responses (Filmmaking Academy, N=36)

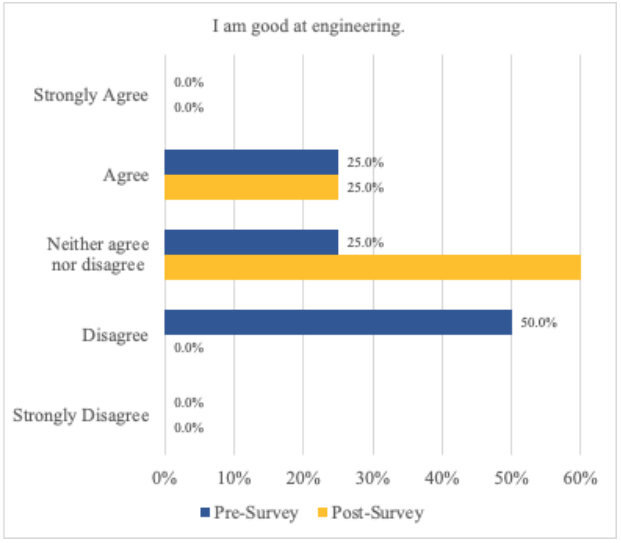




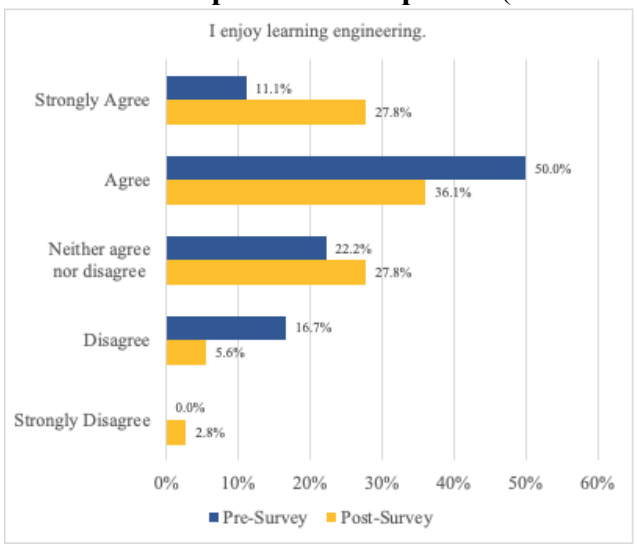
Q7. Engineering & Technology.

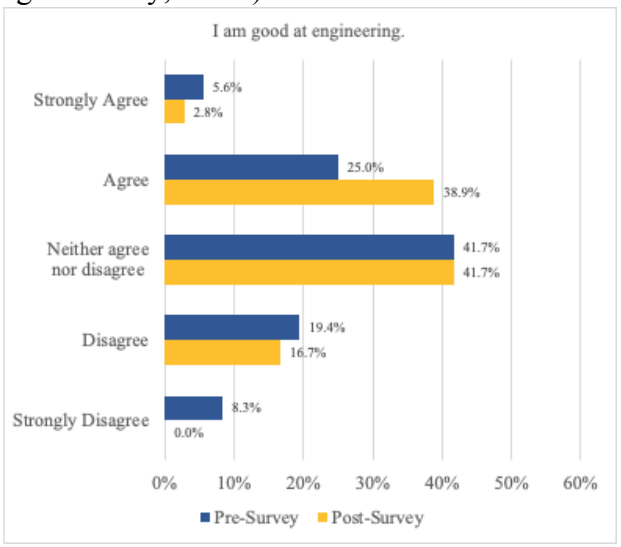
Scholarship Student Responses (Filmmaking Academy, N=4)



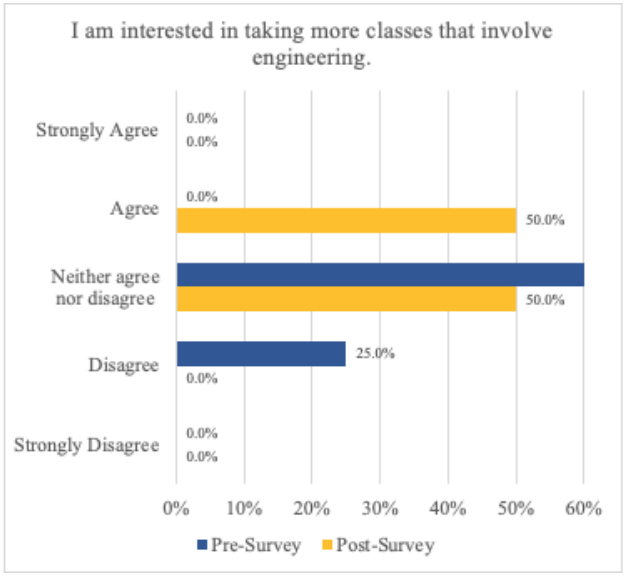


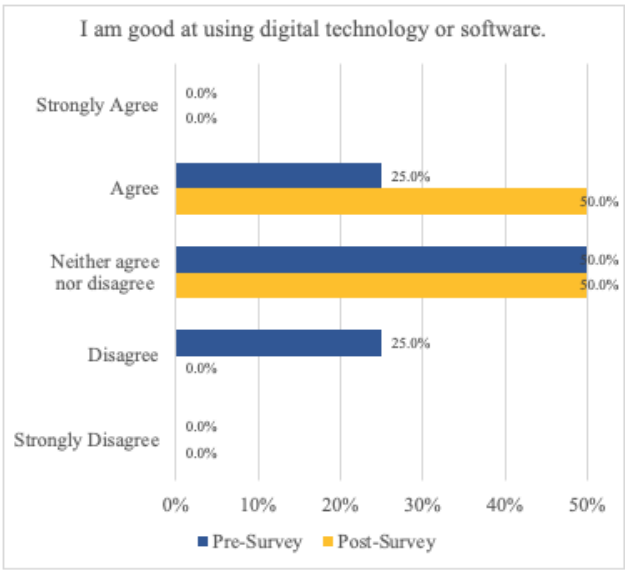
Non-Scholarship Student Responses (Filmmaking Academy, N=36)



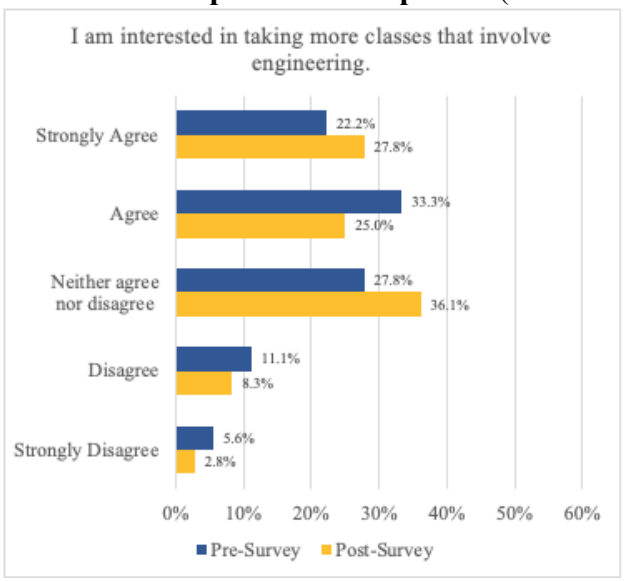


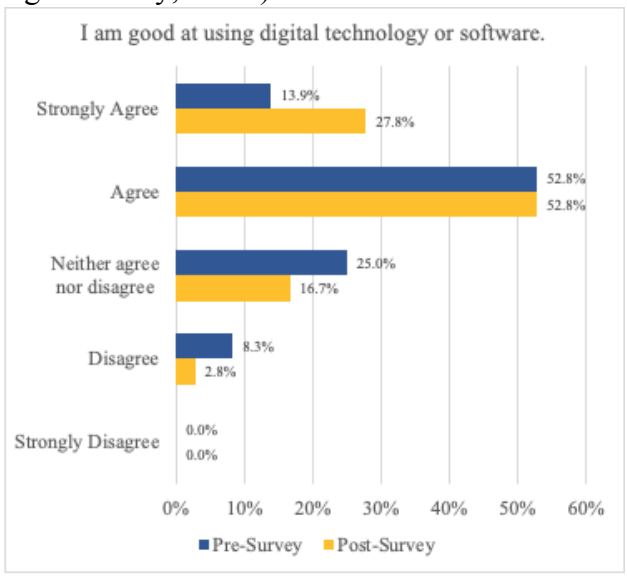
Scholarship Student Responses (Filmmaking Academy, N=4)



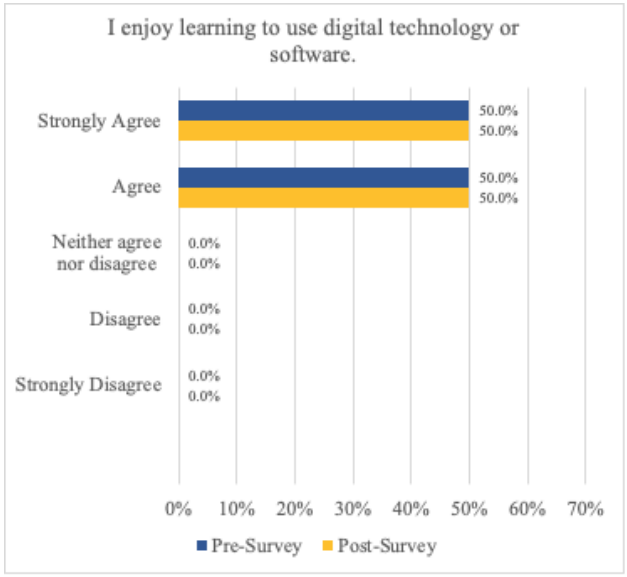


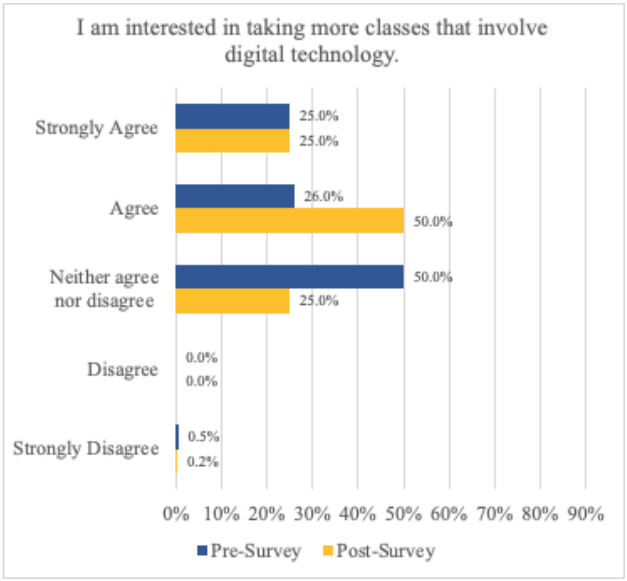
Non-Scholarship Student Responses (Filmmaking Academy, N=36)



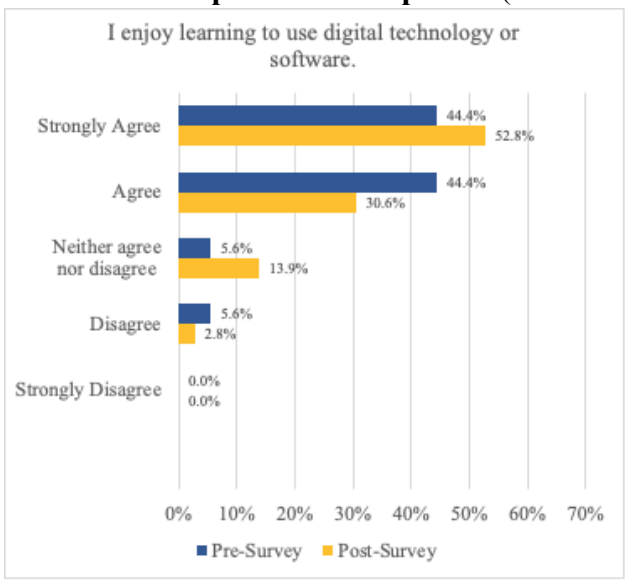


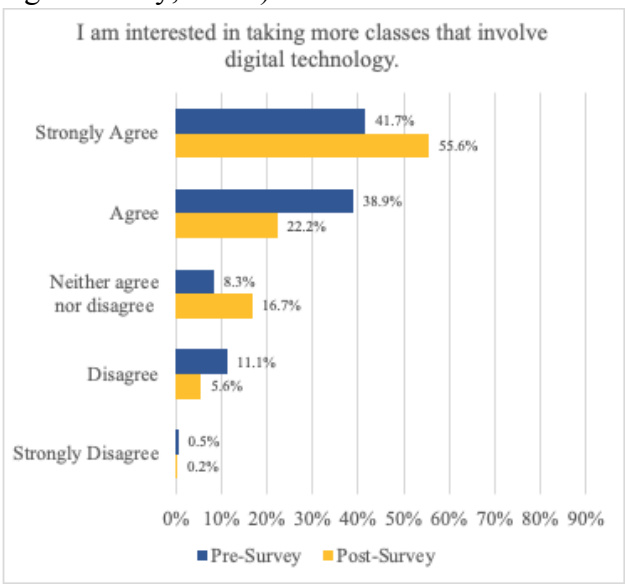
Scholarship Student Responses (Filmmaking Academy, N=4)





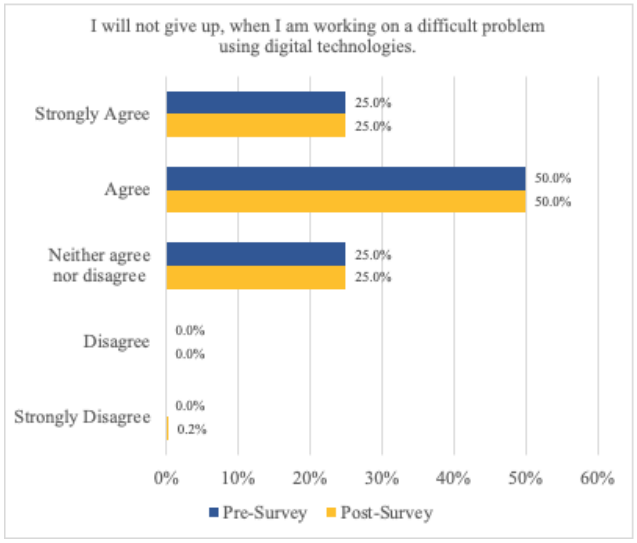
Non-Scholarship Student Responses (Filmmaking Academy, N=36)

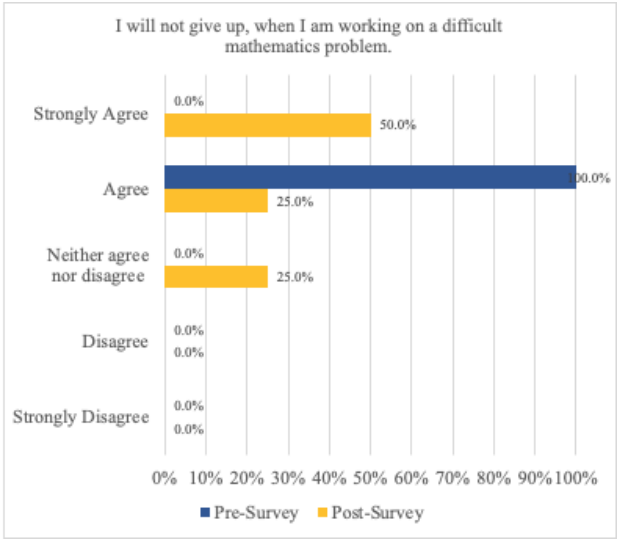




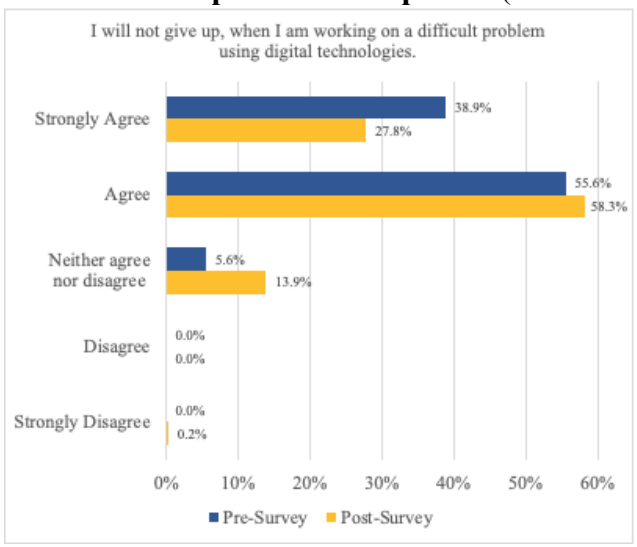
Q8. Persistence and Creativity.

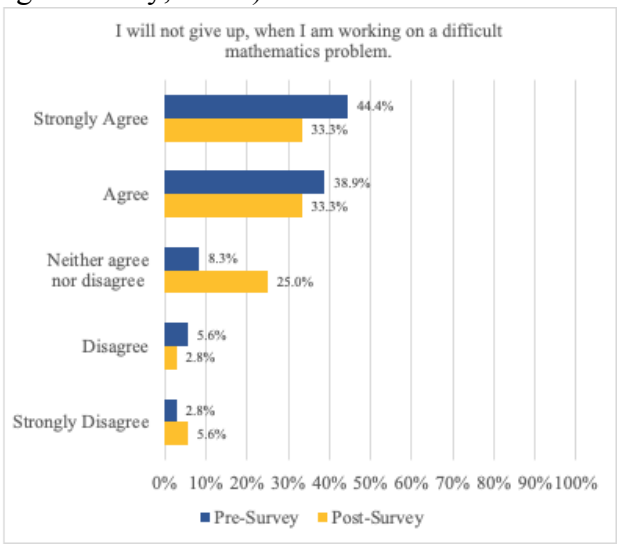
Scholarship Student Responses (Filmmaking Academy, N=4)



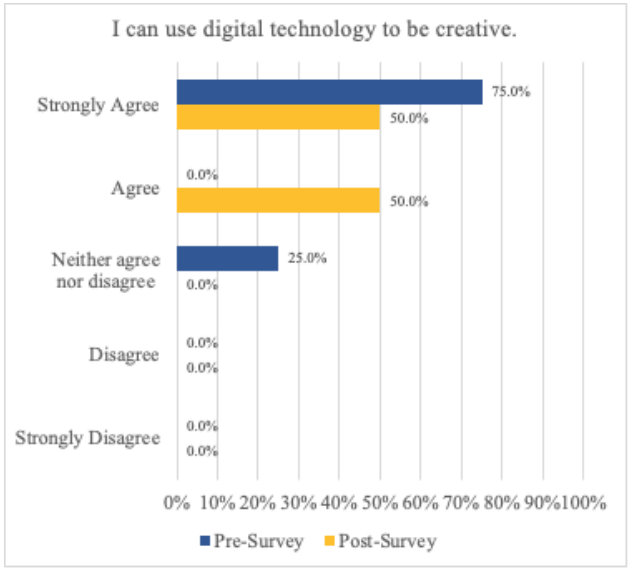


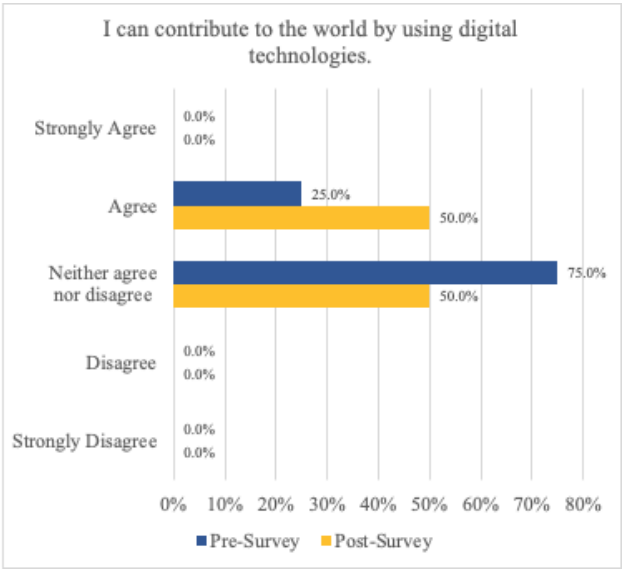
Non-Scholarship Student Responses (Filmmaking Academy, N=36)



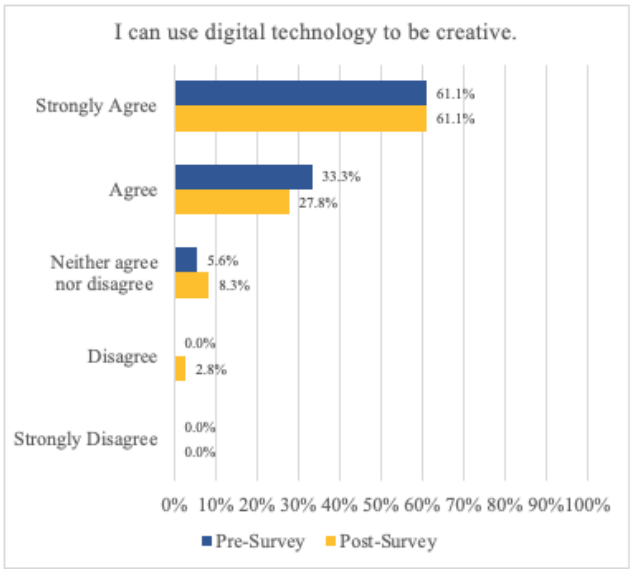


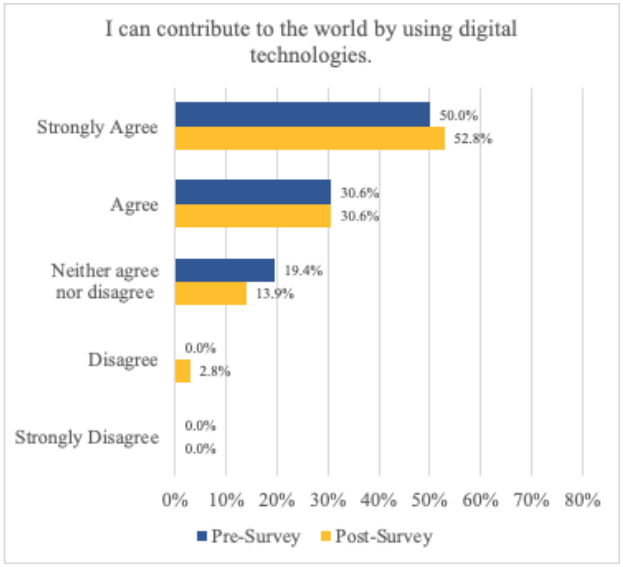
Scholarship Student Responses (Filmmaking Academy, N=4)



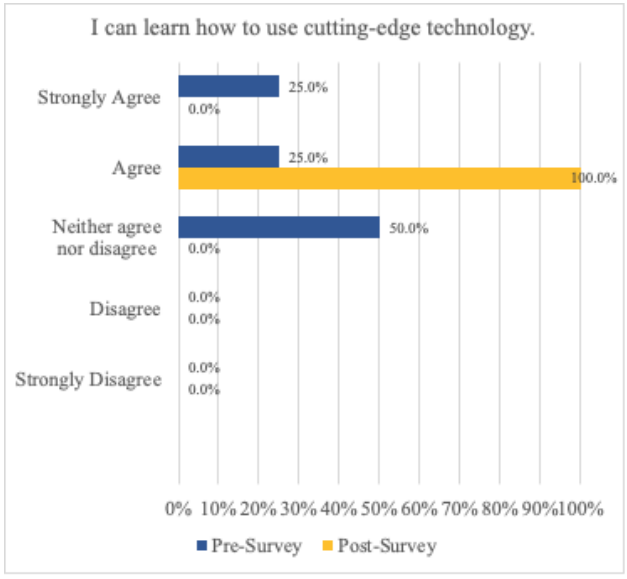


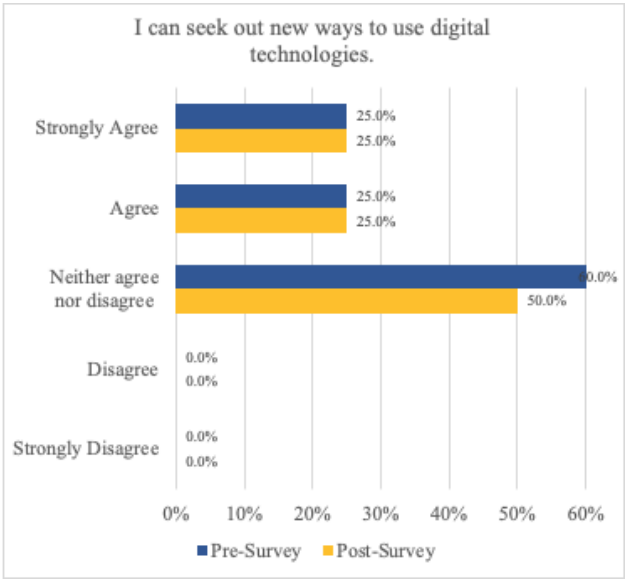
Non-Scholarship Student Responses (Filmmaking Academy, N=36)



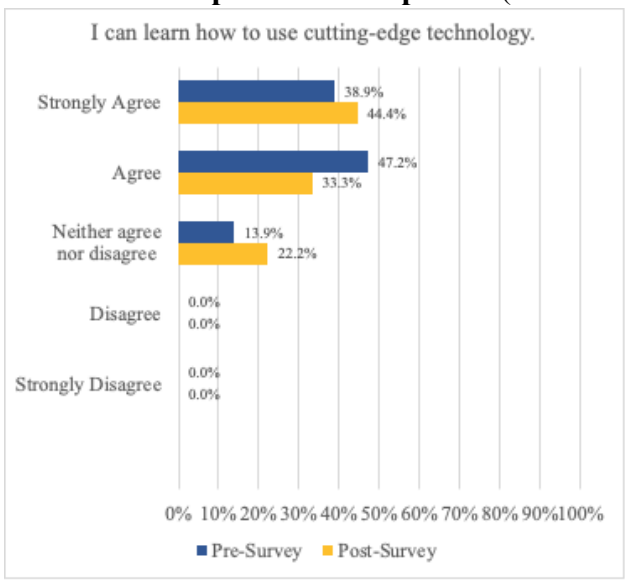


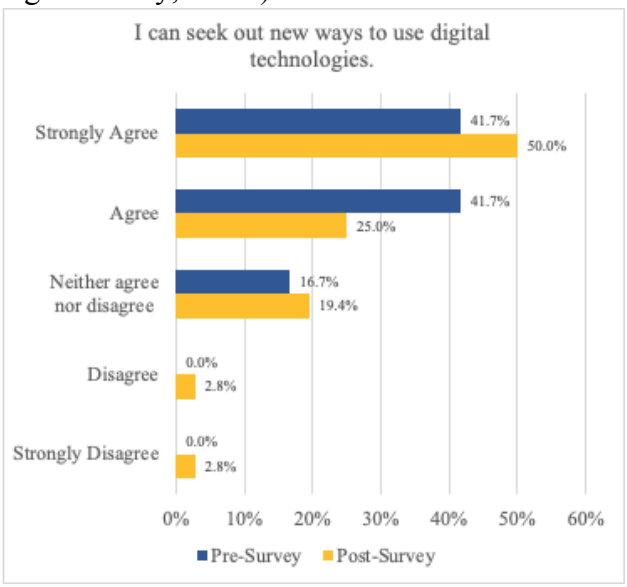
Scholarship Student Responses (Filmmaking Academy, N=4)



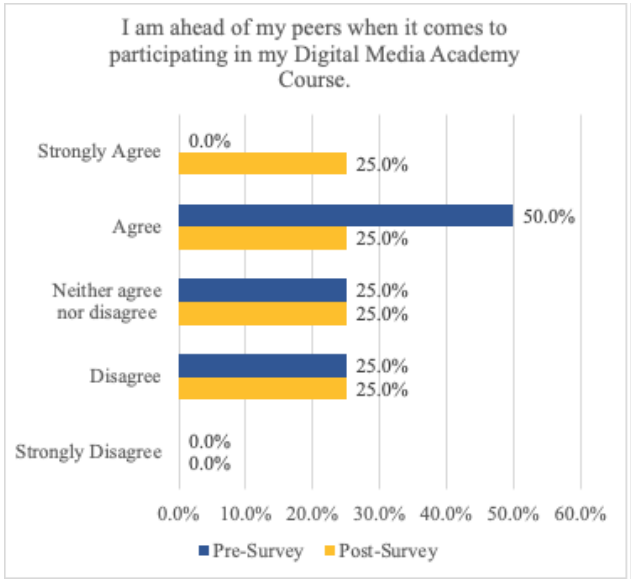


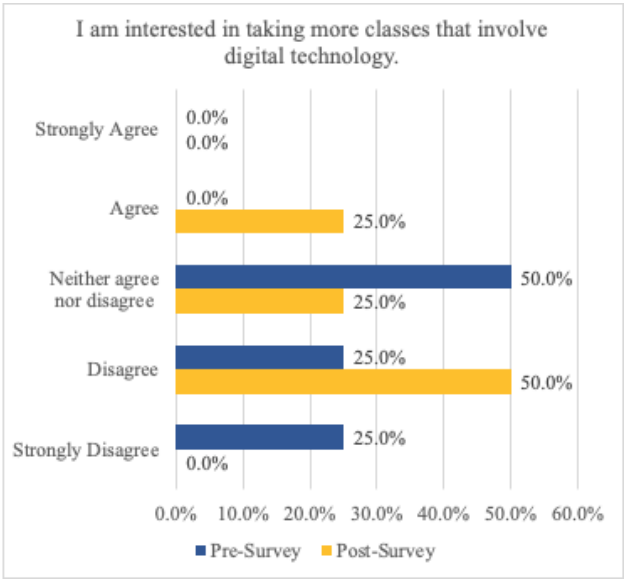
Non-Scholarship Student Responses (Filmmaking Academy, N=36)



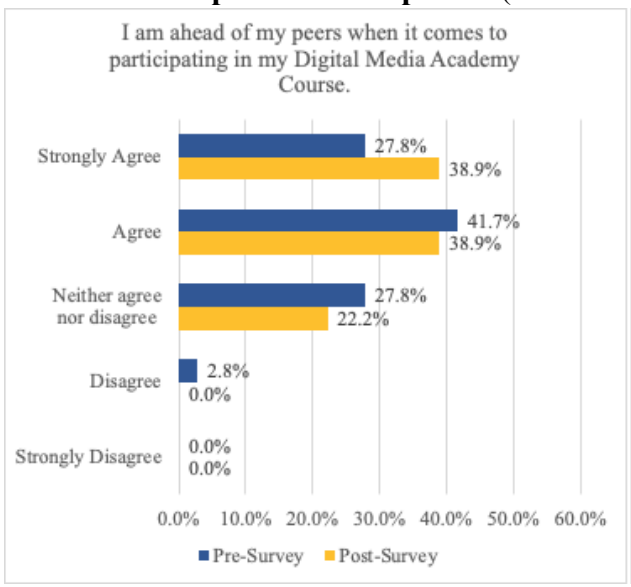


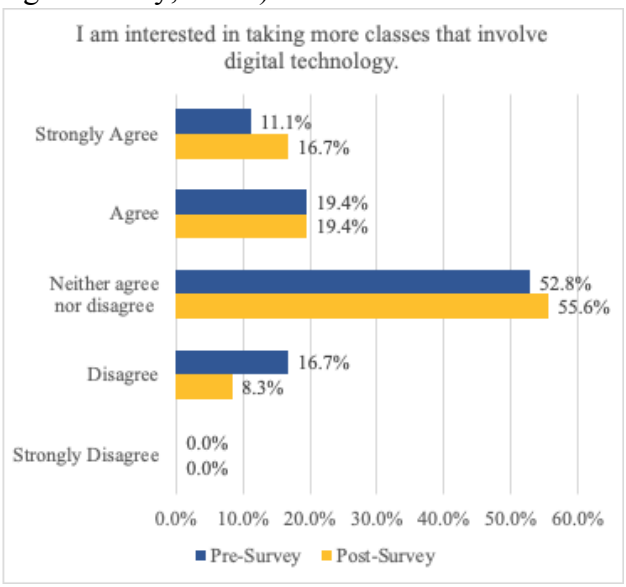
Scholarship Student Responses (Filmmaking Academy, N=4)





Non-Scholarship Student Responses (Filmmaking Academy, N=36)





Overall Findings

Impacts

- **Software & Technology**

Software & Technology. Students in every focus group discussed the importance of learning new and industry-standard. For example, one student in the Electronic Music Production with Ableton stated the following. [Note: The following quote was from one student in response to what impact the camp had on him.]

