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Study on the Design of Micro-lectures for the Visualized Problem Context Teaching of Middle School Mathematics

Taking the Interior Angle Sum of Polygons as an Example*

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***Abstract*—The rapid development of information technology has brought a variety of ways for the reform of education methods. The article takes the mathematics course as an example, has conducted in-depth study on visualized context of problem micro-lectures of middle school mathematics from the creation of visualized context of problems, the design of teaching processes, the production of teaching resources, the feedback of teaching practice, etc., has summarized the process of micro-lecture design for visualized context of problem teaching, which can provide reference for teachers to conduct visualized context of problem teaching.**

Keywords—middle school mathematics; context of problems; instructional design; interior angle sums of polygons

I. INTRODUCTION

With the development of the Internet and the information technology, more and more students are learning through the Internet. The micro-lecture is one of the main forms of online learning. To ensure that students do not get distracted when listening to micro-lectures, the teaching resources must be attractive. Contexts and problems are all important factors in improving the attractiveness of teaching resources. Bruner pointed out in the problem teaching method that students could learn valuable knowledge only by personally experiencing the contexts of the problems. The Soviet educator Mahmutov pointed out that in the process of learning, teachers should create contexts that coincide with students' conditions, and propose problems to be solved, guide students to generate interest in solving problems, finally enable students to achieve the purpose of learning.

The domestic scholar Li Jilin first created the theory system of context teaching method [1], and successfully applied it to the Chinese language discipline, which promoted the development of the context of problem teaching method in China. Lv Chuanhan carried out the study of "setting up mathematics contexts--proposing mathematical problems" in Guizhou Province [2], and applied the context of problem teaching theory to practice. Luo Zengru put forward that much mathematics knowledge needs to be put into practical cases designed by using the context of problem teaching method, teachers should make students use the mathematics knowledge to solve the application problems in life and deal with practical problems [3]. Peng Yufeng pointed out in her article that, in the field of liberal arts, the context of problem teaching is based on contextual teaching theory, focusing on the atmosphere of the classes. In science departments, the context of problem teaching is based on the solution of problems and focuses on cultivating students' abilities [4].

Most of the domestic research on mathematics curriculum context of problem teaching is focused on the creation of contexts of classroom language teaching. Most of them focus on the design of the introduction of classes. There are relatively few context of problem designs for the knowledge points of the whole classes. There is more research on transforming context of problem designs to visualized courseware or micro-lectures. At present, most of the research on visualized teaching is about the visualization of thinking diagrams, such as the studies of Li Mang [5], Zhao Huichen [6] and other scholars. There is very little research on the visualization of contexts.

II. THE THEORY ON CONTEXT OF PROBLEM

The context of problems is one of the basic concepts in mathematics learning theory. It refers to the the systems formed by the mathematical problems that individuals face and their related experiences. Dewey's "problem teaching method" and Bruner's "discovery teaching method" are important supporting theories of the context of problem theory.

Dewey's Problem Teaching Method: Also known as the Five-Step Teaching Method. The teaching process of the five-step teaching method is: (1) Context. Set a context for students and make students find problems in the context and

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generate interest; (2) Questions. Raise questions from the troubles and cause students' reflections; (3) Assumptions. Students should make research and take necessary observations to propose hypotheses for solving problems; (4) Solve. Infer which hypothesis can solve the problem and propose a solution to the problem; (5) Application. Students verify their ideas through taking actions.

Bruner's "Discovery Teaching Method": (1) Set the context of the problem. Raise questions and observe specific things with these questions; (2) Establish hypotheses. Problem discussion, material reorganization, experience linking, put forward hypotheses; (3) Rise to concepts or principles; (4) Transform into the ability of solving problems.

Based on Dewey's "problem teaching method" and Bruner's "Discovery Teaching Method", the teaching resources for visualized context of problems, mainly the teaching videos are produced. In the process of designing and producing teaching resources, first of all, it is supposed to analyze the learners. Based on the characteristics of the knowledge points and the learners, attractive contexts that can be easily understood by students should be set up, so that learners can find problems and then solve them combining with existing knowledge and experience, therefore complete the study of new knowledge.

