PHILLIPS
Programs for Children and Families

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FINAL EVALUATION REPORT

For the Designing Futures Program (3D Design and Print Program) Implemented at PHILLIPS School ~ Annandale

Contents

PROGRAM GOALS

In the spring of 2016, PHILLIPS Programs ~ Annandale School in partnership with YouthQuest implemented a pilot Career and Technical Education (CTE) course focused on STEM-based 3D Design and Print skills. Using the YouthQuest 3D ThinkLink curriculum students on the autism spectrum as well as students with mental health issues were provided the opportunity to take the semester-long course. For student participants, the *primary goals* of the 3D program included the following:

- Students used 3D Design software to create objects

- Students developed critical thinking skills to complete a 3D Design and Print project

- Students problem-solved a design/print error

- Students increased their knowledge of employment opportunities within the field of 3D Design and Print.

In terms of *program goals*, the Designing Futures Program (3D Program) at PHILLIPS School ~ Annandale implemented a range of activities and approaches:

#1: Provided focused individualized instruction and hands-on practice on core 3D software content such as: circles and offset; chamfer and printing; extrude Boolean difference and union; design time; nouns and text; rectangles; polygons; ellipse; array; revolve; align/mirroring; lines and poly-lines; and control points.

#2: Supported students through modeling and social skills instruction how to stay on track and use important steps to design 3D products, using the program's software as well as trial and error.

#3: Provided guidance to increase comprehension of and to use workplace soft skills in key areas: planning; critical thinking; questioning; and dealing with mistakes.

#4: Provided information about the use of 3D Design and Print in today's society through reading articles and attending the US Science and Engineering Festival in Washington DC.

Photo credit: PHILLIPS 3D Program participants with PHILLIPS staff and Mr. Tom Meeks of YouthQuest, receiving Program Certificates, June 2016. (Note: Photo taken by YouthQuest staff person; one PHILLIPS student participant unable to attend this event due to transition to public school planning meeting/school visit.)

MAJOR PROGRAM ACCOMPLISHMENTS

The major accomplishments include the following:

1. Parents felt that youth increased their sense of pride, self-esteem, and their 3D technical skills.

2. Teachers felt that students were "better off" in several skill areas such as: managing problems, having self-control, asking for help from others, problem solving, and being resilient, including not being afraid to fail and being more flexible in terms of making changes to their work plans.

3. All students in the 3D Program completed the course and earned their course certificate.

4. Students described several benefits. For example, they described staying engaged in the 3D program and process. They shared that they had increased opportunities to express their own creativity. They liked that they could design their own products. They

increased their awareness that mistakes happen, and that this is okay; and students felt supported in the 3D program with the curriculum format and by their teachers. They felt further connected to the 3D Program after meeting Mr. Tom Meeks, YouthQuest, because they received positive messaging on the value of 3D education and students' abilities to design innovative items.

5. All 6 participating students experienced positive change between pre- and post-test score in: a) visualizing and thinking about objects in 3D; b) knowing how to use a 3D printer and understanding the printing; c) having a good amount of knowledge on 3D printing; and d) knowing that they can do well in the 3D class.

Below are the study's results and details to support the program accomplishments presented above.

PARENT PERSPECTIVE

PHILLIPS Director of Research and Evaluation invited parent feedback and evaluative comments. One parent described her son gaining a sense of pride and the presence of high-quality staff:

"3-D design program created a sense of pride for my child. It is a marketable skill. It provided him with motivation to want to go to school. It provided a learning experience that he could find value (usefulness) in. Instructional Staff for the program were fantastic, they each have the unique ability to bring out the best in my child."

Another parent described increased self-esteem and the technical benefits of the 3D class:

> "This was equal parts a) boost to his self-esteem for being selected into a special program that honored his strengths and talents and b) gave him an opportunity to learn something technical that draws on his scientific/technical interests."

Parents recommended the following:

- Provide "More recognition for what students "built" in class," and "Possibly more engagement with ways that the class could support projects in the school/community with 3D project outputs."

- Enhance strategic partnerships: "Consider a collaboration/co-enrollment with Northern VA Community College (NVCC) credit or non-credit to expose the kids to the college learning environment."