> I also did this camp because I wanted to brush up on like music stuff, because I know like the basics of music making, but I wanted to, like, learn some more stuff. And for me, I go one year, actually go one year left of high school and I'm really got my eyes set on this college, CalArts and I want to go for music, experimental pop sound design, very similar to this.
>
> I sat and observed in one of the classes, very small, intimate, and it's like very like personalized. It's like creating your own music, doing what you want to do. But they make you take like music theory and all this stuff but I feel like with the Ableton portion, because I know, like, a lot of people like in the music industry use Ableton and stuff.
>
> And so, I feel like now knowing certain key concepts, I feel like that's very important for me for what I want to do in the future and going to college. And if I'm going to go to college like this music stuff and take it seriously, I felt like I now actually learned how to do it as well as what button does what, and, like, the terms and some of the stuff.
>
> - Electronic Music Production with Ableton

Embedded in this quote is also how a course gives a student skills that they may need when pursuing college. We only found these ideas arise in the older group of teens, but we also wonder whether this was a decision to join certain academies. Unfortunately, no student discussed their selection based on preparation for college. Rather, it was interesting that students saw it as advantageous for their future when reflecting back on what impacts the course had on them.

> I think just learning to use the program and also there's just a ton of stuff that we learned, but you know, two weeks isn't really a long time. So we had to kind of pack in a lot, but I think I learned a lot, personally, and I found the class really fun.
>
> - 3D Modeling & Animation
>
> -
>
> I thought about that the program, like, really made me a lot more comfortable with softwares like Premiere and, like, After Effects and just like those things because when I was editing, I was working on different softwares and these ones are a lot more professional and a little bit more difficult to work with. So I think that they did a really good job of, like, teaching us how to use them.
>
> - Filmmaking Academy

Surprises About Camp and Self

- **Personal Strengths**

Personal Strengths. Students talked about learning about their personal strengths through taking courses at DMA. Students were surprised by how quickly they were able to learn advanced software and make a product that matched their interests. Although not interviewed, one of the researchers was able to do an observation of the AI & Machine Learning with Python. A student from this course showed the researcher how he was surprised with how much he was learning about linear algebra by trying to write a program that would predict the best soccer team given a large number of statistical constraints.

> I think some things are surprising, like how fast everyone seemed to pick it up. Like by the end of the first day we were just like, "Yeah!" I mean I didn't really expect that so that was surprising.
>
> - 3D Modeling & Animation
>
> -

> I didn't really expect myself to be keeping up with the pace that he's like teaching us at.
>
> - Autonomous Arduino with Take-Home Robot
>
> -

> For me, I guess like what surprised me the most, at first like I should come here and make a bunch of songs, but mostly I just tried to figure out how to use the softwares and I could go home and use it too.
>
> - Electronic Music Production with Ableton

Students also expressed how they were surprised with how each half of the academy was well-incorporated. One student noted that they were surprised that learning both electrical engineering and Python allowed them to understand how the two together contribute to making a fully working machine.

> Yeah. When I first decided to take this course, I thought it would be more about like engineering part of it. And I thought "Maybe we'd do a little bit of programming on the side." Like I wouldn't be that much into it, but as I took the course more and more, it became clear to me that it was basically you need both to create a fully working machine. You need the best of both worlds.
>
> - Python & Electrical Engineering with Python

Additionally, some students talked about how they also found their personal strengths through collaborating on projects. As one student stated, when working on a film, students all recognized that they had something to contribute.

> Oh yeah. I feel like we all kind of found ourselves playing like a certain role in all of our short films and stuff. I found myself to be kind of like in a lot of them like an actor mostly and sometimes filmmaking. I don't know like Teagan was really with like filming and editing and stuff.
>
> - Filmmaking Academy

Selection of Camp or Academy

- Personal Interest
- Parent(s)
- Friend or Neighbor
- Stanford
- Website Search

There were a total of 48 students interviewed over the eight focus groups. There were 33 students that had clear reasons for deciding to attend DMA. Totals of each category are given in Table 2.

Table 2. Totals for Student Reasons for Attending DMA

Reason for Selecting Camp or Academy	Number of Responses
Personal Interest	18
Parent(s)	9
Friend or Neighbor	5
Website Search	1

Personal Interest. In the focus groups of students that were older adolescents, many of them talked about finding the course themselves because they were interested in acquiring more skills in software such as Python or Abelton. In fact, in the focus group from Electronic Music Production with Ableton, every student said that they decided to take that academy because they were interested in learning more about how to make more sophisticated songs. Similarly, in AI & Machine Learning with Python, all but one student said that they chose the class because they had curiosities or previous interests in artificial intelligence, and found this camp had a class that could support that interest.

Parent(s). The next number of reasons that students gave for deciding DMA was through a parent. Only a few of the students were coerced by a parent to do something over the summer, and chose this camp for their students. Rather, most of the reasons were because the parent found out about the camp online through a website search and asked their student which academy they would prefer. So, although this could also be classified as *personal interest*, we found that they students attributed their choice of DMA as initiated by a parent.

Friend or Neighbor. Only a few students over all the focus groups said that they came to the camp because they heard about it from a friend or a neighbor. Additionally, only one student said they came to the camp with a friend. Most of the students that talked about this were in the youngest group of students aged 7 to 9.

Website Search. Only one student reported that a website search was the reason for selecting to attend DMA. The student was not clear if it was their personal interest or they were asked to find the camp by a parent.

Appreciation

- **Autonomy & Freedom**
- **Collaboration**
- **Instructors**
- **Environment**

*Autonomy & Freedom***.** This was probably the most cited theme from all the focus groups. Many of the students in the focus groups talked about autonomy and freedom to do projects that fit their interests. Much of the autonomy seemed to be attributed to the instructor and course flexibility. Below are some quotes from different courses where students expressed this as one of the highlights of their program.

> I also really like the freedom, both just with breaks so you can just go out as long as you're back in time. And also, in the actual code, even if you like do something that's like a little bit different than what's on the actual lesson to see what happens, the instructors are still willing to help you with that.
>
> - AI & Machine Learning with Python

> Yeah, for me it's just there's a lot of room for creativity, especially in the final projects. There's always a way to do something a little bit different than everyone else and just do whatever you want. They do their best to make sure you're not too stressed out, like maybe you have a deadline, you have to finish it up. They do their best interest to help you along with it."
>
> - Python & Electrical Engineering with Take-Home Laptop

> If you like a lot of freedom with creating your own robot, also they provide like a safe environment where everyone's, like, welcome. So it's good.
>
> - Autonomous Arduino with Take-Home Robot

> Student 1: I don't know, like to kind of just summarize what everyone was saying. At some other STEM camps where there's music making, the instructors might be holding your hand a little bit more and helping you through it. But I feel like DMA is very like professional with all their software and stuff so they're not holding your hand all the way through and they're just kind of like letting you do you kind of in your song.
>
> Student 2: To add on, it's like the instructors help you a lot, but it's not like they're always talking to you and telling you what to do, which is making you become more independent in music making because when you go back to your house, it's not like you're going to have the instructors helping you out. So every 20 minutes or half hour or something, they would bring up a tip, but it's not like they would be talking to us the entire time telling us what to do.
>
> - Electronic Music Production

> Yeah. The entirety of like Thursday this week and last week, it's, like, great because you just spend the whole day doing what you want to. Obviously, you're not like leaving class to go get food or whatever. No, it's not that kind of do what you want, but it's like you can create anything you would like and that's just like a lot of fun.
>
> - 3D Modeling & Animation

> Probably how much freedom they gave us just to kind of, like, learn things and film on our own and stuff. There wasn't a lot of control or pressure about what we were doing. It was just kind of like "Okay, try to get your scenes done. If you need our help, we'll totally help you." But the film or you're the director and the writer and it's your piece of work.
>
> - Filmmaking Academy

Collaboration. Students both expressed appreciation for the ability to work with others and develop projects together. Students expressed finding common interests and even trying to keep in touch with each other once the course was over.

> I've met new people that have the same interests as me, which was hard before because I feel like at my school or something, not many people were into making songs and stuff. But when I came here it's like everybody, not even just in this course, but in all of DMA, everyone you just meet people with the same interests as you.
>
> - Electronic Music Production with Ableton

> For me, it was just like overall the people here. I met some really, really amazing people in these past two weeks that I really want to stay in contact with. And just kind of spending time with them and filming with them and just working with them has been really fun."
>
> - Filmmaking Academy

Instructors. Students in every course attributed their positive experiences related to *autonomy* and *collaboration* to their instructors. Students talked about the instructors' balance of teaching and allow them to make mistakes on their own. In each instance, students talked about feeling supported by well-informed instructors, evidencing that the instructors were well-versed in their technological expertise, but also caring with the children.

> Personally, I know I've learned a lot from small classes because the schools I've been to have always been like small and not too big. So, the counselors or teachers get really close with you so you build a good relationship and from there they can actually help you way better because they know you, they know what type of style you're working with and they know what you're trying to achieve with your work.
>
> - Electronic Music Production with Ableton

> I think also a lot had to do with the teachers because if you're not taught right, it won't stick with you and it won't really make sense to you. And I think our teachers, you know, sort of introducing us to this industry-standard platform and kind of getting us to understand and use it and all within two weeks that's pretty impressive.
>
> - 3D Modeling & Animation

> Student: Yeah. I feel like you should take intro to filmmaking first just to, like, get like a basics, like of an idea of the class. Ellis is a really good teacher. Yeah. He's a really good teacher. I really, really love Ellis. And so I recommend like taking that class and then this class.
> Researcher: What makes Ellis such a good teacher?
> Student: He's very calm. He never gets angry. He, like, knows what he's talking about, so he, like, knows what he's doing.
>
> - Filmmaking Academy

Environment. Although connected to collaboration and the instructors, students seemed to like being at Stanford University and getting exposure to campus life.

> Well, first of all for the camp, like the atmosphere where like one of the best universities in the world. It's pretty cool to be here. I'm not sure if we see students that go bicycling around, but it's pretty cool seeing them around. The camp was pretty cool because it's like very open. So you basically choose what you want to do. So, for instructions you just follow the teacher, but for this final project, you just get what you want to do. It's pretty cool.
>
> - AI & Machine Learning with Python

Improvement Recommendations

- **Marketing Potential**
- **Less Prescribed Structure**
- **Time & Access**
- **More Collaboration**
- **Extended Care**

Marketing Potential. Some students talked about the descriptions of the courses not being explicit enough to really understand what the course experience might be like. Also, students talked about their parents finding the course through searching on Stanford's site, but not sure how DMA was distinct from the other technology camps on campus. For example, students who took the AI course felt that DMA offered a unique experience for machine learning. This could be an opportunity to market it as a distinct experience with some of the quotes and stories from past camp participants. The software and hardware were large selling points for students in selecting to take courses with DMA.

> Yeah, actually, my next door neighbor their son went to some tech camp in Stanford and they told my mom that he really liked it. And so, my mom was like, 'Okay, we'll look into it.' So, we looked at Stanford tech camps and there were like 20, and a lot of them were already full. So we just kind of found DMA.
>
> - 3D Modeling & Animation

> I was looking for summer camps in Stanford and I found this AI course. This topic is really interesting to me.
>
> - AI & Machine Learning with Python

> I think personally, not a lot of camps are aimed towards, like, people who are older, like actually there are a lot of camps meant to introduce people into coding, but once you're introduced they don't really provide…[another student]: Yeah, they just scratch the surface.
>
> - AI & Machine Learning with Python

> I think it would be important for DMA to probably highlight what is expected of someone going into the class. Because I feel like there's a lot of parents that just signed their kids up for the class even if their kids probably don't even know that they're being signed up for the class because they're just thinking that their children is going to come out of this as a genius who knows the material. But I think that they should emphasize the fact that you shouldn't sign your children up for the class if they aren't interested in learning and progressing through the material.
>
> - Autonomous Arduino with Take-Home Robot

> Mainly because it offered something that the other camps didn't because I was looking for an Arduino course because I've been doing it for a while, but I haven't really been able to take an actual class about it."
>
> - Python & Electrical Engineering with Take-Home Laptop

> I've talked to my friends about it and they're like, "I've never heard of that camp." So like it's not that popular because they don't really…like if you do like my mom she does search for camps and then she lets me choose them. But she had to do a lot of research to find this camp last year. This wasn't like one of the first camps you would see pop up.
>
> - Adventures in 3D Printing & Modeling

Less Prescribed Structure. When talking with 3D Modeling & Animation, students offered a specific suggestion to allow them to make their own rigs rather than all be given the same one to make their own characters. In AI, students talked about how there was a lot of "copy and paste" with the codes rather than experience typing them in themselves.

> I think it'd be more like time wise to not make your own characters. But yeah, I would have probably enjoyed that like making rigging like our own characters instead of taking a model that was already rigged and kind of just animating it.
>
> - 3D Modeling & Animation

> They have like a Google Docs where they paste in their codes and then they would paste that into our program. They explain what it does most of the time, but still a valuable experience to type it a lot of the times.
>
> - AI & Machine Learning with Python

Time & Access. Some students from the Python course thought that there was a lot of time where they did not get as much access to the instructors when they needed help. One suggestion students provided for this was to have more online resources other than what was available on their dashboard.

> Yeah. I feel like if you get to camp, I spent a lot of the time sitting waiting for the TA's to get around and talk to everybody. We were all doing group projects. There was a lot of time, we were just sitting still.
>
> - Python & Electrical Engineering with Take-Home Laptop

Some students suggested allowing more access to the classroom space and time with projects during the day.

> Student 1: I know it's Digital Media Academy and they're, like, worried of the computers being stolen or something but they are locked up. They have like, not padlocks but they have locks on them and keeping them there.
>
> Student 2: And also like everyone here is like "What's a middle schooler or like a high school are going to do?" I think we should have access to our rooms if we want to go in there, like we have free time at 8:30 to 10:00. I feel like if the counselors are in there, we should just be able to go in and start working on extra work on a project.
>
> - Electronic Music Production with Ableton

This was not the sentiment of all students, though. Some students talked about being able to do outdoor activities during the breaks. This could provide the possibility to think about offering outdoor activity options for students to give alternatives to screen time. The following students contradict another student who said that they should be able to work during breaks because kids go on their phones anyway.

> (Autonomous Arduino with Take-Home Robot) "Not necessarily. There are quite a few people like all my breaks to play soccer with a couple others. So there are quite a few people, especially the younger ones who don't necessarily have phones or haven't yet been addicted to them. They use their time to actually play games."

More Collaboration. One course seemed to stand out with not having much of a chance to collaborate.

> I have not been to other DMA camps, so I'm not sure if there are more group projects there but here for the most part there weren't really group projects. It was more individual work. And because of that we only could do like individual projects that had one individual goal as we only had one computer and you'd have to run programs in [unclear 23:43]. So if we work together, it would be more interesting and more of a challenge. You learn more about synchronizing systems if that was possible.
>
> - Autonomous Arduino with Take-Home Robot

Extended Care. Not many students talked about after the program hours, but one student in particular suggested activities for extended care. This has implications for students whose parents get off work at 5:00 and cannot be there to pick them up till later.

> Like at 5:00 to 6:00 is extended care and I'm the only one in extended care and all I do is sit my bum and play on my console.
>
> - Adventures in Animation

Perceptions and Attitudes Toward STEM

- **Not Sure**
- **DMA Contributed to Positive Shifts Toward STEM**
- **STEM is More than Science and Math**

When looking at the survey data, we did not see what looks like a significant increase in students' positive perceptions of or attitude towards STEM. However, by looking at the courses separately with the focus group interviews, we saw that some courses showed increases in students' perceptions of the importance of digital technologies or STEM to have a good job (refer back to AI & Machine Learning with Python; Adventures in 3D Printing & Modeling; and Adventures in Animation). Some students, though, were not sure whether their academy was related to STEM. The following findings give an idea of the range of how much students attributed their DMA experience to their shifts in perceptions and attitudes toward STEM.

Not Sure. There were a few students that were unsure whether DMA changed their perceptions or attitudes toward STEM and pursuing it in the future. This was the minority of the responses overall. Most of the unsure responses came from Filmmaking Academy, Adventures in Animation, and 3D Modeling & Animation.

> Student: Yeah. Like STEM, okay, some of my schools just have like physics and like all of that stuff, I don't know like math and stuff. I don't know, like filmmaking would be considered like STEM, I don't know, would it be?
> Researcher: I mean do you feel like all the things that you did, was it like STEM like? Was that stuff that you were doing that would be considered STEM? Because you were talking about like advanced programs and stuff, would you say that was a STEM thing or do you think that's not STEM?
> Student: Yeah, kind of. I don't know.
>
> \- Filmmaking Academy

> I think before I was sort of indifferent towards it I guess. And now like, maybe you know, career in animations sounds kind of interesting. I might go into it in the future. I don't know.
>
> \- 3D Modeling & Animation

DMA Contributed to Positive Shifts Toward STEM. Students were mixed about whether DMA contributed to their positive shift in perceptions and attitudes toward STEM. However, within different groups, there were a few students that talked about how DMA either ignited or re-ignited their interest in STEM. The courses were students felt DMA shifted their perceptions and attitudes toward STEM more involved some sort of coding or advanced software.

> Student 1: Yeah. I don't know if they do it here, but like school in general, my school just like pushing for STEM even like my grade school and it was, like, kind of got a little bit like annoying because you had to get graded on stuff too with STEM. I love DMA, so it's bringing me back towards liking it because when it was new I loved it but then my school kind of just made me hate it.
> Student 2: I've always really done STEM because our school does like a STEM fair and like my school strives for like learning and stuff. Well, don't all schools strive for learning but… I think it showed me like more areas of STEM that I've never, like, discovered. So I think that improved, so now I learned more then.
>
> \- 3D Modeling & Animation
>
> \-

At the beginning of that camp, like I remember on the pre-camp survey was like, "How likely are you to pursue STEM in your actual career?" And I put like 2, and I like 4 now.

- AI & Machine Learning with Python

Well, I was always pretty interested in STEM, but I think the DMA camp has helped me more like get an understanding of what it means to work together with others and programs, like to complete tests and do more problem solving.

- Autonomous Arduino with Take-Home Robot

Yeah. So, I feel like coding classes aren't that common for summer camps. I think like taking a two-week or one-week class for coding helps you understand what coding, in general, could be like. So, that kind of way, it's kind of inspiring. I can do this. I can also do this on my free time.

- Python & Electrical Engineering with Take-Home Laptop

I knew I wanted to be, like, a writer when I was very little, so I never paid much attention to STEM but then coming to this camp, I think I'm more interested in it.
Adventures in 3D Printing & Modeling

STEM is More than Science and Math. These last quotes summarize what some of the students took away from participating in DMA. Students started to have an expanded view of the different ways that they could participate in STEM. Although STEM includes the term 'technology,' it seemed that students who had not had access to more advanced technologies did not understand what that meant for STEM outside of computers.

Student 1: To answer your question, like science and math aren't really like my strong suit. I like them but that's not really like my favorite subject but this has sort of given me a new-found appreciation for it because it kind of broadens my horizons.
Student 2: Yeah. Like a lot in this generation is pushed on us that we have to become like programmers or engineers. But then there's just so much stuff you could do with technology that's not just like engineering. It's pretty cool.

- Electronic Music Production with Ableton

So, then I was just like, "Oh, this is cool." And then when I said that to my parents, they were like, "Okay, science?" So, I started like kind of studying science and I was, like, "Wait, whoa, what am I doing?" But it turned out to be really fun. So, in this camp, I thought STEM was only for like science and math. But in this camp, I learned that engineering and technology and that kind of stuff, so now I'm kind of interested in computer science, too.

- Adventures in 3D Printing & Modeling

References

Glaser, B.G., & Strauss, A.L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.

Guzey, S. S., Harwell, M., & Moore, T. (2014). Development of an instrument to assess attitudes toward science, technology, engineering, and mathematics (STEM). *School Science and Mathematics*, *114*(6), 271-279.

Mohr‐Schroeder, M. J., Jackson, C., Miller, M., Walcott, B., Little, D. L., Speler, L., Schooler, W., & Schroeder, D. C. (2014). Developing Middle School Students' Interests in STEM via Summer Learning Experiences: See Blue STEM Camp. *School Science and Mathematics*, *114*(6), 291-301.

National Research Council. (2011). *Successful K-12 STEM education: Identifying effective approaches in science, technology, engineering, and mathematics*. National Academies Press.

Shahali, E. H. M., Halim, L., Rasul, M. S., Osman, K., & Zulkifeli, M. A. (2017). STEM learning through engineering design: Impact on middle secondary students' interest towards STEM. *EURASIA Journal of Mathematics, Science and Technology Education*, *13*(5), 1189-1211.

Tseng, K. H., Chang, C. C., Lou, S. J., & Chen, W. P. (2013). Attitudes towards science, technology, engineering and mathematics (STEM) in a project-based learning (PjBL) environment. *International Journal of Technology and Design Education*, *23*(1), 87-102.

APPENDICES

Appendix A. Focus Group Interview Protocol

Interviews will be conducted in a semi-structured manner. The following are the base questions that will be used to evaluate the effects of the Digital Media Academy Tech Camp hosted at Stanford University to elicit students' competence, engagement, interests, and attitudes towards STEM learning opportunities during the summer months while participating in a STEM camp.

Introduction

I want to thank you for participating in the research component of this project. Your ideas and opinions are extremely valuable as we seek to improve programs for students interested in STEM.

I want to assure you that what you say will be held in confidence. Your responses will only be analyzed by me and the research team, and we will use your pseudonyms (fake names) rather than your actual name. Also, if there are any questions that you would prefer not to answer, just let me know and we'll skip them.

I would like to audio- and video-record this focus group interview. Recording the interview allows me to focus more on what you are saying than if I had to take detailed notes. If at any time, you would like to speak off the record, please let me know and I will turn off the recorder.

Does anyone have any questions before we get started?

Focus groups Questions

1. What is the biggest impact this course had on you?
2. What surprised you the most about the camp?
3. What surprised you the most about yourself?
4. Why did you decide to take a summer course with Digital Media Academy?
5. What did you like most about this summer camp?
6. What improvements would you like to see in this camp to make it better?
7. How has this camp shaped your thoughts and attitude towards participating in STEM learning opportunities?

Appendix B. Pre-survey

Digital Media Academy Summer Camp @Stanford (Pre-Test)

Start of Block: Welcome

Q1 **Welcome to the Digital Media Academy Summer Camp @Stanford Survey**
We want to make the best camp possible. We need to know what you think. We would like you to take a 15-minute survey. Your answers will remain strictly confidential. Nobody will know you gave certain answers. You do not need to complete the survey if you do not want to, and you may stop at any time if you change your mind. Please click the **BEGIN** button and select →→ **Next** →→ at the bottom of the page to take the survey. We may also ask you to join a focus group later.

Please click the **NO THANK YOU** button and select →→ **Next** →→ at the bottom of the page if you do not wish to complete the survey. We will not ask you to join a focus group later. **Student Assent** Study Title: Evaluation study of the Digital Media Academy summer tech camp at Stanford University **1. What will happen to me in this study?** You will participate in your regular summer camp courses offered by Digital Media Academy on the campus of Stanford University. You will complete a survey pertaining to your experiences in the camp. A small group of students may also participate in a focus group about the camp. **2. Can anything bad happen to me?** No. Whichever summer camp class you are in, we think the class will be interesting! And your survey responses and and the answers to your questions are "confidential"; that means your name will stay a secret and no one but you and the researchers will know "who said what." If there is anything about the summer camp, the surveys, or the questions that upsets you, please tell your parents, and we can try to make it better. **3. Can anything good happen to me?** We hope so! We expect you will learn a lot in the summer camp, and we think that your participation will help us figure out how to make the camp even more interesting for you, your campmates, and all the kids who might participate in the camp and in future years. However, we cannot guarantee you will receive any benefits from the study. **4. Will anyone know I am in the study?** Your parents, Digital Media Academy, fellow camp participants, and the researchers will know you are participating in the study. No one else will know; your name and your participation will be kept secret. **5. Who can I talk to about the study?** If you have any questions about the study or any problems to do with the study you can contact the Protocol Director, Xavier Monroe. You can call him/her at (352) 575-0570. If you have questions about the study but want to talk to someone else who is not a part of the study, you can call the Stanford Institutional Review Board (IRB) at (650)-723-5244 or toll free at 1-866-680-2906. **6. What if I do not want to do this?** You can stop being in the study at any time without getting in trouble. Stopping will mean that you are

no longer completing the surveys answering the questions, but it will not affect your participation in the camp.

O BEGIN (10)

O NO THANK YOU (11)

Skip To: End of Block If Q1 = BEGIN

Skip To: End of Survey If Q1 = NO THANK YOU

End of Block: Welcome

Start of Block: Experience with STEM Camps & Courses

Q2 Please answer the following question about your Digital Media Academy course.

Which Digital Media Academy course are you currently taking? (1)	▼ 2D Animation & Digital Illustration (1) ... VR & Game Design Academy (47)

Q3 Please answer the following question about your Digital Media Academy course.

What dates are you attending this course? (1)	▼ One Week: June 17-21 (1) ... Two Weeks: August 5-9 & August 12-16 (16)

Q4 Please select Yes or No for each of the below questions.

	Yes (1)	No (2)
Have you attended a Digital Media Academy Camp in the past? (1)	O	O
Have you attended another STEM camp in the past? (2)	O	O

Do you plan to attend another Digital Media Academy Camp in the future? (3)	O	O
Will you attend another STEM camp in the future? (4)	O	O
Will you try to take more Science, Technology, Engineering, Mathematics (STEM) related courses in the future? (5)	O	O

End of Block: Experience with STEM Camps & Courses

Start of Block: Block 5

Q5 In the next part, we want to know how much you agree with each statement.

You will select from: *strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree .*

Please **only select one answer for each statement** that you read.

Click →→ Next →→ to continue.

End of Block: Block 5

Start of Block: Personal and social implications of STEM

Q6 STEM Personal and Social Implications

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)

It is important to know engineering to get a good job. (19)	O	O	O	O	O
It is important to know digital technologies to get a good job. (20)	O	O	O	O	O
Science, technology, engineering, and mathematics make our lives better. (21)	O	O	O	O	O
I would like to have a job that involves science, mathematics, engineering, or technology. (22)	O	O	O	O	O

End of Block: Personal and social implications of STEM

Start of Block: Learning of science and engineering and the relationship to STEM

Q7 Engineering & Technology

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)
I enjoy learning engineering. (1)	O	O	O	O	O
I am good at engineering. (2)	O	O	O	O	O
I am interested in taking more classes that involve engineering. (3)	O	O	O	O	O
I am good at using digital technology or software. (8)	O	O	O	O	O
I enjoy learning to use digital technology or software. (9)	O	O	O	O	O
I am interested in taking more classes that involve digital technology	O	O	O	O	O

or software. (10)	

End of Block: Learning of science and engineering and the relationship to STEM

Start of Block: Learning of mathematics and the relationship to STEM

Q8 Persistence and Creativity

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)
I will not give up, when I am working on a difficult problem using digital technologies. (1)	O	O	O	O	O
I will not give up, when I am working on a difficult mathematics problem. (2)	O	O	O	O	O
I can use digital technology to be creative. (3)	O	O	O	O	O
I can contribute to the world by using digital	O	O	O	O	O

technologies. (4)					
I can learn how to use cutting-edge technology. (5)	O	O	O	O	O
I can seek out new ways to use digital technologies. (6)	O	O	O	O	O
I feel like I belong at this camp. (7)	O	O	O	O	O
I am ahead of my peers when it comes to participating in my Digital Media Academy Course. (8)	O	O	O	O	O

End of Block: Learning of mathematics and the relationship to STEM

Appendix C. Post-survey

Digital Media Academy Summer Camp @Stanford (Post-Test)

Start of Block: Welcome

Q1 **Welcome to the Digital Media Academy Summer Camp @Stanford Survey**
We want to make the best camp possible. We need to know what you think. We would like you to take a 15-minute survey.

Your answers will remain strictly confidential. Nobody will know you gave certain answers. You do not need to complete the survey if you do not want to, and you may stop at any time if you change your mind.

If you do take the survey, please remember to click on the ***SUBMIT*** button when you are done. You will receive a "Thank You" notice that confirms you are done.

Thank you for your time. If you have any questions at any time, please ask your instructor.

Please click the ***BEGIN*** button and select →→ **Next** →→ at the bottom of the page to take the survey. We may also ask you to join a focus group later.

Please click the ***NO THANK YOU*** button and select →→ **Next** →→ at the bottom of the page if you do not wish to complete the survey. We will not ask you to join a focus group later.

O BEGIN (10)

O NO THANK YOU (11)

Skip To: End of Block If Welcome to the Digital Media Academy Summer Camp @Stanford Survey We want to make the best camp... = BEGIN

Skip To: End of Survey If Welcome to the Digital Media Academy Summer Camp @Stanford Survey We want to make the best camp... = NO THANK YOU

End of Block: Welcome

Start of Block: Experience with STEM Camps & Courses

Q2 Please answer the following question about your Digital Media Academy course.

Which Digital Media Academy course are you currently taking? (1)	▼ 2D Animation & Digital Illustration (1) ... VR & Game Design Academy (47)

Q3 Please answer the following question about your Digital Media Academy course.

What dates are you attending this course? (1)	▼ One Week: June 17-21 (1) ... Two Weeks: August 5-9 & August 12-16 (16)

Q4 Please select Yes or No for each of the below questions.

	Yes (1)	No (2)
Have you attended a Digital Media Academy Camp in the past? (1)	O	O
Have you attended another STEM camp in the past? (2)	O	O
Do you plan to attend another Digital Media Academy Camp in the future? (3)	O	O
Will you attend another STEM camp in the future? (4)	O	O
Will you try to take more Science, Technology, Engineering, Mathematics (STEM) related courses in the future? (5)	O	O

End of Block: Experience with STEM Camps & Courses

Start of Block: Block 5

Q5 In the next part, we want to know how much you agree with each statement.

You will select from: *strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree .*

Please **only select one answer for each statement** that you read.

Click →→ Next →→ to continue.

