

Design Thinking: Additive Manufacturing Summer Institute: Student Survey Brief Report

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August 2019



This material is based upon work supported by the National Science Foundation under grant number 1700455. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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Background

The 2019 Additive Manufacturing Summer Institute (AMSI) for incoming 10th to 12th grade students ran from June 3, 2019, to June 28, 2019, at the PAST Foundation. Twenty-four students participated in the program where they learned and utilized additive manufacturing concepts through team-based activities to identify, design, and then prototype an assistive device. Students had the opportunity to tour central Ohio manufacturing employers to learn about additive manufacturing-related career opportunities and the demand for such jobs in the area. At the end of each week, students completed a brief survey how interesting and effective that week’s program was and any suggestions they might have for improvement. The full set of survey questions is provided in Appendix A. The distribution of AMSI student responses per week is shown below.

Survey Dates	AMSI student responses
June 7, 2019	20
June 14, 2019	19
June 21, 2019	12
June 28, 2019	17

On June 13 and 14, at the end of the second week, AMSI students attended the last two days of a four-day program called Advanced Automation Summer Institute (AASI) which included hands-on, self-guided instruction in the areas of measurement, fluid power, mechanical drives, and AC/DC electrical. AMSI students answered a set of questions on their week two survey about their experiences at the AASI program. The non-AMSI students who were enrolled in the full AASI program also answered this set of questions; the full set of results from the non-AMSI students is provided in Appendix B.

Findings

Most students heard about AMSI from a parent or teacher.

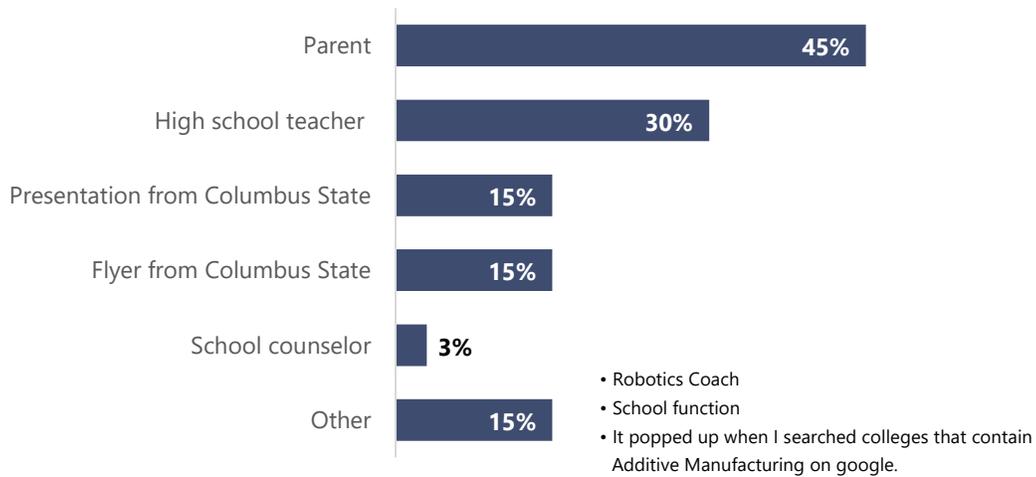


Figure 1. Frequency distribution to the question, "How did you hear about the Additive Manufacturing Summer Institute." (Choose all that apply; N=20)

More than half of the students cited their own interest in 3D printing or technology as having the biggest impact on their decision to attend AMSI.

