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Secondary education and 3D printing. The case of a technical vocational school in Greece

Apostolos Kaltsas
*[*1]1st Ergastiriako Kentro of Piraeus, Secondary Education,Greece*

Abstract
3D printing is a prosthesis method that has significant applications in education, such as facilitating learning and creating a pleasant environment. Students in history can print copies of exhibits, whereas students in technology fields can create objects in their specialty, giving them a three-dimensional appearance. In Mathematics, students design and print their own geometric shapes, while in Informatics, students print through lines of code and mathematical functions, and in Geology, students create models of various types of soil. The purpose of the current study is to demonstrate the value of 3D printing in the field of education through the creation of the instructional materials for a technical vocational school in Greece. In conclusion, students produced items in their areas of expertise at school and learned that 3D printing represented the realization of an educational revolution.

Keywords: *3D printing, High school 3D printing, 3D printing software*

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I. INTRODUCTION

The three-dimensional printing (3D-printing) is known as additive manufacturing and is essentially a material addition process in which an object is manufactured by the deposition, solidification, or welding of successive thin layers of material, appropriately designed to use techniques similar to two-dimensional printing techniques, according to the stored in computer drawing or image. A three-dimensional (3D) printer, manufacturing material, and a 3D digital model are required (electronic file). The final object is created by stacking mattresses of the printing material on top of each other.

The three-dimensional (3D) model is a digital design, typically in the STL or OBJ file format, that is created using a CAD application, a 3D-mold, or even digital cameras with the assistance of appropriate software.

Fused Deposition (FDM), one of the most popular 3D printing techniques, uses a heated tube-shaped head to melt the printing material and extract it via the head (nozzle). The material, which is typically some type of plastic but can also be porcelain or clay, is powered in the form of fine yarn. Other processes include stereolithography (SLA), where the model is built layer by layer with liquid resin that solidifies when exposed to specific lighting, and selective laser sinttering (SLS), where laser firefighting melts specifically saved granules (such as metal) (UV-laser or digital headlamp).

1.1.1 Secondary education and 3D printing

In math, students design their own geometric forms that they can print out using free tools like Tinkercad to develop their spatial perception and visualization skills. Students gain a deeper grasp of mathematics and space through the use of 3D printing in computer science to create items utilizing code lines and mathematical functions. OpenScad is a free program that can be used by students. During the technology session, students can design a variety of objects on the computer and give them three-dimensional shapes. Through group collaborative instruction, they can create games or other things with other students [2]. They can use the Sketchup software, which is free.

II. METHODOLOGY

In three (3) sectors at the school, 3D printing was used. It was combined with a Smooth Double-Sided Pei Steel Sheme with a 3D Prusa i3 Mk3 printer. Esunblackpla+ 1.75, Esunesteel 1.75, and Prusament 1.75 Petgjetblack were the materials used. The Autodesk software was employed. The Maritime Professions Department of the Merchant Navy utilized the printer for printing ship components. Propellers and ship parts with exact trigonometric geometry were printed.