End of Block: Block 5

Start of Block: Personal and social implications of STEM

Q6 STEM Personal and Social Implications

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)
It is important to know engineering to get a good job. (19)	O	O	O	O	O
It is important to know digital technologies to get a good job. (20)	O	O	O	O	O
Science, technology, engineering, and mathematics make our lives better. (21)	O	O	O	O	O

I would like to have a job that involves science, mathematics, engineering, or technology. (22)	O	O	O	O	O

End of Block: Personal and social implications of STEM

Start of Block: Learning of science and engineering and the relationship to STEM

Q7 Engineering & Technology

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)
I enjoy learning engineering. (1)	O	O	O	O	O
I am good at engineering. (2)	O	O	O	O	O
I am interested in taking more classes that involve engineering. (3)	O	O	O	O	O

I am good at using digital technology or software. (8)	O	O	O	O	O
I enjoy learning to use digital technology or software. (9)	O	O	O	O	O
I am interested in taking more classes that involve digital technology or software. (10)	O	O	O	O	O

End of Block: Learning of science and engineering and the relationship to STEM

Start of Block: Learning of mathematics and the relationship to STEM

Q8 Persistence and Creativity

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)
I will not give up, when I am working on a difficult problem using digital	O	O	O	O	O

technologies. (1)					
I will not give up, when I am working on a difficult mathematics problem. (2)	O	O	O	O	O
I can use digital technology to be creative. (3)	O	O	O	O	O
I can contribute to the world by using digital technologies. (4)	O	O	O	O	O
I can learn how to use cutting-edge technology. (5)	O	O	O	O	O
I can seek out new ways to use digital technologies. (6)	O	O	O	O	O
I feel like I belong at this camp. (7)	O	O	O	O	O

I am ahead of my peers when it comes to participating in my Digital Media Academy Course. (8)	O	O	O	O	O

End of Block: Learning of mathematics and the relationship to STEM

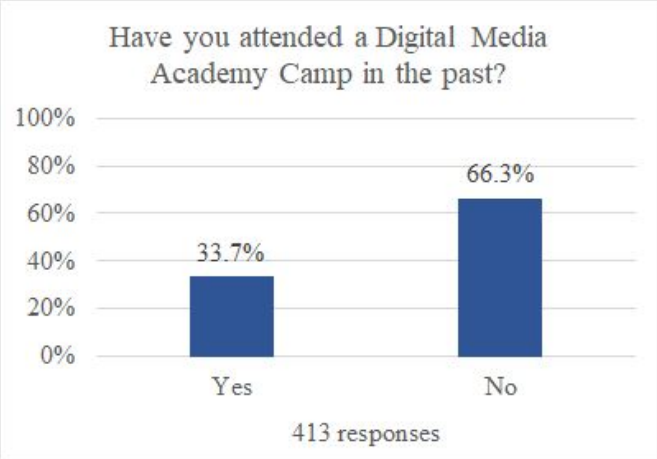
Appendix D. Aggregated Survey Results (N=413)

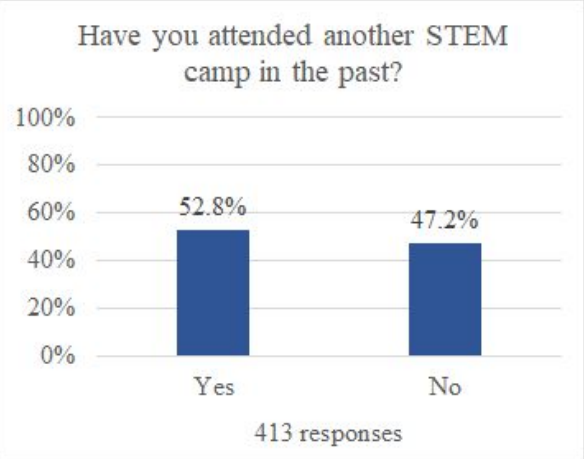
Q1. Assent.

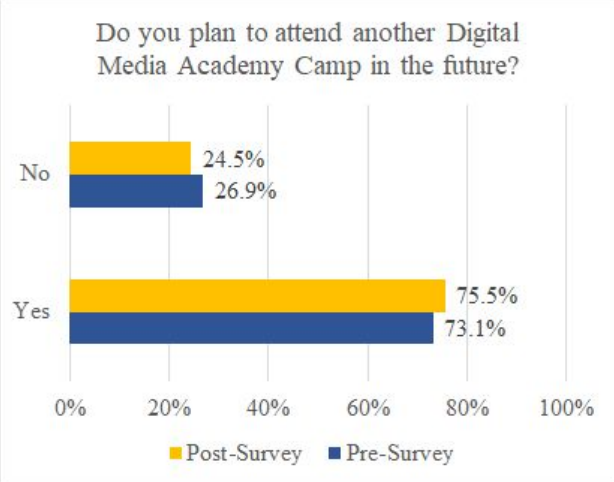
Q2. Which Digital Media Academy course are you currently taking?

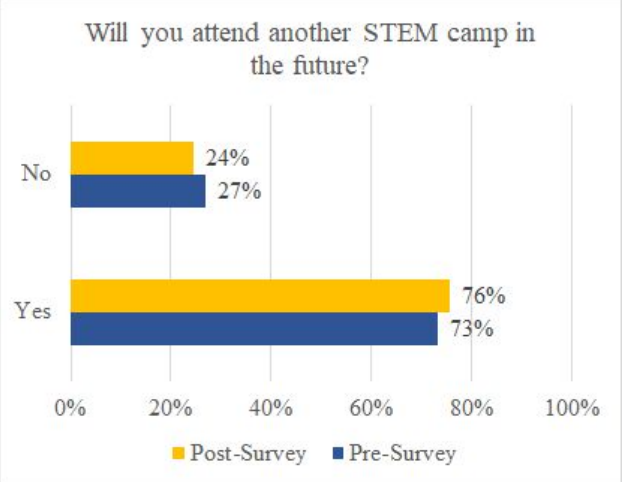
Q3. What dates are you attending this course?

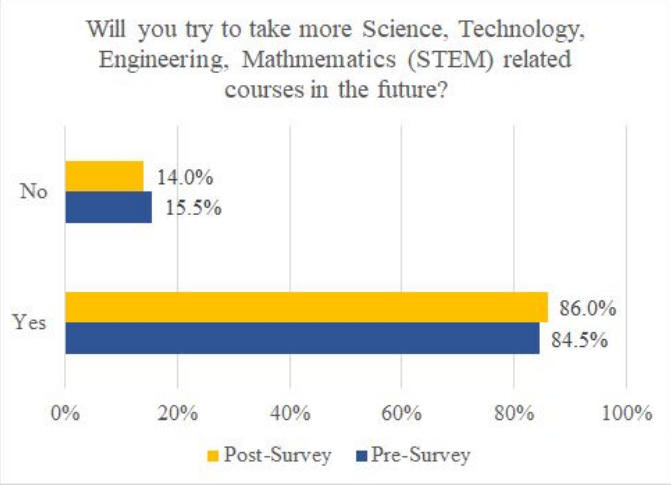
Q4. Please select Yes or No for each of the below questions.





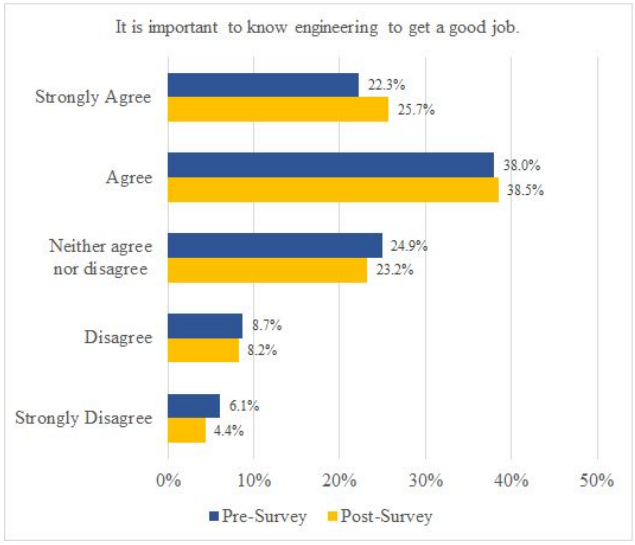


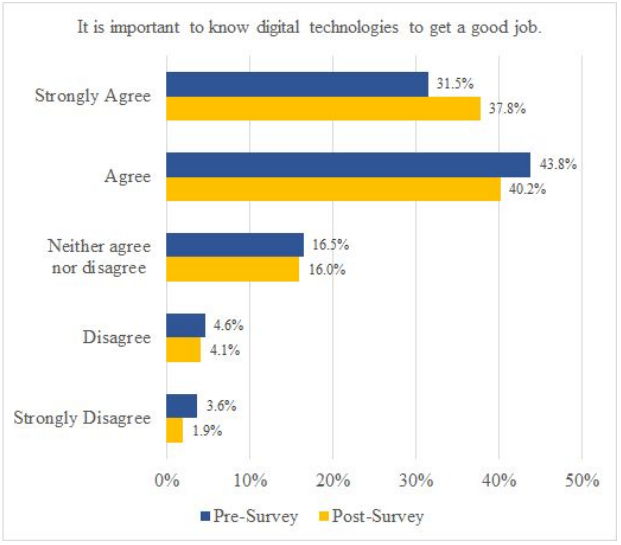


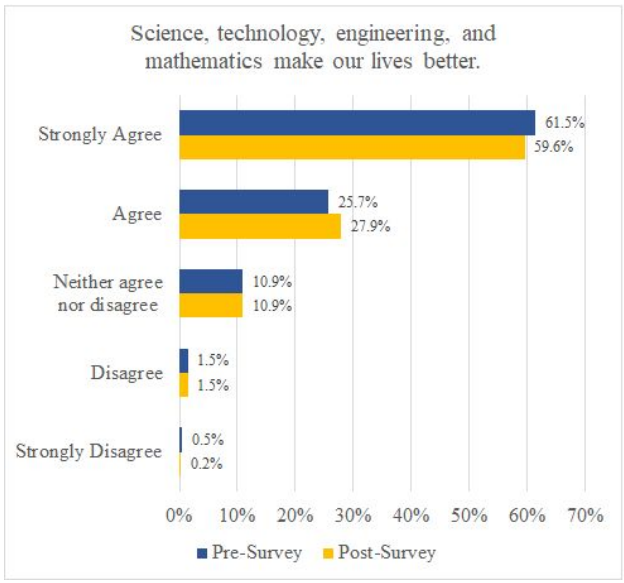


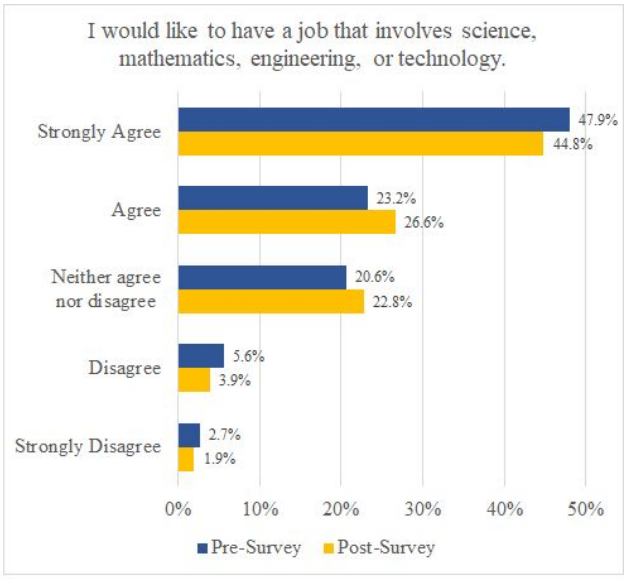
Q5. In the next part, we want to know how much you agree with each statement.
You will select from: *strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree.*

Q6. STEM Personal and Social Implications.

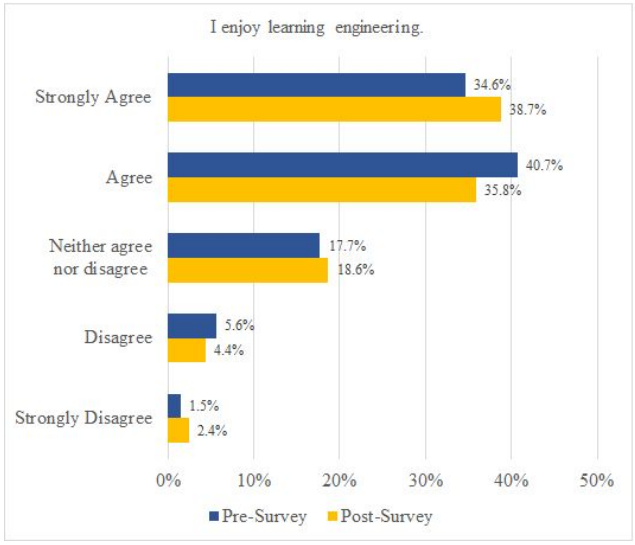


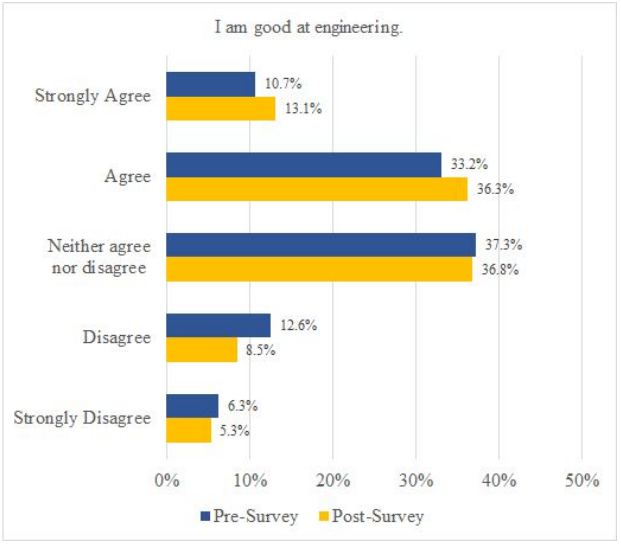


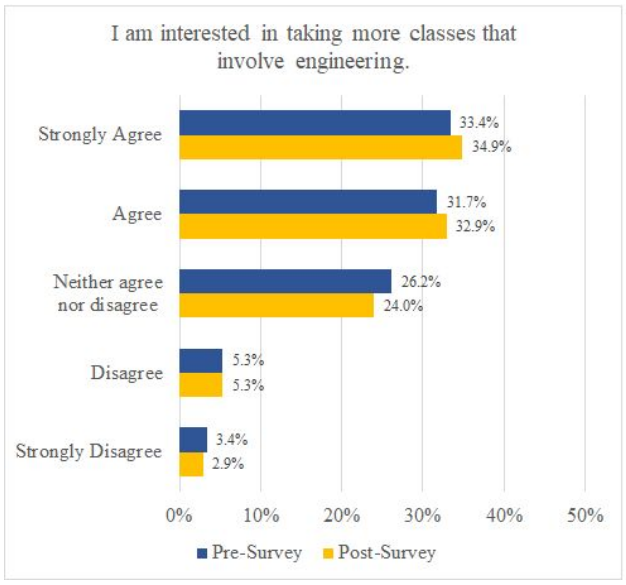


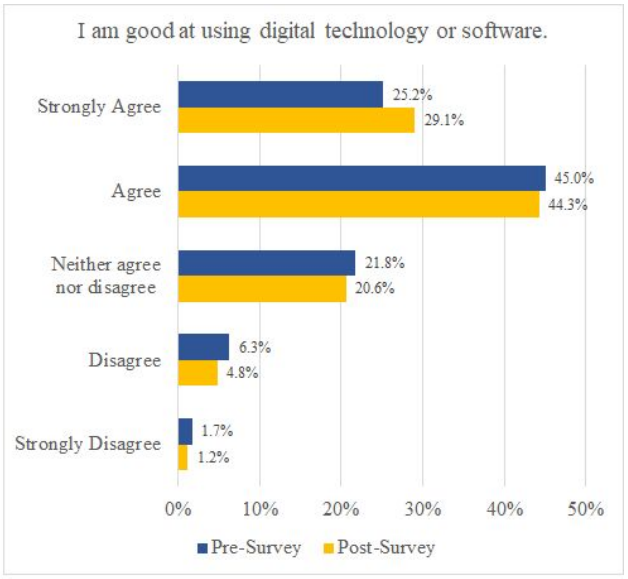


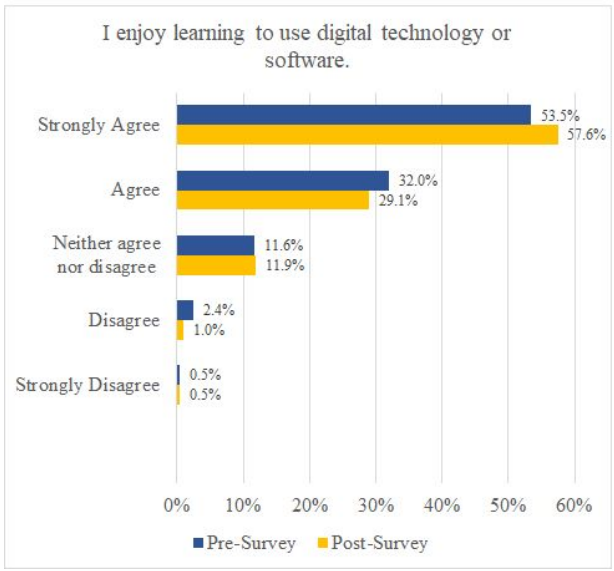
Q7. Engineering & Technology.

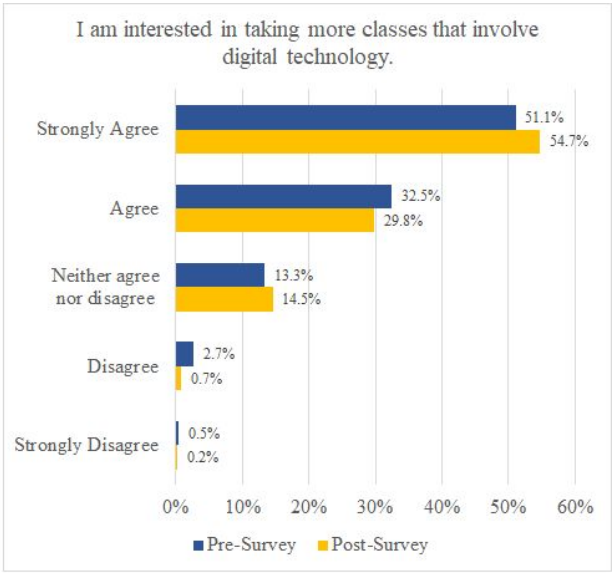




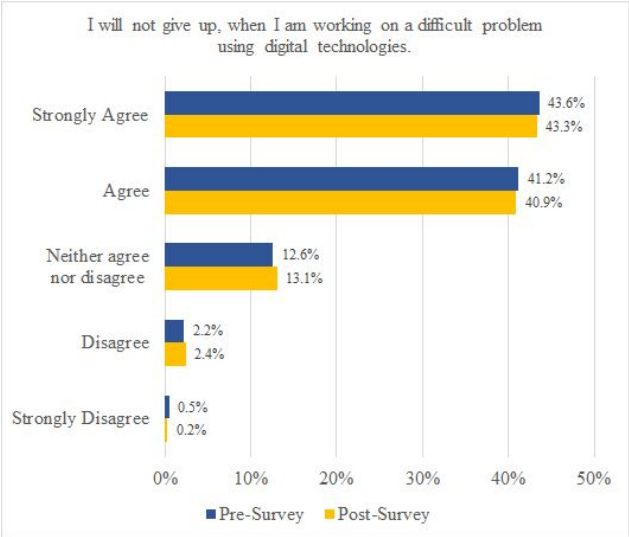


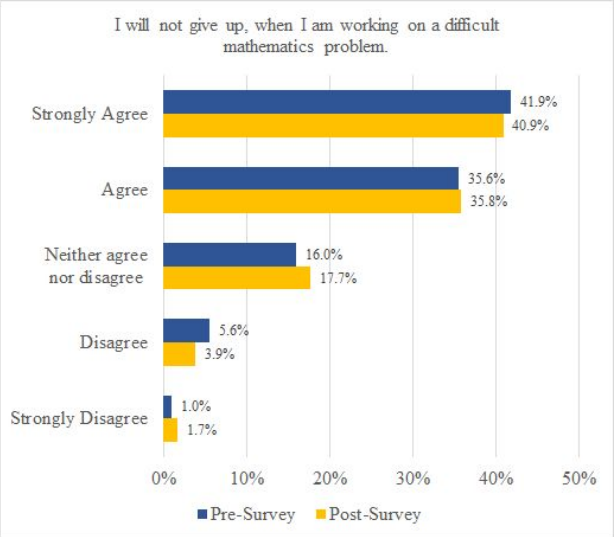


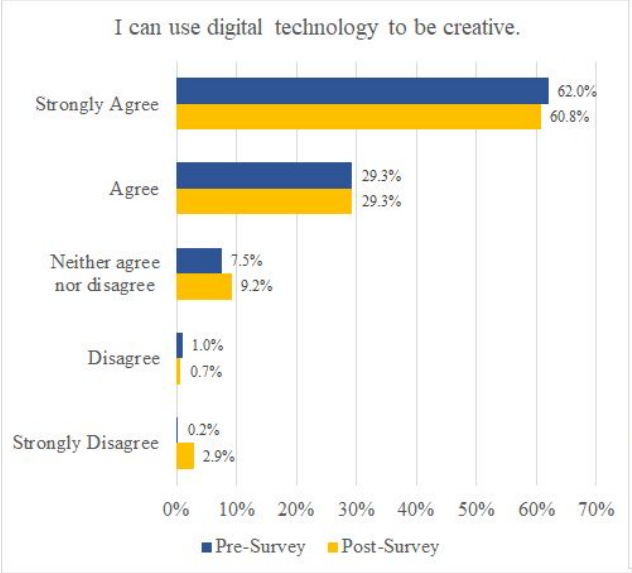


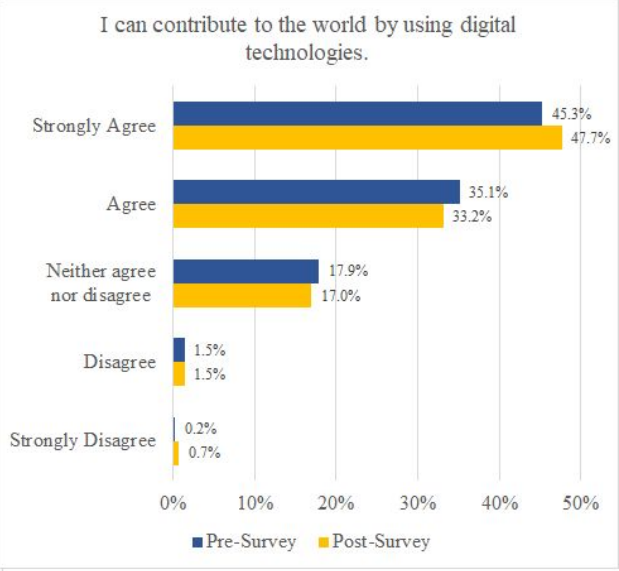


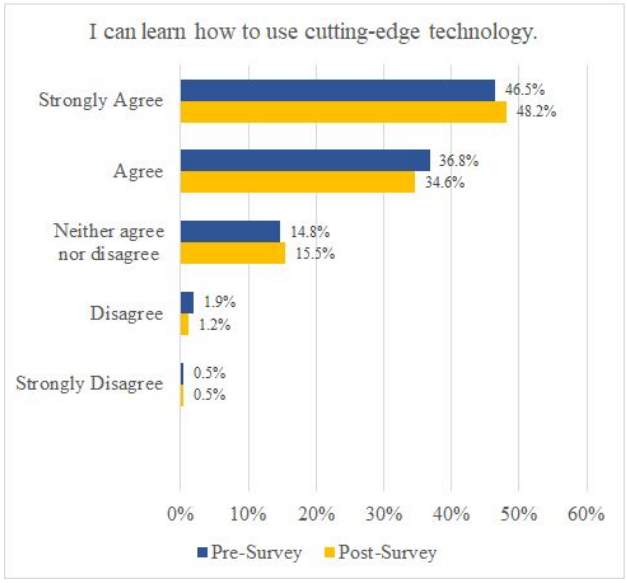
Q8. Persistence and Creativity.

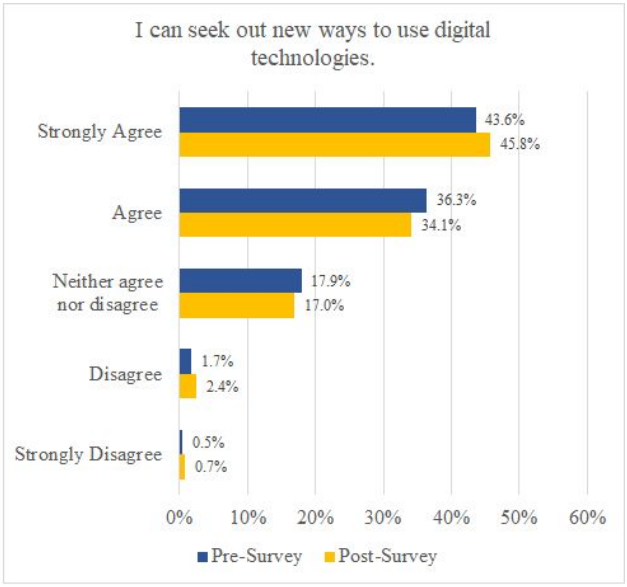


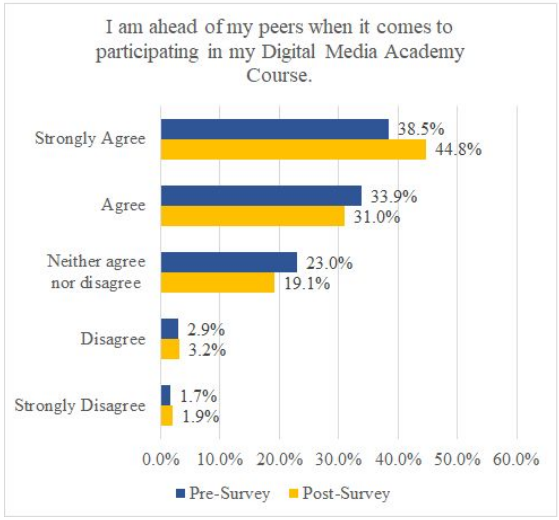


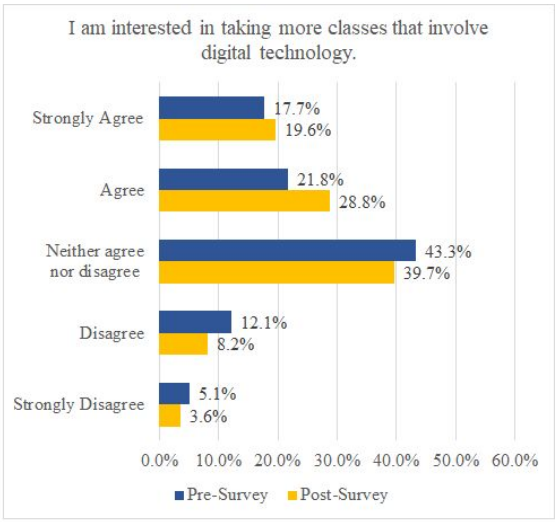





I can learn how to use cutting-edge technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
46.5%
48.2%
36.8%
34.6%
14.8%
15.5%
1.9%
1.2%
0.5%
0.5%
0%
10%
20%
30%
40%
50%
60%
Pre-Survey
Post-Survey


I can seek out new ways to use digital technologies.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
43.6%
45.8%
36.3%
34.1%
17.9%
17.0%
1.7%
2.4%
0.5%
0.7%
0%
10%
20%
30%
40%
50%
60%
Pre-Survey
Post-Survey


I am ahead of my peers when it comes to participating in my Digital Media Academy Course.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
38.5%
44.8%
33.9%
31.0%
23.0%
19.1%
2.9%
3.2%
1.7%
1.9%
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
Pre-Survey
Post-Survey


I am interested in taking more classes that involve digital technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
17.7%
19.6%
21.8%
28.8%
43.3%
39.7%
12.1%
8.2%
5.1%
3.6%
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
Pre-Survey
Post-Survey

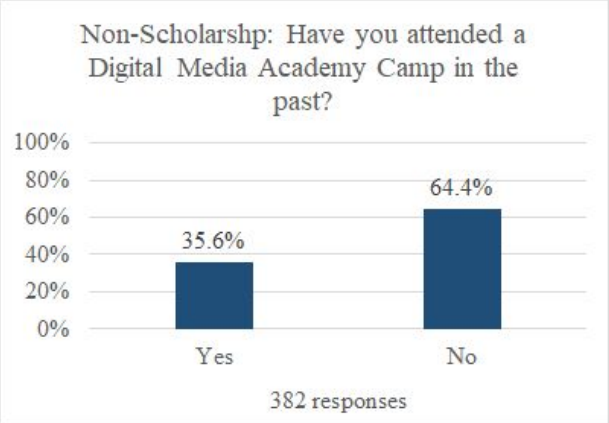
Appendix E. Non-Scholarship (N=382) versus Scholarship (N=31) Student Survey Results

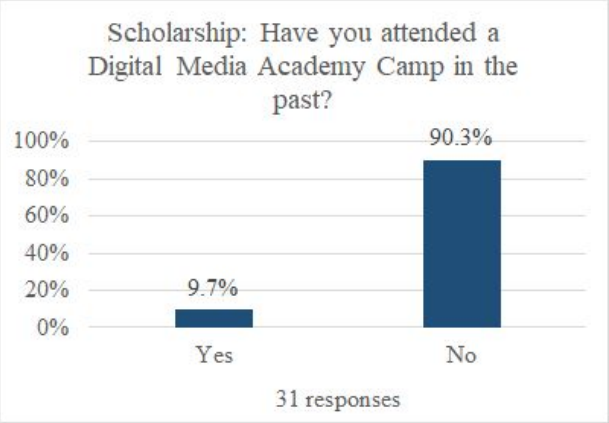
Q1. Assent.

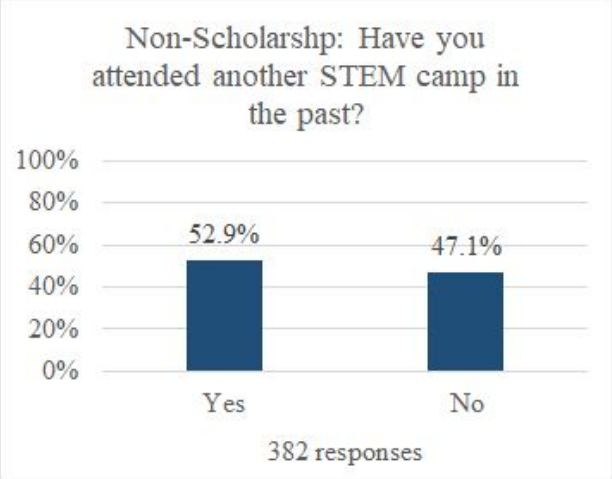
Q2. Which Digital Media Academy course are you currently taking?

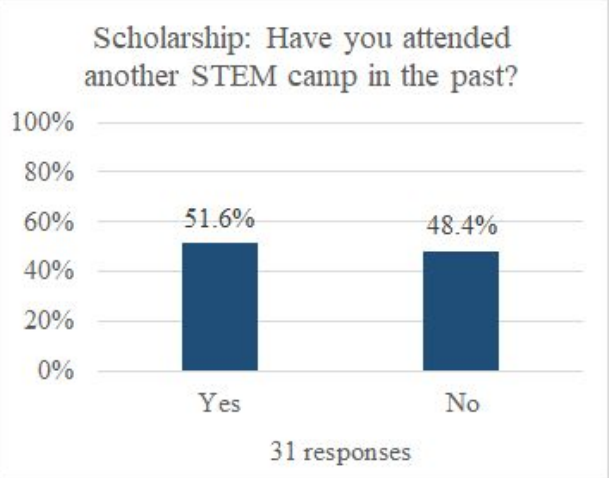
Q3. What dates are you attending this course?

