

## Two Dimensions of Mathematics Infiltrating Aesthetic Education

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**Keywords:** Mathematics; Aesthetic Education; Teaching Reform; Colleges and Universities

**Abstract:** The infiltration of aesthetic education in mathematics teaching can not only cultivate and develop students' aesthetic sense and intuition of mathematics, but also stimulate students' interest in learning. How to guide students to appreciate and apply mathematical beauty is very important for teachers. Based on this, the concept of mathematical beauty and its classification were outlined in this study, and two dimensions of mathematics infiltrating aesthetic education were analyzed, then how teachers infiltrate aesthetic education in mathematics teaching, as well as the role of infiltrating aesthetic education in mathematics teaching to students were further explored. The research shows that teachers should reveal the beauty of mathematics in the teaching process, use the beauty of mathematics to infect students, induce students' aesthetic desire, and make them consciously participate in the cognitive activities of mathematics.

### 1. Introduction

Aesthetic education, as an educational activity, is a kind of aesthetic education that harmoniously penetrates into human mind in consciousness and reason, image and abstraction, emotion and knowledge, pleasure and utility, it plays an inestimable role in correcting human behavior and building healthy personality, and is an indispensable part of quality education. The infiltration of aesthetic education into teaching field has not only become the main way to implement quality education, but also a trend of future teaching. Infiltrating aesthetic education in mathematics teaching is not only helpful to stimulate learning interest, improve classroom efficiency and cultivate innovative consciousness, but also helpful to cultivate students' sentiment, establish correct aesthetic view, improve intuitive thinking and creative thinking ability. This mode plays an important role in cultivating students' overall quality, which not only is an indispensable link in training all-round development talents, but also the requirement of contemporary quality education. Mathematics teachers must strive to improve their knowledge level to provide a strong guarantee for aesthetic education penetration in the teaching process.

### 2. Concept and Classification of Mathematical Beauty

Mathematical beauty is the perceptual and rational presentation of the essential power of mathematics and the presentation of human's essential power through a pleasant mathematical thinking structure, and it is a kind of scientific beauty [1]. Mathematics is a science that studies the relationship between spatial form and quantity, its rich content makes mathematics full of beauty, and its complete structure, symmetry of graphics, reasonable layout and concise form all reflect the factors of beauty in mathematics. Many theorems and formulas in mathematics show concise beauty [2]. Many phenomena in real life can often be summed up as a formula, an equation or a functional relationship in mathematics, which reflects the unified beauty of mathematics, such as the side area formula of a regular prism and a regular pyramid can be unified as  $S = \frac{1}{2}(c + c')h$ . In algebra, the conjugate factors in simplifying algebraic expressions, and the symmetry of images of functions and inverse functions on lines  $y = x$ , as well as equilateral triangles, circles, hyperbola and other graphics all give people a sense of beauty of symmetry [3].

### 3. Two Dimensions of Mathematics Infiltrating Aesthetic Education

#### 3.1 Natural beauty of teaching

According to the survey, at present, most students prefer a challenging classroom which is completely extended according to their own thinking, that is, a "natural" classroom, rather than a classroom where teachers instill knowledge and students are tired of coping with the sea of questions [4]. The teaching idea of the new curriculum embodies this point. The connotation of "textbooks" changes greatly, the assistant tools of knowledge learning increase, and the methods of inquiry are closer to the students' learning conditions. In fact, this provides teachers with a way of creating "natural" classroom. Permeating the beauty of nature requires teachers to be diligent in analyzing textbooks and setting and answering questions in the direction of students' thinking development [5].

#### 3.2 Essential beauty behind phenomenon

The intrinsic beauty behind mathematical phenomena attracts students. This kind of intrinsic beauty needs to be excavated by students themselves. Thus, "intrinsic beauty" is more attractive, and students will enjoy the process of thinking, discussing and excavating intrinsic beauty [6]. This learning psychological state of excellent students should be emphasized and promoted in the design and organization of classroom teaching.

For example, in a regular monthly examination paper review, the preparation group chose such a "difficult problem".