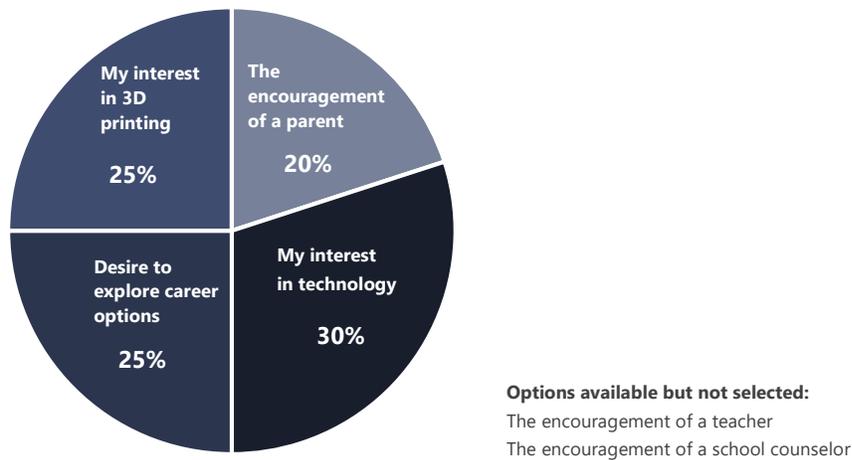


Figure 2. Frequency distribution to the question, "Which of the following had the biggest impact on your decision to attend AMSI?" (N=20)

Each week's program was at least "Moderately interesting" for most students. Week's 2 and 4 were had the highest ratings.



Figure 3. Frequency distribution to the question, "How interesting was this week's AMSI program for you?"

Each week's program was rated as being as being at least "Moderately effective" for most students. Week's 2 and 4 had the highest ratings.

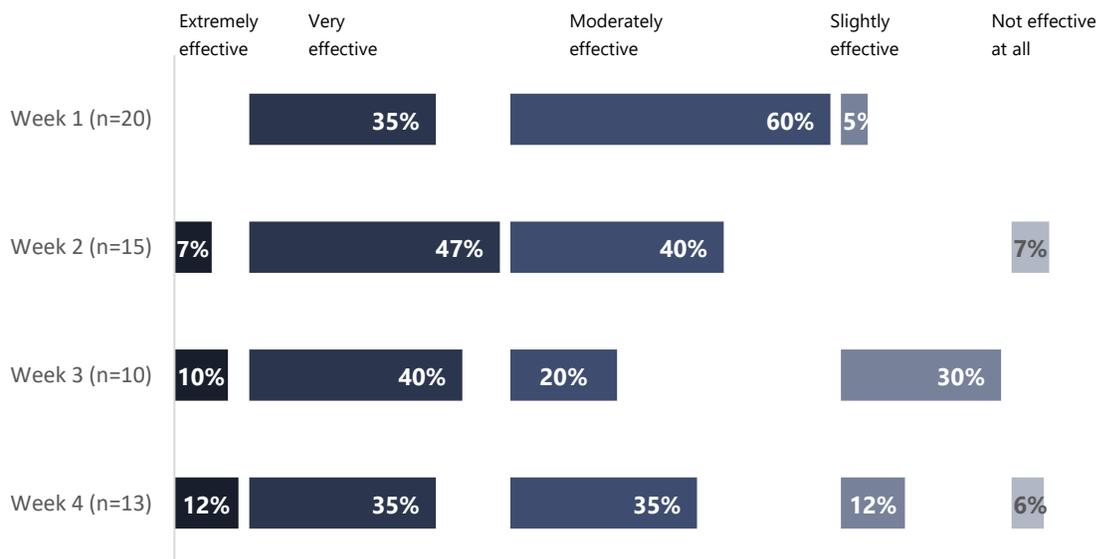


Figure 4. Frequency distribution to the question, "How effective was this week's AMSI program for building your knowledge and skills in Additive Manufacturing?"