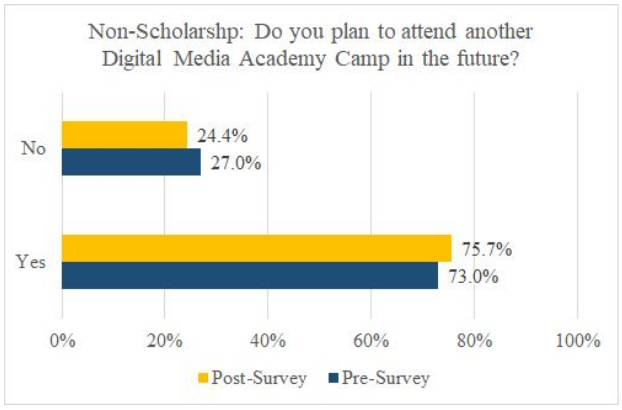
Q4. Please select Yes or No for each of the below questions.

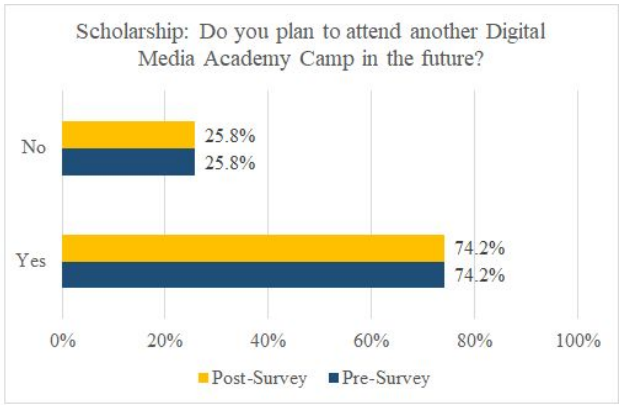


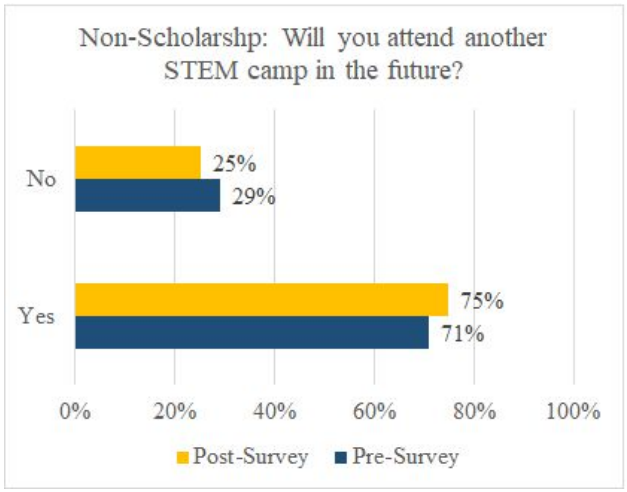


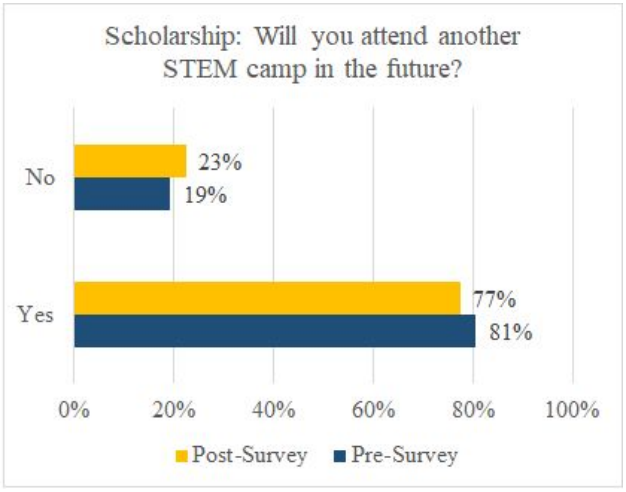


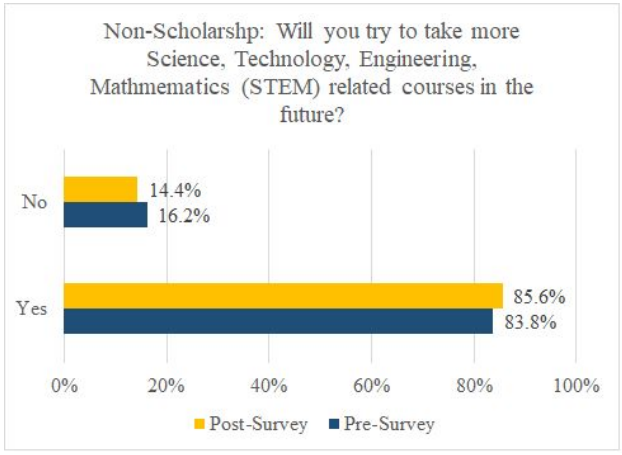


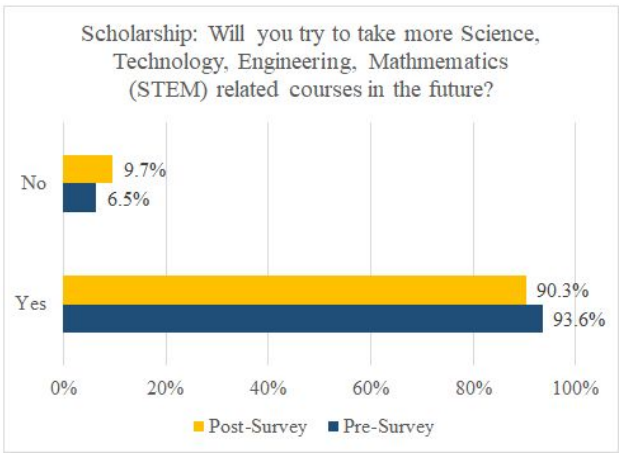

Non-Scholarshp: Do you plan to attend another Digital Media Academy Camp in the future?
No
Yes
24.4%
27.0%
75.7%
73.0%
0%
20%
40%
60%
80%
100%
Post-Survey
Pre-Survey


Scholarship: Do you plan to attend another Digital Media Academy Camp in the future?
No
Yes
25.8%
25.8%
74.2%
74.2%
0%
20%
40%
60%
80%
100%
Post-Survey
Pre-Survey


Non-Scholarshp: Will you attend another STEM camp in the future?
No
Yes
25%
29%
75%
71%
0%
20%
40%
60%
80%
100%
Post-Survey
Pre-Survey

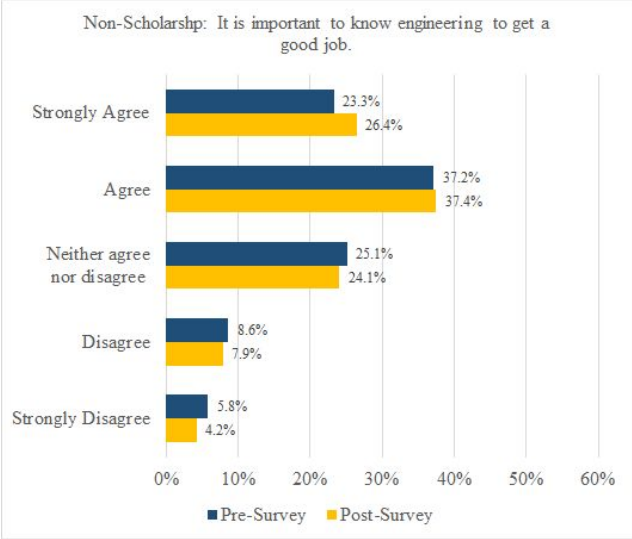

Scholarship: Will you attend another STEM camp in the future?
No
Yes
23%
19%
77%
81%
0%
20%
40%
60%
80%
100%
Post-Survey
Pre-Survey

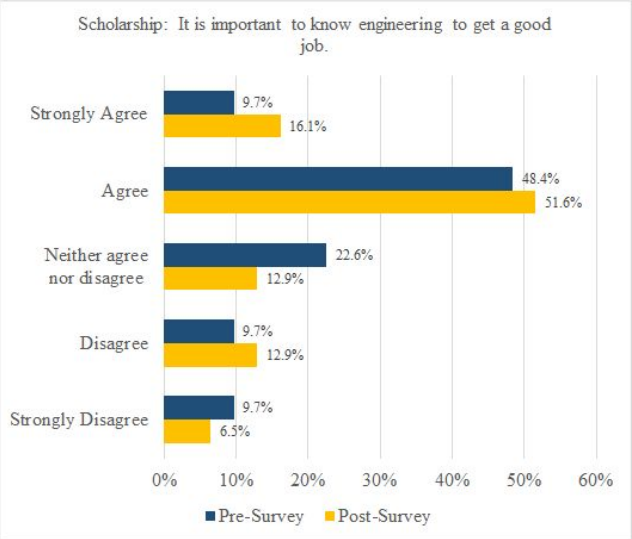

Non-Scholarshp: Will you try to take more Science, Technology, Engineering, Mathmematics (STEM) related courses in the future?
No
Yes
14.4%
16.2%
85.6%
83.8%
0%
20%
40%
60%
80%
100%
Post-Survey
Pre-Survey

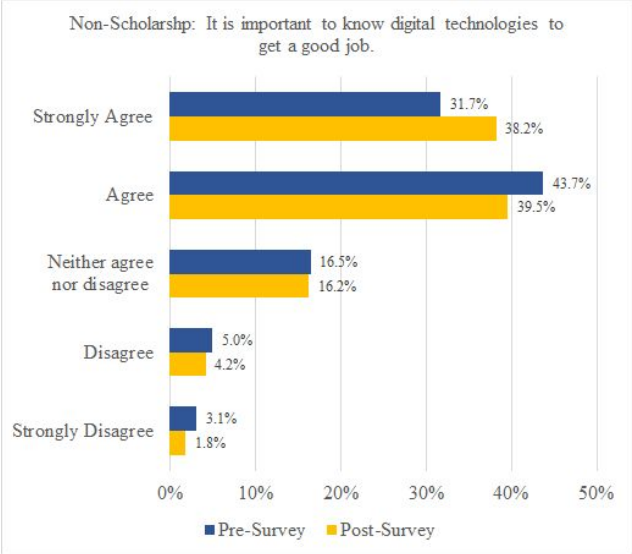

Scholarship: Will you try to take more Science, Technology, Engineering, Mathmematics (STEM) related courses in the future?
No
Yes
9.7%
6.5%
90.3%
93.6%
0%
20%
40%
60%
80%
100%
Post-Survey
Pre-Survey

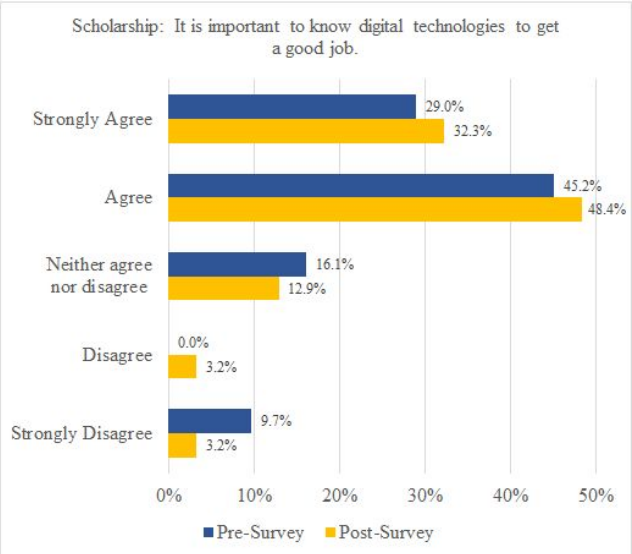
Q5. In the next part, we want to know how much you agree with each statement.
You will select from: *strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree.*

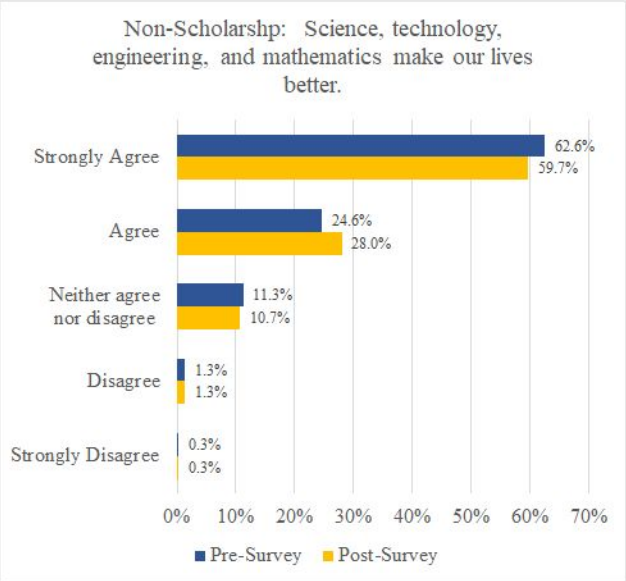
Q6. STEM Personal and Social Implications.

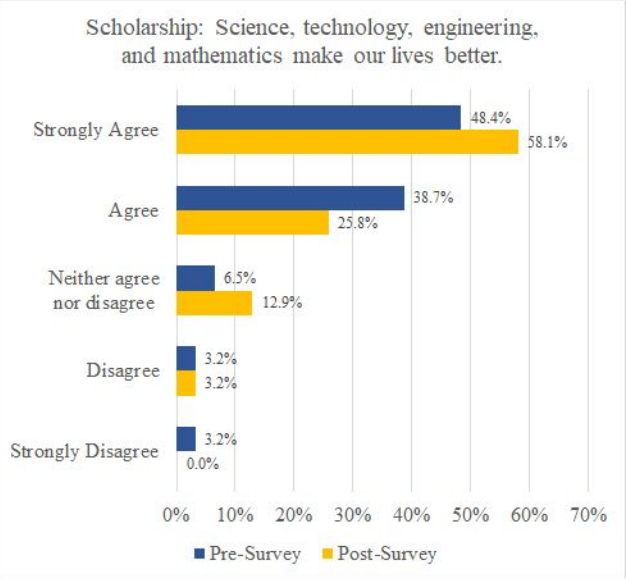


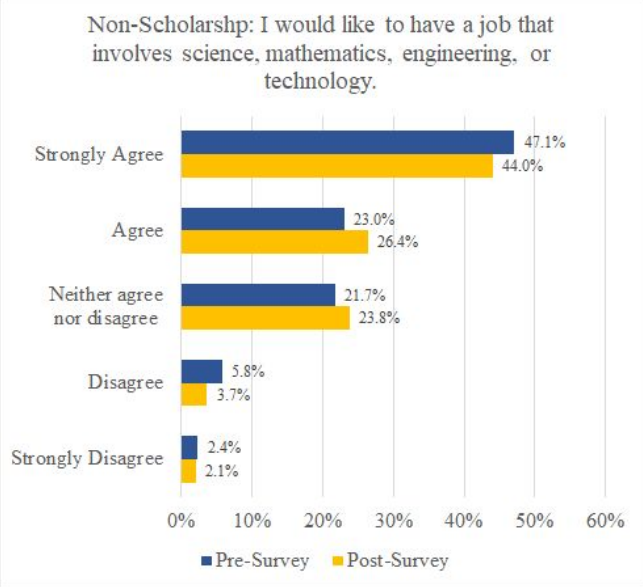


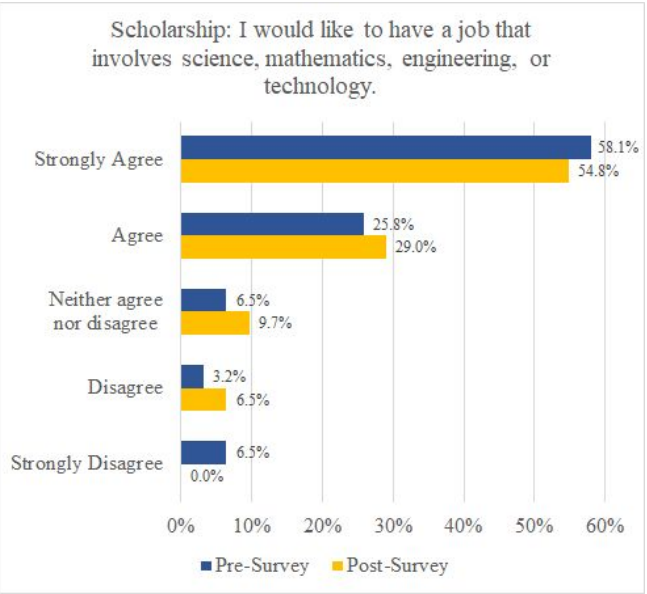




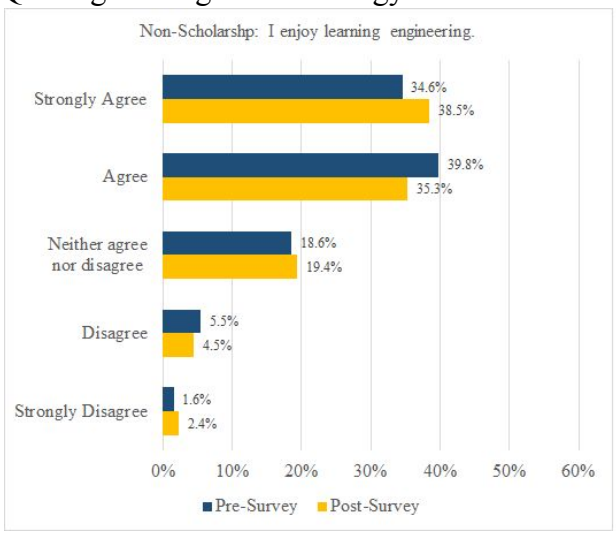

Non-Scholarshp: Science, technology, engineering, and mathematics make our lives better.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
62.6%
59.7%
24.6%
28.0%
11.3%
10.7%
1.3%
1.3%
0.3%
0.3%
0% 10% 20% 30% 40% 50% 60% 70%
Pre-Survey
Post-Survey

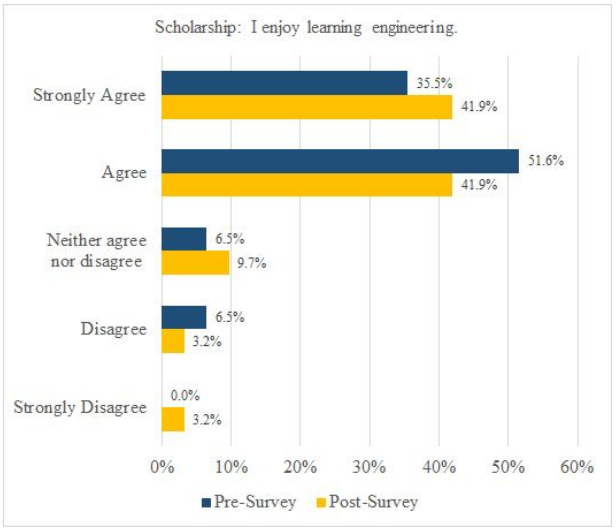

Scholarship: Science, technology, engineering, and mathematics make our lives better.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
48.4%
58.1%
38.7%
25.8%
6.5%
12.9%
3.2%
3.2%
3.2%
0.0%
0% 10% 20% 30% 40% 50% 60% 70%
Pre-Survey
Post-Survey

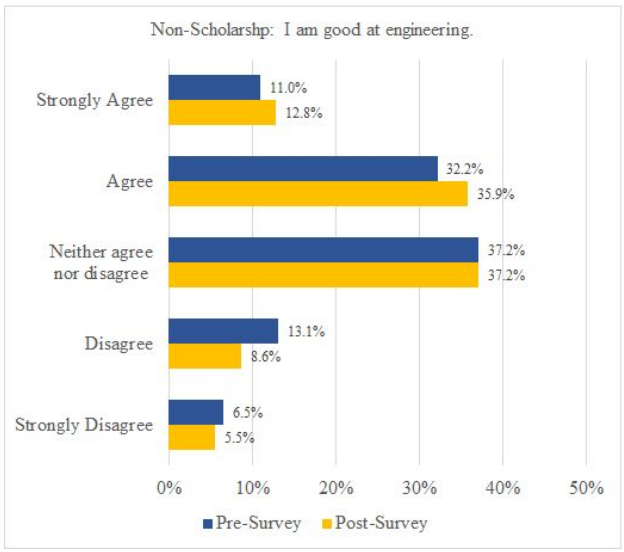

Non-Scholarshp: I would like to have a job that involves science, mathematics, engineering, or technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
47.1%
44.0%
23.0%
26.4%
21.7%
23.8%
5.8%
3.7%
2.4%
2.1%
0% 10% 20% 30% 40% 50% 60%
Pre-Survey
Post-Survey

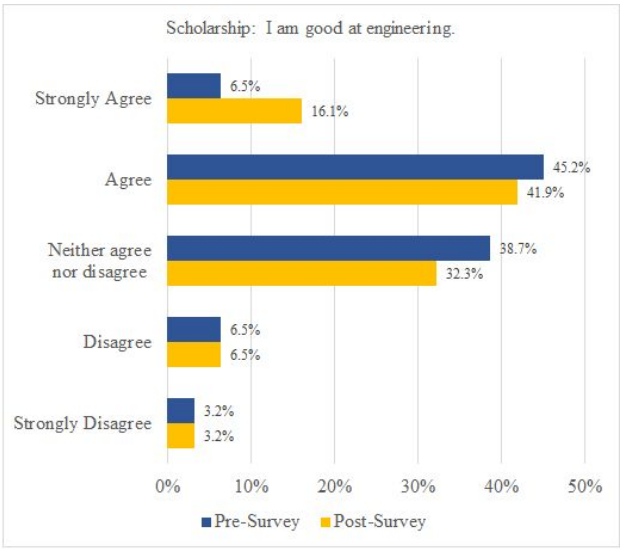

Scholarship: I would like to have a job that involves science, mathematics, engineering, or technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
58.1%
54.8%
25.8%
29.0%
6.5%
9.7%
3.2%
6.5%
6.5%
0.0%
0% 10% 20% 30% 40% 50% 60%
Pre-Survey
Post-Survey

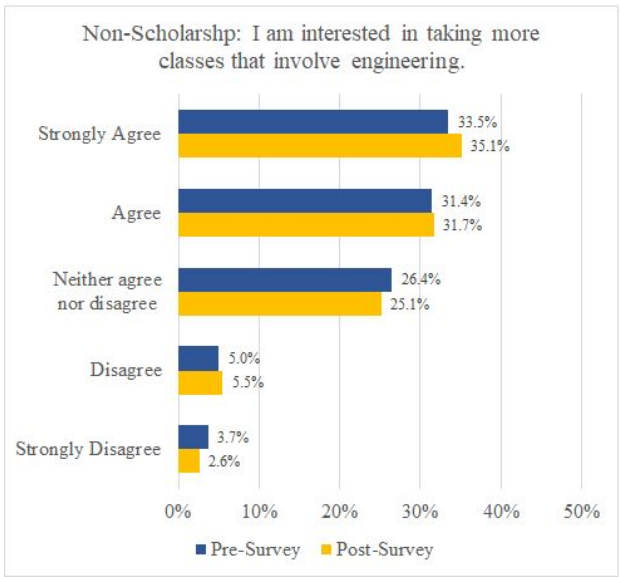
Q7. Engineering & Technology.

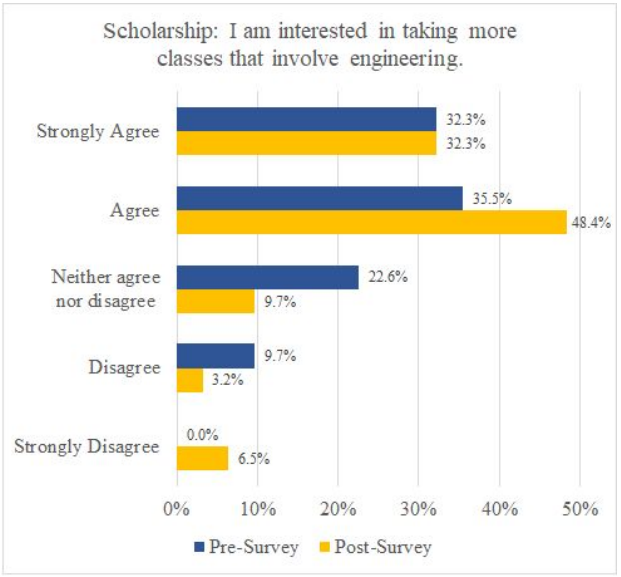


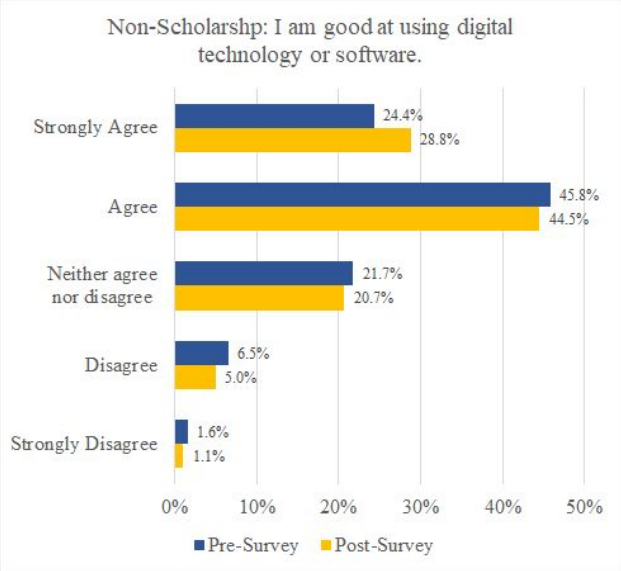


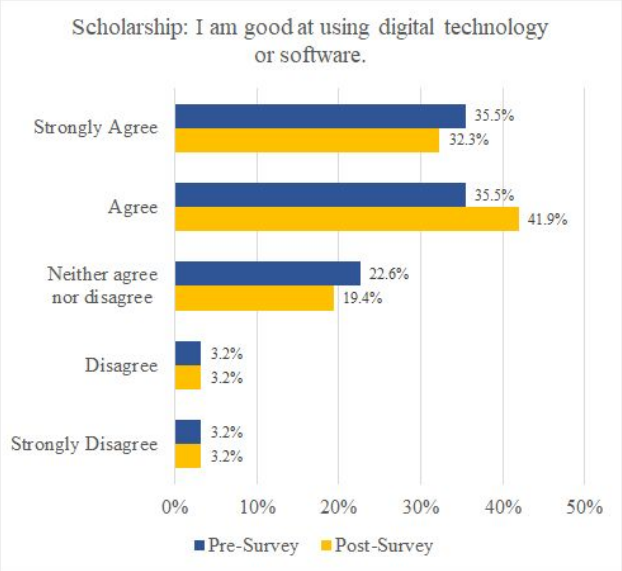


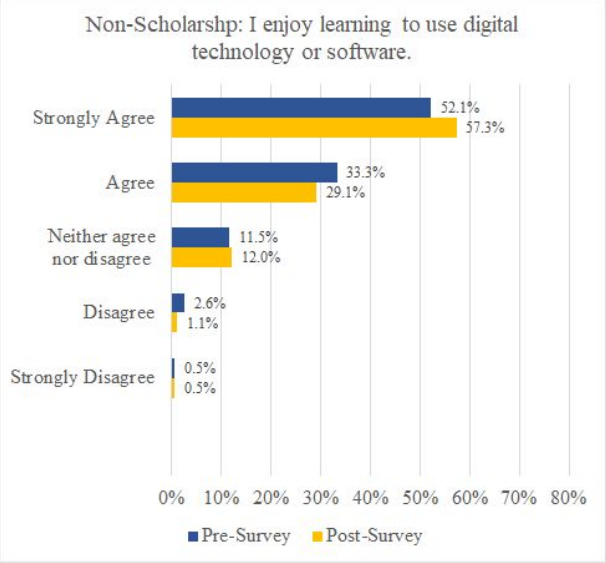


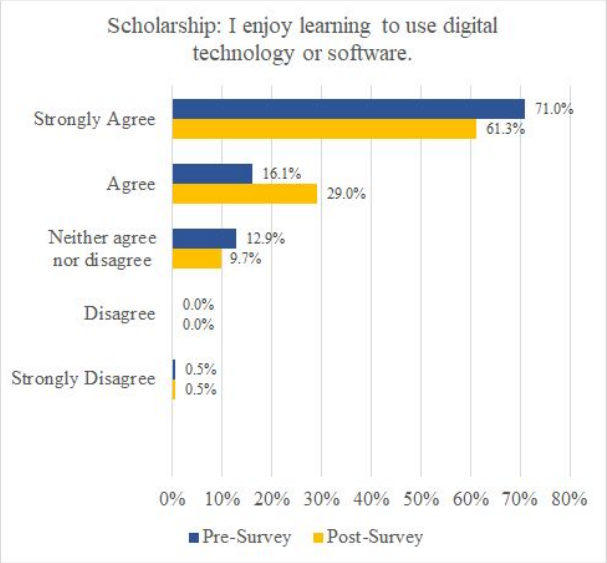


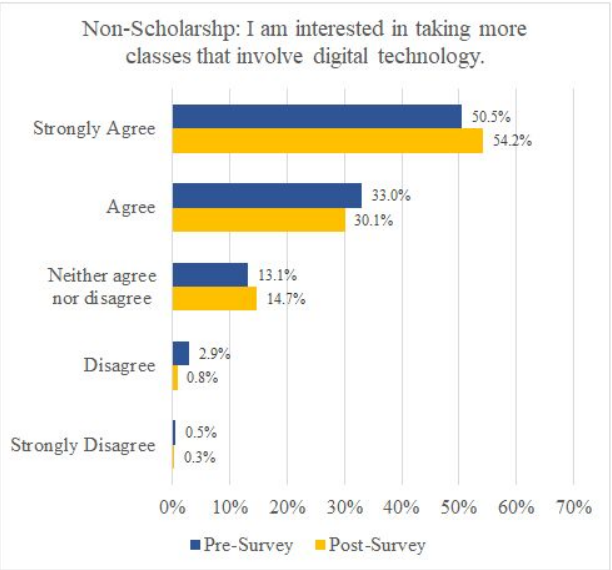


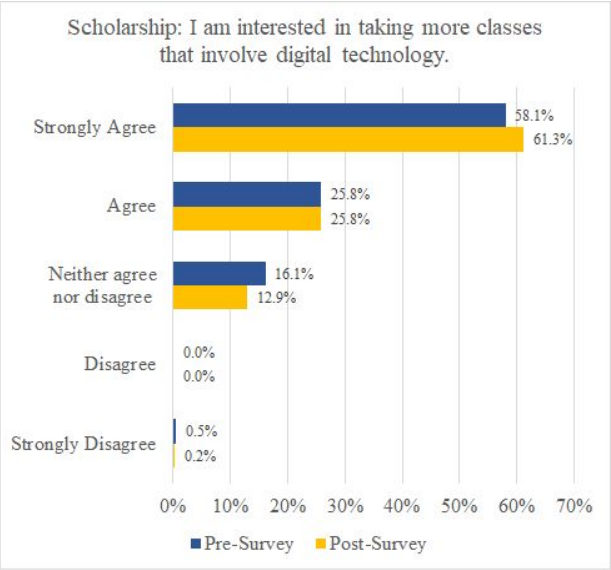

Non-Scholarshp: I am good at using digital technology or software.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
24.4%
28.8%
45.8%
44.5%
21.7%
20.7%
6.5%
5.0%
1.6%
1.1%
0%
10%
20%
30%
40%
50%
Pre-Survey
Post-Survey


Scholarship: I am good at using digital technology or software.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
35.5%
32.3%
35.5%
41.9%
22.6%
19.4%
3.2%
3.2%
3.2%
3.2%
0%
10%
20%
30%
40%
50%
Pre-Survey
Post-Survey

