

# An Inquiry Teaching Case Based On Geometric Sketchpad

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**Abstract—Combining the Geometer's Sketchpad and mathematics knowledge in middle school, this paper studies an inquiry teaching case, its aim to help improve the students' interest in classroom effectively and optimize the teaching effect.**

**Keywords—Inquiry teaching; Middle school mathematics; Geometric Sketchpad**

## I. INTRODUCTION

Mathematics is difficult and abstract. In middle school mathematics teaching, due to the limit of traditional teaching methods, more students meets with learning barrier. Some students do not know how to study math. Someone say, 'I am not good at mathematics,' or 'I am not interested in it,' and 'Mathematics is too abstruse to learn'. In the 21st century, with the rapid development of information technology, various fields of the education have changed a lot. The New Mathematics Curriculum Standards of Senior High School emphasizes the integration of information technology and mathematics teaching to improve the drawbacks of the traditional teaching modes. The Geometer's Sketchpad as a production of computer's graphics theory and mathematics knowledge integration. Owing to its operation is simple and functions are various, especially it has incomparable convenience with some teaching software when it will provide some intuitive mathematical graphics and images, and analyze some math problems and reveal mathematical rules by using animation form, it is called as "the dynamic geometry in Twenty-first Century".[1]

Inquiry teaching method, which is learner-centered, breaks from the traditional lecture format and ask the student to take an active role in his or her own learning. Inquiry learning begins when students are presented with a problem and some suggestions and tools for finding the answer to that problem. They struggle, with help from the instructor, through the problem until they reach their answer, having constructed it themselves [2]. The core of the process of inquiry teaching is the loop consisting of "forming-debugging hypothesis" and "testing hypothesis." Once a hypothesis is successfully verified, one exits the loop

and proceeds to study the generalizations or the applications of the rule [3]. With the development of computer technology, especially the rapid development of artificial intelligence technology, People pay more attention to modern technology combined with the education. In this paper, we aim to design an inquiry teaching case combining the Geometer's Sketchpad and mathematics knowledge in high school. Through case study, we hope to help students learn math content, solve mathematical problems, change the way of learning.

## II. AN INQUIRY TEACHING CASE

### Problem:

The radius of the circle O is fixed length, the A is a fixed point on the circle of O, the midnormal of the line AB intersects the radius OP at point Q, if the point P moves on the circle, what is the locus of point Q?

**Analysis:** Through the dynamic demonstration of the geometry sketchpad, it is easy know that the trajectory of the point Q is an ellipse. The focal point of the ellipse is the point O and A(as shown in Fig.1).

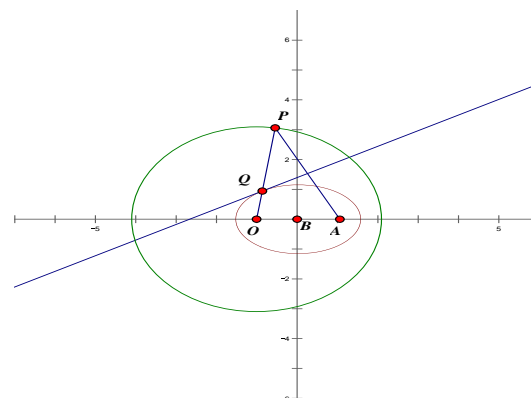


Fig. 1

### Solution :

$$\because |QO| + |QA| = |QO| + |QP| = |OP| = r (r > |OA|),$$

∴ Establish a coordinate system as shown in Figure 1, the locus of point Q is an ellipse, which focal point is O and A.

Let  $|OP| = r = 2a (a > 0)$ ,  $|OA| = 2c (c > 0)$ , then the locus equation of point Q is

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \text{ (where } b^2 = a^2 - c^2, a > b > 0)$$

The problem is common fixed point locus problem in middle school mathematics, the key to solve this problem is to find out the conditions to meet the geometric point, teachers can use the geometer's sketchpad in the teaching, through the "Variations of a Question" to guide the students to find and sum up the general law on the track problem.

**Exploration 1 :** Set M as the midpoint of line AP, seeking point M trajectory.

**Analysis:** Using the Geometer's Sketchpad can know the M locus is a circle (as shown in Fig.2).

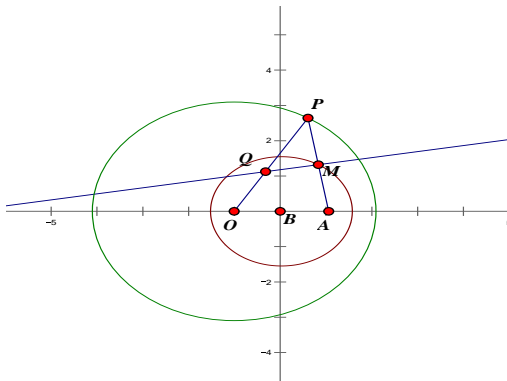


Fig.2

**Solution:** Set up coordinate system as Fig.2. In  $\triangle POA$ , B and M is the midpoint line OA and AP, respectively, we obtain  $|BM| = |OP|/2 = a$ . Thus, The locus of point M is a circle, which equation of a circle with center at B(0,0) and radius  $r = a$  is  $x^2 + y^2 = a^2$ .