III. MICRO-LECTURE CASE PRODUCTION

This paper takes the knowledge point of "interior angle sum of polygons" as an example to design the context of problem teaching.

A. Learning Condition Analysis

1) Analysis of middle school mathematics knowledge points: There are many abstract and difficult knowledge points in the middle school mathematics curriculum. These knowledge points are difficult for teachers to teach. Most teachers still use the "pass-and-accept" method to impart the knowledge to students and have not fully considered the characteristics of middle school students. They spend a lot of class time in explaining the theories to students, lacking time for the exercises and the explanation of the application of knowledge. For students, the knowledge is difficult to master, and it is more difficult to link the learned knowledge with practical problems. This has caused that students spend a great deal of time and effort in learning knowledge, but they still cannot relate the learned knowledge to the real life. For students, learning is difficult, the effect of learning is poor, and the learned knowledge is easily forgotten.

The abstract and difficult knowledge points are put into the contexts according to real life, and practical problems are raised. The designed contexts are visualized by means of software and hardware, so that students can improve their ability to use the learned knowledge to solve practical problems in life, improve their interest in learning and apply what they have learned. For students, by entering the contexts and solving problems, they can master the knowledge better and have a deeper understanding of the practical application of the knowledge.

2) Learner analysis: The logical thinking of middle school students is gradually changing from empirical to theoretical, so learning knowledge in the method of creating contexts - raising questions - solving problems by observing and summarizing is in line with the thinking development of high school students. At the same time, high school students are active in thinking and have a strong desire for knowledge. Therefore, organizing cooperative inquiries and other activities in the teaching process can mobilize the students' enthusiasm for learning and satisfy their learning aspirations. Hands-on practice and mutual communication can further stimulate students' enthusiasm for learning and desire for knowledge. At the same time, students can feel the sense of accomplishment coming from the confirmation of their assumptions.

3) Teaching objectives: Students can derive and master the interior angle sum formula of polygons, and be able to apply it to solve some simple problems. Let students experience the process of conjecture, exploration, reasoning, induction, etc., and develop students' ability of reasoning and language expression. By transforming polygons into triangles, let students understand the thought of transforming unknown into known. By exploring the interior angle sum formula of polygons, let students understand the from-special-to-general way of recognizing problems.

B. Script Design of the Problem Context Teaching of the Interior Angle Sums of Polygons

Problems generally consist of three basic components: known conditions, goals, and solutions [7]. The students have already studied the calculation of interior angle sums of triangles before learning the calculation of interior angle sums of polygons. Therefore, in order to achieve the goal of calculating the interior angle sums of polygons, the existing knowledge should first be used, the teaching introduction can be designed as follows: Two students are undertaking an exploration, they find a shield which is broken into multiple triangles, if they can figure out the interior angle sum of the shield, they can continue to explore. The context introduces students into calculating the interior angle sum of the shield. Figure out the interior angle sum of one triangular piece of the broken shield using the triangle interior angle sum formula, and further dynamically demonstrate the changes from triangles to quadrilaterals, pentagons, etc., until the triangular pieces change into the shield. Use the induction method to figure out the interior angle sum of the shield. Derive the interior angle sum formula of the N-shapes from quadrilaterals, pentagons and the shield, completing the learning of the interior angle sum of polygons. The design of questions in the teaching resources and exercises will be based on the context created. The questions and exercises will be related to the shield and the follow-up parts of the adventure to attract students' attention, so that students can use the learned knowledge to solve relevant problems after learning the course. According to the theory of context of problems, the teaching script design of the "interior angle sums of polygons" is shown in "Table I":