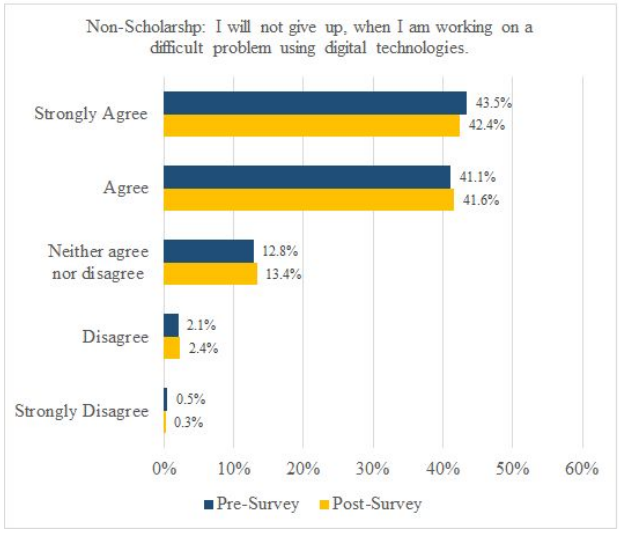

Non-Scholarshp: I enjoy learning to use digital technology or software.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
52.1%
57.3%
33.3%
29.1%
11.5%
12.0%
2.6%
1.1%
0.5%
0.5%
0%
10%
20%
30%
40%
50%
60%
70%
80%
Pre-Survey
Post-Survey

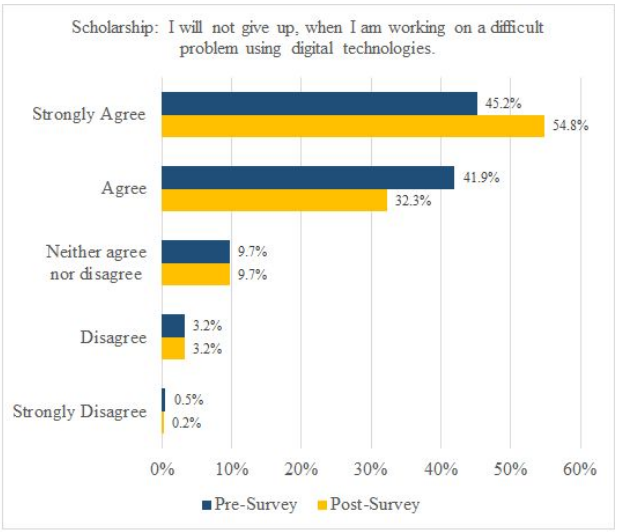

Scholarship: I enjoy learning to use digital technology or software.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
71.0%
61.3%
16.1%
29.0%
12.9%
9.7%
0.0%
0.0%
0.5%
0.5%
0%
10%
20%
30%
40%
50%
60%
70%
80%
Pre-Survey
Post-Survey

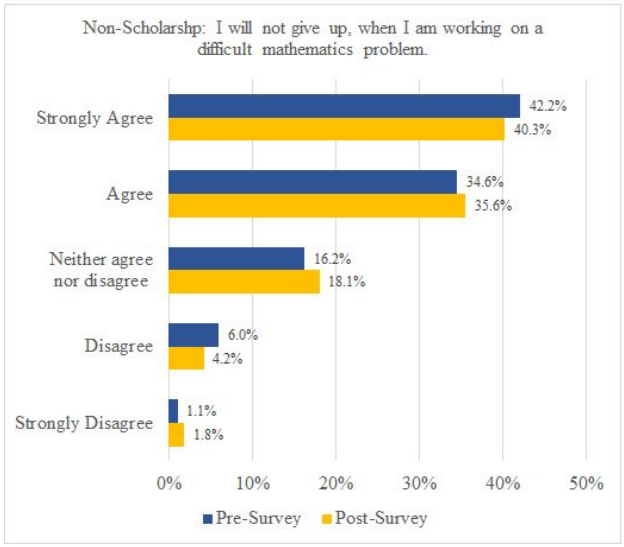

Non-Scholarshp: I am interested in taking more classes that involve digital technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
50.5%
54.2%
33.0%
30.1%
13.1%
14.7%
2.9%
0.8%
0.5%
0.3%
0%
10%
20%
30%
40%
50%
60%
70%
Pre-Survey
Post-Survey

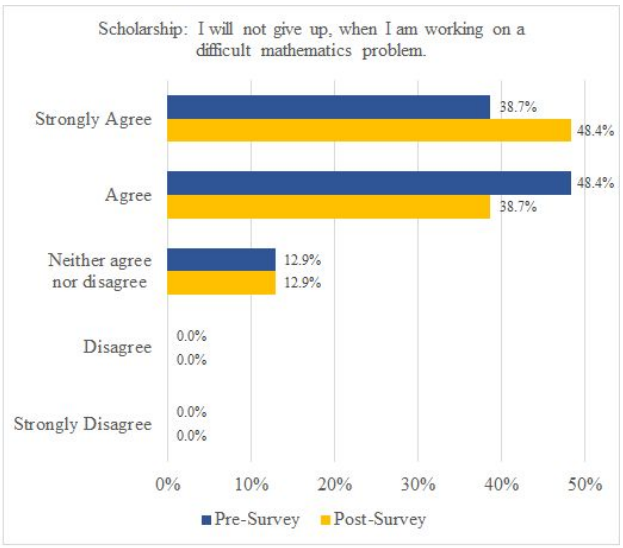

Scholarship: I am interested in taking more classes that involve digital technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
58.1%
61.3%
25.8%
25.8%
16.1%
12.9%
0.0%
0.0%
0.5%
0.2%
0%
10%
20%
30%
40%
50%
60%
70%
Pre-Survey
Post-Survey

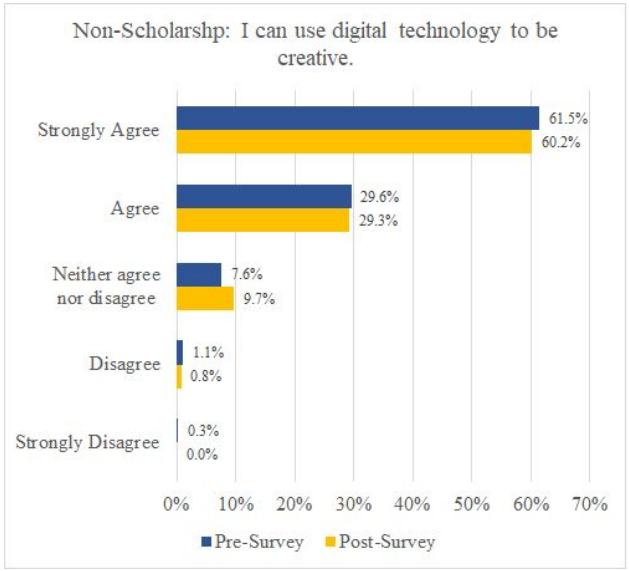
Q8. Persistence and Creativity.

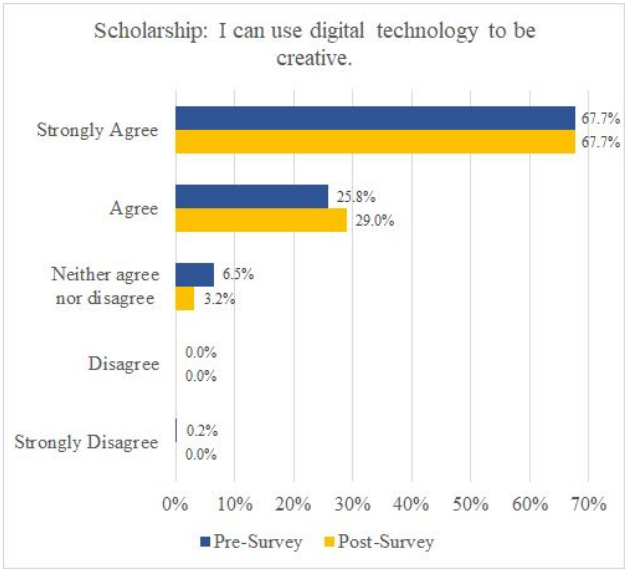


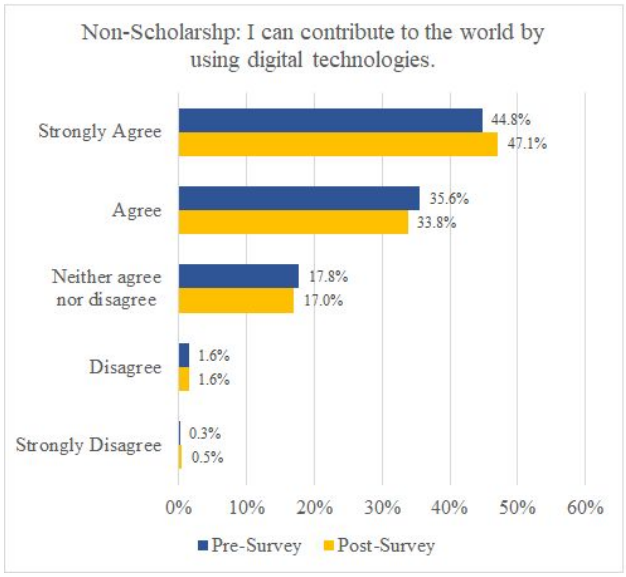


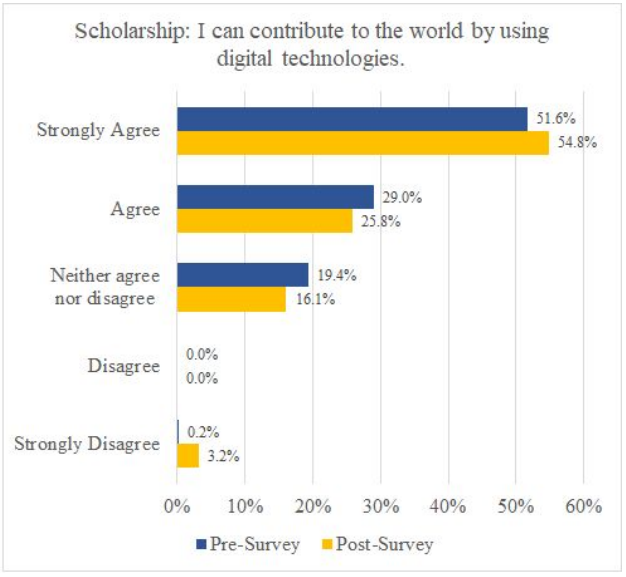


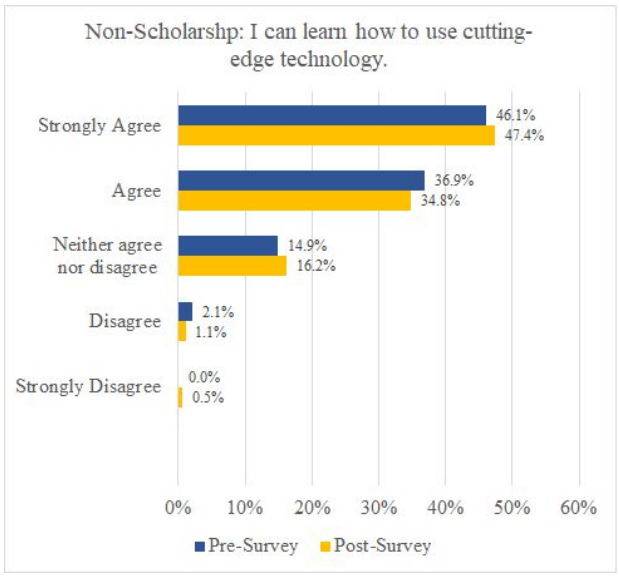


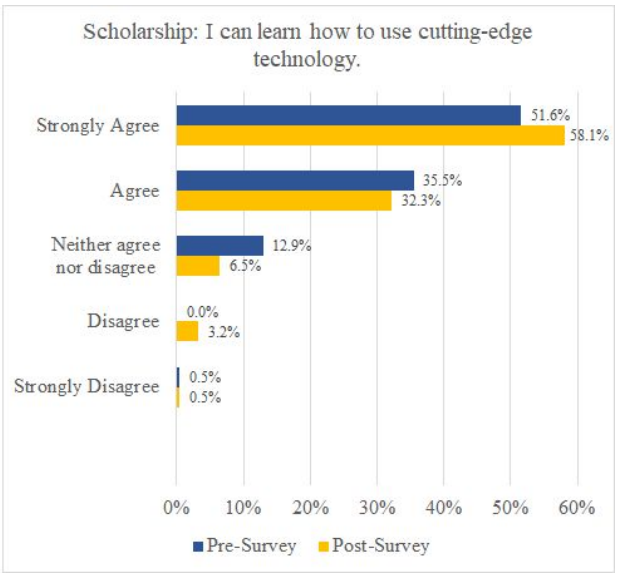


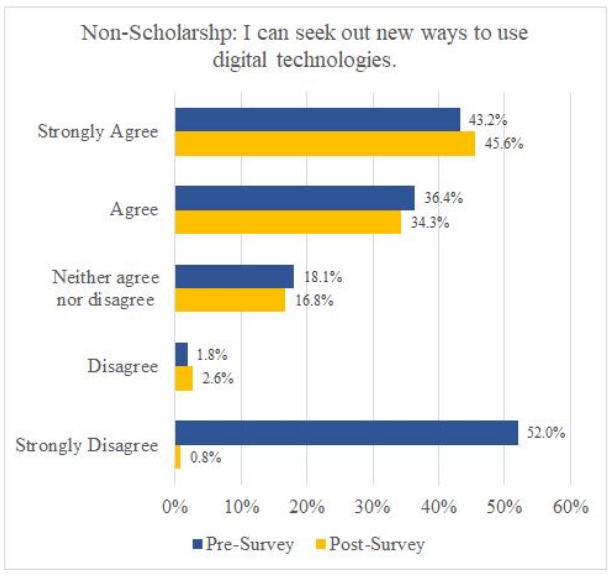


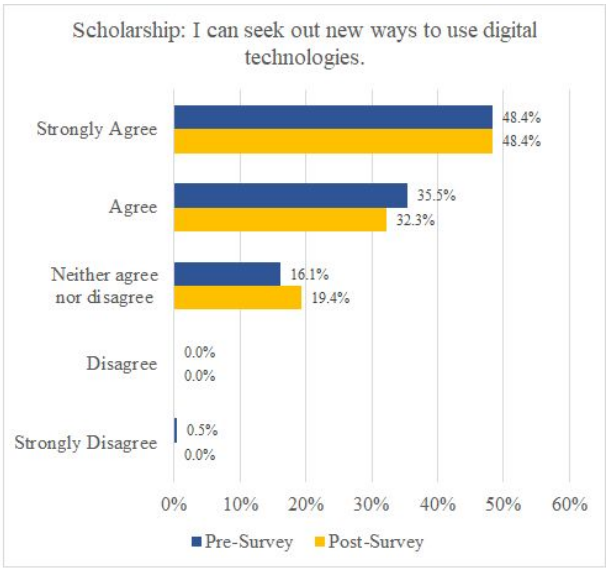

Non-Scholarshp: I can contribute to the world by using digital technologies.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
44.8%
47.1%
35.6%
33.8%
17.8%
17.0%
1.6%
1.6%
0.3%
0.5%
0%
10%
20%
30%
40%
50%
60%
Pre-Survey
Post-Survey

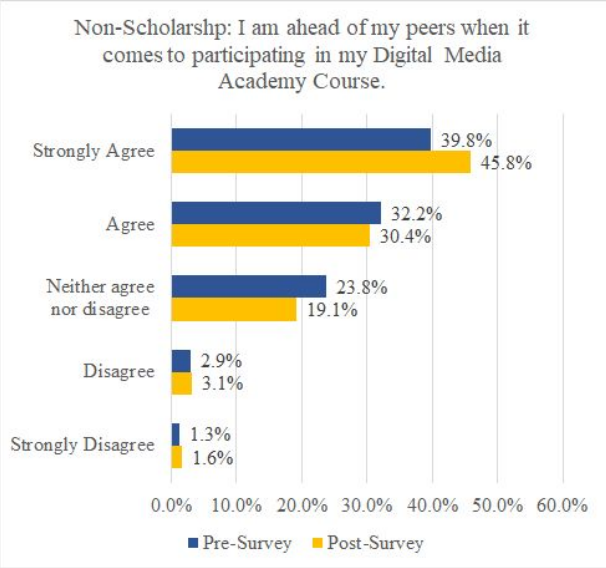

Scholarship: I can contribute to the world by using digital technologies.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
51.6%
54.8%
29.0%
25.8%
19.4%
16.1%
0.0%
0.0%
0.2%
3.2%
0%
10%
20%
30%
40%
50%
60%
Pre-Survey
Post-Survey

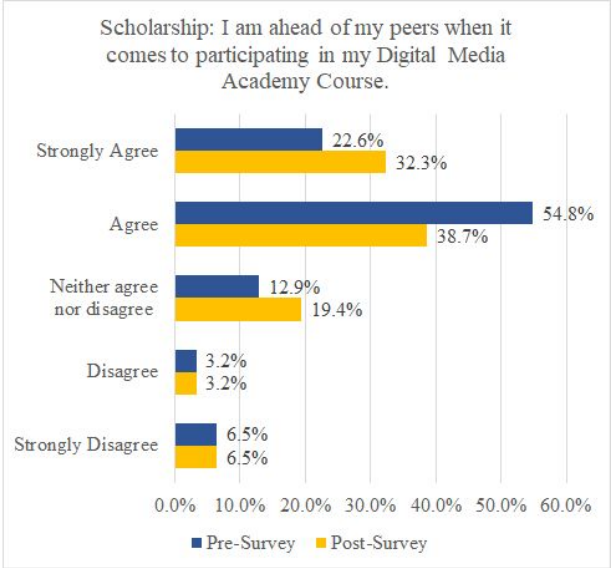

Non-Scholarshp: I can learn how to use cutting-edge technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
46.1%
47.4%
36.9%
34.8%
14.9%
16.2%
2.1%
1.1%
0.0%
0.5%
0%
10%
20%
30%
40%
50%
60%
Pre-Survey
Post-Survey

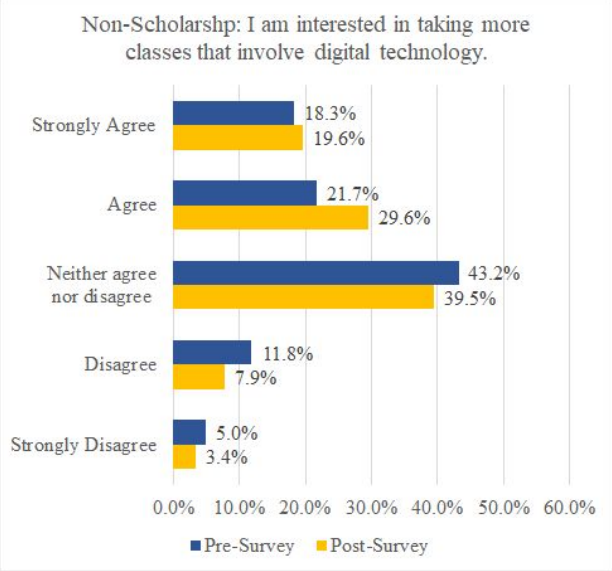

Scholarship: I can learn how to use cutting-edge technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
51.6%
58.1%
35.5%
32.3%
12.9%
6.5%
0.0%
3.2%
0.5%
0.5%
0%
10%
20%
30%
40%
50%
60%
Pre-Survey
Post-Survey

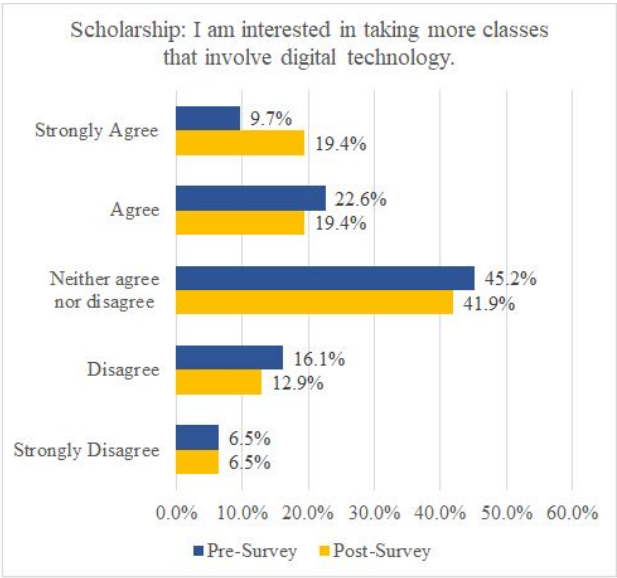

Non-Scholarshp: I can seek out new ways to use digital technologies.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
43.2%
45.6%
36.4%
34.3%
18.1%
16.8%
1.8%
2.6%
52.0%
0.8%
0%
10%
20%
30%
40%
50%
60%
Pre-Survey
Post-Survey


Scholarship: I can seek out new ways to use digital technologies.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
48.4%
48.4%
35.5%
32.3%
16.1%
19.4%
0.0%
0.0%
0.5%
0.0%
0%
10%
20%
30%
40%
50%
60%
Pre-Survey
Post-Survey


Non-Scholarshp: I am ahead of my peers when it comes to participating in my Digital Media Academy Course.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
39.8%
45.8%
32.2%
30.4%
23.8%
19.1%
2.9%
3.1%
1.3%
1.6%
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0%
Pre-Survey
Post-Survey

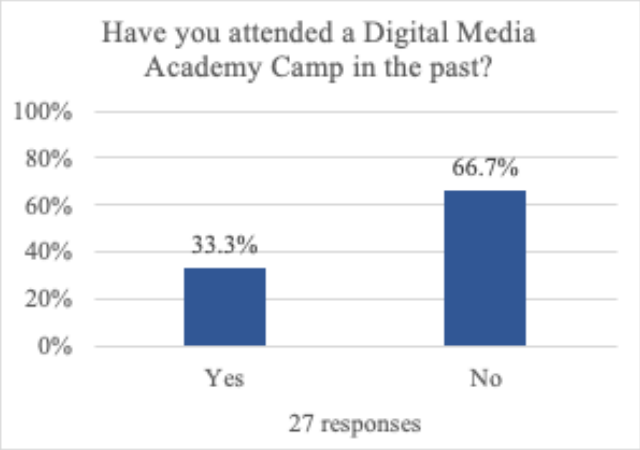

Scholarship: I am ahead of my peers when it comes to participating in my Digital Media Academy Course.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
22.6%
32.3%
54.8%
38.7%
12.9%
19.4%
3.2%
3.2%
6.5%
6.5%
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0%
Pre-Survey
Post-Survey

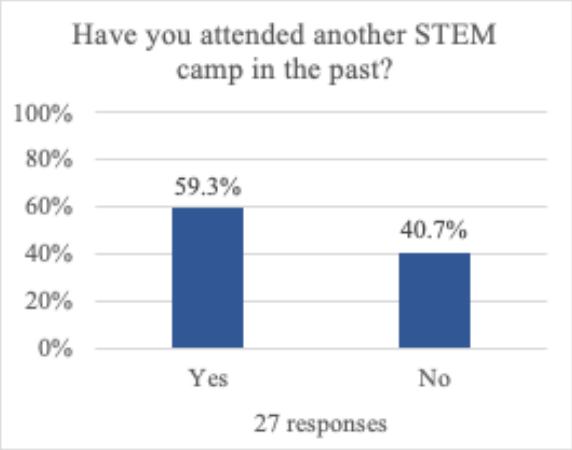

Non-Scholarshp: I am interested in taking more classes that involve digital technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
18.3%
19.6%
21.7%
29.6%
43.2%
39.5%
11.8%
7.9%
5.0%
3.4%
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0%
Pre-Survey
Post-Survey

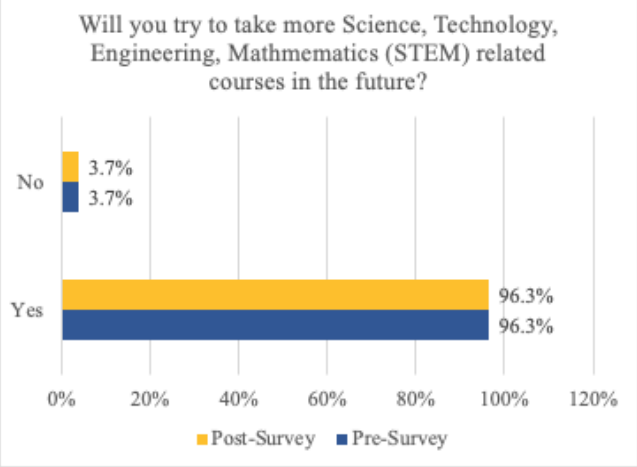

Scholarship: I am interested in taking more classes that involve digital technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
9.7%
19.4%
22.6%
19.4%
45.2%
41.9%
16.1%
12.9%
6.5%
6.5%
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0%
Pre-Survey
Post-Survey

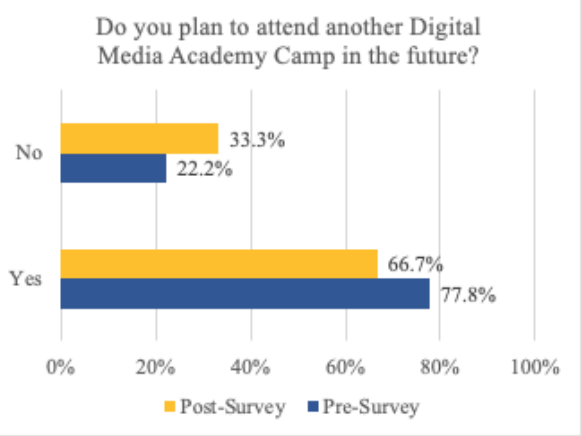
Appendix F. AI & Machine Learning with Python Survey Results (N=27)

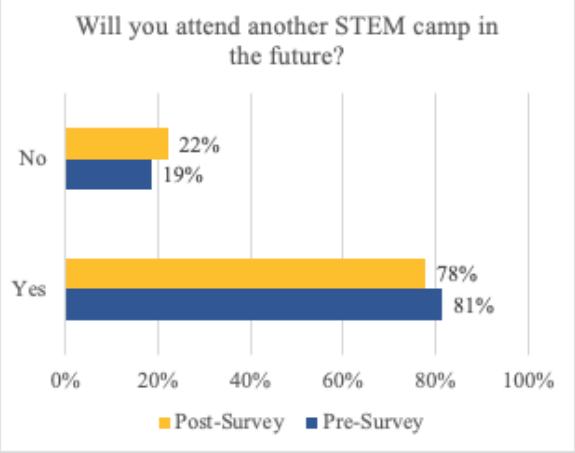
Q1. Assent.
Q2. Which Digital Media Academy course are you currently taking?
Q3. What dates are you attending this course?
Q4. Please select Yes or No for each of the below questions.





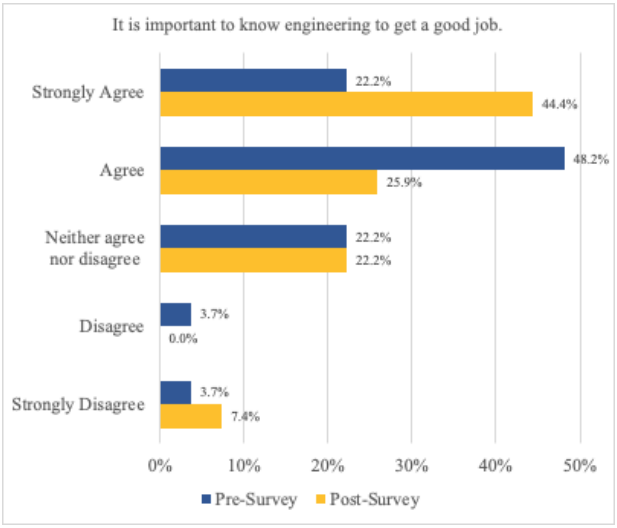


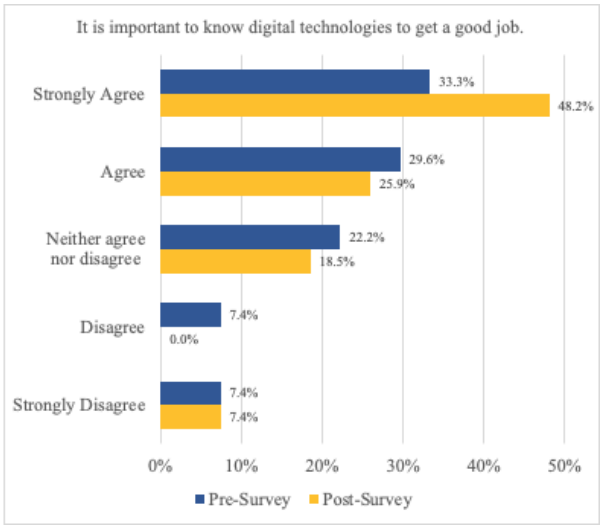


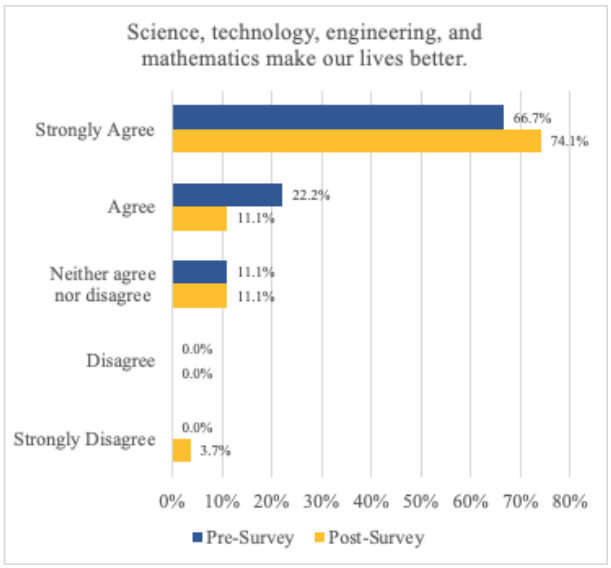


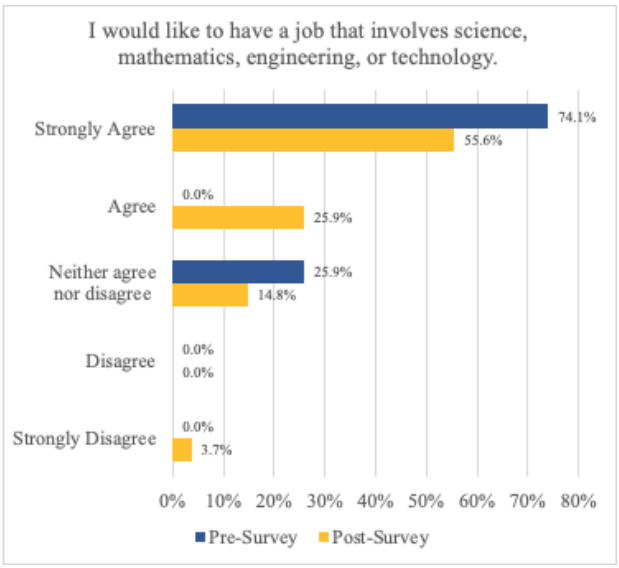
Q5. In the next part, we want to know how much you agree with each statement.
You will select from: *strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree.*

Q6. STEM Personal and Social Implications.

