

The Exploration and Practice of 3D Printing Pen in Primary School Education

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ABSTRACT

Drawing ability is the common among the kids in primary school. Usually they use the pen or pensile as a tool to draw the image. This can help the kids to form a basic knowledge about the 2D scene. With 3D printing pen the kids can not only learn knowledge but also construct the 3D models in their mind. Meanwhile their character can be built from the courses. To do so we design the various courses relating to the school books. This paper reports on the results of research efforts in investigating and developing the children's ability. We describe the designed courses on a constructive task with 3D printing pens.

Keywords: *Printing pen, Knowledge, Ability, Character, Primary school education.*

1. INTRODUCTION

Drawings and sketches are a common course in primary school and already in preschool education. Usually, teachers use chalk to draw on a chalkboard to show the drawing methods to help students to learn the drawing ability. After school the students are asked to practice the drawing skill on the text-book. At present the IPADS or computers are used to draw with the multi-media learning tools. Most of the time drawings can be used before children can read and write or later, thus constituting an early and universal way of illustration [1]. The active creation of drawings and sketches is widely regarded as having the potential of being beneficial to learning [2]. In addition to the beneficial use of drawing activities in educational contexts, it may bring forth its full potential when applied in collaborative scenarios [3]. However, drawing with pen or pencil can only help the students to form 2D image in their minds. In this paper, we will use 3D printing pen to draw and construct 3D models. With this practice we design the various courses to help the young students to learn the knowledge and build the 3D ability. Concretely, we explore the effects of awareness information and the use of 3D printing pens on the process and the learning outcomes. The general goal of using 3D printing pens is to increase students' awareness of 3D image so that they can build 3D model to construct 3D objects in their learning activities.

As one major focus of this paper, we will deal with the three purposes in one course. One is to learn some basic knowledge. The second is to practice the constructive ability and the Third is to help children to build their characters. We will point out, that the presented approach relies on the creation of "Playing with 3D printing pens" with the help of easy-to-use and easy-to-understanding.

2. DESIGNING COURSE

With the popularization of information technology, 3D printing technology has developed rapidly at home and abroad. In the field of basic education in China, many primary and secondary schools have opened 3D printing related courses [4], which is of great significance. Take Wujiashan Fifth Primary School as an example. After designing experiments, implementing courses, questionnaires, collecting and analyzing data and other research processes, it is found that after 3D printing course education, students' overall innovation ability has been developed, and the following conclusions are summarized: 1. Under the condition of technical intervention (3D printing pens, 3D printers), students' creativity tendencies are higher, innovation ability develops faster, students' hands-on ability has been significantly improved, and 3D printing promotes the development of students' innovation ability Effective tools. 2. The teaching strategy of group cooperation can effectively improve students' problem-

solving ability. 3. The teaching goal of imitation works can effectively improve students' spatial thinking ability [5].

For another example, in the mathematics class "Interesting Graphic Combinations", the teacher provided some graphics for children, and the children were asked to make combinations. In the original mode, the graphics used by children are mostly flat, without strong visual impact. Although this can meet the needs of some children for activities, it will appear boring and not challenging for children with strong abilities. At this time, if you provide children with a 3D printing pen, let them combine their own ideas and combine the graphics into three-dimensional shapes, it will greatly stimulate the children's interest and curiosity, and truly feel the spatial relationship between the plane and the three-dimensional [6].

There are also related courses abroad, such as Department of Chemical Education, Jagiellonian University, Krakow, Poland. Their team applies 3D printing pens to chemistry classes. With the help of 3D templates, children can directly draw molecular models in three dimensions. The modular nature of the template allows a wide variety of structures to be created [7].

At present, the education courses with 3D printing pens at home and abroad are of great age, high difficulty in starting hands, and not suitable for primary school students or children of lower age. However, the primary school stage is the stage of laying foundation for the lifelong development of people and a good opportunity to cultivate innovation ability. Because students have strong curiosity and curiosity, the awareness and ability to develop in this stage, the formation of thinking will have a long-term impact on the growth of students [8]. 3D printing education integrates practical education, innovation education, project learning and other ideas, and trains students' imagination, creativity and problem solving ability [9], which is in line with the nature of curiosity and creativity of primary school students. So we designed a 3D printing course suitable for primary school students, which not only helps them learn knowledge and build 3D ability, but also establishes their character and personality.