What did you learn this week that was most interesting - or most surprising - to you?			
3D Printing <ul style="list-style-type: none"> • Week 1 (11 respondents) • Week 2 (3) • Week 3 (4) • Week 4 (2) 	Computer-aided design <ul style="list-style-type: none"> • Week 1 (3) • Week 2 (0) • Week 3 (1) • Week 4 (2) 	Mars <ul style="list-style-type: none"> • Week 1 (5) • Week 2 (1) • Week 3 (0) • Week 4 (2) 	Solid Works <ul style="list-style-type: none"> • Week 1 (2) • Week 2 (4) • Week 3 (4) • Week 4 (2)
MISC <ul style="list-style-type: none"> • Week 1 (1) <ul style="list-style-type: none"> ○ I learned using Solid Works instead of using Inventor and I learned to think wider • Week 2 (3) <ul style="list-style-type: none"> ○ The different dimensions ○ Nuclear fail safe ○ That I am easily distracted, and I have ways to work on that • Week 3 (4) <ul style="list-style-type: none"> ○ Money is important ○ more communication with the team ○ I learned all about aluminum alloys. Too much about them ○ Practice does make perfect • Week 4 (9) <ul style="list-style-type: none"> ○ Work as a group ○ That the test was a stupid advertisement ○ I learned that I could pass the test ○ How to make a poster in 1 week ○ Proper presenting strategy from Jim ○ That presenting becomes easier, as you present more often. ○ How to put the most important things before other things ○ I learned to not procrastinate. ○ My inherent leadership ability 			

Table 1. Responses to the open-ended question, "What did you learn this week that was most interesting - or most surprising - to you?"

What - if anything - would have made this week's program more effective for building your knowledge and skills?

More Computer-aided Design	More Time / Hands-On	More Solid Works
<ul style="list-style-type: none"> • Week 1 (4 respondents) • Week 2 (3) • Week 3 (1) • Week 4 (4) 	<ul style="list-style-type: none"> • Week 1 (5) • Week 2 (2) • Week 3 (2) • Week 4 (2) 	<ul style="list-style-type: none"> • Week 1 (1) • Week 2 (1) • Week 3 (1) • Week 4 (1)
<p>MISC</p> <ul style="list-style-type: none"> • Week 1 (4) <ul style="list-style-type: none"> ○ A reference sheet or a short video explaining how it works ○ It would be better if we had more Columbus state computers ○ It's good as far. ○ what I have learned was effective and I'm interested to learn more • Week 2 (0) • Week 3 (2) <ul style="list-style-type: none"> ○ Doing more with learning about additive besides FDM and SLA ○ Better outline • Week 4 (8) <ul style="list-style-type: none"> ○ I think if we learned how to code ○ It was effective ○ Being less stressful ○ I thought it was very good overall ○ Less stress about presenting ○ I think nothing really would have improved my knowledge anymore we were taught well ○ People's attitudes specifically teachers ○ LESS VIDEOS 		

Table 2. Responses to the open-ended question, "What - if anything - would have made this week's program more effective for building your knowledge and skills?"

Industry tours were the most interesting activities for students. The Robotic Tic-Tac-Toe was rated as the most interesting of the hands-on activities.