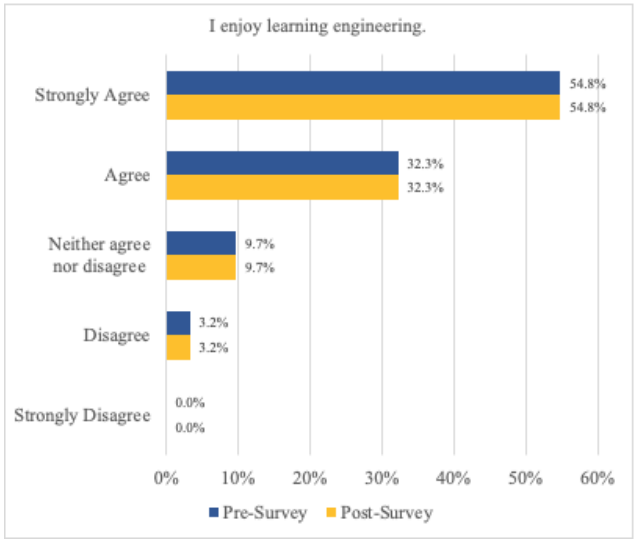


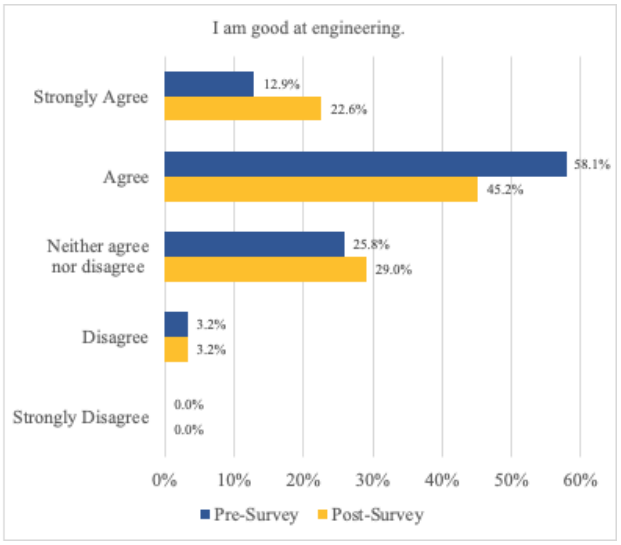


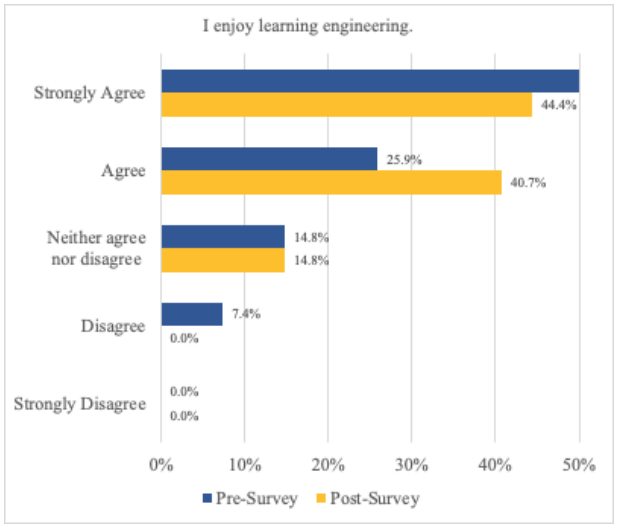


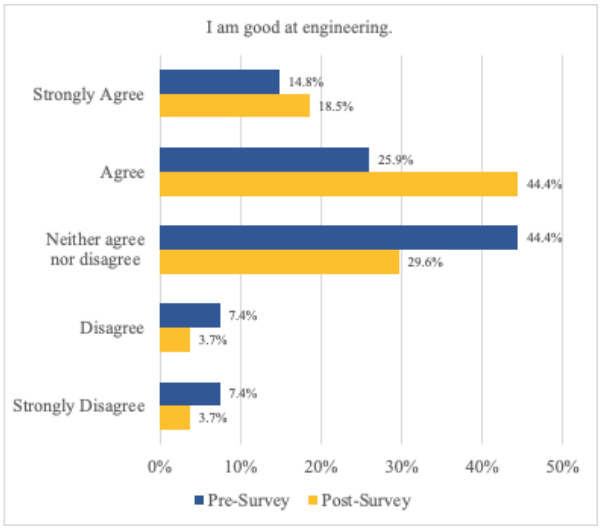


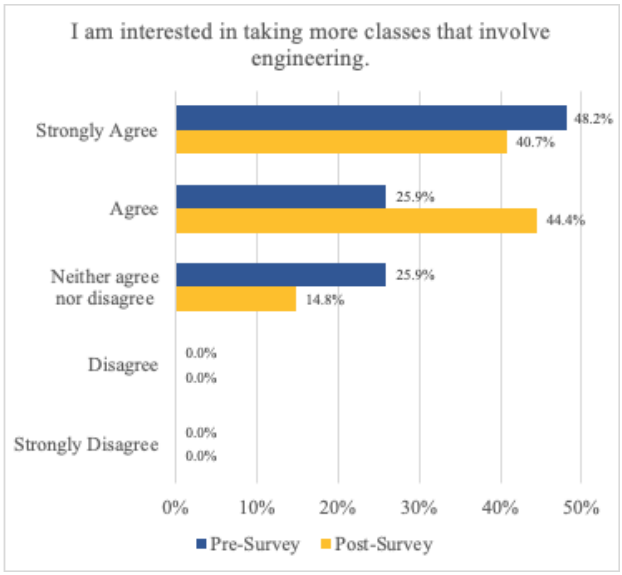
Q7. Engineering & Technology.

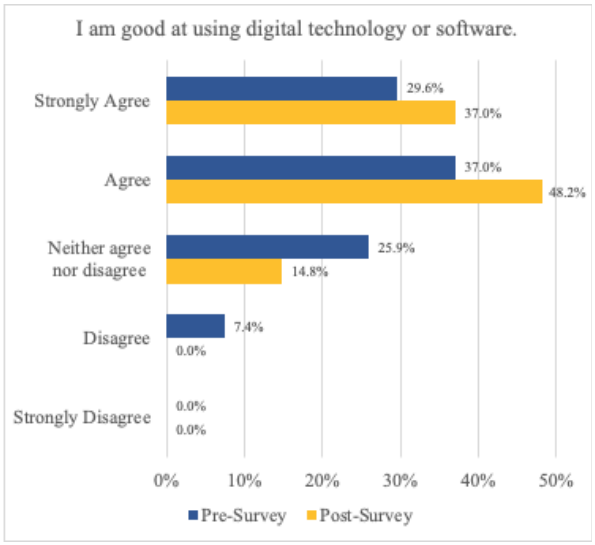




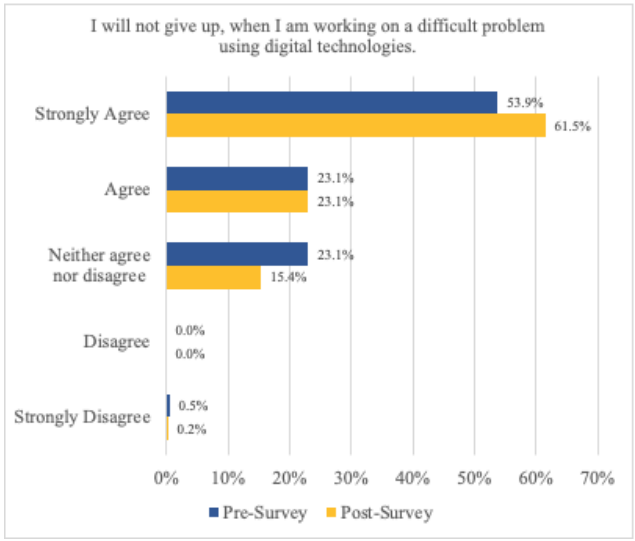


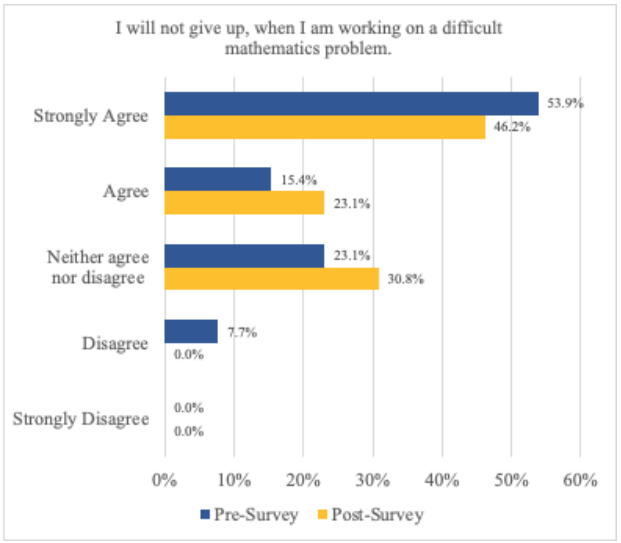


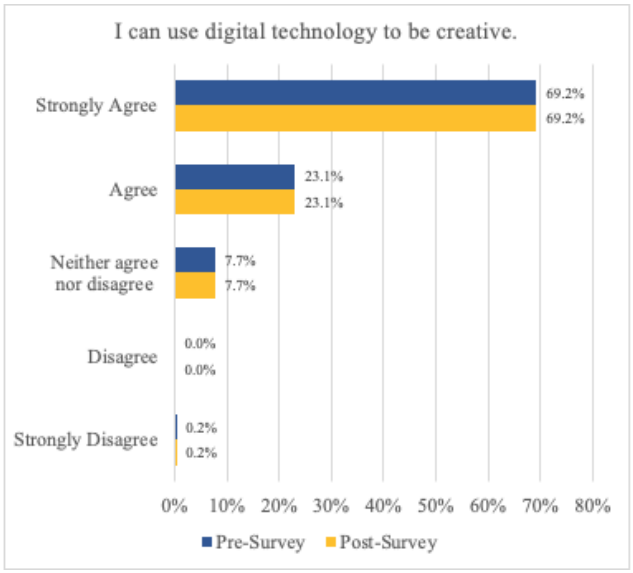


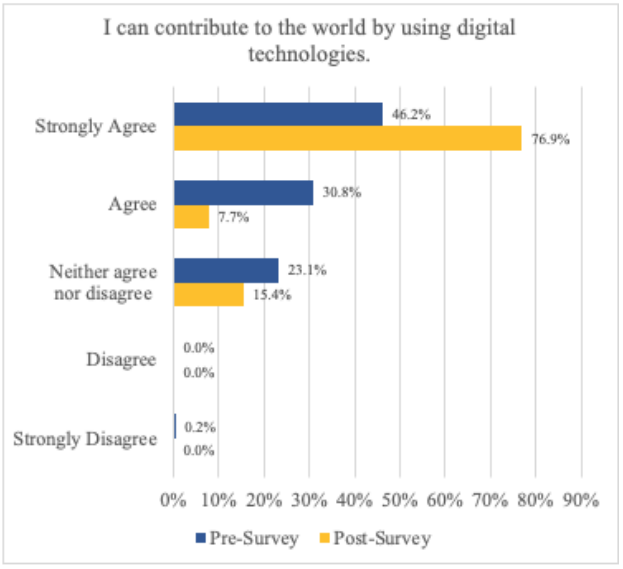


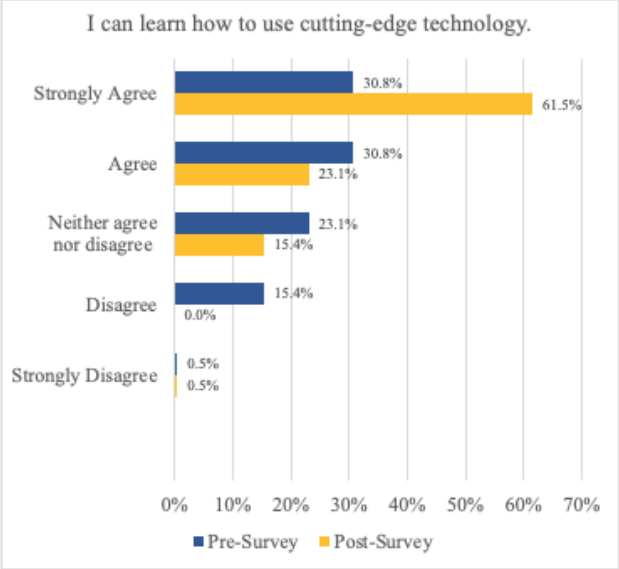
Q8. Persistence and Creativity.

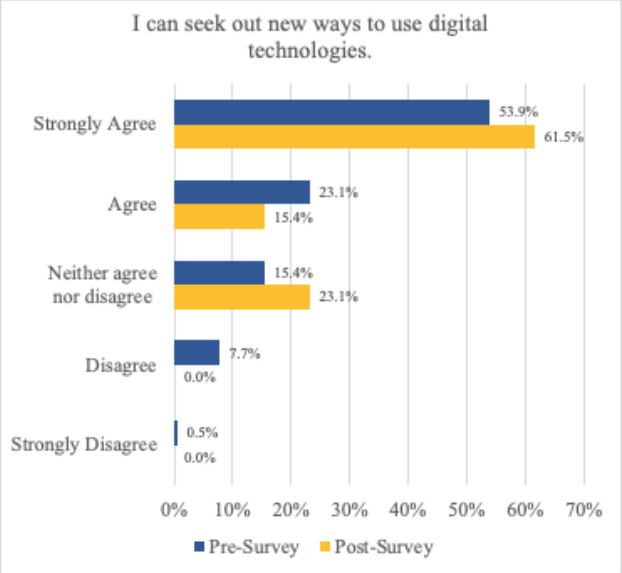


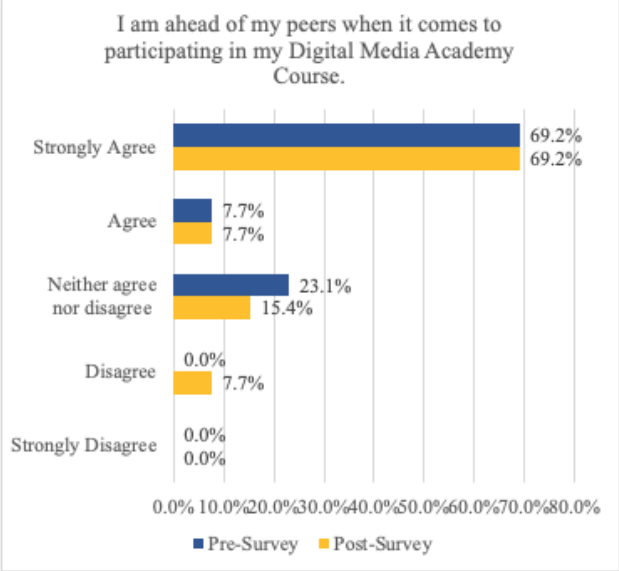


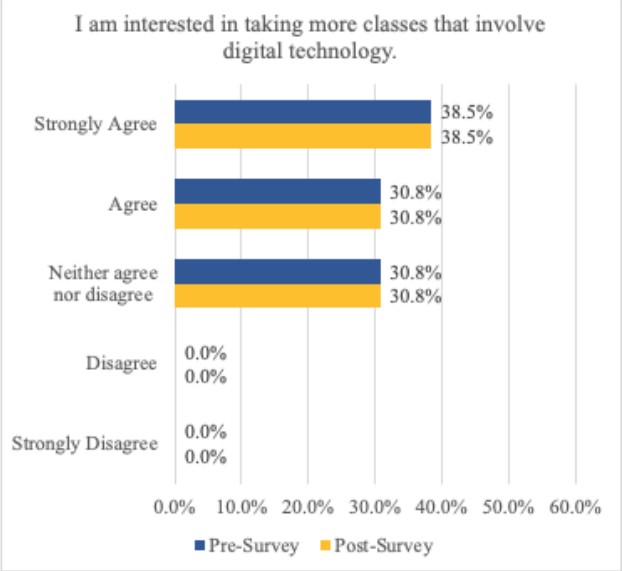





I can learn how to use cutting-edge technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
30.8%
61.5%
30.8%
23.1%
23.1%
15.4%
15.4%
0.0%
0.5%
0.5%
0% 10% 20% 30% 40% 50% 60% 70%
Pre-Survey
Post-Survey

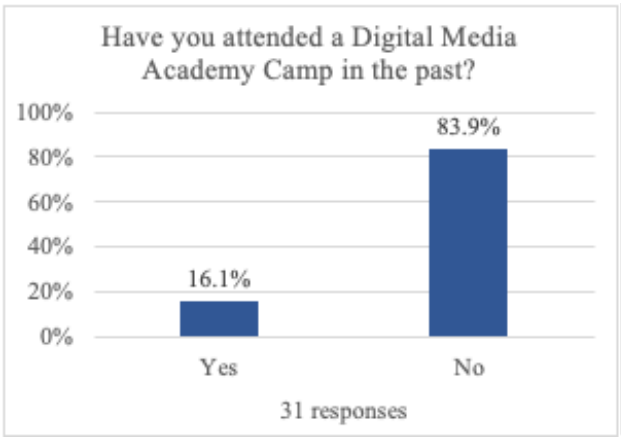

I can seek out new ways to use digital technologies.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
53.9%
61.5%
23.1%
15.4%
15.4%
23.1%
7.7%
0.0%
0.5%
0.0%
0% 10% 20% 30% 40% 50% 60% 70%
Pre-Survey
Post-Survey

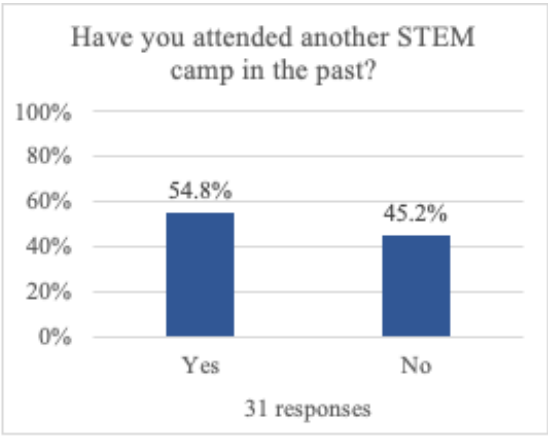

I am ahead of my peers when it comes to participating in my Digital Media Academy Course.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
69.2%
69.2%
7.7%
7.7%
23.1%
15.4%
0.0%
7.7%
0.0%
0.0%
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0% 70.0% 80.0%
Pre-Survey
Post-Survey

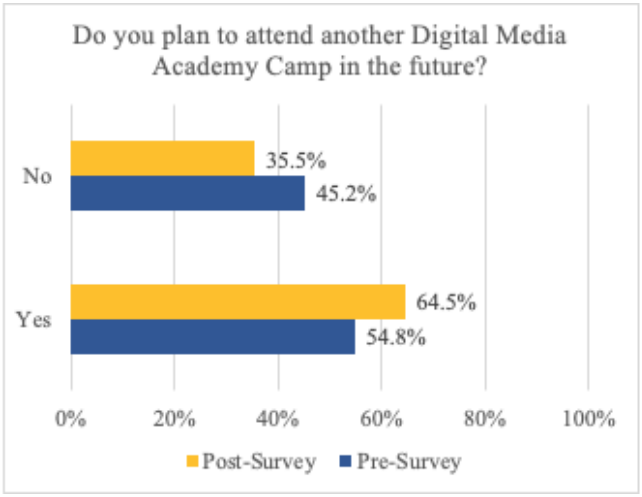

I am interested in taking more classes that involve digital technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
38.5%
38.5%
30.8%
30.8%
30.8%
30.8%
0.0%
0.0%
0.0%
0.0%
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0%
Pre-Survey
Post-Survey

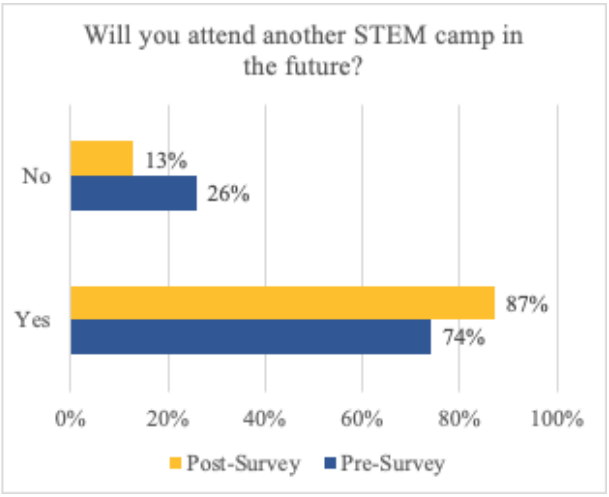
Appendix G. Autonomous Arduino with Take-Home Robot Survey Results (N=31)

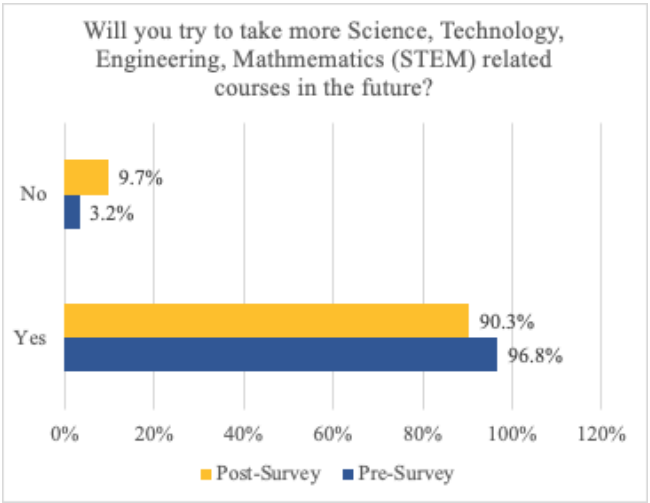
Q1. Assent.
Q2. Which Digital Media Academy course are you currently taking?
Q3. What dates are you attending this course?
Q4. Please select Yes or No for each of the below questions.





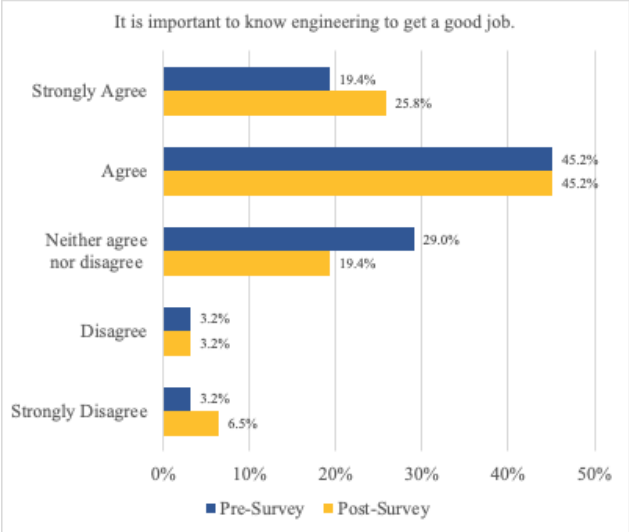


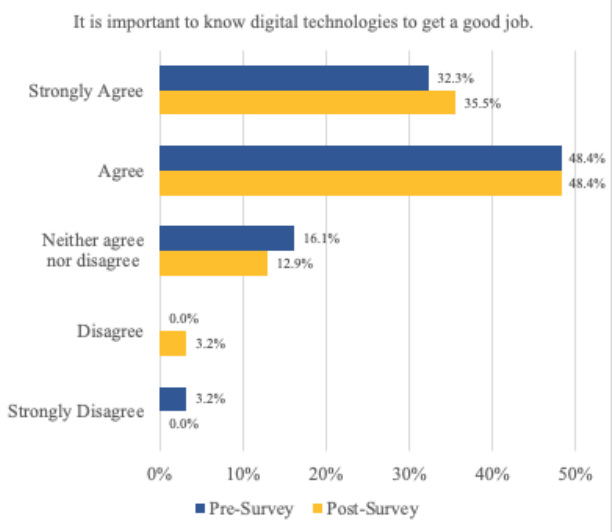


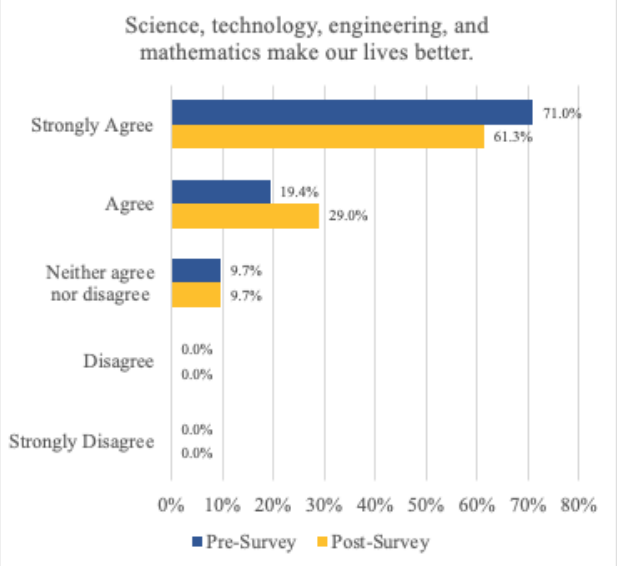


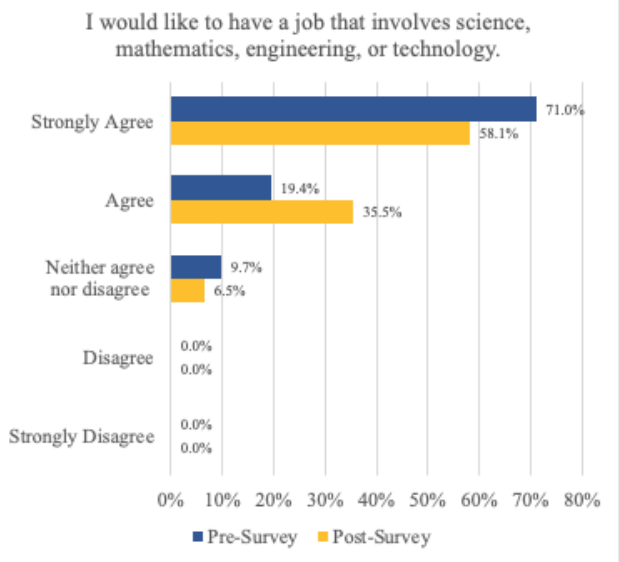
Q5. In the next part, we want to know how much you agree with each statement.
You will select from: *strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree.*

Q6. STEM Personal and Social Implications.

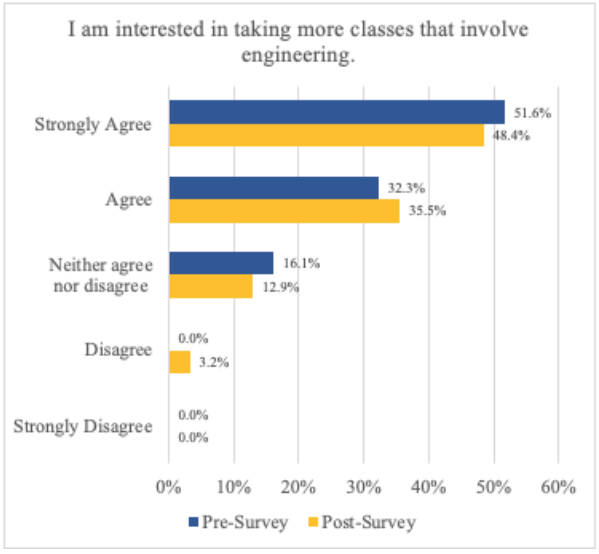


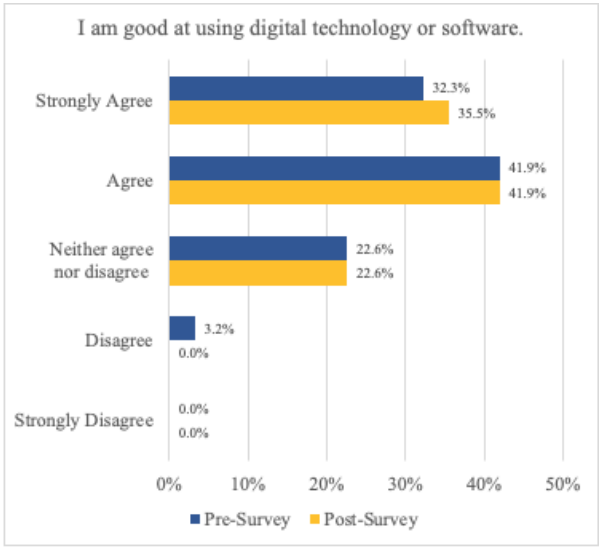


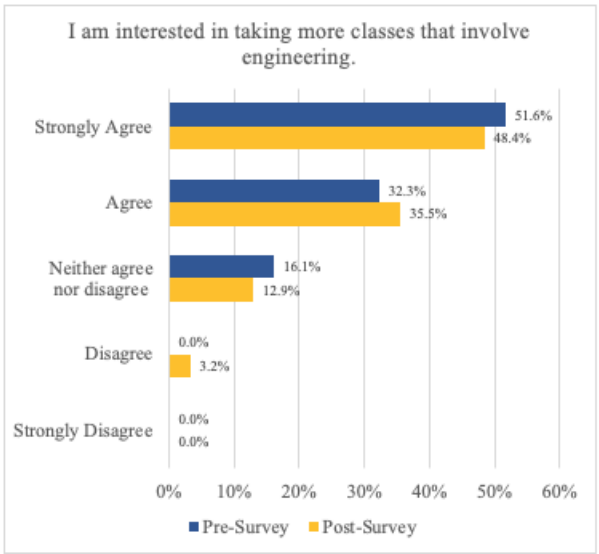


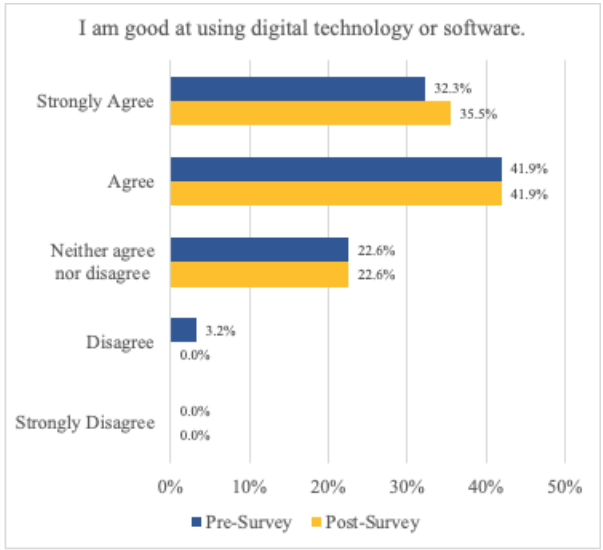


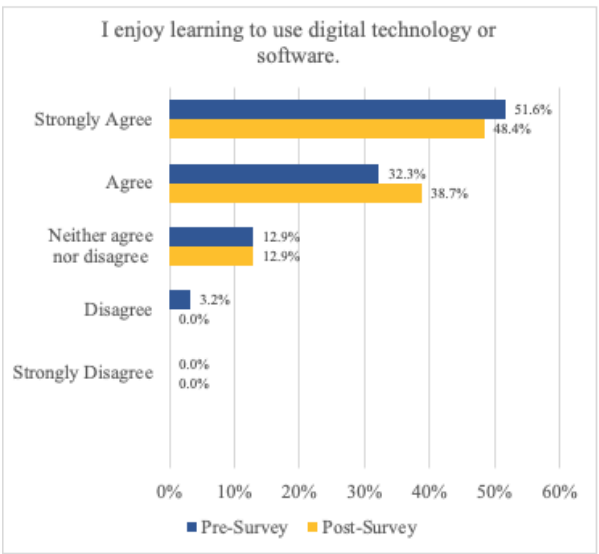
Q7. Engineering & Technology.