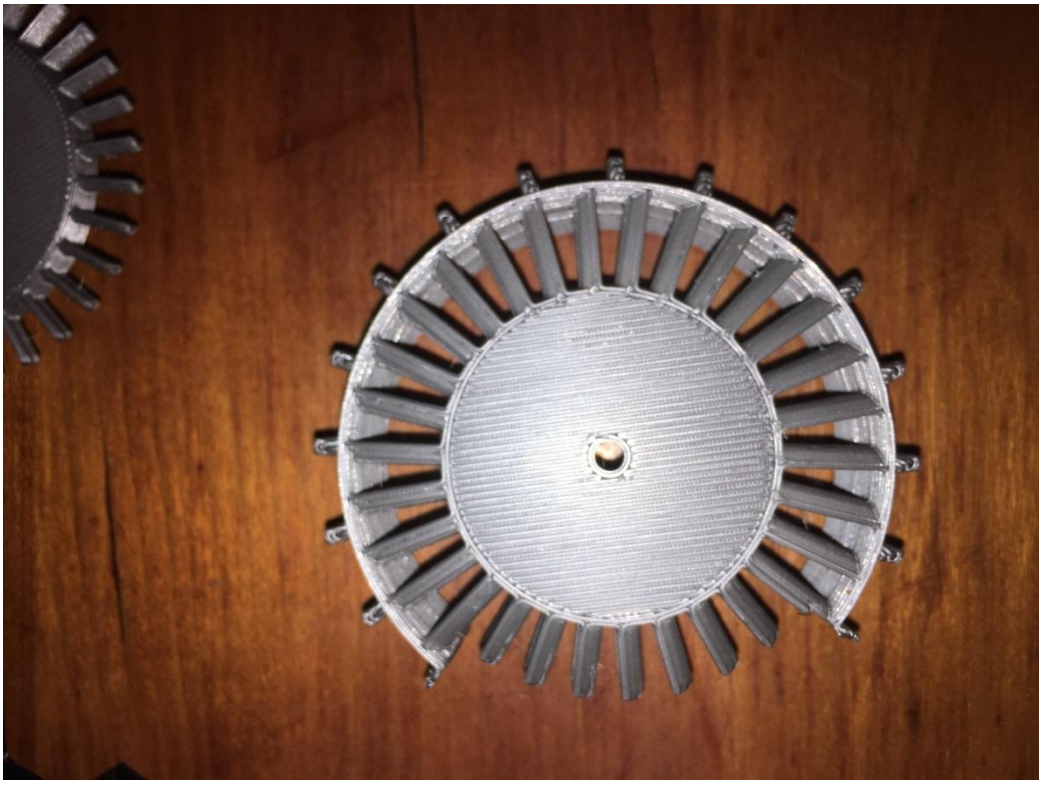

Figure1: Engine components for ships

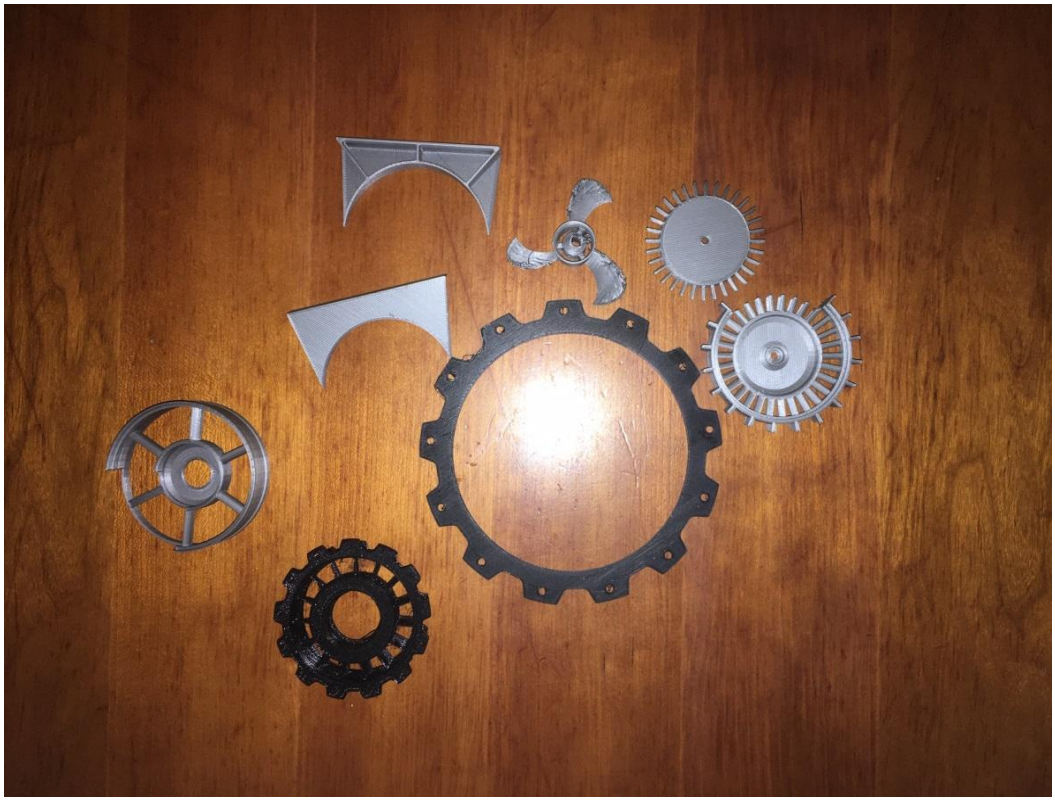

Figure 2: Small ship components with trigonometric accuracy

The printer was also utilized by students who produced various items, including tiny cups, in the sector of applied arts. According to the curriculum, engineering teaching aids for the corresponding lessons in the speciality of vehicle technician were produced with automotive parts such the crankshaft axis, transmitters, and gearbox.

Figure 3: Shaft of the turbine

An introduction to the 3D printer and its uses was first given by a 3D printing expert. Information on the stages of 3D printing development as well as examples of specific applications were provided to students in the fields. The students learned about modern technology while also seeing the variations between printers they were already familiar with [5].

Figure 4: Component of a turbocharged engine

III. RESULTS AND DISCUSSION

The students claimed that utilizing the printer was rather complicated and that they had trouble using the programs because they had not before used anything comparable. When building their project, they wanted the teacher right there with them. The 3D printing procedure reportedly improved student interest in the lecture while entertaining the work that needed to be done, according to all students in all three (3) sectors. The twenty-one (21) students experienced an increase in creativity, which boosted their self-confidence[6]. In the mechanical sector, ten (10) students thought it was crucial that their printed products helped them recall the theory. As a result, they had a considerable mix of theory and practice [4].

All of the maritime sector students stated that their three-dimensional components provided them with a more comprehensive picture that improved their understanding. Students in the mechanical sector indicated interest in learning how 3D printing is used in their profession and the advantages it offers. The car gasoline engine, which can be produced in just two days instead of a few months at a substantially cheaper cost, is a typical example for the mechanical area. A 3D-printed spoiler that weighs less than half as much as the same cast aluminum is another typical example. As a result, it can be employed to create lighter vehicle components, which increase fuel efficiency and, of course, have a significant impact on the environment.

IV. CONCLUSION

It is accurate to say that, according to their evaluations of the use of 3D printers, students find the technology to be extremely enjoyable while attending classes and piqued their interests. Students started to understand that, rather than adopting something pre-made, they might alter and improve each species to suit their needs [3]. They feel that because they have influence over the direction of their education, they learn more effectively [8]. In the laboratory courses for their speciality, their components improved their sense of open cooperation and teamwork [9]. The final finding was that by widening their views, letting their imaginations run wild, and stepping up their collaborative efforts, students from all three sectors who utilized the Prusa I3 obtained specialized skills in computer handling [7]. The inclusion of 3D printing and related technologies in the educational program give students the resources they need to develop their imagination and creativity [1,10]. In a world where technology is always changing, 3D printing can be very helpful to students (especially high school students) as they transition to a new employment prior to graduating by promoting the idea of an educational revolution.

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