Application of 3D Printing Technology in Practical Teaching of Environmental Design

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Abstract. With the development of high and new technology, the computer industry is in full swing in China. The computer derivative industry related to it has also been greatly developed, especially the 3D printing technology. Nowadays, 3D printing technology is also widely used in many education industries. Especially in the field of environmental research, researchers have widely used 3D printing technology in many environmental topics. As we all know, environmental problems are usually very complicated. Whether it is water environment, atmospheric environment or solid waste, its scheme design requires researchers' rich imagination in order to get the best analysis results. The traditional teaching method of environmental design practice is inefficient and cannot stimulate students' interest. The application of 3D printing technology to environmental courses can effectively improve the efficiency of classroom teaching. 3D printing technology can also present some complex physiological structures of organisms and pollutants in the environment in detail. In this study, the application of 3D printing technology in environmental design practice is described in detail.

Keywords: 3D Printing Technology, Environmental Design, High Technology

1. An overview of 3D printing technology

3D printing is a concept often heard in recent years. The essence of 3D printing technology is to "print" the "printing materials" in the printer layer by layer according to the physical graphics drawn on the computer. It is precisely because of this layer-by-layer approach that 3D printing technology also has a more official name: incremental manufacturing. This term can be compared with "reduced material manufacturing" in traditional industrial manufacturing. To take a simple example, people should have heard of the carving process. The carving process is to carve out the needed handicrafts by constantly removing the redundant parts of a whole piece of material. In fact, the carving process is a typical "reduced material manufacturing". The most important feature of the final product is fineness. But at the same time, the finer the product, the more waste it will produce because of the "reduction of materials". Because of the principle of "increasing material", 3D printing basically does not produce industrial waste in the manufacturing process. At the same time, the finished products produced by 3D printing technology can be comparable to the traditional reduced material manufacturing. The
characteristics of economy and refinement are very important in the field of industrial manufacturing. 3D printing technology is absolutely perfect in both aspects. This is of epoch-making significance in the industrial field [1].

The 3D scanning modeling process is used in a wide range of areas. It can be used not only in the 3D printing process, but also in some very interesting places. For example, a well-known foreign 3D printing social platform called MyMinifactory once launched a very interesting activity. The name of this activity is "Scan The World". Participants are required to use 3D scanners to scan and model the works of art they see. After modeling, participants can upload it to the activity's website, that is, share the works of art over the Internet. The significance of this activity is to enable people to really appreciate works of art from museums around the world. Visitors to the site can download 3D models and print them themselves, and they will be able to appreciate the same proportion of works of art in their hands. This is completely different from the feeling of traditional web browsing. Participants can feel the flavor of art from 3D printing technology.

Prior to 3D printing, because the printing materials really put into use are based on a variety of "plastics", the products are more likely to stay in the product research and development stage. In other words, 3D printing technology can not really be used in the mass production stage of the product. As a result, the impact of the technology will be much weaker. However, after the development in recent years, with the continuous innovation of 3D printing materials in domestic and foreign markets, 3D printing technology has gradually moved towards the stage of "direct manufacturing" and "mass production". A typical example is that some footwear brands, whether foreign Adidas or domestic Peak, have launched 3D printing sneakers. The soles and uppers of these sneakers all use 3D printing technology. In the production process, the material used in shoe printing is the material of engineering plastic. This kind of material is strong, durable and easy to shape. The finished shape of the shoes is unique and very eye-catching. Although the price of thousands of yuan is not cheap, there are still many people who are willing to pay for the technology. This actually shows that 3D printing is coming into the lives of ordinary people [2].

In fact, some researchers have investigated people's understanding of 3D printing technology, and the results are shown in figure 1 and figure 2.

![Pie Chart](image_url)

**Figure 1.** Whether 3D printing technology is attractive when choosing products.
It can be seen that most people think that 3D printing technology can attract them, and this proportion has become larger in the survey of people with relevant professional backgrounds. And 3D printing technology is recognized for a variety of advantages.