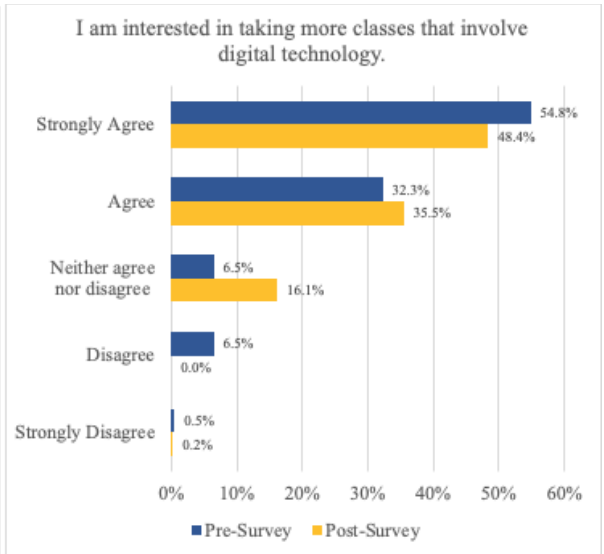




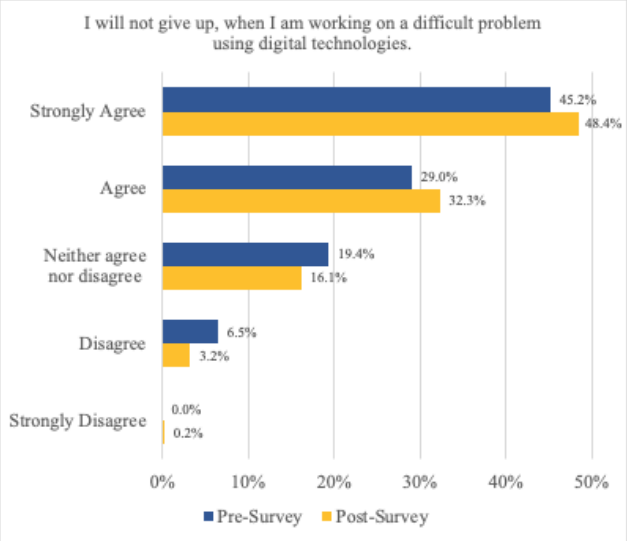


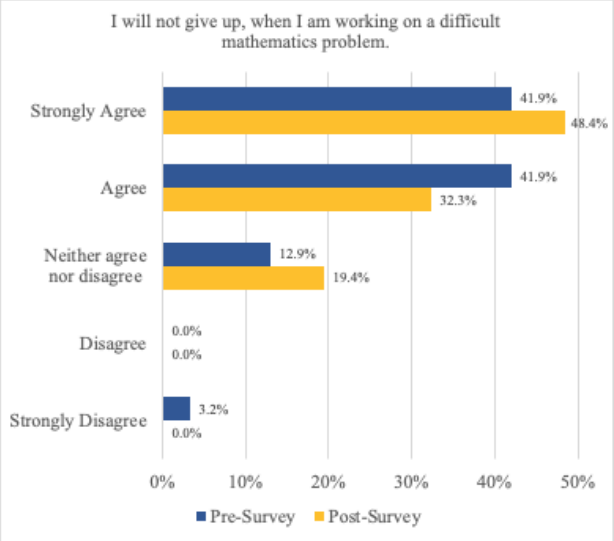


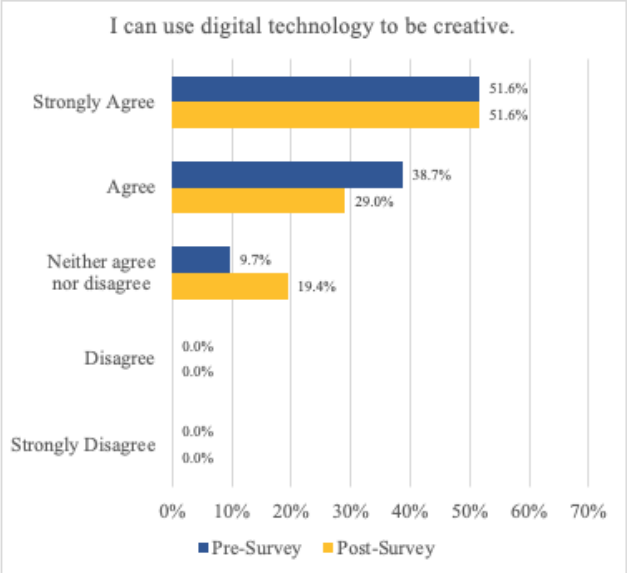


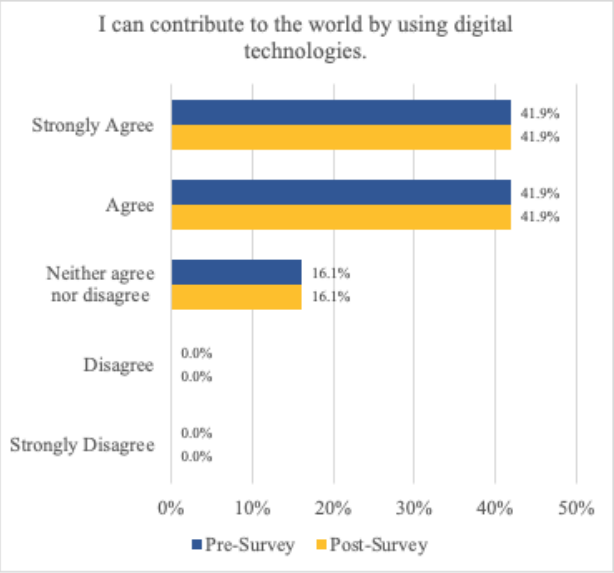


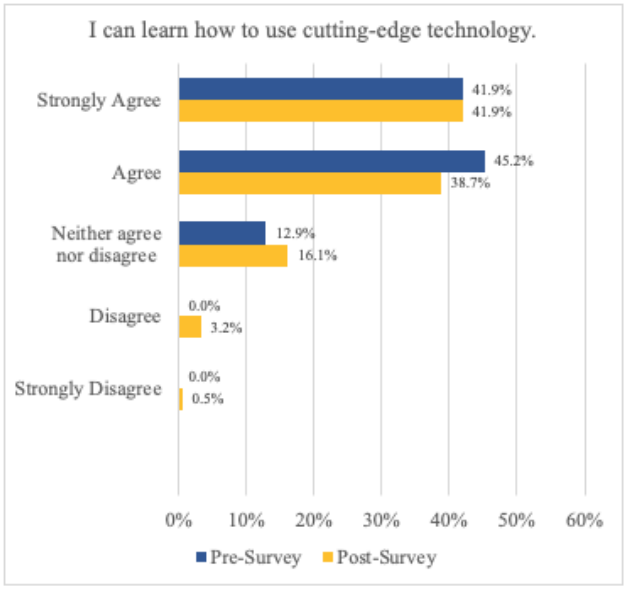
Q8. Persistence and Creativity.

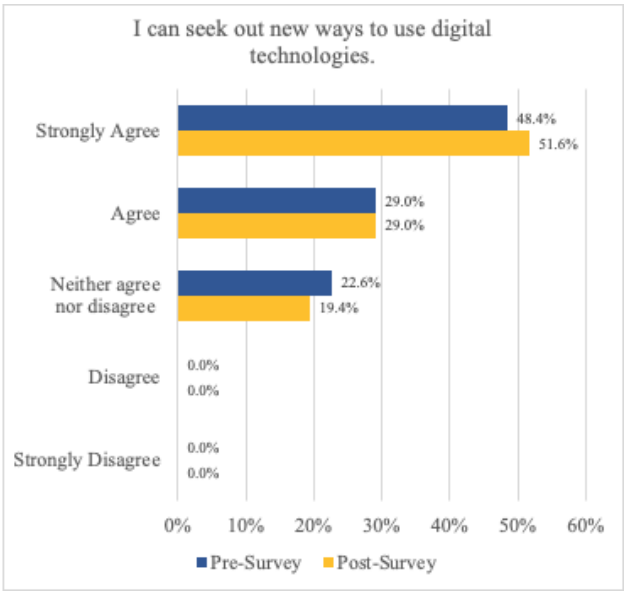


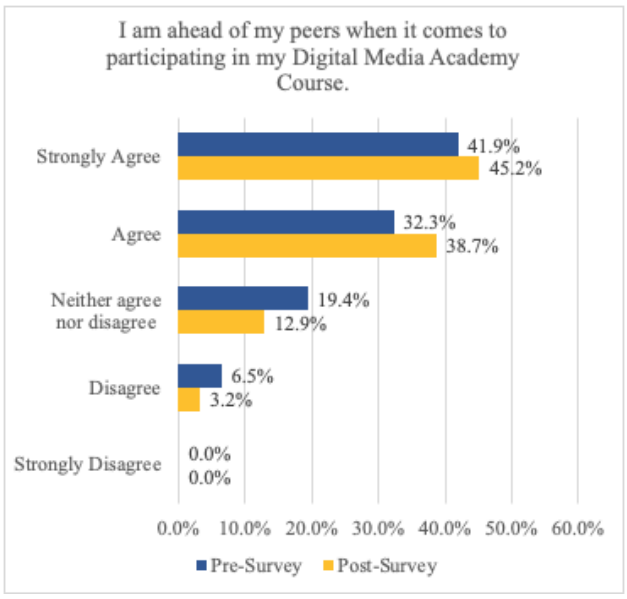


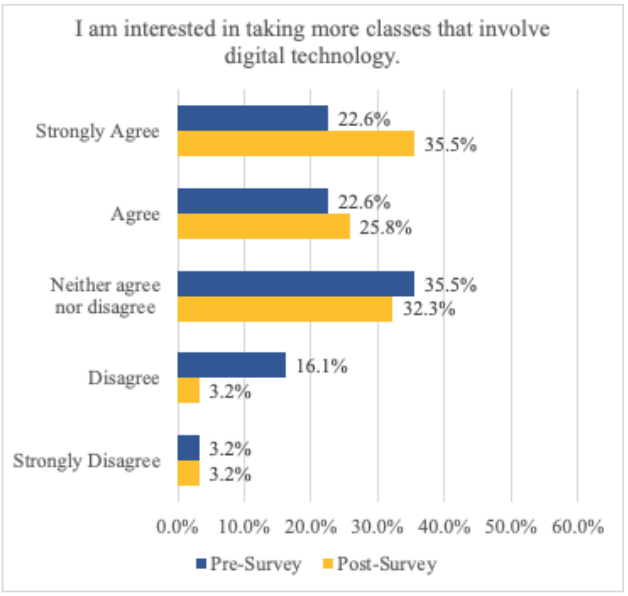





I can learn how to use cutting-edge technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
41.9%
41.9%
45.2%
38.7%
12.9%
16.1%
0.0%
3.2%
0.0%
0.5%
0%
10%
20%
30%
40%
50%
60%
Pre-Survey
Post-Survey

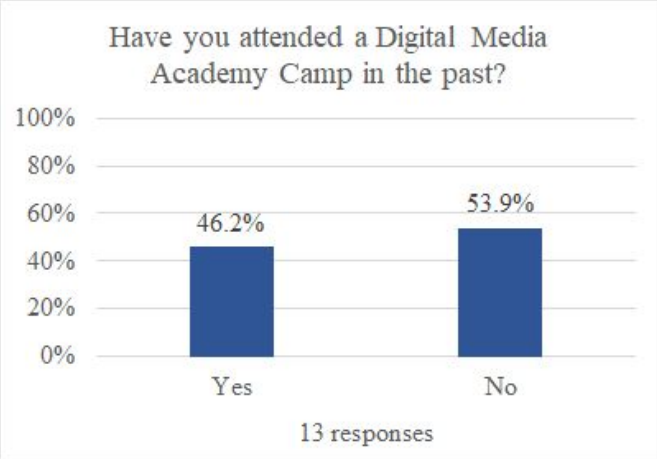

I can seek out new ways to use digital technologies.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
48.4%
51.6%
29.0%
29.0%
22.6%
19.4%
0.0%
0.0%
0.0%
0.0%
0%
10%
20%
30%
40%
50%
60%
Pre-Survey
Post-Survey

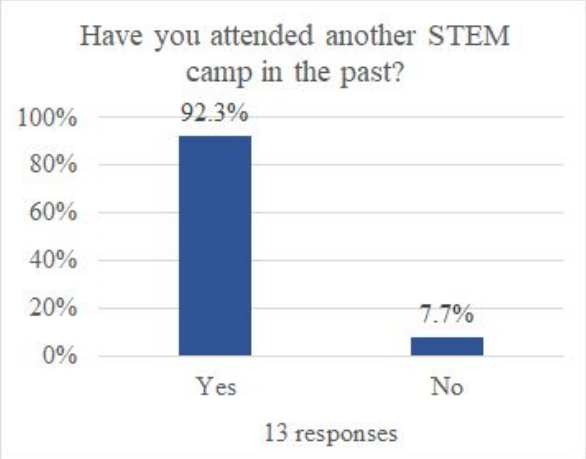

I am ahead of my peers when it comes to participating in my Digital Media Academy Course.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
41.9%
45.2%
32.3%
38.7%
19.4%
12.9%
6.5%
3.2%
0.0%
0.0%
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
Pre-Survey
Post-Survey

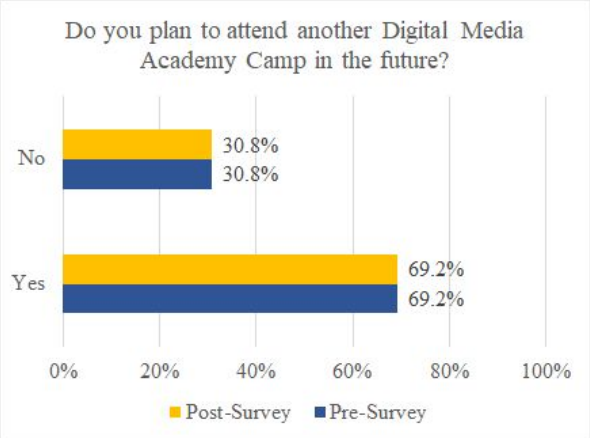

I am interested in taking more classes that involve digital technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
22.6%
35.5%
22.6%
25.8%
35.5%
32.3%
16.1%
3.2%
3.2%
3.2%
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
Pre-Survey
Post-Survey

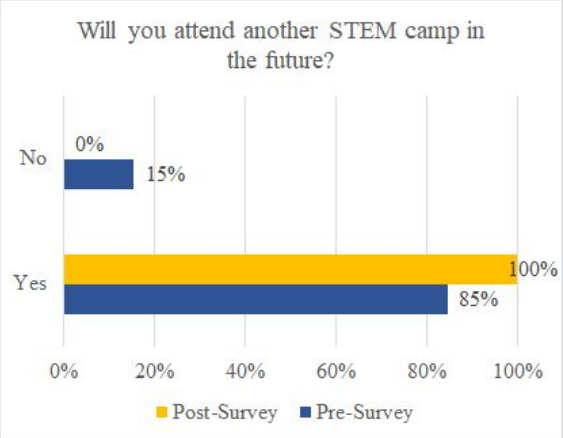
Appendix H. Adventures in 3D Printing & Modeling Survey Results (N=13)

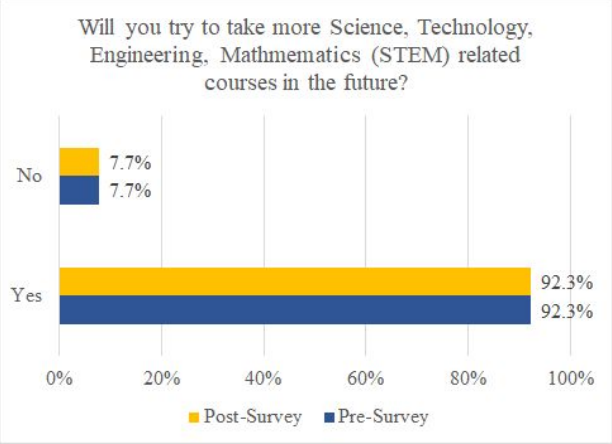
Q1. Assent.
Q2. Which Digital Media Academy course are you currently taking?
Q3. What dates are you attending this course?
Q4. Please select Yes or No for each of the below questions.





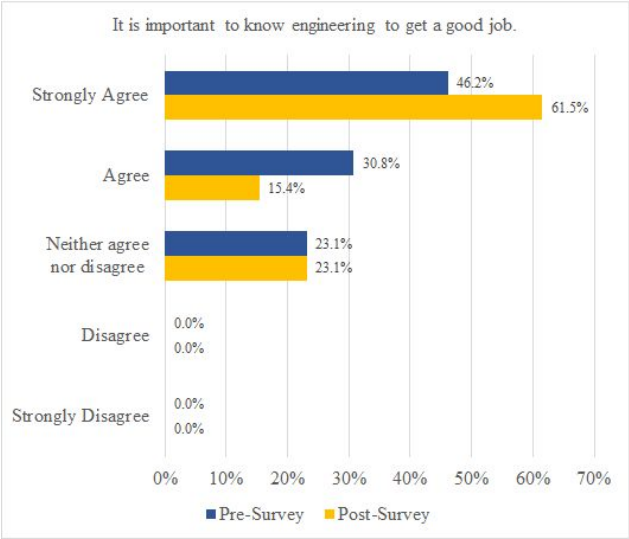


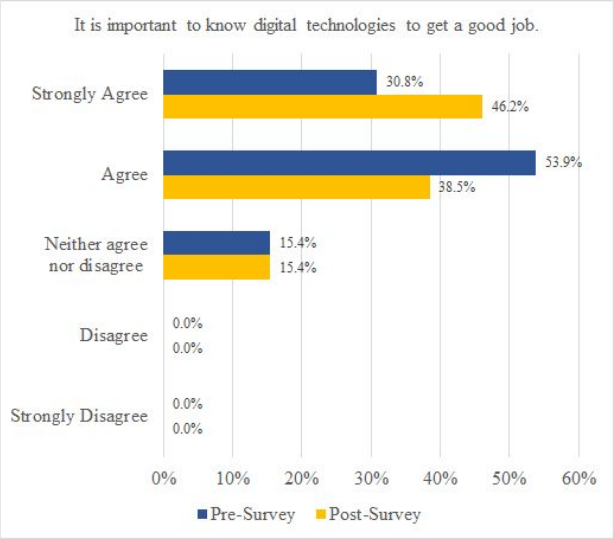


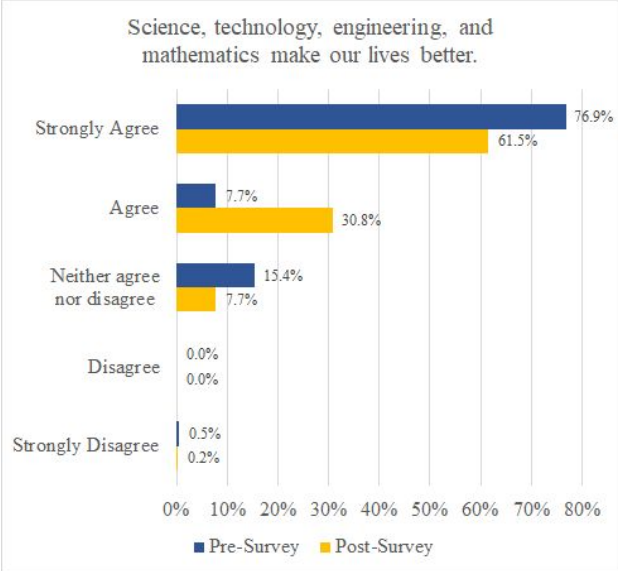


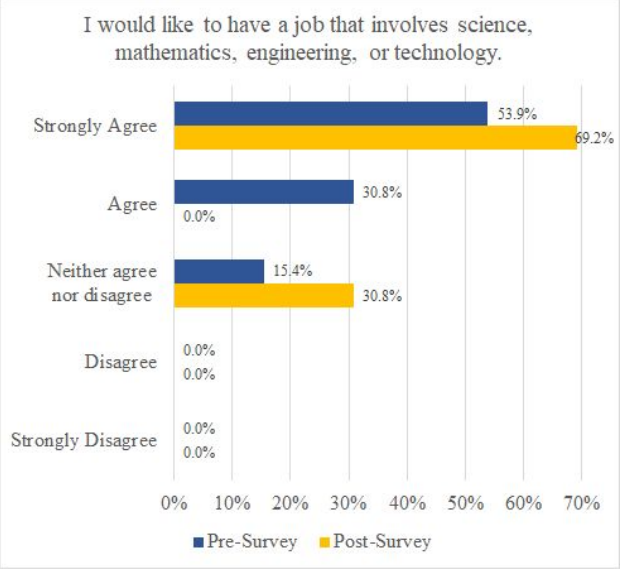
Q5. In the next part, we want to know how much you agree with each statement.
You will select from: *strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree.*

Q6. STEM Personal and Social Implications.

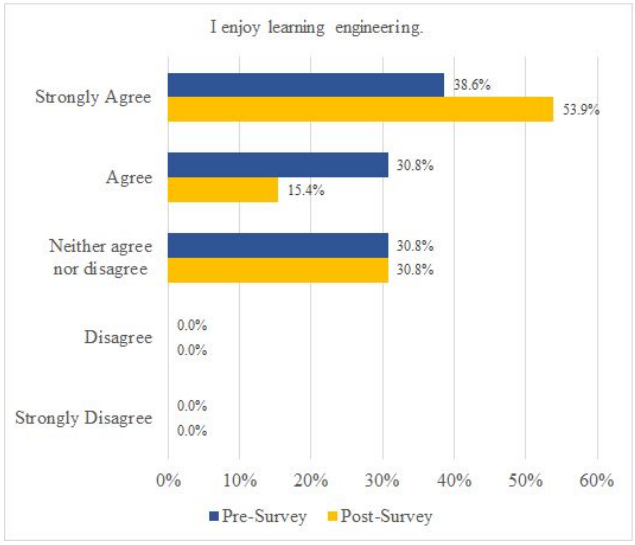


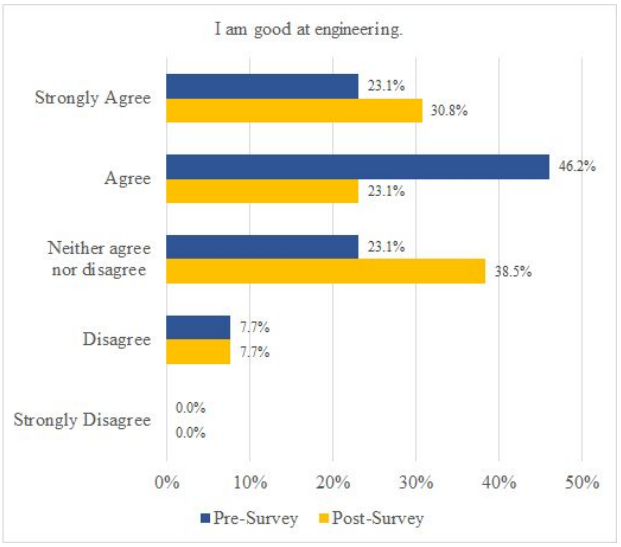


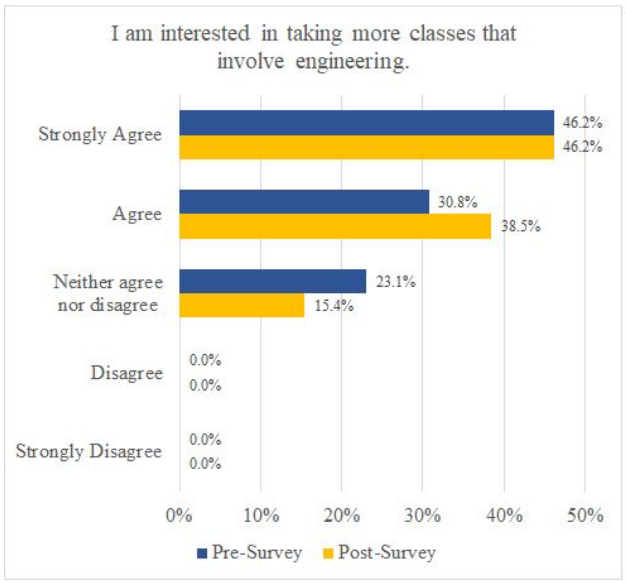


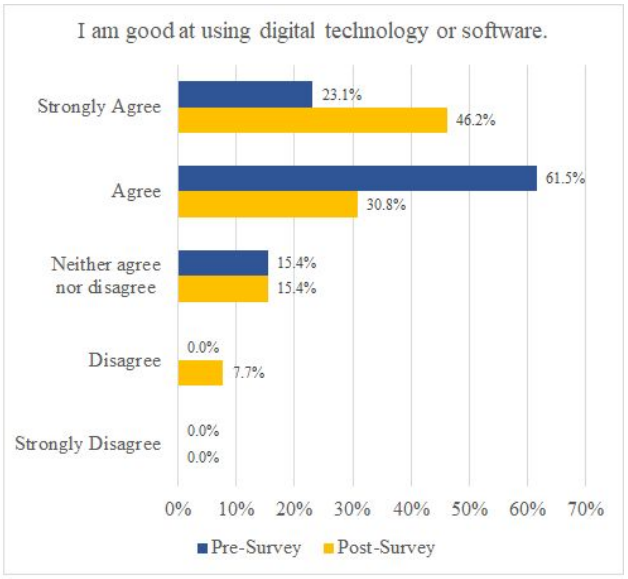


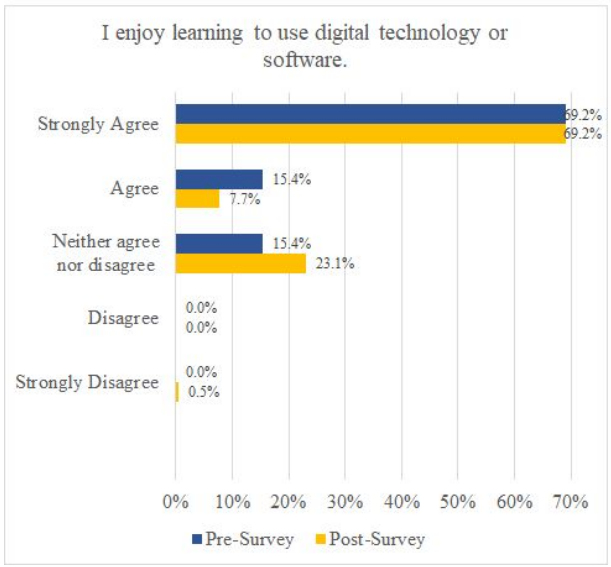
Q7. Engineering & Technology.

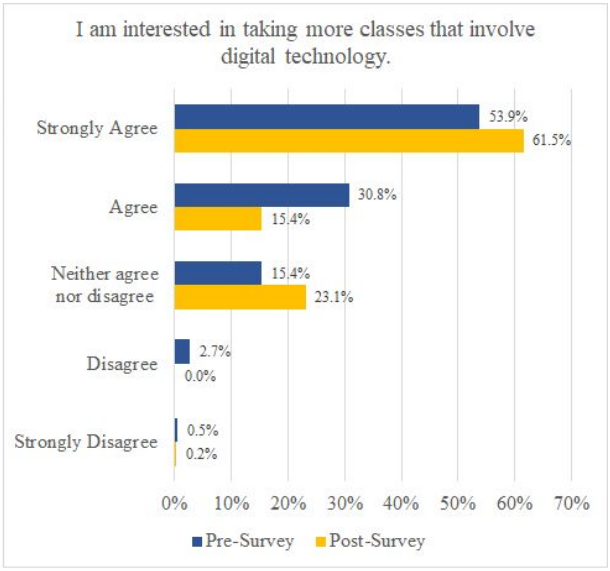




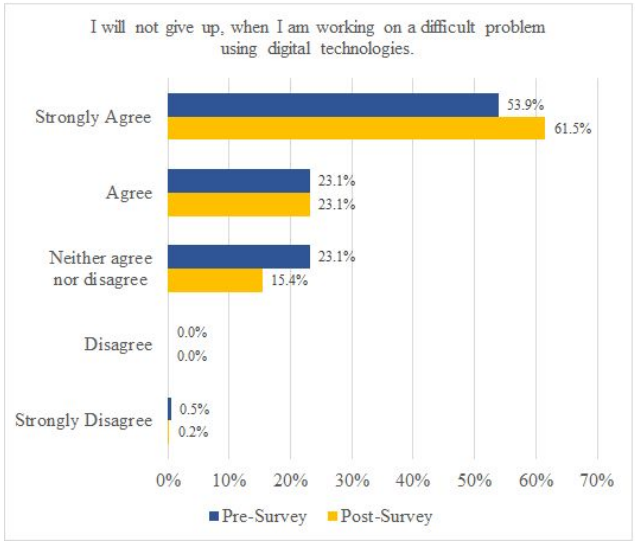


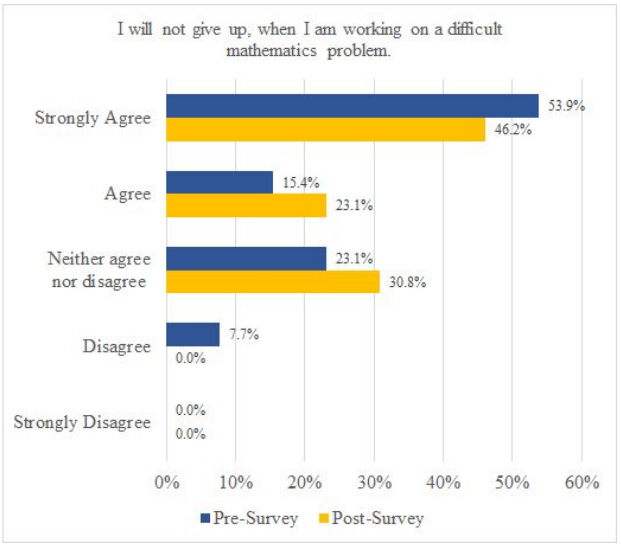


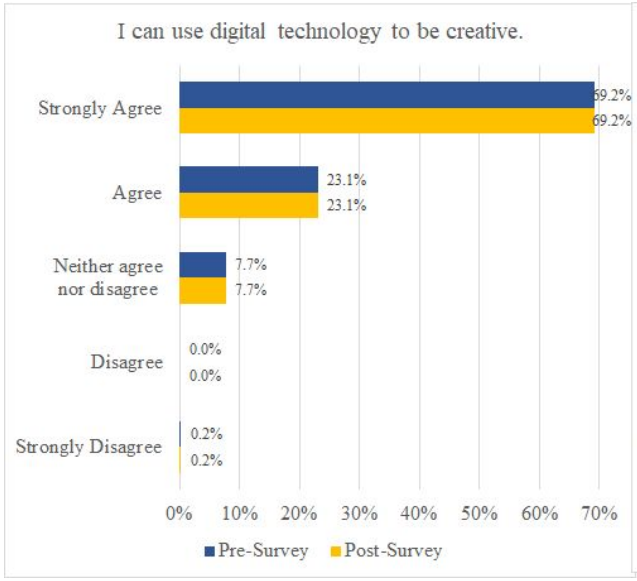


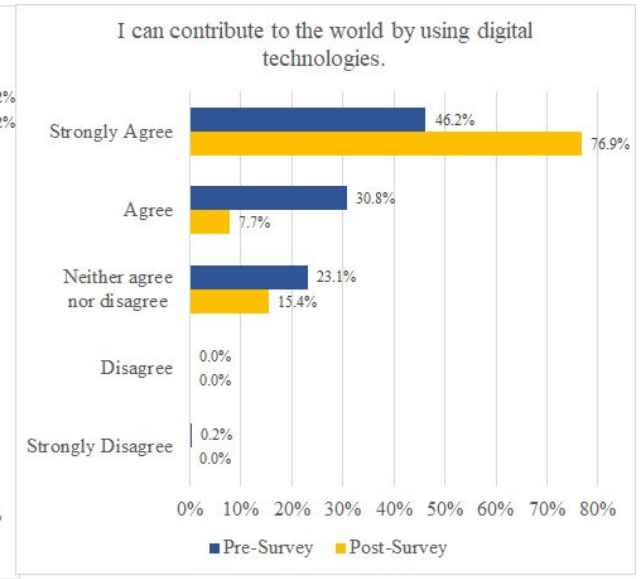


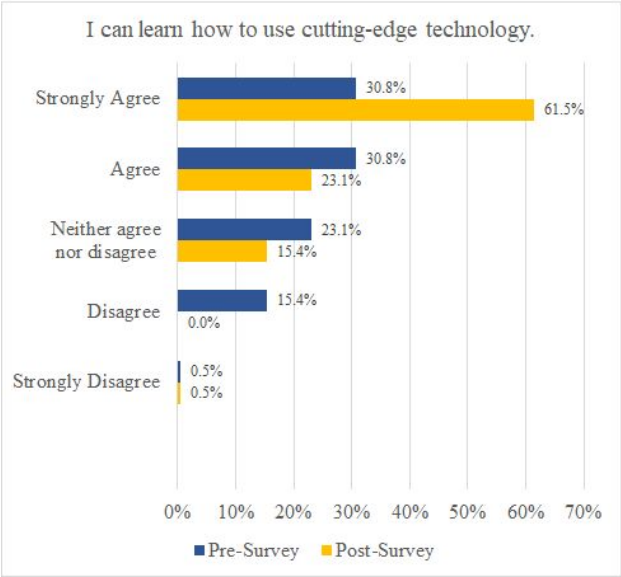
Q8. Persistence and Creativity.

