

The Current Situation and Analysis of the “Geometer’s Sketchpad” in Mathematics Teaching in Secondary School

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Keywords: The geometer’s sketchpad; Function; Mathematics teaching in secondary schools

Abstract: The integration of information technology into mathematics (abbreviated as math) classroom has become a teaching trend in the new era. Geometer’s Sketchpad, with its simple operation and powerful animation function, has changed the traditional teaching method of math, and is favored by teachers and students. In this paper, the main functions of Geometer’s Sketchpad is briefly introduced. Through questionnaire survey, from the aspects of teachers’ attitudes and usage, it can be seen that more than half of the teachers are familiar with Geometer’s Sketchpad and use it in math teaching. The main reasons for not being used frequently are: heavy teaching tasks for high school and college entrance examinations, tight time, insufficient computer knowledge, unfamiliar operation and so on.

1. Questions Raised

“The National Mathematics Curriculum Standard for Full-Time Compulsory Education (Experimental Draft)” promulgated by China in 2011 clearly points out that “the design and implementation of math curriculum should reasonably use modern information technology according to the actual situation, and pay attention to the organic combination of information technology and curriculum content”. Therefore, the rational use of modern educational technology in math classroom teaching is the inevitable trend of curriculum reform and development. In recent years, math teachers have integrated information technology into classroom teaching, and Geometer’s Sketchpad has won the favor of secondary school teachers. Nowadays, with the continuous reform of the new curriculum, how to apply the Geometer’s Sketchpad flexibly in the math classroom teaching in secondary school, how to simulate students’ interest in learning math and how to improve the quality of math teaching all need us to think and explore.

2. The Function of Geometer’s Sketchpad

Geometer’s Sketchpad was originally a geometric dynamic software produced and published by Key Curriculum Press Company in the United States. Its full name is “Geometer’s Sketchpad—Dynamic Geometry for the 21st Century”. It is a widely used teaching software based on computer and math. Geometer’s Sketchpad software has low requirements for hardware configuration and can run independently without the support of other software. It has the characteristics of simple operation and powerful animation, which is mainly manifested in the study of functions, geometric relations and verification theorems through animation changes. The basic elements of the Geometer’s Sketchpad are points, lines and circles. By constructing, transforming, measuring, calculating in data, creating new functions and drawing, the complex geometric figures or function images are drawn, and the complex mathematical relationships are revealed. It mainly includes the following four functions:

2.1 Geometric Drawing Function.

The basic tools of the Geometer’s Sketchpad are “point”, “line segment” and “circle”. With these three basic tools, more complex geometric figures can be drawn accurately and correctly by means of construction, transformation, measurement, calculation of data and new functions, drawing, etc.

For example, using the drawing tool of the Geometer's Sketchpad can quickly draw the intersection point, parallel line, and vertical line of two geometric figures, and can also draw the midline and angular bisector of some geometric figures. Compared with the conventional blackboard drawing, it is more accurate, fast and convenient to draw geometric figures with the help of Geometer's Sketchpad.

2.2 Dynamic Demonstration Function.

All graphics drawn by the Geometer's Sketchpad can move. There are three ways to move the graphics in the Geometer's Sketchpad. One way is to drag a part of the object so that the graphics connected by various geometric relations move together and the basic properties of graphics are kept unchanged. The other two ways are object movement and animation. According to the requirements of dynamic graphics, the direction and speed of graphics movement can also be set in the motion button, such as setting points to move at medium speed on the circumference. In addition, the toolbar of the Geometer's Sketchpad can also rotate, zoom, reflect and iterate the graphics, which makes it possible to observe the movement of the graphics.

2.3 Measurement, Parameters and Calculation Functions.

The measurement, parameters and calculation functions of the Geometer's Sketchpad are convenient tools for our in-depth study of geometric figures. Using the Geometer's Sketchpad, we can not only measure the length, perimeter, area, etc., but also construct and calculate to obtain new data on the basis of measurement data. In order to facilitate calculation, the Geometer's Sketchpad also has the function of constructing new parameters. By executing the command of "data" - "new parameters", the new parameters can also participate in calculation and other operations. For example, for the calculation, the "data" - "calculation" command is selected, the new calculation dialog box is opened, and then the calculation value is input to participate in the calculation together. Finally, a new data expression will be formed in the Geometer's Sketchpad.