**Exploration 2 :** Point N is the point on the line segment AP, seeking point N trajectory.

**Analysis:** It is easy to see that Exploration 1 is a special case of Exploration 2. Is it still a circle? Describe the track of point N by the Geometer's Sketchpad, it is still a circle (see Fig.3).

Solution : Let

$$N(x, y), P(x_0, y_0), A(c, 0), \frac{AN}{AP} = \lambda,$$

then  $x_0 = \frac{x-c+\lambda c}{\lambda}, y_0 = \frac{y}{\lambda}$ . For the point  $P(x_0, y_0)$

on the circle O, we have

$$(x_0 + c)^2 + y_0^2 = 4a^2,$$

i.e.

$$\left(\frac{x-c+2\lambda c}{\lambda}\right)^2 + \left(\frac{y}{\lambda}\right)^2 = 4a^2.$$

Thus, the locus equation of point M is  $(x-c+2\lambda c)^2 + y^2 = 4\lambda^2 a^2$ .

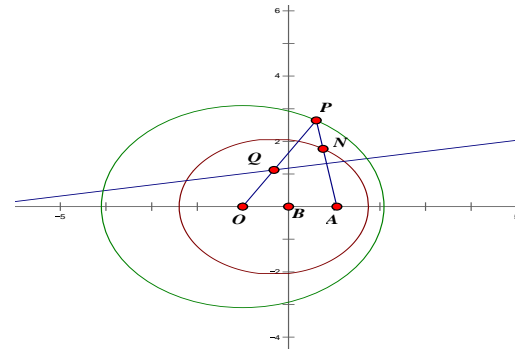


Fig.3

**Exploration 3 :** Set H as the midpoint of line AP, seeking point H trajectory.

**Solution :**

$$\begin{aligned} \because |HB| + |HA| &= \frac{1}{2}|QO| + \frac{1}{2}|QA| \\ &= \frac{1}{2}(|QO| + |QA|) = \frac{1}{2} \cdot 2a = a \end{aligned}$$

which implies that

$$\frac{(x-\frac{c}{2})^2}{\frac{a^2}{4}} + \frac{y^2}{b^2} = 1$$

The graph of the ellipse is shown in Fig.4.

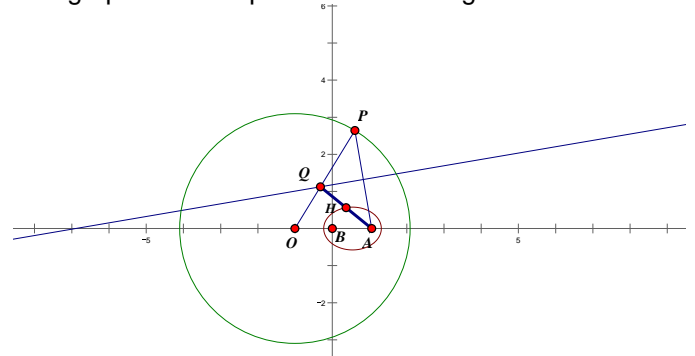


Fig.4

**Exercise :** Point K is the point on the line AQ, seeking point K trajectory (prompt: see Fig.5).

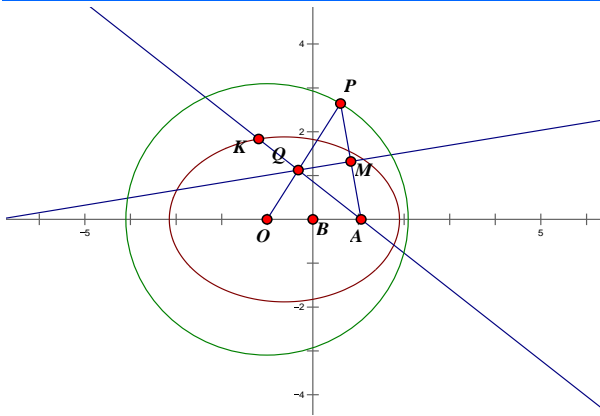


Fig.5

### III. CONCLUSION

Most teaching styles follow the traditional lecture format—we talk—they listen. Students are conditioned to be passive learners, and do not have enough time and opportunity to explore and cooperation in math classroom. In this paper, we consider an inquiry

teaching case combined with geometer's sketchpad, the model could increase learners' interest, cultivate their creative ability and stimulate their self-exploration.

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