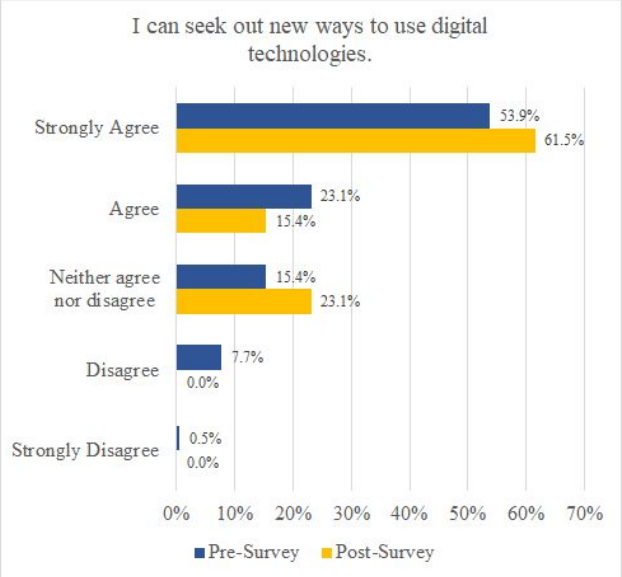


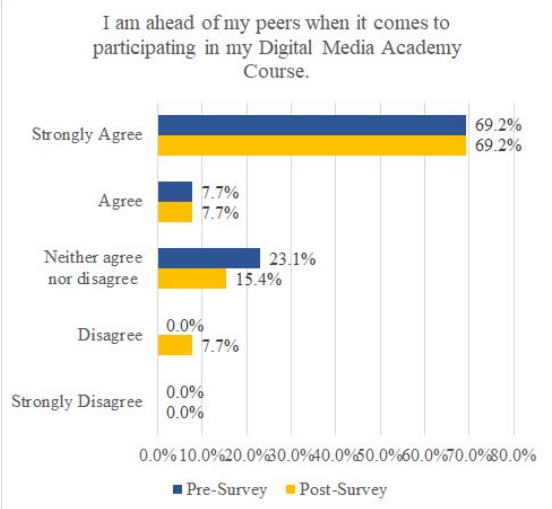


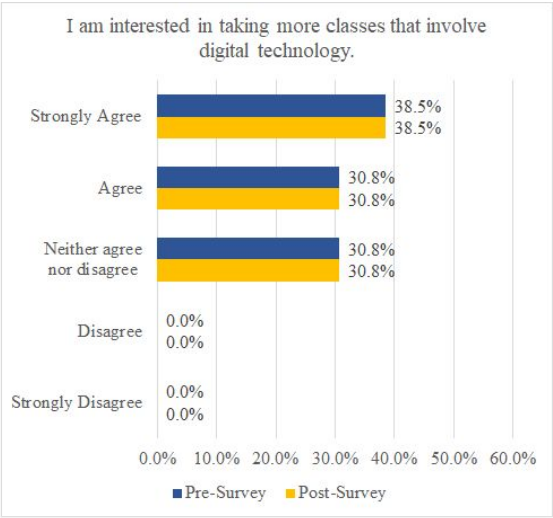





I can learn how to use cutting-edge technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
30.8%
61.5%
30.8%
23.1%
23.1%
15.4%
15.4%
0.0%
0.5%
0.5%
0% 10% 20% 30% 40% 50% 60% 70%
Pre-Survey
Post-Survey

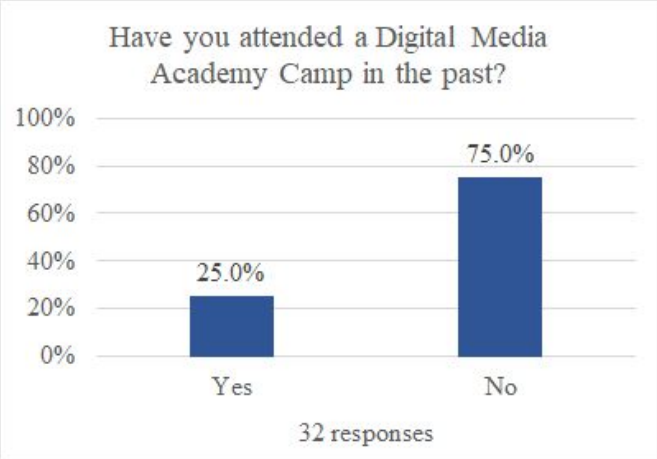

I can seek out new ways to use digital technologies.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
53.9%
61.5%
23.1%
15.4%
15.4%
23.1%
7.7%
0.0%
0.5%
0.0%
0% 10% 20% 30% 40% 50% 60% 70%
Pre-Survey
Post-Survey

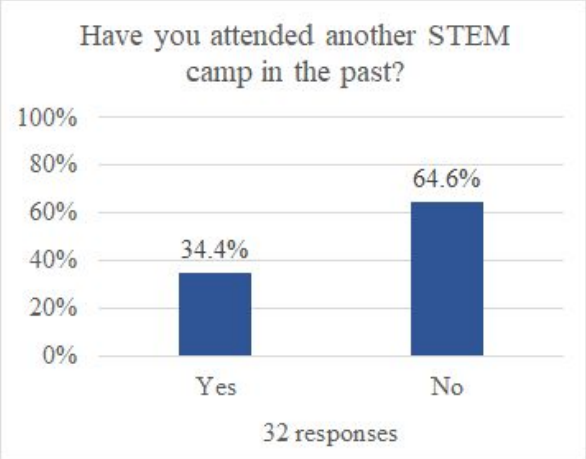

I am ahead of my peers when it comes to participating in my Digital Media Academy Course.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
69.2%
69.2%
7.7%
7.7%
23.1%
15.4%
0.0%
7.7%
0.0%
0.0%
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0% 70.0% 80.0%
Pre-Survey
Post-Survey

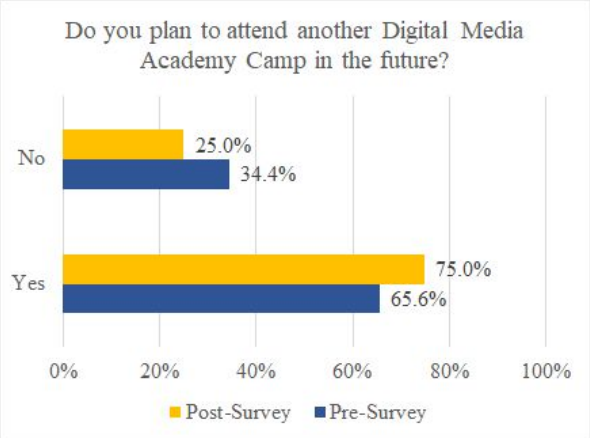

I am interested in taking more classes that involve digital technology.
Strongly Agree
Agree
Neither agree nor disagree
Disagree
Strongly Disagree
38.5%
38.5%
30.8%
30.8%
30.8%
30.8%
0.0%
0.0%
0.0%
0.0%
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0%
Pre-Survey
Post-Survey

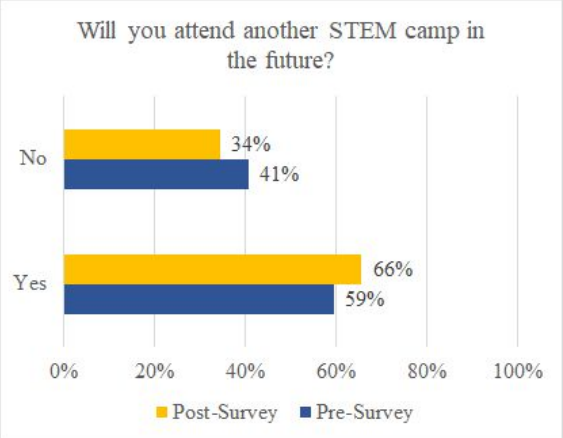
Appendix I. Adventures in Animation Survey Results (N=32)

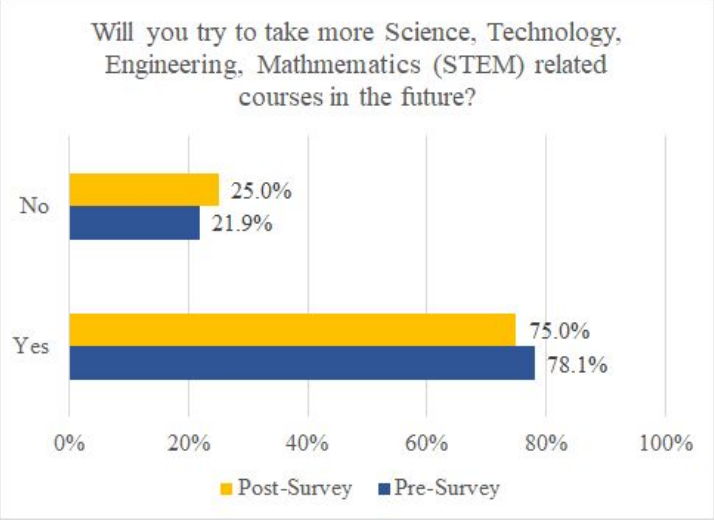
Q1. Assent.
Q2. Which Digital Media Academy course are you currently taking?
Q3. What dates are you attending this course?
Q4. Please select Yes or No for each of the below questions.





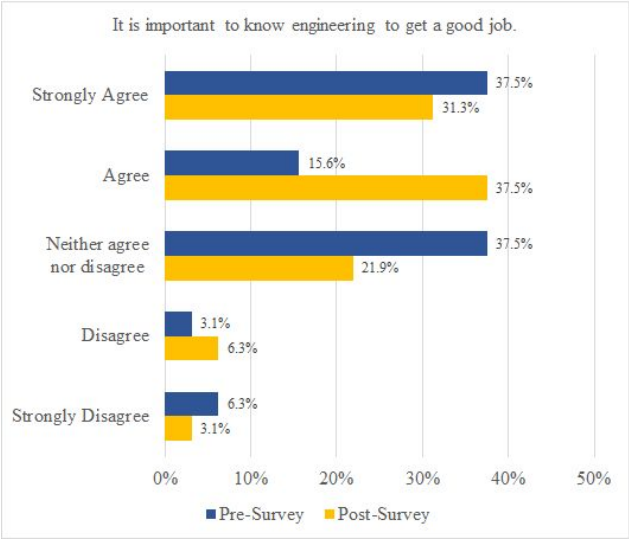


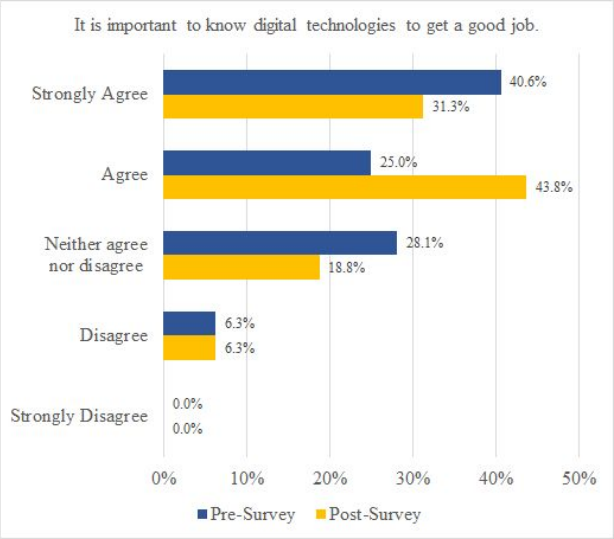


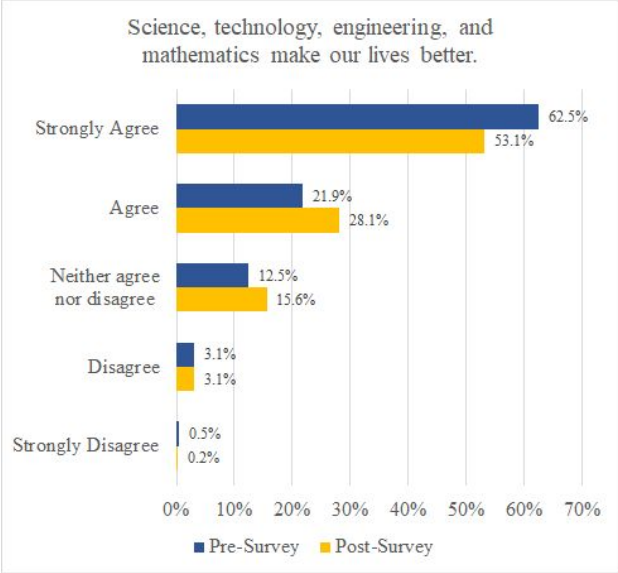


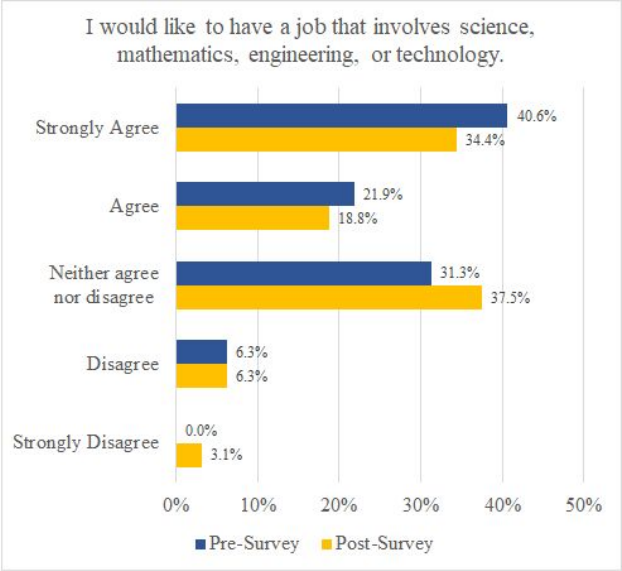
Q5. In the next part, we want to know how much you agree with each statement.
You will select from: *strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree.*

Q6. STEM Personal and Social Implications.

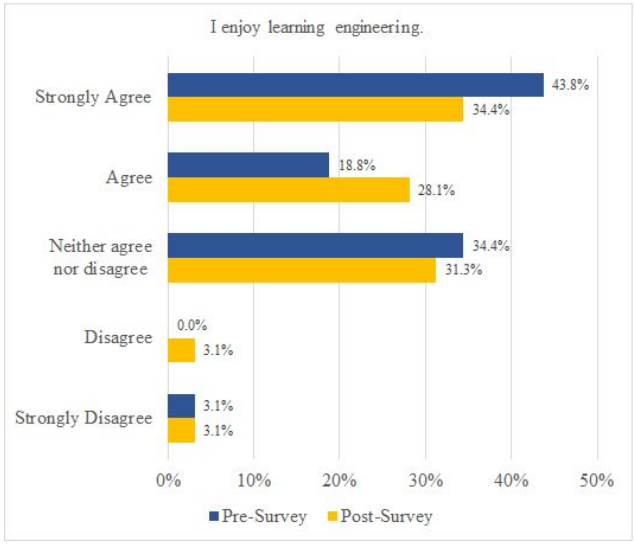


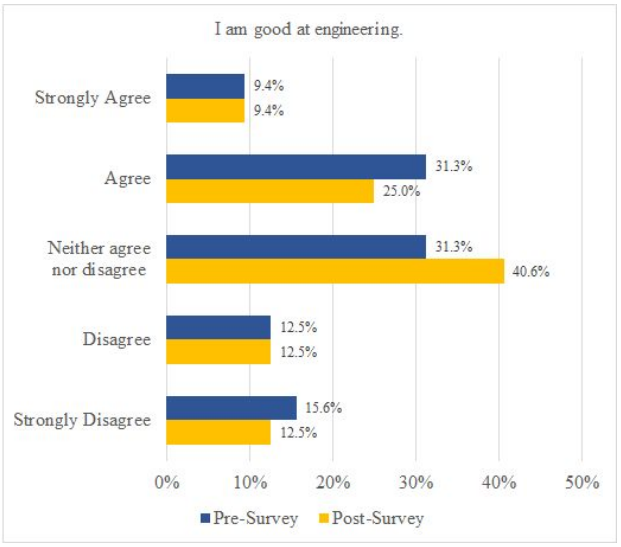


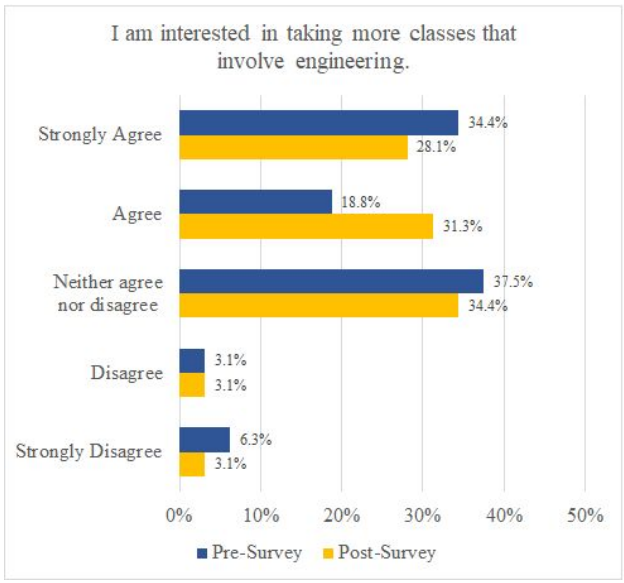


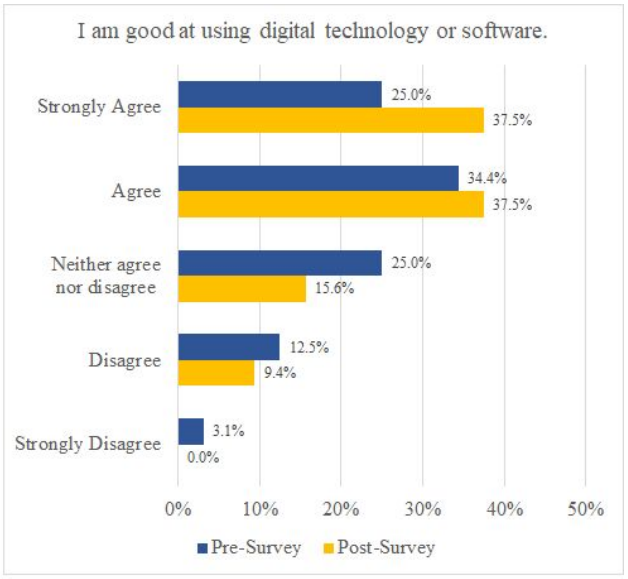


Q7. Engineering & Technology.

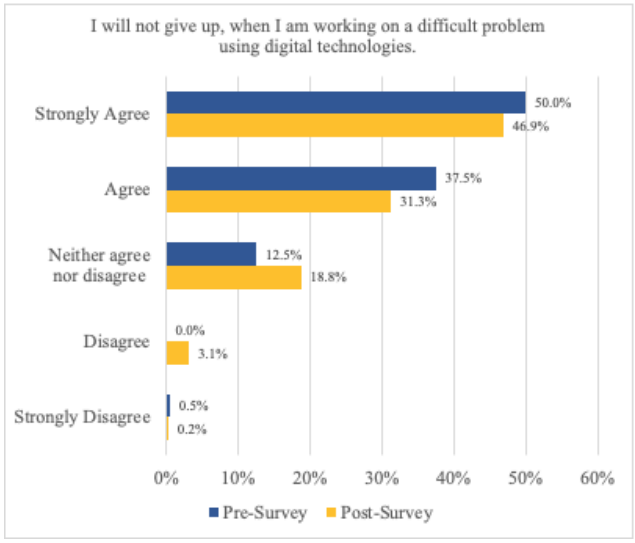


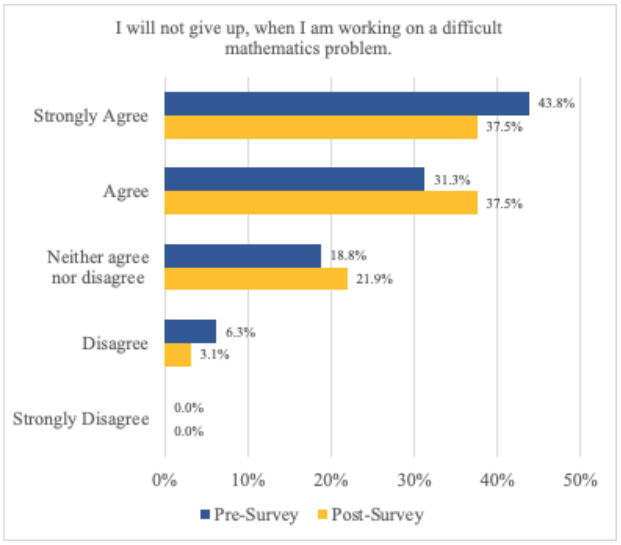


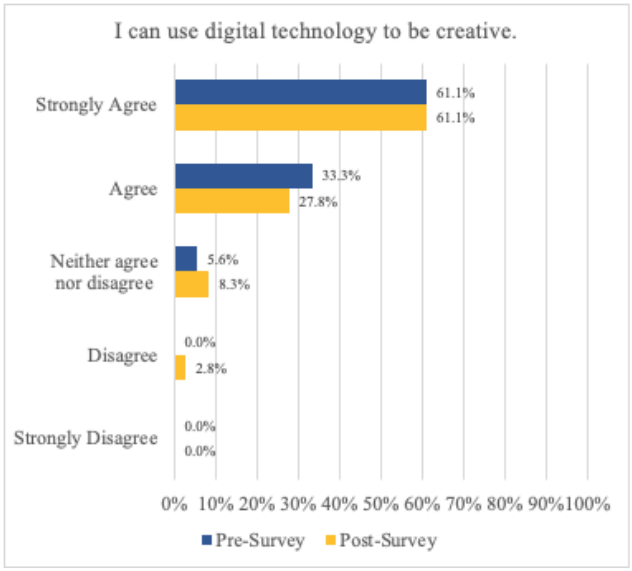


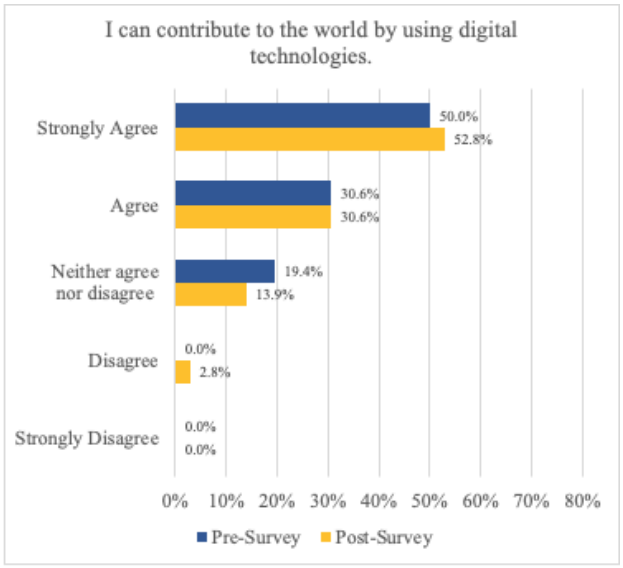


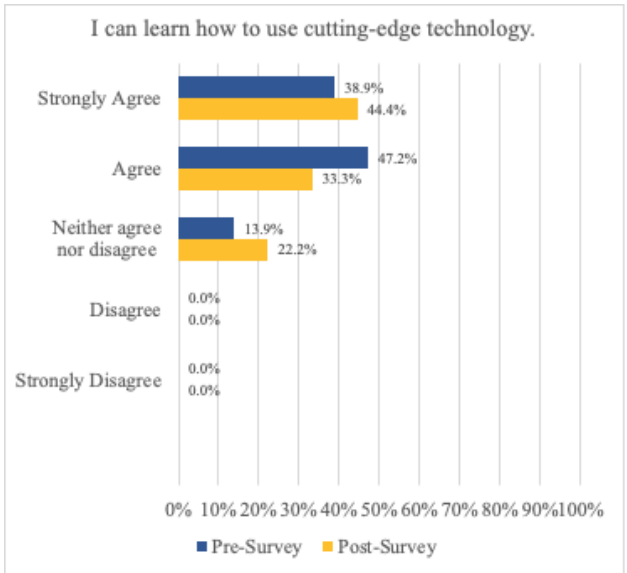
Q8. Persistence and Creativity.

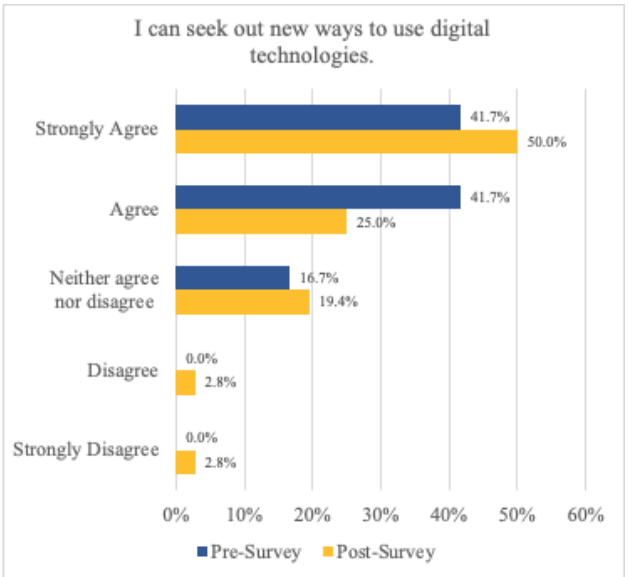


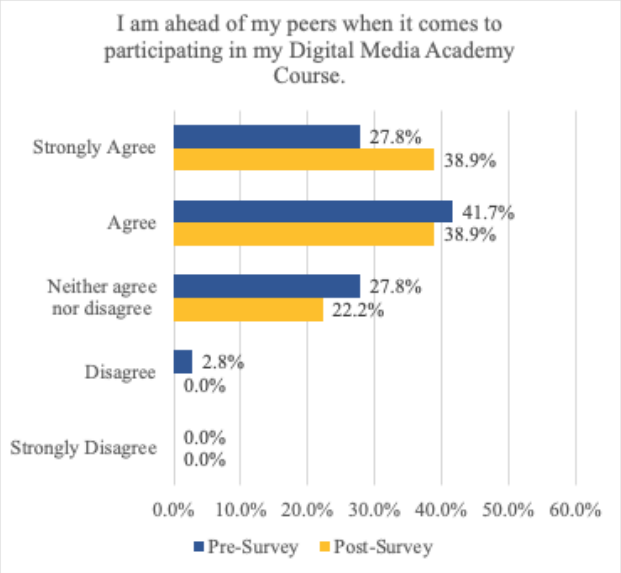


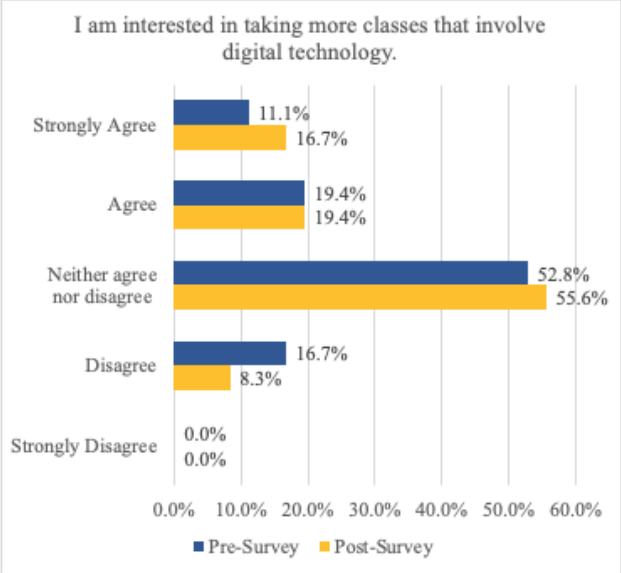









I am ahead of my peers when it comes to participating in my Digital Media Academy Course.
Strongly Agree
27.8%
38.9%
Agree
41.7%
38.9%
Neither agree nor disagree
27.8%
22.2%
Disagree
2.8%
0.0%
Strongly Disagree
0.0%
0.0%
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0%
Pre-Survey
Post-Survey


I am interested in taking more classes that involve digital technology.
Strongly Agree
11.1%
16.7%
Agree
19.4%
19.4%
Neither agree nor disagree
52.8%
55.6%
Disagree
16.7%
8.3%
Strongly Disagree
0.0%
0.0%
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0%
Pre-Survey
Post-Survey

Appendix J. List of Courses with Matched Surveys

2D Animation & Digital Illustration
3D Modeling & Animation Academy
3D Modeling with Maya
3D Printing & Product Design
Advanced Filmmaking & Visual Effects
Advanced Java Programming
Adventures in 3D Printing & Modeling
Adventures in Animation
Adventures in App Development
Adventures in Artificial Intelligence
Adventures in Electronic Music
Adventures in Filmmaking
Adventures in Game Coding
Adventures in Java Programming with Minecraft
Adventures in LEGO Robotics & Programming
Adventures in Minecraft Game Design
Adventures in Roblox Game Development
AI & Machine Learning
Applied AI & Data Science
Artificial Intelligence Academy
Audio Engineering & Songwriting
Autonomous Arduino with Take-Home Robot
Digital Photography & Photoshop
Electronic Music Production Academy
Electronic Music Production with Ableton
Filmmaking Academy
Fortnite Game Mechanics and Unreal Level Design
Front-End Web Development
Game Design with Unity
Graphic Design
Intro to Filmmaking
Intro to Java Programming
Made by Girls: Adventures in Game Design
Made By Girls: Adventures in Wearable Tech & Fashion Design
Makers Workshop with Take-Home Electronics Kit
Mobile App Development
Python & Electrical Engineering with Take-Home Laptop
Robotics & Engineering Academy
Studios: 3D Animated Short Film Production
Studios: Film Production
Studios: Game Development
Studios: Music & Audio Production
VR & AR App Design with Unity & Oculus
VR & Game Design Academy