2.1. Mastering Skill

We have designed various courses related to elementary school textbooks, such as small fish courses, bird courses, turtle courses, snail courses, envelope courses, etc. We take the turtle course as an example to explain. First of all, we let the children use 3D printing pens to practice drawing, so as to lay a foundation for the painting of the little turtle later. The tools we use are 3D printing pens and drawing boards equipped with consumables. Painting exercises are divided into two parts: simple shapes and complex shapes. Usually,

children use simple shapes to practice 3D printing pens, while complex shapes are optional.

Simple shape exercise

We will let children practice drawing simple shapes such as straight lines, rectangles, squares, circles, ellipses, and arcs, and let them master the basic drawing methods of quadrilaterals and circles.

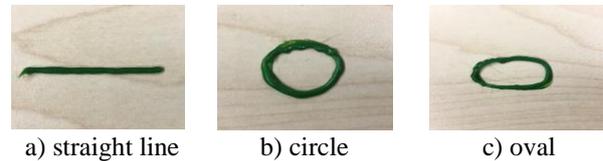
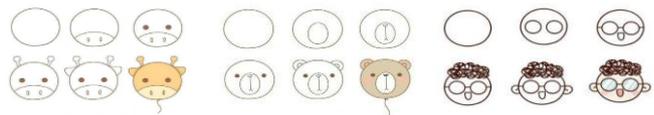


Figure 1 Simple shape drawing exercises

Complex shape exercises (optional)

After practicing simple shapes, children can basically complete simple shapes, but they still lack experience in complex shapes. Taking into account the differences in children's age and learning ability, this



part of the exercises is optional.

Figure 2 Drawing exercises for complex shapes

After the children's drawing practice, you can proceed to the steps of drawing the tortoise. Children only need to follow the steps in the lesson and draw step by step to draw the last little tortoise.

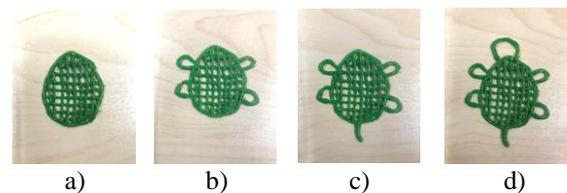


Figure 3 The painting process of the little tortoise

After the tortoise course drawing exercises, the children mastered the drawing of straight lines, quadrilaterals, circles, ellipses and other shapes, and were able to draw a small turtle by themselves. They improved their own skills while drawing the small turtle with a 3D printing pen. Observation ability, hands-on ability and drawing ability.

2.2 Learning Knowledge

The contents of the courses we designed are closely related to the knowledge learned in primary school textbooks, such as the turtle course we designed:

The painting process of the turtle is closely related to the third unit of the first grade mathematics volume of

primary school, unit 3, the group of figures, the fifth unit of Volume I of the second grade, the third unit of Volume II, the figure and transformation, the third unit of volume three, quadrilateral, unit 1, position and direction in Volume II. In the process of painting, it will involve lines, arcs, circles and ellipses, etc Shape, need children to draw these shapes and according to their own position and direction to complete the overall painting of the turtle.

The nature of the ellipse: The product of the slope of the line connecting the point on the circle and the major axis of the ellipse (in fact, as long as it is a diameter) is a constant value. The product of the slope of the line connecting the point on the ellipse and the major axis of the ellipse (in fact, as long as it is the diameter) is a fixed value, and the fixed value is e^2-1 , (provided that the major axis is parallel to the x-axis. If the major axis is parallel to the y axis). The ellipse has symmetry, that is, it is axial symmetry and center symmetry. It is necessary to know the formation of the ellipse, that is, the sum of the distance from the moving point to the two fixed points on the plane is a constant, and the other is that the moving point to a certain point is related to the moving point. The ratio of the distance to a certain straight line is a constant (note: this constant is between 0 and 1), the fixed point is the focal point, and the fixed straight line is the guideline.

The relationship between an ellipse and a circle is a special ellipse. That is, when the eccentricity is 1, the ellipse becomes a circle. The larger the eccentricity, the closer the ellipse is to a circle, and vice versa.



