The Application of the Geometer's Sketchpad in the "Graphics and Geometry" Section of Junior High School Mathematics

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Abstract. The part of "Graphics and Geometry" is characterized by abstract and logic, and students will inevitably have cognitive bias in the learning process. The Geometer's Sketchpad can visualize abstract shapes, so this paper focuses on how to apply the Geometer's Sketchpad to the "Graphics and Geometry" part of junior high school mathematics. First, four examples of applying it are given: application to the nature of perpendicular bisector, isosceles triangle three lines one theorem, the definition of neutrality line, and the demonstration of the folding process. Then, the advantages of applying The Geometer's Sketchpad in junior high school mathematics classrooms are analyzed, and corresponding teaching suggestions are given: master The Geometer's Sketchpad, but use it reasonably and not as a substitute for traditional teaching.

Keywords: The Geometer's Sketchpad; junior high school mathematics; Graphics and Geometry.

1   Introduction

Digital development and change are sweeping across the globe and are bound to bring about a comprehensive transformation of society.[1] Education should also seize this major historical opportunity and integrate modern information technology into classroom teaching. The integration of modern information technology into classroom teaching is a major step in the digital transformation of education, and at the same time, it is more capable of changing the way students learn and improving their learning efficiency.

Mathematics itself has a high degree of abstraction, if the teacher can not visually and dynamically show the process of mathematical knowledge trip, students will inevitably appear a variety of confusion. The Geometer's Sketchpad, as a visual educational software, coincides with the abstract characteristics of mathematics, and the combination of the two can change abstraction into concrete and static into dynamic, which is more conducive to students' learning of mathematics.[2]

learning of elementary geometry, which puts forward new requirements for students' spatial imagination, summarization and generalization abilities. If The Geometer's Sketchpad is applied to the teaching of this block, it can concretely and graphically represent the formation process of mathematical knowledge and reduce the cognitive load of students. Therefore, it is necessary to study the application of The Geometer's Sketchpad in junior high school mathematics graphics and geometry board.

After analyzing the literature, it can be found that the research literature on the integration has been increasing year by year after 2008, but there is still a relative lack of research in the field of Graphics and Geometry. Therefore, this paper will conduct a research on the application of The Geometer's Sketchpad in the "Graphics and Geometry" section. This study can enrich the relevant theoretical research, and at the same time, guide teachers to dig deeper into the teaching resources, and guide students to effectively use modern information technology to promote learning.

2   The application examples of The Geometer's Sketchpad in the middle school math "Graphics and Geometry" section

2.1   Applied to the Properties of Perpendicular Bisectors

The perpendicular bisector is a section after learning the properties and determination of perfect equilateral triangles. Referring to the teaching design of this lesson, it can be found that many teachers guide students to measure the distance from a point on the perpendicular bisector to the ends of the line segment, and summarize the theorem of the nature of the perpendicular bisector through the results of the measurement. However, the measurement is not free from error, and the nature of the vertical bisector emphasizes "any point on the vertical bisector", only a few points for the measurement of students may have questions. The Geometer's Sketchpad can avoid these problems.
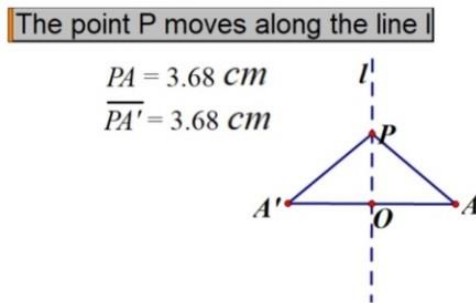

Fig. 1. Geometer's Sketchpad presentation of the perpendicular bisector property

As shown in Figure1, through The Geometer's Sketchpad "measure" tool, measure the length of the line segment PA' and the line segment PA. The teacher can move the position of point P and guide the students to observe the length of line PA and line PA', and they can find that no matter how to move, the length of the two lines are equal. Further, the teacher can set up the operation button of "move point P along line l", and

the teacher can directly click the operation button to take any point on line l, and then get the points on the perpendicular bisector to the ends of the line segment are equal in distance. Similarly, this method can be used to teach the properties of angle bisectors.