2.4 Functions of Mathematical Experiments.

Formulas and theorems in math need to be proved and deduced, and rigorous logical reasoning is needed to prove their correctness. To some extent, it is difficult for students to understand them. The essence of the Geometer's Sketchpad is to "maintain a given geometric relationship in motion", for example, the intersection of two given figures is always kept as the intersection point. Using the Geometer's Sketchpad to demonstrate the movement process of graphics can well reveal the formation principle of mathematical theorems. Geometer's Sketchpad can be used to prove formulas and theorems and explore their properties, such as the proof of Pythagorean theorem related to triangles, the proof of standard deviation formula, and the exploration of the properties of parallelograms with equal and parallel opposite sides.

3. Data Analysis

In order to better understand the current situation of Geometer's Sketchpad in math classroom teaching in secondary schools, we set up a questionnaire, distributed 100 copies, and collected 98 copies. The questionnaire contains 17 questions, which are divided into four dimensions. It mainly focused on the basic situation of secondary school math teachers, their use of Geometer's Sketchpad in math classes, their attitudes and influencing factors.

3.1 Basic Situation.

The proportion of males and females in the survey was about 3:7, of which 34.38% were teachers in Grade Seven, 31.25% in Grade Eight, 12.5% in Grade Nine, 18.75% in Senior One, 9.38% in Senior Two and 3.13% in Senior Three, mainly in Grade Seven and Eight. In the composition of teaching years, it was found that only 12.5% of teachers have worked for 6 to 10 years, 40.63% of them have worked for more than 10 years, and 46.88% of them have worked for less than five years. 7/8 of the respondents were young teachers who had just started working or

math teachers with rich teaching experience. The scope of investigation was wide.

3.2 Usage Situation.

Statistics showed that about 74% of math teachers were in a familiar, relatively familiar or even very familiar state on the question “Your knowledge of Geometer’s Sketchpad and related operations”. More than 50% of teachers often looked up relevant courseware materials and literature of Geometer’s Sketchpad through various channels, and used them according to the teaching content, and the frequency of use was high. A few teachers were accustomed to using Geometer’s Sketchpad for teaching.

3.3 Teacher Attitude.

It reflected that 31% of teachers believed that the use of Geometer’s Sketchpad in math teaching was to demonstrate to students, and a small number of teachers had objections. About 81% of teachers thought that using the Geometer’s Sketchpad was not to teach the knowledge of Geometer’s Sketchpad, and thought that using the Geometer’s Sketchpad can stimulate students’ interest, help students understand the concept of math and help students understand the essence of math (geometry). Teaching demonstration, using courseware instead of blackboard writing, simulation experiment or actual situation were the main teaching methods adopted by most secondary school math teachers.

Nearly half of the secondary school math teachers could not tell whether there was a difference between traditional teaching and Geometer’s Sketchpad teaching. Some teachers felt that there was a difference. 75.51% of teachers believed that the use of Geometer’s Sketchpad teaching had certain advantages, but it could not completely replace the traditional teaching. From the feedback results, it could be seen that most teachers supported the inclusion of Geometer’s Sketchpad in the elective content, and were willing to improve their understanding of Geometer’s Sketchpad by participating in the training of “Geometer’s Sketchpad” or self-learning. The main reasons why Geometer’s Sketchpad failed to go deep into the secondary school math teaching were “inadequate school hardware facilities”, “heavy teaching tasks, tense schedule, and insufficient time” and “Geometric Sketchpad not involved in college entrance examination”. A few teachers thought that their computer knowledge was insufficient and their operation was unfamiliar.

3.4 Survey Results.

From the above data, it can be concluded that more than half of math teachers believe that the application of Geometer’s Sketchpad in secondary school math teaching has certain advantages, which can stimulate students’ interest, help students understand mathematical concepts and understand the essence of math(geometry). In the choice of teaching methods, the general classroom teaching uses lecture demonstration and courseware instead of blackboard writing and simulation experiment, but teachers are not skilled in computer knowledge and operation, resulting in the unskilled and inflexible use of Geometer’s Sketchpad software to make courseware. Most math teachers express their willingness to learn the Geometer’s Sketchpad and consider it necessary to include it in the elective course. Therefore, the integration of the Geometer’s Sketchpad into the classroom teaching of math in secondary schools not only enables students to get more opportunities to practice, but also helps to cultivate their learning attitude to think positively about math, innovative spirit and practical ability. It is imminent to strengthen teachers’ understanding of Geometer’s Sketchpad and help secondary school math teachers skillfully use Geometer’s Sketchpad in teaching.

Acknowledgements

This work was supported by Special research program of education department of shaanxi province (No. 15JK2157). 2018 key curriculum project of Xi 'an university,(No. KGB201825)

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