For example: there is a point  $P(3,0)$  in the plane rectangular coordinate system  $xOy$ , and the known point  $P(3,0)$  is in the circle  $C: x^2 + y^2 - 2mx - 4y + m^2 - 28 = 0$ . There is a moving straight line  $AB$  at the crossing point  $P$ ,  $A, B$  are exactly two intersections of the moving straight line and the circle. If the maximum area of  $\triangle ABC$  is 16, try to find the range of real number  $m$ .

Step 1: show the students' preliminary ideas of cliff-type.

Student ideas 1:  $(x-m)^2 + (y-2)^2 = 32$  can be obtained by transforming the equation of circle  $C$ , and radius  $r$  which satisfies  $r^2 = 32$  can be obtained. Because the point  $P(3,0)$  is in the circle, there is  $(3-m)^2 + (0-2)^2 < 32$ , namely,  $3 - 2\sqrt{7} < m < 3 + 2\sqrt{7}$ .  $S_{\triangle ABC} = \frac{1}{2}r^2 \sin A = 16 \sin A$ , and the maximum area is 16, so  $(\sin A)_{\max} = 1$ .

Student ideas 2: the preceding ideas are identical, and the differentiation with thought 1 appears when the area is calculated. Suppose that the distance from point  $A$  to line  $BC$  is  $d$ , there is  $S_{\triangle ABC} = \frac{1}{2}BC \cdot d$ , and  $BC = 2\sqrt{r^2 - d^2} = 2\sqrt{32 - d^2}$ , thus,  $S_{\triangle ABC} = \sqrt{32 - d^2} \cdot d \leq 16$  (if and only if  $d = 4$ ). Assuming linear equation  $y = k(x-3)$  and combining the distance formula from point to line,  $4 = \frac{|km - 2 - 3k|}{\sqrt{1+k^2}}$  can be obtained.

Step 2: discuss freely and continue thinking.

In fact, the above two ideas are correct, thinking can be further close to the essence of mathematics. Therefore, the author allows the students to discuss freely in the commentary, so as to continue the cliff-like thinking mentioned above.

Student ideas 1: these two ideas are essentially the same, because when  $(\sin A)_{\max} = 1$ ,  $d = \frac{\sqrt{2}}{2}r = 4$ ,  $4 = \frac{|km - 2 - 3k|}{\sqrt{1+k^2}}$  can also be transformed into a question about whether the equation of  $k$  has a solution, that is  $[(m-3)^2 - 16]k^2 - 4(m-3)k - 12 = 0$ . Then, the range of real number can be obtained by discussing whether the equation has solutions in two cases,  $(m-3)^2 - 16 = 0$  and  $(m-3)^2 - 16 \neq 0$ .

Student ideas 2: this is a geometric problem, students can start from a geometric point of view. If

we start from the geometric nature of the figure, we may connect the thinking after getting  $d = 4$  in train of thought 1, because the moving line is the moving line  $AB$  passing through fixed point  $P$ , so  $d \leq CP$ . When  $CP \geq 4$ , there is  $d = 4$ , at this time, the area is maximized, and  $(3-m)^2 + (-2)^2 \geq 16$ , that is,  $(m-3)^2 \geq 12$ .

Step 3: trace the origin and dig the root of thinking.

Students need to explain more thoroughly their understanding of the deep nature of mathematical phenomena and the advantages of their own thinking, and the process of reviewing their starting point and inflection point is full of the beauty of logic and conciseness of mathematics, which can't be achieved by teachers through indoctrination.

The beauty of education lies in arousing students' mathematical thinking, letting students have real and unique feelings and discoveries in the process of learning, improving students' thinking, analyzing and thinking with scientific thinking in the process of solving mathematical problems and daily life, which is the best explanation of using the beauty of teaching to improve the effectiveness of classroom teaching [7].

## **4. Mathematics Infiltrating Aesthetic Education**

### **4.1 Infiltration process**

Teachers' aesthetic education in mathematics teaching is mainly to guide students to appreciate the beauty of mathematics and learn to apply it, which can be done from the following aspects.

Firstly, there are many contents in the history of mathematics for teachers to teach students in combination with mathematics teaching, teachers should guide students to appreciate the beauty of mathematics, this introduction will help students understand the history of mathematics and the deeds of mathematicians, and help students understand the essence of the spirit of mathematics.