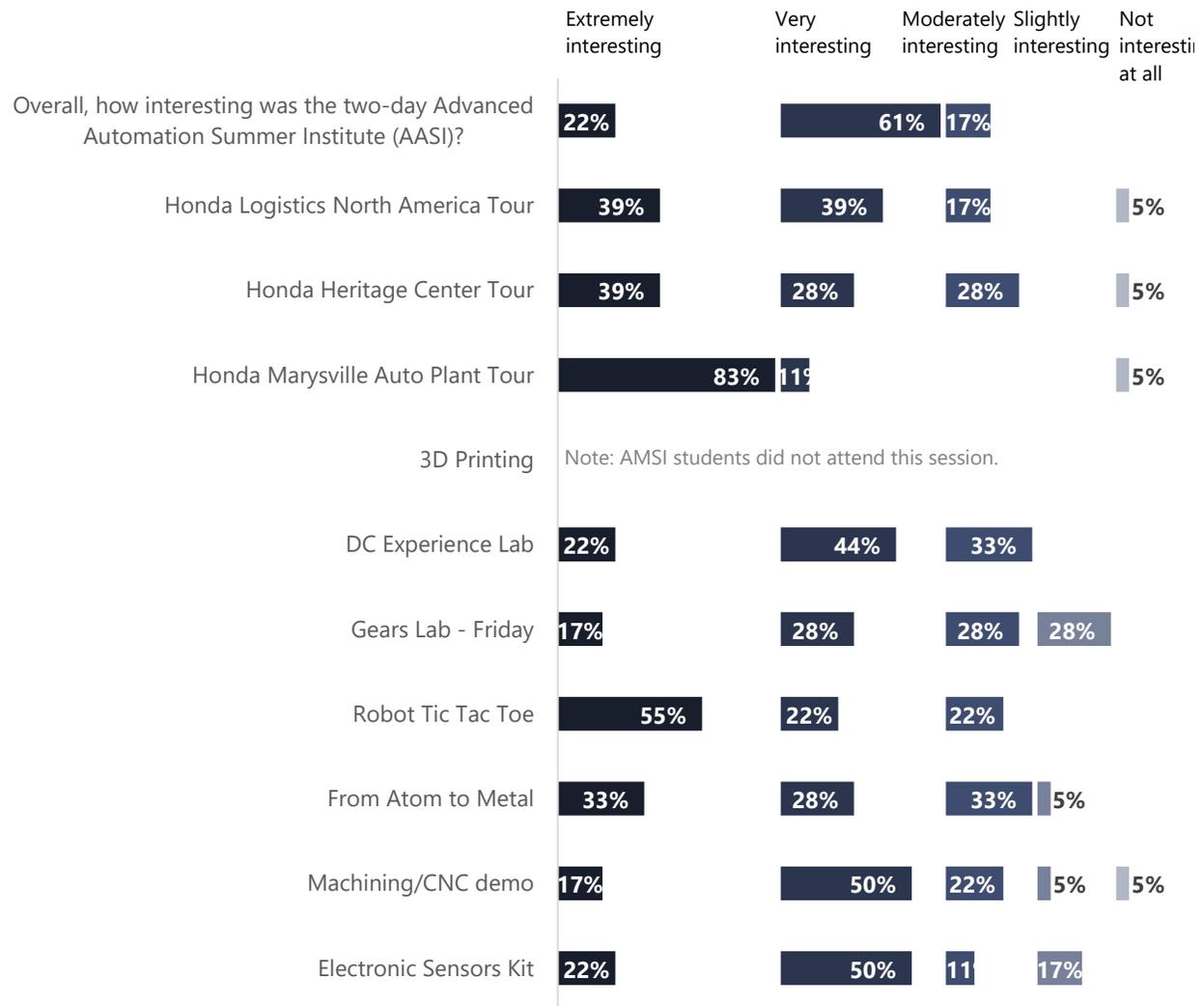


Figure 5. Frequency distribution to questions asking respondents to rate how interesting each AMSI activity was for them. (N=17)

What did you learn during the AASI program that was most interesting or surprising to you?		
Education Opportunities (9 respondents)	Career Opportunities (6)	Production Process (4)
MISC (4) <ul style="list-style-type: none"> ○ The wazer machine ○ I enjoyed the various tours of the manufacturing facilities. ○ I learned a lot in material science ○ That a computer can be made entirely from NAND switches. 		

Table 3. Responses to the open-ended question, "What did you learn during the AASI program that was most interesting or surprising to you?"

Interest in pursuing a career in Modern Manufacturing increased for a few students after AASI.

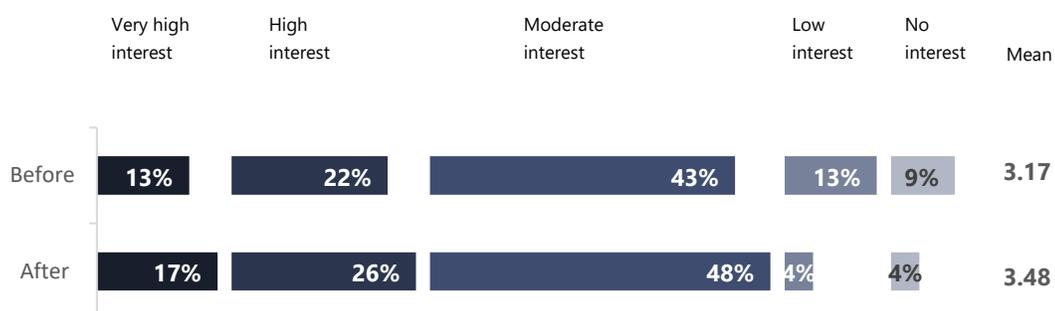


Figure 6. Frequency distribution to the question, "What is your level of interest in pursuing a career in Modern Manufacturing BEFORE/AFTER attending AASI?" (N=17)