Figure 4 Recognition of shape

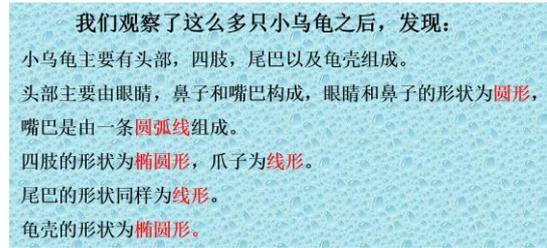
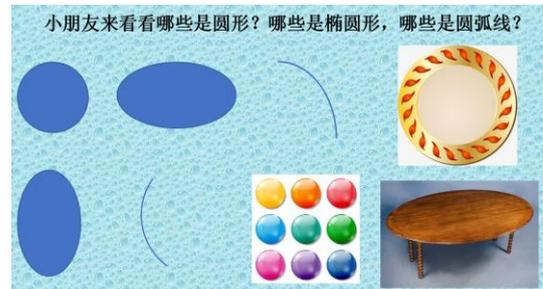


Figure 5 Turtle shape composition

For another example, the snail course we designed contains the following knowledge:

The snail course is closely related to unit 4 "recognizing position" in Volume I, unit 6 "recognizing objects" and unit 2 "recognizing figures" in Volume II of primary school mathematics. In the process of children's painting, straight lines, arcs, circles and other shapes will be involved. Children need to draw these figures and distinguish their relative positions before they can finally draw a complete snail.



小朋友来看看哪些是圆形? 哪些是正方形, 哪些是长方形?

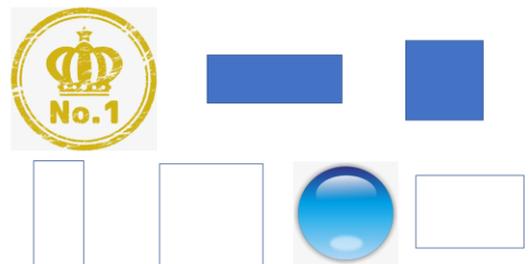


Figure 6 Shape discrimination

The properties of a circle: 1. A circle is a collection of points whose distance from a fixed point is equal to a fixed length. 2. The inside of a circle can be regarded as a collection of points whose center distance is less than the radius. 3. The outside of a circle can be regarded as a distance greater than the center of the circle. The radius of the set of points 4, the same circle or equal circle has the same radius.

A circle is a geometric figure, which refers to the collection of all points in the plane whose distance to a fixed point is a fixed value. This given point is called the center of the circle. The fixed distance is called the radius of the circle. When a line segment rotates in a plane around its one end point, the trajectory of its other

end point is a circle. There are countless diameters of a circle; There are countless axes of symmetry of a circle. The diameter of the circle is twice the radius, and the radius of the circle is half the diameter.

When drawing a circle with a compass, the point at which the needle point is located is called the center of the circle, which is generally represented by the letter O. The line segment connecting the center of the circle with any point on the circle is called the radius, which is generally represented by the letter r. The length of the radius is the distance between the two corners of the compass. The line segment that passes through the center of the circle and has both ends on the circle is called the diameter, and is generally represented by the letter d.

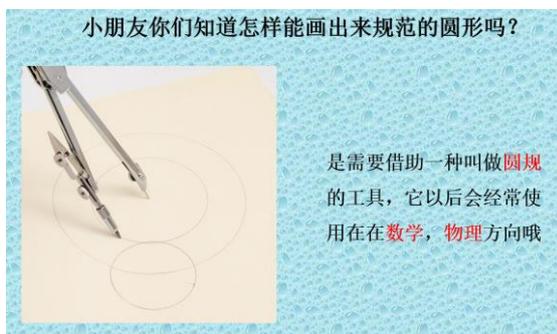


Figure 7 Understanding of compasses

A circle is a curved figure on a plane, and it is an axisymmetric figure. Its symmetry axis refers to the straight line where the warp lies. The circle has countless symmetry axes.

Therefore, our curriculum allows children to not only consolidate and review the knowledge learned in textbooks while drawing, but also to learn some new knowledge, improve their spatial thinking ability, and truly "educate while having fun".

2.3 Constructing Character

Cultivating "all-rounded people" is the core of the core literacy of Chinese primary and middle school students. The core literacy is comprehensively expressed in six categories, including practical innovation literacy [10]. In the "National Medium and Long-term Educational Reform and Development Plan (2010-2020)" [11] and other programmatic documents, all emphasized the strategic goals of rejuvenating the country through science and education and making the country strong through innovation. It is very important in terms of national development.

The curriculum we design will also cultivate the children's personality and guide them to establish a correct outlook on life and values. For example, the tortoise course includes the second volume ideological and moral class of the second grade in the first unit of

the first unit "where I live" and the second unit "let home" Better", the knowledge of the first unit "Cherish Life" in the first volume of the fourth grade.