Secondly, teachers need to deal with textbooks from the aesthetic point of view, organize teaching content, and excavate the factors of mathematical beauty, which can not only improve students' interest in learning mathematics, but also cultivate their appreciation of mathematical beauty [8]. When there is no obvious method of applied aesthetics, teachers should guide students to analyze the beauty of mathematics embodied in the teaching process. In teaching, they should not only guide students to appreciate the beauty of mathematics, but also let students learn to use the method of mathematical beauty to consider problems.

Thirdly, in teaching, if teachers can often add some practical problems related to real life to expand the application of knowledge, introduce mathematical concepts, theorems and formulas through vivid examples and visual teaching aids familiar to students, organize students to carry out practical operations, students can feel that mathematics is closely related to daily life, which will certainly enable students to have a deeper understanding of the beauty of teaching and mathematics [9]. Image metaphors of abstract concepts, geometric illustrations of complex analytic expressions and living examples of profound theories not only give students a relaxed learning atmosphere, but also stimulate aesthetic feelings of mathematics.

Fourthly, teachers can integrate the beauty of mathematics by guiding students to compare the knowledge they have learned before and after, summarizing it, revealing its inherent laws and forming an orderly structural system, and teach students the methods of induction and collation, which can not only promote students to further consolidate and deepen their understanding and application of the knowledge they have learned, but also improve the quality of teaching and achieve twice the result with half the effort.

### **4.2 Role of aesthetic education in mathematics teaching**

Mathematics aesthetic perception is an intuitive grasp of the aesthetic factors in mathematics, which is the basis of teaching aesthetics. In the process of mathematics learning, students are first exposed to mathematical concepts, formulas, theorems, rules and so on. Although they contain aesthetic factors, the beauty of mathematics is mainly embodied through mathematical language,

which is indirect and vague [10]. Therefore, not all students can feel the existence of mathematical beauty, this requires teachers to consciously cultivate students' aesthetic perception of mathematics in teaching, and guide them to discover and appreciate beauty.

Mathematics learning ability is the decisive factor affecting the effect of mathematics learning, and the cultivation of mathematics learning ability is directly related to learners' understanding of mathematics beauty, so there is a mutually reinforcing relationship between the two. Full understanding of mathematical beauty is conducive to the enhancement of mathematical learning ability, and the enhancement of mathematical learning ability will promote students' deeper understanding of mathematical beauty in turn.

The quality of mathematics learning is mainly the ability of exponential learning and the effect of mathematics learning. Current textbooks attach importance to strengthening the teaching of basic knowledge, and pay attention to teaching students the methods of learning, developing students' intelligence and cultivating their learning ability. While the improvement of mathematics learning effect mainly refers to the accurate grasp of mathematical concepts, the proficiency of mathematical methods, the free use of mathematical laws, especially the systematic construction of mathematical knowledge system.

Like literature and art, aesthetic education in mathematics has the potential function of ideological education. However, the beauty of mathematics is an advanced form of beauty. For those who lack mathematical literacy, especially for teenagers, it is impossible to feel and realize it as easily as literature and art because of the limitations of experience, knowledge and aesthetic ability. This requires teachers to constantly improve their professional knowledge and aesthetic accomplishment, study textbooks carefully, and explore and refine the aesthetic education contained in textbooks thoroughly, so as to create a harmonious, beautiful and pleasant learning environment and atmosphere for students, guide students to discover, feel, appreciate and create beauty according to the law of beauty.

## 5. Conclusion

The aim of aesthetic education is to form a complete and harmonious personality, and the implementation of aesthetic education in schools is the need of today's times and educational policy. The infiltration of aesthetic education in the teaching process conforms to students' learning psychology, which is conducive to stimulating students' learning positive emotions, making students experience the process of creative learning under the guidance of positive emotions, and improving the quality of thinking of learning results. In addition, in the infiltration activities of aesthetic education, mathematics teachers must fully understand and clearly the demand of mathematics teaching, strive to improve their knowledge level, pay attention to the beauty of appearance, and be good at creating beautiful situations, so as to provide a strong guarantee for the infiltration of aesthetic education in the process of mathematics teaching.

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