TABLE I. THE TEACHING SCRIPT DESIGN OF INTERIOR ANGLE SUMS OF POLYGONS

Teaching Sessions	Teaching Contents	Pictures	Design Ideas
Context creation Raise questions	Two high school students are exploring the monuments and encounter a pass to ask them to figure out the interior angle sum of the broken shield. How to figure out the interior angle sum of the shield?	Teachers appear PPT presentation	Inspire students' curiosity and desire for knowledge through the small story. The small story triggers students' thinking about the problem.
Existing knowledge review	What is the interior angle sum of the triangle? What is the interior angle sum of the square? What is the interior angle sum of the rectangle? Further ask: The squares and rectangles are all quadrilaterals and their interior angle sums are both 360°. So is the interior angle sum of any quadrilateral 360°?	PPT presentation Teacher-student interactive questions and answers	Raise questions directly, awaken the students' existing knowledge, and lead the students to the closest development area of the thinking of this class. This will pave the way for the learning of the new lesson.
Conjecture exploration	Conjecture: The interior angle sum of any quadrilateral is 360°. 1. Cut out each corner of the quadrilateral and put it together. Observe the formed corner. 2. Convert the quadrilateral to triangles and then use the triangle interior angle sum to prove. That is to connect the quadrilateral diagonal and divide the quadrilateral into two triangles. 3. Conclusion: The interior angle sum of any quadrilateral is 360°.	Quadrilateral cardboard cuts	Teachers use teaching aids to show students the corner made up of the cut corners. Through hands-on operation, the result is obtained intuitively, making students easy to accept and understand. Let students experience the process of guessing and exploring, and figure out the unknown interior angle sum of quadrilaterals by converting them into triangles.
Ask questions	Can you use similar methods to figure out the interior angle sum of pentagons, hexagons, and heptagons? What is the interior angle sum of the n-shapes?	Teachers explain	Learn from easy knowledge to deep knowledge progressively.
Induction and reasoning	The interior angle sums of the three simple polygons of pentagonal, hexagonal, and heptagonal shapes are obtained by connecting their diagonal lines. Observe the relationship between the number of edges of each graph and the number of triangles divided. The interior angle sum formula of the n-shapes is summed up:180o × (n-2)	PPT presentation Teachers explain	Through the interior angle sums of pentagons, hexagons, and heptagons, summarize the interior angle sum formula of polygons, make students understand the from-special-to-general way of solving problems, and at the same time improve students' reasoning ability and language expression ability.
Solve the problem	What is the interior angle sum of the shield? 1. By making diagonals, divide the shield into several triangles and figure out the interior angle sum of the shield. 2. Use the derived formula to directly figure out the interior angle sum of the shield.	PPT presentation Whiteboard writing	Know about the learning effect, allow students to experience the process of using knowledge to solve problems,make students learn useful mathematics knowledge.
Knowledge extension	In addition to making diagonals, in the case of a pentagon or a hexagon, it is also feasible to select a point P inside the polygon or on a side of the polygon to divide the polygon into triangles.	PPT presentation Geometric sketchpad demo	Cultivate students' divergent thinking, make students try to solve problems from different angles and further experience the special-to-general idea.

C. The Production of "Interior Angle Sum of Polygons" Visualized Context of Problem Micro-Lectures

1) Real shot: When shooting the teacher's question and answer interaction part in class and the teacher's explanation part, the camera's white balance should be first adjusted, a well-lighted time period should be selected, and the shooting background can be somewhere in the campus, the library, the classroom, etc. Some screens need to be shot in the blue background, if there is no special studios, it is feasible to hang a blue cloth in a well-lit classroom as the background.

2) Courseware video production: Use the powerpoint2010 to produce the courseware, set the courseware to play in full screen, explain the knowledge according to the designed lines, at the same time use the screen recording software for PPT playback and recording, number the PPT according to the order of instructional design, generate courseware videos.

3) Sound editing: Use the CoolEdit software to record the sound in the quiet indoor environment as the noise reduction sample, record the sounds according to the steps in the instructional design and number and name them sequentially. After recording, cut out unnecessary parts and save the sounds in the folder after the noise processing.

4) Sound and screen recording: Set the microphone, the sound is recorded by the CoolEdit software, set the order of PPT playback. For the geometric sketchpad demonstration part, design the lines that match the rhythm of the screens according to the presentation process. In the super screencap 8.0, set the sound and the mouse not to be recorded, click "start recording", the screen animation can be recorded,

press F3 to stop recording, record each scene separately, the sound and animation completely match, the sound files and the animation files are saved separately according to their serial numbers, which is convenient for later integration and editing.