The specific content includes: "Work hard and rush to the end" is the tortoise spirit. Our world is sometimes like the "turtle world". We should not back down and challenge ourselves bravely when we encounter opponents, but we must remember that what we have to challenge is that we only win if we win. Therefore, we must learn from the tortoise's humility, diligence, pragmatism, and unremitting efforts.

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Figure 8 Stories in the course

Due to the deterioration of the environmental quality of the habitat, the tortoise has been destroyed and killed indiscriminately, and the amount of wild natural resources is declining. Many people now suggest that tortoises should be listed as the second-level national key protected aquatic wildlife in China, not only to protect their habitat and reproduction environment, to ensure their natural proliferation, but also to accelerate the development of artificial breeding, proliferation and release to supplement natural populations. Therefore, we must protect the turtles, not only to protect the surrounding environment, but also to persuade our family members not to eat turtles! Reject game!

For another example, the snail course is closely related to the second unit of the first grade ideological and moral lesson Volume II "into nature". The specific contents include: Although the snail climbs slowly, as

long as it bravely climbs forward, grits its teeth and insists on not giving up, it will reach the end. So we have to learn the spirit of being brave and not giving up. When we encounter difficulties, although we will "climb" very slowly, as long as we don't give up and stick to it, we will be able to overcome the difficulties and face them!

Our course contains many stories or news to improve children's learning enthusiasm. Some let children choose to move forward when they are frustrated; Some let children understand the hard work of farmers and cherish food; Some let children understand the value of life and protect rare species. Children learn these fine qualities while drawing. These fine qualities will accompany children all their lives and benefit a lot.

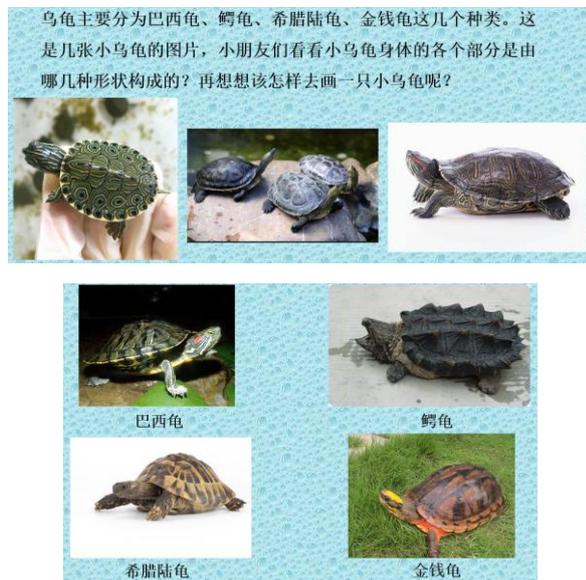


Figure 9 Classification of tortoises

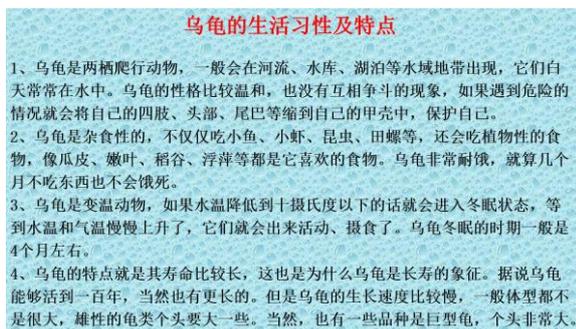


Figure 10 The life habits of tortoises

3. CONCLUSIONS

The children's various abilities can be significantly improved in the course of this course. Mainly reflected in the following aspects: 1. Exercise the observation ability, the child observes more meticulously. Through training, children can concentrate their attention highly

in the process of observing objects, and summarize the characteristics of things in a multi-angle and meticulous manner. 2. The practical ability is greatly improved. Children can use the 3D printing pen proficiently, and can continue to modify the model according to the deficiencies in the finished product obtained by observing the printing. 3. The spatial thinking ability has been improved, and the three-dimensional model can be constructed in the mind through the teacher's description and made with the printing pen. If you are able to learn more, you can also use the knowledge you have learned to create other models of interest. 4. Personality has been cultivated. Through the sharing of stories and news included in the course, children can set a correct example and convey excellent quality, so that children can get a good moral education while drawing and learning.

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