What 1 or 2 changes - if any - would have made the AASI program more interesting or useful for you?		
Hands-on Activities (6)	Career Path Education (2)	No Changes (4)
MISC <ul style="list-style-type: none"> ○ Actually tour the Honda heritage center. ○ Actually talking to a student panel on Friday. ○ Less walking. ○ Make sure there's a bathroom at the Honda plant ○ More field trips. 		

Table 4. Responses to the open-ended question, "What 1 or 2 changes - if any - would have made the AASI program more interesting or useful for you?"

Interest in developing skills in Modern Manufacturing increased for many of students after AMSI.

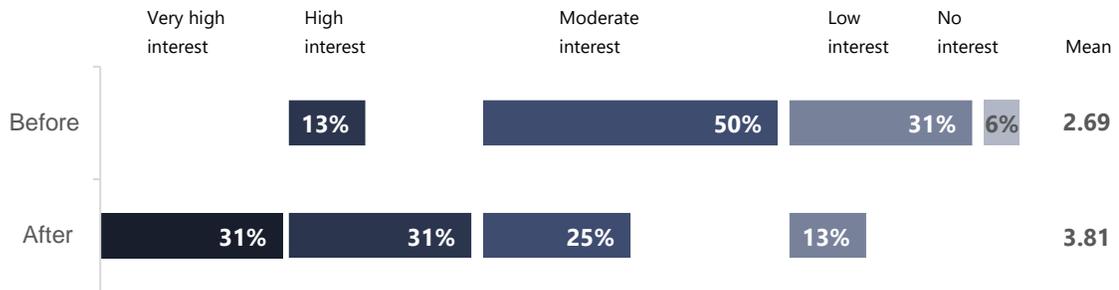


Figure 7. Frequency distribution to the question, "Please rate what your level of interest was in developing your Additive Manufacturing skills BEFORE/AFTER the AMSI program started." (N=17)

Many students "Definitely will" or "Probably will" be taking various actions to continue building their Additive Manufacturing knowledge and skills.