2. Defects in practical teaching of traditional environmental design

2.1. Traditional practical teaching methods of environmental design

Environmental design is a major that requires strong hands-on ability and rich imagination. In the current environmental design major in China, some schools pay attention to landscape design, some schools pay attention to interior design, and some schools have both. However, whether it is landscape design or interior design, students majoring in environmental design need to practice and really apply their knowledge to practice. At present, although the environmental design majors in Chinese colleges and universities have paid attention to the design of practical courses, they are still relatively backward. The teaching method of environmental design practice course which is often adopted is the three-step method of "textbook-virtual design book-design image". Among them, the textbook stage refers to the students' theoretical study in the textbook. This stage is no different from other courses and is a necessary step for practical teaching. The virtual design book stage means that the teacher assigns a target task to the students, and the students need to make their own understanding of the task and write a detailed design book. In fact, this process is for students to apply what they have learned flexibly. The design image is that the students present the final design plan in a clearer way in accordance with the ideas in their own design books [3].

2.2. The disadvantages of traditional teaching methods

This traditional teaching method is not conducive to students' practical ability. Students only talk on paper, even if they make drawings, they can not prove their practical application ability. The thinking of some teachers is also old-fashioned. Many teachers believe that the major of environmental design is to improve the visual design level of students in the teaching process. In this process, teachers often ignore the comprehensive teaching of many related knowledge. In the actual process of environmental design, a variety of disciplines will be applied, such as psychology, behavior, sociology, economics and so on. Simple practical teaching can not fundamentally improve the aesthetic level of students, nor can it open up students' thinking. The overly routine practical curriculum puts the environmental design scheme in a high position. The formulation of a good design plan usually requires a lot of experience of the designer, and these experiences are the combination of invisible knowledge. It is difficult for students to understand the inherent meaning of the scheme from
these teaching processes. Therefore, the works involved by the environmental design majors under the
traditional teaching methods are not convincing. Whether in the internship process or in the work
process, this is a fatal defect. In the summary of universities in China, students’ hands-on ability is an
unnecessary standard of evaluation. The result is that what Chinese students lack most is hands-on
ability and innovation ability. Under the existing teaching program, students are equivalent to a
storage hard disk. The more content is stored in it, the higher the student's score will be. However,
today, when there are a large number of mechanical storage tools, the functions of students who have
no hands-on ability and only storage function may be replaced by storage tools. Today, when the
market competition is ultimately the competition of science and technology, if graduates only have the
storage function, but do not have the ability of innovation and practical operation, they will not be able
to find their own existence space. Therefore, the application of new teaching methods is very
important [4].

3. Application of 3D printing technology in practical teaching of environmental design

3.1. The applicability of 3D printing technology in the practical teaching of environmental design

As an emerging technology, 3D printing technology will inevitably be daunting. Teachers usually
worry about whether students can successfully understand and master 3D printing technology, and
apply it smoothly in the design process of the scheme [5].

In fact, worries about such problems are superfluous, because workflow of 3D printing is very
simple. Generally speaking, 3D printing is to model the product to be made in advance, and then send
it to the 3D printer to "print" the model. In this process, the modeling process is a part that students
need to focus on.. Because the modeling process represents the detailed styles and details of the 3D
printed product. The modeling process can be divided into three ways [6].

(1) Draw the model directly according to the finished product.

This direct rendering process is very different from the traditional rendering process. The drawing
in modeling is made by special computer software. 3DMaxMagneMayaCAD and so on are commonly
used softwares. In some industrial designs, software such as Rhino is often used for modeling and
design of 3D printing.

(2) Get modeling samples.

This is a relatively simple way that requires a certain amount of luck. Due to the rapid development
of 3D printing technology, in fact, the scale of development in this field has begun to take shape.
Therefore, researchers and enthusiasts in the field of 3D printing often upload and share 3D models on
some related websites. According to the wishes of the uploader, these model cases are divided into
"downloadable model" and "non-downloadable model". If a model similar to the model students need
falls within the downloadable category, then they can download the model directly for application.

(3) Reverse modeling.

This method is usually used in the process of industrial modeling. Reverse modeling is realized by
3D scanner. Therefore, this method is actually an auxiliary technology accompanied by 3D printing
technology. There are many kinds of 3D scanners. According to the scope of application, 3D scanners
can be divided into two types. If some small and medium-sized objects are modeled by 3D scanning,
then a desktop-level 3D scanner is sufficient. If students need to model some large products with 3D
scans, a handheld 3D scanner is necessary. In the process of teaching, the students' design scheme is
relatively simple. Therefore, a desktop-level 3D scanner can fully meet the needs of students.