2.2   Applied to isosceles triangle three lines one theorem

"Isosceles triangle three lines one theorem" is an important theorem of isosceles triangles, and teachers often get it through rigorous proof. However, students only recognize the unity of the three lines at the logical level, but lack of knowledge of the visual presentation.
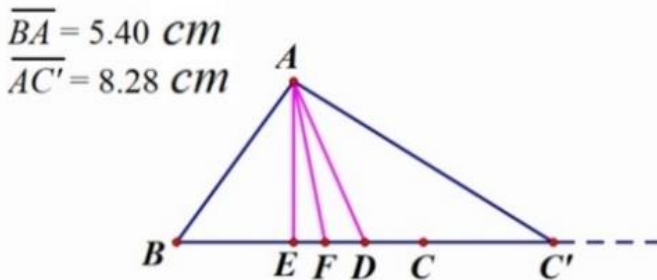

Fig. 2. Geometer's Sketchpad display of isosceles triangle three lines one theorem.

With the help of The Geometer's Sketchpad dynamic demonstration is to enable students to more intuitively see the three lines together a isosceles triangle unique properties. As shown in Figure2, teachers can move the point C 'to guide students to observe the position of the point D, E, F changes, which can be found when the point C 'moved to a certain position, point D, E, F three points coincide, at this time the measurement of the distance between the line segment AB and the line segment AC 'can be found that the distance between the two are equal. This means that at this time the triangle ABC ' is isosceles triangle, in the process of moving the point C 'also want to show students that "three lines three one theorem" is a unique property of isosceles triangles, which can deepen students' understanding of knowledge and perception [3].

2.3   Applied to the definition of neutrality line

The definition of the median of a triangle is the line segment that connects the midpoints of any two sides of a triangle, but teachers should not stop at the definition alone, but should further reveal how the median of a triangle is formed as a trajectory [4].
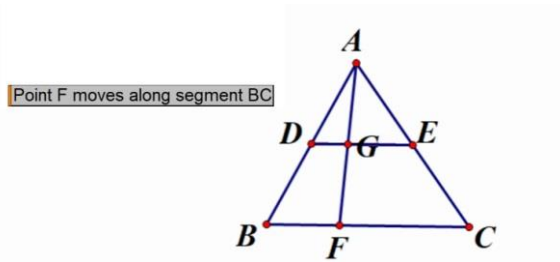
Fig. 3. Geometer's Sketchpad presentation of the median of a triangle

As shown in Figure3, line DE is a median line of triangle ABC, point F is any point on the side of BC, connect the line AF, point G is the midpoint of line AF. Setting the manipulation button "Point F moves along line BC" and tracking the trajectory of point G, it can be found that the trajectory formed by point G is exactly the line DE. The Geometer's Sketchpad display allows students to visualize and dynamically experience the formation of the median line as a trajectory, deepening their understanding of the definition of neutrality line.

2.4   Through the Geometer's Sketchpad realistic dynamic folding process

The formation of a large amount of knowledge in mathematics requires the use of folding, such as axisymmetric figures, the nature theorem of perpendicular bisector and so on. Students may not be able to understand the process of folding and the final effect if it is simply explained [5]. Using The Geometer's Sketchpad to create the process of folding, the conclusion can be clearly and intuitively seen by demonstrating the folding.

