Technology of 3D Printing in the creation of design by Interior Design Students

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Abstract. Printing technology continues to grow rapidly from time to time, which initially could only print two dimensional object, is now able to produce real three dimensional object. Three-Dimensional printing or three-dimensional printer can create a work of design easily, quickly and in detail. 3D printers can do various things such as; statues, car parts, toys, shoes, furniture, clothing, weapons, human body parts, and more, and even this printing ability will continue to increase. This kind of technology needs to be introduced formally and in creative ways to the students, in their creation activities and to train them to be creative thinker who can use the technology as a media to actualize the creativity. The technology of 3D printing can affect creativity, with the result that can realize idea inside the creation of design without experiencing the lead time design process. The creation of design experiment is done to observe the creativity of student in the utilization of that technology.

Keywords: Technology, 3D Printing, Creation of Design

1. INTRODUCTION

The development of technology which spread globally has given impact to all aspects of life, even in the creation of visual works. One of the creations of visual work is printing technology. In its development, printing technology has created various important breakthroughs that can help the development of the world of interior design education. Printing technology now can create real three dimension object, even a work that never thought before, that is 3D printing. 3D printing technology supports the needs of the learning process of interior design student creativity. The long creative process of students is carried out starting from determining design concepts, making alternative design sketches, digital modeling, to making prototypes of works without the right media will make the creation of visual works taking long time and can hamper the creativity process. Therefore, the right technology is needed in the learning process of creativity.

According to the M. Heleihil research about 3D printing technology as innovative tool for math and geometry teaching applications, explains that *3D printing requires higher levels of thinking, innovation and creativity. It has the power to develop human imagination and give*

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students the opportunity to visualize numbers, two dimensional shapes, and three-dimensional objects. The combination of thinking, design, and production has immense power to increase motivation and satisfaction[1]. The 3d printing technology makes it possible for students of interior design faculty to explore their creativity in creating visual works. Heidegger, a philosopher, said about 'technology perspective' that " the technology perspective is a perspective that is challenging, embracing (framing) and dissecting (revealing, exposing)[2].

Therefore, it is very interesting to study the relationship between creativity and technology, because technology enables students to explore unique forms. *Form accommodates a need to embody an idea or a perception*[3]. With this technology students will be able to create creative designs with unlimited geometric shapes as a manifestation of their creativity compared to the traditional one.

2. METHOD

This study was carried out by experiments with furniture design creations using 3D printing by students of Interior Design Faculty of Sebelas Maret University, which were used to find out the level of creativity in interior design students. In the world of education, experiment is a research action that aims to assess the effect of a treatment / action on student behavior or test hypotheses about whether or not the effect of the action. Experiments are only a way to achieve goals [4]. Creativity can be seen in the design experiment with 3D printing.

3. RESULT AND DISCUSSION

Technology processes, tools, and interfaces rekindle an interest in creativity and its expression, as exemplified by the many online activities that are engaging creative innovation[5]. 3D Printer Technology allows students to express their creativity in new ways through exploration of unlimited design forms. For this reason, students must learn the 3D printing technology and its utilization so that they can create design creations from their creativity with these technologies. According to David Gurteen, *technology coupled with the human mind creates a synergy that allows us to transcend traditional ways of thinking and working* [6].

3.1. Technology of 3D Printing

3D Printing is a new technology that is very useful in the process of creation of design. *Initially, and in line with their capabilities, these technologies were understood from a modeling or prototyping perspective whereby complex one-off objects could be more quickly and cheaper when compared with traditional model making procedures*[7]. 3D printers work by stacking layer after layer of material which is released to form three-dimensional objects. 3D printers can print in several of extraordinary materials, including extrusion plastic or powder and metal. Currently the type of material that is often used is PLA (*Poly Lactid Acid*) and ABS (*Acrylonitrile Butadiene Styrene*) plastic material, *which have melting temperatures low enough to use in melt extrusion outside of a dedicated facility, while high enough for prints to retain their shape at average use temperatures*[8]. This technology can make all the simple shapes, to print very complex shapes we want, some of which are not possible using traditional techniques.

Before one can print an object with a 3D printer, the object must first be created in a computer model. Various Computer-Aided Design (CAD) programs (Google Sketchup, AutoCAD, etc.) allow users to design and modify three-dimensional objects on a computer.