3.2. Some specific teaching processes for the application of 3D printing technology

Teachers play an important role in the educational application of 3D printing. First of all, the teacher
himself is the user of 3D printing. They can make personalized teaching models through 3D printing.
Like multimedia courseware, the teaching model made by 3D printing can shorten the relationship
between knowledge and students, so that students can feel the use of knowledge more accurately from
many aspects. In addition, teachers should make reasonable teaching design for 3D printing courses,
so as to better help and guide students to carry out practical learning activities of environmental design. Therefore, teachers need to learn and improve from the aspects of technology and teaching design, so as to play the role of guides. In the process of applying 3D printing technology to teaching, the most important thing is to make students dare to touch 3D printing equipment. In the 3D printing course, students need to learn some basic principles of 3D printing technology, 3D design, 3D printing process, employment prospects and industrial applications of 3D printing technology, as well as the application of simple printing devices. SolidWorks and 123D Design are several 3D printing devices suitable for teaching. Some researchers have applied it to teaching. Research shows that 3D printing is not a difficult teaching method. After the popularization of technology and the simple teaching of equipment for junior high school students, students are completely able to design some small objects and print them out smoothly. Some students can even print some models of note shapes and wheel shapes in an hour and a half. This is naturally very different from industrial model printing, but it is sufficient for university environmental design majors.

In terms of curriculum planning, teachers should accurately control the process. First of all, the teacher should give a comprehensive introduction to the technology and let the students feel the printing process and the printed products. By observing a large number of printed products, students can more accurately understand the process of environmental design from scheme to implementation, and generate a lot of inspiration from it. In addition, as mentioned in the above article, students need to print the scheme by themselves using 3D design software, and constantly adjust the original scheme according to the results. The school should also organize students to conduct competitions related to environmental design, so that students can be more proficient in the application of 3D printing technology from the competition, and make better and more practical environmental design plans in the collision of thinking.

4. Conclusion
Today, with the rapid development of science and technology, with a variety of industrial technologies continue to infiltrate into various fields, the social requirements for the ability of students are also higher. In the major of environmental design, it is often difficult for students to quickly adapt to the relevant jobs after graduation. This is because they simply design the scheme of the target task in the process of traditional practical teaching, while ignoring its actual application. In the process of teaching, it is difficult for students to put every plan into practice. 3D printing technology provides a feasible way for this purpose. The use of 3D printing technology in the teaching process can help students quickly turn virtual solutions into finished products visible to the naked eye. In this process, students not only master the simple technical principles of 3D printing, but also can constantly find out the defects of the scheme from the finished products. This can help them achieve a qualitative leap in the level of scheme design. However, at present, the use of 3D printing technology is still relatively rare in Chinese classrooms. However, the classroom value of this technology makes it worthy of being vigorously used in the teaching process. We believe that in the future, there will be more 3D printing technology in the classroom of environmental design major.

References
[1] Wang Xinyan, Shen Fang; A Summary of 3D Printing Technology and its Application [J]; Jiangxi Chemical Industry; 2019.
[2] Hu Fuwen, Cheng Jiajian; A Summary of Research on 3D Printing and Manufacturing Technology of metamaterials [J]; Industrial Technology Innovation; 2017.
[3] Xu Yan; The present situation, Development and Innovation of practical Teaching course of Environmental Design Specialty [J]; Industrial Design; 2020.
[4] Yang Jian; Research on the Teaching Reform path of Environmental Art and Design Specialty based on practice [J]; Journal of Hubei Open Vocational College; 2020.
[5] Qi Na, Zhang Xun; A Summary of the Application of 3D Printing Technology in the Field of Product Design [J]; Industrial Design Research; 2017.
[6] Feng Xianwei, Wu Xiaoyan; A probe into the Application of 3D Printing Technology in the Teaching of Environmental Art Design Specialty in higher Vocational Education-- taking the course of Furniture Design as an example [J]; Art Education Research; 2018.