As shown in Figure4, triangle ABC is isosceles and the line AE is the perpendicular bisector of line segment BC. In order to discover the perpendicular bisector property theorem, it is now necessary to fold the triangle ADE and the triangle ACE to obtain a complete overlap, thus showing that AB = AC. The Geometer's Sketchpad can also be used to set up operation buttons, so that when the point D moves along the arc, it drives the triangle ADE to move, and then the effect of folding occurs. This operation saves the teacher the time of actually demonstrating the folding process through the pieces of paper and also allows students to visualize the folding process.
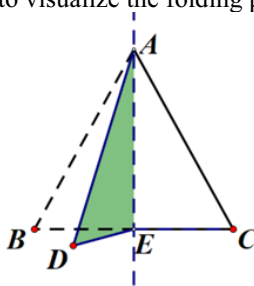

Fig. 4. the folding of an isosceles triangle using Geometer's Sketchpad

3   Advantages of integrating it into math classroom

3.1   Enhance basic knowledge and basic skills, stimulate learning interest

The Geometer's Sketchpad's integration into the middle school math classroom alleviates the abstract nature of math and makes it feasible to present mathematical knowledge to students in a realistic and visual way. Incorporating The Geometer's Sketchpad into junior high school mathematics classroom can improve students' knowledge and ability, and improve students' understanding of geometry problems in an invisible way [6]. The Geometer's Sketchpad provides accurate graphs, which is conducive to students' observation of graphs, analysis of graphs, and cultivation of students' rigorous logical thinking, the idea of combining numbers and shapes, as well as problem-solving ability. With the difficulty of math learning greatly increased, many students' motivation to learn declined. The Geometer's Sketchpad as a new thing into the curriculum, is conducive to alleviate this phenomenon, improve students' motivation to learn mathematics.

3.2   Enhance teachers' information literacy and improve their teaching quality

Many old teachers are reluctant to contact new things due to the decline of their own learning ability, but if they can learn to master The Geometer's Sketchpad and try to integrate it into junior high school classroom teaching, it is bound to improve teachers' information literacy. It can also help teachers save time on the use of teaching aids, explain abstract knowledge, effectively solve the key difficulties in teaching, and facilitate the solution of abstract and dynamic knowledge [7]. It also saves classroom graphing time and increases students' classroom thinking time. Better student-centered, pay attention to the process of students' understanding of knowledge, and then improve the efficiency of classroom teaching and improve the quality of teaching.

4   Suggestions for integrating it into the math classroom

4.1   Mastering and applying Geometry Board

The Geometer's Sketchpad, although relatively simple compared to other software for making classroom materials, will be more beneficial to students' exploration in mathematical practice, in addition to enabling teachers to make it more convenient. Nowadays, most colleges and universities have offered the course The Geometer's Sketchpad, so many young teachers are able to master the basic functions of it, but the production of The Geometer's Sketchpad class requires sufficient multimedia operation and design capabilities, which requires teachers to explore more of the other functions of The Geometer's Sketchpad after the class.

4.2   Utilize The Geometer's Sketchpad wisely, it can't completely replace traditional teaching

Multimedia has the advantages of good dynamics, large classroom capacity and experimentation, and all are advantages that should not be ignored, but if everything is done with the help of computers, then the teacher's own presence seems redundant. Therefore, although it is frequently used in the teaching classroom, the math teacher is still the main subject of math, and should not lose sight of the other side of the coin and hold The Geometer's Sketchpad in too high a position. The Geometer's Sketchpad should be used reasonably and appropriately, to know the proportion, and in the process of teaching mathematics, not everything is suitable for the use of the Geometer's Sketchpad, for example, such as integer operations or equations and other algebraic knowledge points. The Geometer's Sketchpad in the teaching function can only be auxiliary, the main body of teaching is the teacher, The Geometer's Sketchpad only with the right to really play its role.

5   Conclusion

Using The Geometer's Sketchpad as a tool, this paper examines how to integrate The Geometer's Sketchpad into the teaching of the "Graphics and Geometry" module in middle school math. The paper lists four examples of its application in the "Graphics and Geometry" module. It analyzes the advantages of its application in junior high school mathematics classroom and gives the corresponding suggestions for teaching use: proficiency but reasonable use.

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