Depending on the CAD program used, the CAD file might need to be translated into a format that a 3D printer can understand[9]. In addition to making CAD files from scratch, users can use a 3D scanner to scan objects and translate the result into CAD files. CAD files allow verification in object design before printing, so as to reduce errors and make repairs before the design is printed in a 3D printer. *All 3-D printers also use 3-D CAD software that measures thousands of cross-sections of each product to determine exactly how each layer is to be constructed*[10]. Based on the description of 3D printing technology, it is possible for Sebelas Maret University students of the Fine Arts and Design Faculty to explore their creativity in creating visual works. *Technology now plays a critical role in the formation and ongoing competitiveness of clusters of creative activity*[11]. The application of this technology allows students to explore and create difficult and complex geometric shapes.

3.2. Creation of Design by 3D Printing

In this experiment, interior design students of Sebelas Maret University were given a challenge to create a chair design in accordance with their concept of creativity. This assignment provides benefits to express their creativity in the realization of forms and serves as a portfolio of their original work. To achieve the appropriate results, students also need to master skills in CAD making, so that students also indirectly demonstrate expertise in mastering CAD. *These creative aspects of the project were very important as technology is not only facilitating new possibilities but, particularly in digital and data driven fields, reducing human input in traditional economic sectors raising questions on what are we training students for? An example is technology replacing human input with driverless cars, which are being tested on public highways. This highlights the need for creativity to resolve issues in different ways*[12].

The experiment was conducted to determine the level of creativity of students in the challenges given. As was described by Georgi V. Georgiev, *the advantages of 3D printers that can easily produce forms that were previously difficult to make, and use this advantage to enhance physical interactions with the design idea and have a positive impact on design creativity* [13]. The first step, students make models in CAD files, then realize the design through 3D printing with PLA material. This material is used because it is ideal for 3D printing where aesthetic is important. Due to its lower printing temperature, its is easier to print and therefore better suited for parts with fine details. Then, the printed model is finished with spray paint. Five students gave different design results according to their chair concept. The following is the chair created by students of Interior Design Department in furniture design subject;

Two students made Stool designs (chairs without backrest) with different creativity. The first design shows a simple work, 4 cylindrical chair legs cone up and the holder with a curve and distance are created with the same repetition. Whereas one stool creation form is more complex, 2 pointed leg curves that are curved and become one and a stand with unique geometry. That visual creativity can be realized with 3D printing technology.

Fig.1. Creation of Stool Design by Students

The side chair design (the type of single chair with backrest) by two other students with different creativity. The creation of the first side chair by uniting the backrest curve with the chair legs together to form the base frame of the chair as a cradle holder. The second side chair emphasizes the curvature of the armrest that merges with the rest of the chair like a creeper. This design creation is not easily realized by traditional production techniques.

Fig. 2. Creation of Side Chair Design by Students

The design creation of the last chair is a type of lounge chair. The curvature that merges in such a way as to form the unity of the hanging chair is very difficult to form with traditional techniques, but 3D technology allows the creation to be realized.

Fig. 3. Creation of Lounge Chair Design by Students

The work shows students creative thinking in making furniture design creations. Students explore practically the possibility of creativity by using 3D printing to produce unique original visual designs with complex shapes. According to K. Dorst, *In every design project creativity can be found—if not in the apparent form of a distinct creative event, then as the evolution of a unique solution possessing some degree of creativity*[14]. In his article, Vidal states that *we can develop our creative abilities by approaching everyday problems in an innovative way. Four of the key abilities are: Fluency, flexibility, originality, and elaboration* [15]. Gunawan [16] also concluded in his research that the application of learning using technology has a positive effect on student creativity. Jeff Bariie [17] describes 3D printing technology can help in increasing 3D spatial awareness, understanding and promoting creativity.

4. CONCLUSION

The application of 3D printing and related technology will help interior design students in their study of creativity, so they can enhance their design creativity. 3D printing technology is an attractive and powerful tool, reducing production costs and can explore complex and unique forms that were previously impossible to make with traditional production techniques that can only produce limited forms. In the experiment above shows the strands of student creativity in responding to the challenges of making the design of chair design given, created five chair designs with different originality and creativity. With the correct and appropriate application of this technology, it will create an explosion of more creativity for students in expressing their ideas.

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