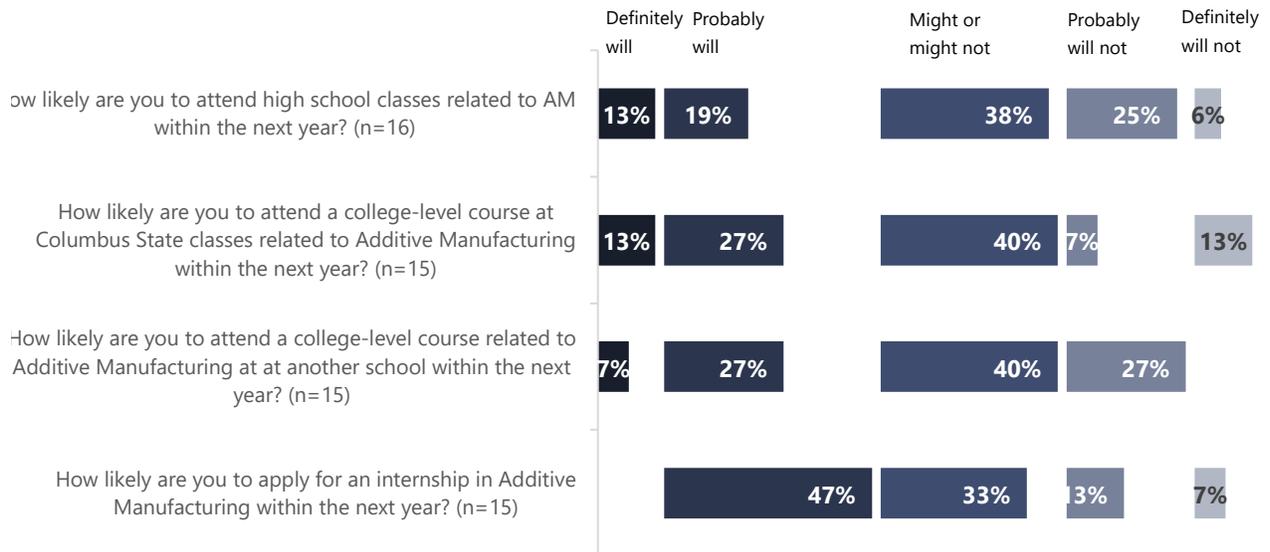


Figure 8. Frequency distribution in response to the questions, "There are many options you might choose for continuing to build your Additive Manufacturing (AM) knowledge and skills. How likely are you towithin the next year?."

What, if anything, else will you likely do as a way to build your Additive Manufacturing knowledge and skills?	
More CAD Practice (7)	3D Printer (1)
MISC <ul style="list-style-type: none"> ○ I might take the advanced test Eventually ○ Look up YouTube videos 	

Table 5. Responses to the open-ended question, "What, if anything, else will you likely do as a way to build your Additive Manufacturing knowledge and skills?" (N=17)

What kinds of courses are of most interest to you? Please list all courses that you are interested in taking even if you don't know the actual name of the college course.	
<ul style="list-style-type: none"> • Chemistry (3 Respondents) • Material science (3) • Engineering (3) <ul style="list-style-type: none"> ○ Biomedical Engineering (1) ○ Mechanical Engineering (1) ○ Design Engineering (1) • Computer programming/design (2) <ul style="list-style-type: none"> ○ CAD (3) 	<ul style="list-style-type: none"> • Neurology (1) • 3D printing (1) • Architecture (1) • Industrial design (1) • Logistics (1) • Mechanics (1) • Math (1) • Coding (1) • CAS (1)

Table 6. Responses to the open-ended question, "What kinds of courses are of most interest to you? Please list all courses that you are interested in taking even if you don't know the actual name of the college course (e.g., engineering, CAD, 3D printing, math, physical science, chemistry, etc.)." (N=17)

Interest in pursuing a career that involves Modern Manufacturing increased for a few students after AMSI.

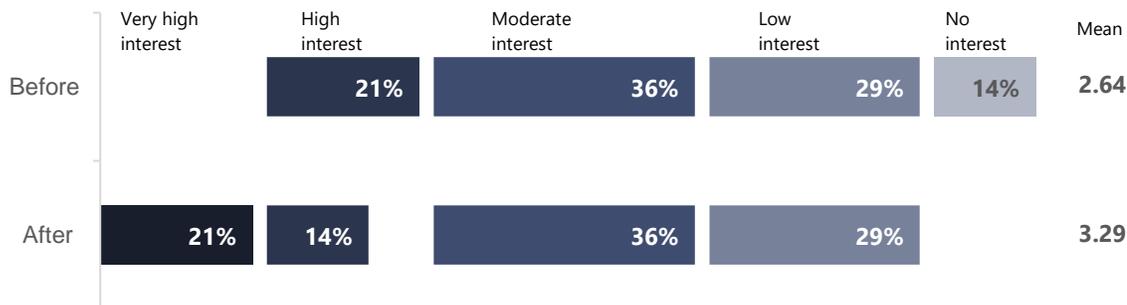


Figure 9. Frequency distribution from week two regarding the statement, "Please rate what your level of interest was in pursuing a career that involves Additive Manufacturing BEFORE/AFTER the AMSI program started." (N=17)

Think about the entire 4-week AMSI program: What aspect, or activity, did you like the most?	
CAD (4)	3D Printing (2)
MISC <ul style="list-style-type: none"> ○ I liked working with everyone in the LEGO challenge ○ The field trips ○ The main project ○ I liked doing the mars project ○ The tours of different facilities to witness firsthand the applications of additive manufacturing and robotics that are already taking place. ○ The designing part to push the limits and create something cool ○ The bond between teammates 	

Table 7. Responses to the open-ended question, “Think about the entire 4-week AMSI program: What aspect, or activity, did you like the most?” (N=17)

What is the biggest improvement that you would suggest?	
Presentation improvement (4)	
MISC <ul style="list-style-type: none"> ○ CAD ○ Don't be so disrespectful and aggressive to the students when they don't understand situation from your point of view ○ More Solidworks ○ Less overarching projects ○ More challenges ○ Maybe more time or more time to work 	

Table 8. Responses to the open-ended question, “Think about the entire 4-week AMSI program: What aspect, or activity, did you like the most?” (N=17)

Most students said they would be “Extremely likely” or “Moderately likely” to recommend AMSI to others.