- And, "Consider collaborations with local businesses - Potential Business Community Mentors for the students may encourage the students to consider higher education. Collaboration with business partners could create a pathway for these students to gain meaningful employment..."

TEACHER PERSPECTIVE

Teachers shared several emerging and positive outcomes in the form of vignettes. For example, one teacher shared the following:

> "During the 3rd session, the student suddenly ran back into the classroom, buried his head on the desk and shut down. He would not talk to me. He has a habit of never revealing or identifying the problem. I talked to the 3D Design Teacher who said the student got frustrated trying to create something. Then, during one of the final 3D classes, I was

observing the class and this student had stopped working on the project and was doing other things on the computer. When the 3D Design Teacher went to him, the student showed him the project, identified the problem and together they problem solved. The student was able to finish and print his design – this is a major change. I have seen it in other areas as well. The student does not shut down as often."

From the lead teacher working with the 3D Program:

"I've seen an increase in their (the students') resiliency. They're not afraid to fail. Whenever they do see the mistakes, they want to go back into the program – called Moment of Inspiration – to make sure they find out exactly where it's wrong and maybe tweak it, because, you know, failure is not final and they want that final product to be exactly what they want. Not only are we interested in their academics, but it's also the social/emotional pieces that we also want to help nurture so they're able to be more successful with their academics." (Youth Quest, June 2016).

Concerning a female student in the 3D program, the teacher shared:

"She was always getting compared to her sister because her sister is in the gifted and talented classes. She's always felt left out. But for her to actually be working with 3D printers and designers that people at the university are working with, it actually brings out a lot in her and the confidence has skyrocketed recently." (Youth Quest, June 2016).

100% 3D PROGRAM CERTIFICATION

All of the six student participants in the 3D program successfully completed the course requirements and were awarded the 3D ThinkLink Certificate. The certificates were awarded during a joint closing ceremony in June 2016.

PARTICIPANT OUTCOMES: YOUTH VOICE AND PERSPECTIVES

Five of the six students participated in two focus groups in June 2016, sharing qualitative outcomes such as likes and dislikes and Emerging, Positive Changes and benefits for youth. Key accomplishments are listed below with quotes.

STUDENTS FELT ENGAGED WITH THE CURRICULUM AND PROCESS

- o "It's really exciting to be part of a pilot program."
- o "I really like 3D printing and it's helped me along and I want to keep at it. I'm really good at it."
- o "I really like the 3D program because I get to design my ideas."
- o "I liked that the staff actually helped you step-by-step; if you did not get it, the PHILLIPS staff would help.
- o "I've always wanted to build my own stuff. And, I see it as more cost effective in the future. 3D is fantastic and it has great potential."
- o "One of the reasons I enjoy coming to 3D printing is that I already have the ideas that I want to put down. I've always had these designs that I wanted to implement. However, until recently, I lacked the means and the resources to actually make them reality. Now, I

possess both. The idea of a technology such as this suddenly popping out of the blue is almost right up there with magic. … Right now, we can only create simple novelties, but I personally look beyond what this technology can currently do and what it has the potential to do."

STUDENTS FELT SUPPORTED IN THEIR CREATIVITY

- o "I liked everything about the program. I liked well…I like designing things – it meant creativity. It means that if you think of something really cool in your head, you can just make it."
- o "It released the creativity and it was important to me. Like everybody has a piece of creativity in their brain so you have to find a way to get it out (the creativity) and the class helped me to get it out."
- o "It basically lit a spark in my creativity that just hadn't been there for a long time. And, I've been dealing with issues with creativity, and I think this helped me get through this a little bit faster. Mistakes are never the end; even some mistakes can be innovation. I mean think about it…"

STUDENTS LEARNED ABOUT TRIAL AND ERROR – AS WELL AS ACCEPTING THAT MISTAKES HAPPEN

- o "What I liked about the 3D program was that it taught me that I could innovate…it's teaching me "don't give up on your design" – and, that you can innovate on your design. I usually I give up on my objects/designs. It helped me a lot. For example, no matter what, like when you lose your data, you can always get it back – "just keep going." I am

using this now, every day – "it is okay to lose data because you can always do it again. It helped me tolerate the loss – to start again, to start over.""