5) Character key: Import the video to be keyed into Adobe Ultra CS3. The key menu is used for keying. Through the virtual scene menu, the video can be imported with virtual scenes built in the software to become more contagious.

6) Video editing: Import the produced title into Adobe Premiere pro CC, and then import the PPT courseware, the teacher explanation screens and the geometric sketchpad dynamic demonstration screens, and add the keyed video to the PPT courseware. Import sounds for each screens on the audio track, cut off extra pictures and sounds, and generate video files. It is better to make the time of the final teaching video 5-10 minutes.

IV. MICRO-LECTURE APPLICATION

Apply the produced micro-lectures to practical teaching, there are three types of teaching: Teachers' teaching, playing teaching videos, playing teaching videos plus teachers' teaching. After students have studied the course in the three ways, a class test is performed. The results are shown in "Table II":

TABLE II. TEST SCORES

Type	Class	Average Score
Teachers' teaching	5	72
Teachers' teaching	1	80
playing videos	3	88
playing videos+teachers' teaching	4	95
playing videos+teachers' teaching	2	100

It can be seen from the comparison of class 5 and class 1 with class 3 that the teaching effect of playing instructional videos is better than that of teachers' teaching. It can be seen from the comparison of Classes 4 and 2 with Class 1, Class 3, and Class 5 that the teaching effect achieved by playing videos plus teachers' teaching is the best, and students have mastered the knowledge the best.

Most students stated that micro-lectures on context of problems can attract their attention. The screens are interesting, making it easy for them to be concentrated, and the content is intuitive and easy to understand. The context of problems designed based on the characteristics of the knowledge points directly attracts the attention of the students. The teacher's lectures plus playing the micro-lecture video can ensure the students to follow the class and digest the knowledge. Some students also made some suggestions, such as allowing students to watch teaching videos before class and designing more exercises according to the context created.

V. CONCLUSION

The general process of the visualized context of problem teaching method is: selecting knowledge points suitable for the context of problem teaching method, analyzing characteristics of students and knowledge points, and designing teaching contexts and questions based on the analysis of characteristics of students and knowledge points. Write the micro-lecture teaching script design according to the designed context of problems, use various software to produce and edit the created context of problems into visualized materials in the order of the teaching script design, and finally integrate the materials and publish the teaching resources.

Use the context of problem teaching method to design the teaching, and use various software to produce teaching resources that students can independently learn. If the designed context of problems is attractive enough, it can achieve better teaching results than traditional teaching. Playing micro-lecture videos combined with the teacher's classroom teaching can greatly improve the students' learning effect. The micro-lectures on the context of problem teaching can well achieve the teaching objectives and assist teachers in teaching. The produced micro-lectures can also be uploaded to the campus network teaching platforms, the WeChat public platforms, the MOOC platforms, etc., so that students can learn new knowledge at anytime, anywhere, review learned knowledge, and improve learning effects.

REFERENCES

[1] Li Jilin. Using Context Teaching to Develop Children's Languages [J]. Chinese Journal of Education. 1995(12):pp.44-47.

[2] Lv Chuanhan; Wang Bingyi. The Theoretical Basis and Implementation Strategy of the Teaching of "Mathematical Contexts and Raising Questions" in Primary and Middle Schools[J]. Journal of Guizhou Normal University(Natural Science), 2007(02): pp.95-100.

[3] Luo Zengru. Cases and Cognition of Context Import [J]. Bulletin of Mathematics. 2009 (4): pp.1-6.

[4] Peng Yufeng. Research on the Application of Context of Problem Teaching of Biology in Junior Middle Schools [D]. Zhangzhou. Minnan Normal University, 2015.

[5] Li Mang. Design Methods and Application of Visualized Teaching [J]. Electrification Education Research. 2013.

[6] Zhao Huichen; Wang Shuyan. A New Perspective on the Application of Knowledge Visualization to Subject Teaching——An Interview with Professor Martin Epp, a Pioneer in Knowledge Visualization in Switzerland[J]. Open Education Research.2014(04):pp.4-10.

[7] Cai Yaping. Teaching design based on real context problem solving [J]. Electrification Education Research. 2011(06):pp.73-75,p80.