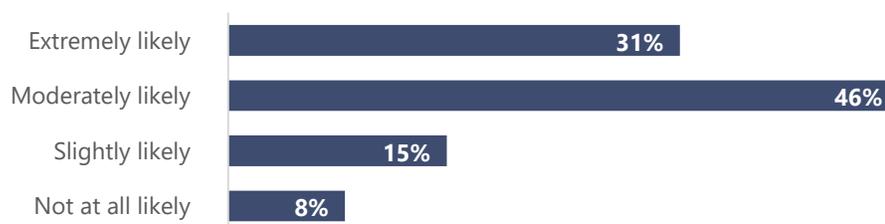


Figure 10. Frequency distribution from week four regarding the statement, “How likely would you be to recommend AMSI to others?” (N=17)

Final Thought

This brief report is intended to provide a clear and concise summary of the weekly survey responses from students who attended the June 2019 Design Thinking: Additive Manufacturing Summer Institute. The interpretation of this information in relation to this project's evaluation questions along with corresponding recommendations will be included in the annual evaluation report.

Appendix A: AMSI 2019 - Student survey questions

Please take a brief moment to answer a few questions about your experiences with the program. Your participation is entirely voluntary. All responses will be kept strictly anonymous. Read each question carefully and please feel free to respond candidly. Thanks!

Q2.1 Please select today's date

- Friday, June 7
- Friday, June 14
- Friday, June 21
- Friday, June 28

Q3.1 How did you hear about the Additive Manufacturing Summer Institute (AMSI)? (Choose all that apply)

- High school teacher
- Parent
- School counselor
- Presentation from Columbus State
- Social media (e.g., Twitter, Instagram, Facebook)
- Flyer from Columbus State
- Other (Please describe) _____

Q3.2 Which of the following had the biggest impact on your decision to attend AMSI?

- The encouragement of a teacher
- The encouragement of a school counselor
- The encouragement of a parent
- My interest in technology
- My interest in 3D printing
- Desire to explore career options
- None of the above

Display This Question: If Q3.2 = None of the above

Q3.3 What DID have the biggest impact on your decision?

Q4.1 How interesting was this week's AMSI program for you?

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q4.2 What did you learn this week that was most interesting - or most surprising - to you?

Q4.3 How effective was this week's AMSI program for building your knowledge and skills in Additive Manufacturing?

- Not effective at all
- Only slightly effective
- Moderately effective
- Very effective
- Extremely effective

Q4.4 What - if anything - would have made this week's program more effective for building your knowledge and skills? _____

Q5.1 Overall, how interesting was the two-day Advanced Automation Summer Institute (AASI)?

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q5.2 What did you learn during the AASI program that was most interesting or surprising to you? _____

These next questions ask you to rate how interesting specific AASI activities was for you. We'll start with the Thursday activities.

Q5.4 Honda Logistics North America Tour

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q5.5 Honda Heritage Center Tour

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q5.6 Honda Marysville Auto Plant Tour

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q5.8 3D Printing

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q5.9 DC Experience Lab

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q5.10 Gears Lab

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q5.11 Robot Tic Tac Toe

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q5.12 From Atom to Metal

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q5.13 Machining/CNC demo

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q5.14 Electronic Sensors Kit

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q5.16 What was your level of interest in pursuing a career in Modern Manufacturing just BEFORE attending AASI?

- No interest
- Low interest
- Moderate interest
- High interest
- Very high interest (

Q5.17 What is your level of interest in pursuing a career in Modern Manufacturing now AFTER attending AASI?