STUDENTS LIKED TO DESIGN AND KEEP THEIR OWN OBJECTS

- o "It's just really fun to design things. We had an assignment where we had to make a cookie cutter or a snowman, so I decided to do both at once. What happened was, when I went to print it out, his entire middle section just disappeared. … I just dealt with it. On my head, it's just like "a design is a design. I have to deal with it."
- o "It helped me to experiment with design and see the printer print the items layer by layer. I could use that to make strong architectural innovations. Think about it – metal printing!"
- o "I like that you could design pretty much anything – cartoons, people, anything. I could design anything – let's say you like Emoji's then you could design it. I designed an Emoji, a dog tag for my dog. I like it because it was actually fun. It was fun because that I could design my own ideas and create your own structure – I like this."
- o "I really liked the 3D program because it is fun to keep souvenirs."

STUDENTS LIKED THE STEP-BY-STEP FORMAT

- o "The 3D program – it was very helpful; it was interactive; it was simple. I think the step-by-step stuff works. And, overall, I just liked it."
- o "I like the video because it does show you step-by-step – I liked it because it shows you step-by-step and it does not leave you hanging - it shows you exactly what to do."

STUDENTS FELT CONNECTED TO MR. TOM MEEKS OF YOUTHQUEST BOTH VIA THE VIDEO CURRICULUM AND BY MEETING MR. MEEKS DURING THE CLOSING CEREMONY FOR THE 3D PROGRAM

Mr. Tom Meeks of YouthQuest was perceived "as a real person in the real world." The Tom Meeks Factor provided students with critical real-time feedback on the student's designs; they felt like what they were able to accomplish with the 3D program was very important; it boosted their self-esteem.

- o "The program – taught me how to utilize the 3D program, and I found ways to utilize it in my designs and use it in ways that very few have ever done, according to Mr. Tom Meek's feedback."
- o "I liked that we got to meet Tom Meeks… we just thought he was a character, then I realized he was a real person. I liked shaking his hand and hearing him."
- o "I can't believe that my design is one of the most complex designs across YouthQuest students, according to Tom Meeks."

PARTICIPANT OUTCOMES: PRE- AND POST-STUDENT INVENTORY

Our student inventory (data collection tool) was administered at pre- and post-3D program implementation. A total of 20 survey items assessed students' confidence, comfort and ability to: work with computers; design; stay engaged at school; teach others; handle making mistakes; and use 3D skills/printer. A 5-point Likert scale was used, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, and 5 = Strongly Agree.

Below are the items tested:

1. I am confident with my computer skills	11. I stay engaged in instruction throughout the school day
2. I am comfortable learning on the computer	12. I am a quick learner
3. I have the ability to do very well on a computer	13. I am capable of teaching others
4. I can name most of the parts of the computer	14. I can handle repeatedly failing at a task
5. I think computer skills are important for me to learn	15. I enjoy coming to school everyday
6. I am capable of designing with computer software	16. I have printed at least one thing with a 3D printing
7. I design on pen and paper very well	17. I know how to use a 3D printer
8. I am a good artist	18. I understand how 3D printing works
9. I can draw very well	19. I have a lot of knowledge about 3D printing
10. I can visualize and think about objects in 3D	20. I can do well in the Designing Futures class

The evaluation found:

All 6 participating students experienced positive change between pre- and post-test score in key 3D areas

- o Including visualizing and thinking about objects in 3D; knowing how to use a 3D printer and understanding the printing; having a good amount of knowledge on 3D printing; and knowing that they can do well in the 3D class.

4 out of 6 students (over 66%) improved their overall test score between pre- and post-program implementation

- o Students' post scores ranged between 53 and 78, out of 100 possible points

4 out of 6 students (over 66%) had post-total scores in the "moderately high range"

- o The post total scores ranged between 68 and 78, out of 100 possible points

The study's results demonstrate where we have done well with the 3D Program and implementation, especially in areas of student engagement, curriculum implementation, and staff support. As we move forward, both YouthQuest and PHILLIPS can refine processes and evaluation/data collection to further enhance results and share insights on positive outcomes.