

MAKER: 3D Pen Utilization in 3D Printing Practices

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1. Abstract

During the 2017 Engineering-a-Future activities at Tennessee Tech University, a set of 3D Pen activities has been organized for the female Middle School Students (5th and 6th grades) so that they learn more about the engineering fields and their practices in daily life. Various Additive Manufacturing technologies have been presented to students, and students have toured the lab facilities. During the 45-minute timeframe, students were grouped and constructed 3D art objects (butterfly, necklace, bird, and glasses) using the available 3D Pens. It was observed that the students had high enthusiasm about the new technology. This study will present the utilization of 3D Printing Pens in various practices, and report the current advantageous and disadvantageous of 3D Pen exercises detected through recent studies.

2. Background

3D Pens usually use PLA or ABS type filaments, and work like a hot glue gun. Their most impressive feature is that they allow anybody to prototype their imagination and concept quickly, and eventually create 3D objects in a short period of time. Figure 1 presents a blue bird made with a 3D Pen.

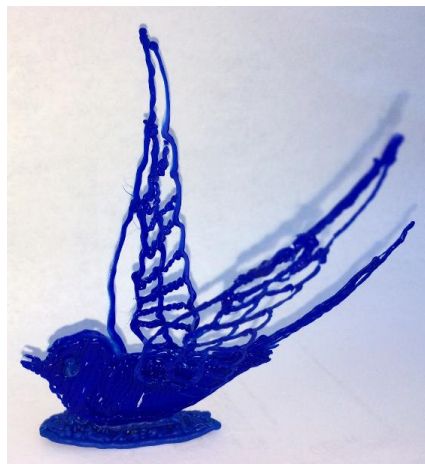


Figure 1: Blue Bird made with a 3D Pen

Drawing with these pens is enjoyable and extremely creative because it adds a new dimension to doodling and helps you gain various soft skills in critical thinking, visualization, and creativity. 3Doodler invented the first 3D Pen and after 3Doodler's success on Kickstarter, many other 3D Pens came on the market, but only one competitor really stood out: Scribbler's 3D Pen. Similar pens are sold by many distributors in China, but Scribbler is the only one that offers customer service, a 6-month warranty, and full return policy. 3Doodler and Scribbler have released several versions of these 3D Pens over the years. Recently, a few other 3D Pen companies have delivered their pens such as Lix (the smallest 3D Pen), 3D Simo Mini (a multipurpose pen), and a new type of pen: cool ink pens [1]. In literature, various comparative studies have been performed in order to tabulate the final outcomes of the 3D Pens [2]. Figure 2 presents a close view of a 3D Pen.

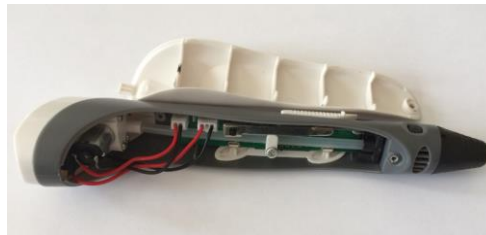


Figure 2: Close View of a 3D Pen

3. Advantageous of 3D Pens

Based on various 3D Printing and 3D Pen exercises made at the Tennessee Tech University. The following advantageous have been tabulated on the 3D Pen practices.

- These compact and portable devices could easily be used for laboratory, household, and office part repairs.
- K-12 STEM outreach activities have proved that they are one of the most liked activities among the majority of students.
- All 3D Printed objects still have some minor defects or inaccuracies in their finishes. 3D Pens are then used to finalize the not-fully finished 3D parts.
- Utilization of the 3D Pens is in very diverse from Art to Design, Engineering, Technology, and Biology. Figure 3 shows a rainbow made with a 3D Pen.



Figure 3: Rainbow made with a 3D Pen

- They are easy to use, and there is no software to learn.
- The mistake you made in any drawing could be erased easily.
- Materials and supplies used could be recycled.
- 3D Pens help students gain various skills in experiential learning, visualization, studio, and hands-on learning.
- 3D parts produced could easily be used in various level of the life since they provide a cheap, quick, and economical solutions [3].

4. Disadvantageous of 3D Pens

Studies on current 3D Pens indicate that further investigations must be performed on this technology since it is relatively new. 3D Pens' utilization results are promising in several STEM R&D, outreach, and art practices. The following list provides a list of dis-advantages identified based on various 3D Printing and 3D Pen Exercises made at the Tennessee Tech University.

- 3D Pens are not environmentally friendly since they consume a large amount of PLA or ABS material, and they could be very expensive.
- When the plastic comes out of the 3D Pen it is very hot, and this could cause substantial injuries especially in K-12 Education.
- The tip of the 3D Pen usually tends to clog, and it easily reaches very high temperature levels.
- When the 3D Pen changes its filament, the colors are not pure. And, this requires unnecessary waste of plastic.
- It is well-proven that lots of practice are needed to create refined masterpieces. Figure 4 shows a butterfly made with a 3D Pen.

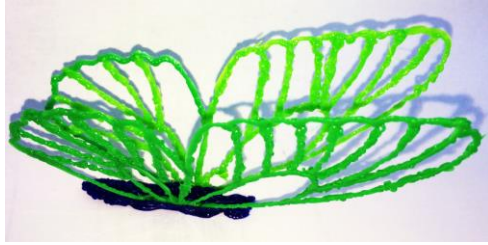


Figure 4: Butterfly made with a 3D Pen

- Most of the time, the end-product looks to be very fragile and breaks easily.
- There is a learning curve needed to be an expert in 3D Pen practices. So, it takes time to be a professional 3D Pen user [4].

5. Conclusions

The 3D Pen market is growing rapidly in line with the 3D Printing market. A 3D Pen allows anybody to sketch in the air. Once finished, it is seen that this process could be an amazing tool for wire framing future products, especially in the small-scale realm of various usable objects in daily life. Since there is no software to learn, anyone can get started right away designing and making their creation even if they have never tried 3D Printing before. This brief paper provides the advantageous and disadvantageous of using these pens in various STEM environments.

Acknowledgements

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References

- [1] ULTIMATE 3D PRINTING PEN BUYING GUIDE!, Official Rainbow Girl & Official Rainbow Guy on October 8, 2016, <http://officialrainbowgirl.com/ultimate-3d-printing-Pen-buying-guide/>, visited on April 25, 2017.
- [2] BEST 3D PEN COMPARISON CHART – TOP 10 3D PENS, Published by Official Rainbow Girl on December 7, 2016, <http://officialrainbowgirl.com/best-3d-Pen/>, visited on April 25, 2017.
- [3] 3Doodler 2.0, <http://threedoodler.blogspot.com/2015/03/advantages.html>, visited on April 25, 2017.
- [4] 3Doodler 2.0 Disadvantageous, <http://threedoodler.blogspot.com/2015/03/disadvantages.html>, visited on April 25, 2017.