- No interest
- Low interest
- Moderate interest
- High interest
- Very high

Q5.18 What 1 or 2 changes - if any - would have made the AASI program more interesting or useful for you?

Q6.1 Are you a student from the Advanced Manufacturing Summer Institute (AMSI)?

- Yes
- No

Q7.1 How interesting was this week's AMSI program for you? (Not including the two-days you spent at AASI)

- Not interesting at all
- Slightly interesting
- Moderately interesting
- Very interesting
- Extremely interesting

Q7.2 What did you learn during the AMSI portion of this week (Mon. to Wed.) that was most interesting or surprising to you? _____

Q7.3 How effective was the AMSI portion of this week for building your knowledge and skills in Additive Manufacturing?

- Not effective at all
- Only slightly effective
- Moderately effective
- Very effective
- Extremely effective

Q7.4 What - if anything - would have made the AMSI portion of this week's program more effective for building your knowledge and skills? _____

Q8.1 Please rate what your level of interest was in developing your Additive Manufacturing skills BEFORE the AMSI program started.

- No interest
- Low interest
- Moderate interest
- High interest
- Very high interest

Q8.2 Please rate your current level of interest in continuing to build your Additive Manufacturing skills now AFTER attending the AMSI program.

- No interest
- Low interest
- Moderate interest
- High interest
- Very high

Q8.3 There are many options you might choose for continuing to build your Additive Manufacturing (AM) knowledge and skills. How likely are you to attend high school classes related to AM within the next year?

- Definitely will
- Probably will
- Might or might not
- Probably will not
- Definitely will not

Q8.4 How likely are you to attend a college-level course at Columbus State classes related to Additive Manufacturing within the next year?

- Definitely will
- Probably will
- Might or might not
- Probably will not
- Definitely will not

Q8.5 How likely are you to attend a college-level course related to Additive Manufacturing at at another school within the next year?

- Definitely will
- Probably will
- Might or might not
- Probably will not
- Definitely will not

Q8.6 How likely are you to apply for an internship in Additive Manufacturing within the next year?

- Definitely will
- Probably will
- Might or might not
- Probably will not
- Definitely will not

Q8.7 What, if anything, else will you likely do as a way to build your Additive Manufacturing knowledge and skills?

Q8.8 What kinds of courses are of most interest to you? Please list all courses that you are interested in taking even if you don't know the actual name of the college. _____

Q8.9 Please rate what your level of interest was in pursuing a career that involves Additive Manufacturing BEFORE the AMSI program started.

- No interest
- Low interest
- Moderate interest
- High interest
- Very high interest

Q8.10 Please rate your current level of interest in pursuing a career that involves Additive Manufacturing now AFTER the AMSI program.

- No interest
- Low interest
- Moderate interest
- High interest
- Very high

Q9.1 Think about the entire 4-week AMSI program: What aspect, or activity, did you like the most? _____

Q9.2 What is the biggest improvement that you would suggest? _____

Q9.3 How likely would you be to recommend AMSI to others?

- Extremely likely
- Moderately likely
- Slightly likely
- Not at all likely

Appendix B: AASI survey results from non-AMSI students

	Extremely interesting	Very interesting	Moderately interesting	Slightly interesting	Not interesting at all
Overall, How Interesting Was The Two-Day Advanced Automation Summer Institute (AASI)?	17%	50%	33%	-	-
Honda Logistics North America Tour	33%	-	66%	-	-
Honda Heritage Center Tour	17%	-	50%	33%	-
Honda Marysville Auto Plant Tour	50%	17%	33%	-	-
3D Printing	-	-	-	-	-
DC Experience Lab	17%	17%	50%	-	-
Gears Lab	-	50%	17%	33%	-
Robot Tic Tac Toe	66%	17%	17%	-	-
From Atom to Metal	17%	50%	17%	17%	-
Machining/CNC Demo	17%	33%	50%	-	-
Electronic Sensors Kit	17%	50%	-	33%	-

Table 8. Frequency distribution to questions asking respondents to rate how interested each AMSI activity was.