



REFLECTIVE TEACHING DESIGN AND CASE ANALYSIS OF MATHEMATICS PROPOSITION COURSE IN MIDDLE SCHOOL—TAKE THE DECISION OF CONGRUENT TRIANGLE AS AN EXAMPLE

Shuo Zou¹, Yuxin Chen², Jerito Pereira²

¹ Department of Mathematics and Statistics, Guangxi Normal University, Guilin, and China, 1530822450@gg.com

² Yuxin Chen, Baotou No. 28 middle school, 1285847745@qq.com

³ Departamento de Ensino de Matematica, Universidade Nacional Timor-Lorosa'e, Timor-Leste, Dili, Timor-Leste, jeritopereira@gmail.com

Abstract

The theory of rethinking teaching originated from the European and American countries, and then it was paid attention to gradually in our country. Reflective teaching theory is an important means to enhance teachers' thinking ability and students' learning ability and improve teaching quality. Based on the overview of reflective teaching theory and its teaching strategies, the author discusses the teaching practice of reflective teaching theory in the middle school mathematics proposition lesson of the same triangle decision lesson, in order to provide reference for improving teachers' professional quality and students' learning ability.

Keywords: Reflective teaching, mathematics proposition, case analysis

How to cite:

Zou, S., & Chen, Y., & Pereira, J. (2023). Reflective teaching design and case analysis of mathematics proposition course in middle school—take the decision of congruent triangle as an example. *Journal of Songke Math*, 6(1), 12-19.

INTRODUCTION

Professor Xiong Chuanwu defines reflective teaching as "reflective teaching is a process in which the teaching subject, with the help of action research, constantly explores and solves the problems of itself, teaching purposes and teaching tools, combines' learning to teach 'with' learning to learn', strives to improve teaching practice and rationality, and becomes a learning-oriented teacher". It can be seen that reflective teaching focuses on "two learning", enabling teachers to

"learn to teach" and students to "learn to learn". Based on problem solving, it promotes the rationality of teaching practice and the development of teachers' own profession.

According to Pollack, "Reflection is the ability to critically examine one's own actions and situations outside the self. The purpose of using this capacity is to facilitate the effort to think of convincing action based on professional knowledge rather than on the simple action of habit, tradition or impulse." Thus, reflective teaching is a cognitive process of one's own thinking, which belongs to the category of metacognition.

Modern cognitive psychology believes that, among the five systems of teachers' teaching activities, namely, target, material, operation, product and monitoring system, monitoring system is in the core position and plays an active and dominant role in the other systems. In the actual teaching process, monitoring is reflected in teachers' ability to reflect on and monitor their own behaviors.

In a word, reflective teaching, as a new highlight of teaching reform, develops both students and teachers. It is of great significance to teachers' professional development, students' independent learning and teaching practice.

The ideological origin of reflective teaching can be traced back to Dewey's discussion on reflective activities. "Reflection" refers to introspective thinking. Dewey believes that reflection is a kind of consciousness that is not satisfied with the status quo, and it is a conscious and purposeful activity process to solve problems. Reflective teaching has the following theories:

The theory of metagogy (Weiping, 2005; Pereira et al., 2022) is a research viewpoint on metacognition put forward by Flavell in the 1970s. Metacognition is the cognition about cognition. It takes the cognitive process of people as the research object, and monitors and regulates the cognitive process of people. This process is reflection. Mathematical metacognition refers to people's understanding and control of mathematical cognitive activities, such as the planning of teaching steps, the choice of problem solving strategies, etc.

In the late 20th century, the trend of postmodernism started a cultural criticism and reflection movement. It is a kind of reflective thinking that reflects and criticizes modernity. Although it has a certain one-sidedness, it has a great influence on reflective teaching and curriculum reconstruction.

Reflective teaching can greatly promote teaching reform. Through continuous critical thinking on teaching, teachers dare to question existing teaching concepts, teaching methods and teaching strategies. Teachers and experts in the field of education constantly practice, think and construct new educational concepts.

The deepening of teaching reform has put forward higher requirements for new teachers. The blindly mechanical and repetitive teaching method is not suitable for today's educational development thought. The professional development of teachers cannot be separated from the continuous reflection of individuals. Only by reflection and creative solution of practical teaching problems can teachers transform from experience-oriented teachers to research-oriented teachers and realize their own professional development (Jinli, 2011).

Dewey proposed "five steps of introspective thinking", that is, to create problems, propose hypotheses and seek solutions in the situation Strategy of the problem, adjust the strategy according to the actual situation in solving the problem, and finally solve the problem to verify the hypothesis (Tang et al., 2022). This process is the process of developing students' introspective thinking. Students will get a firm grasp of knowledge after going through this process, which also plays a crucial role in the development of students' thinking.

RESEARCH METHODOLOGY

Classroom is an important place for teachers' guidance and students' learning. To implement reflective teaching, it is important to pay attention to and understand students' existing learning styles and the implementation of teachers' guidance strategies. Therefore, classroom observation and interview are important qualitative research methods (Wen & Hongmei, 2013).

Themed classroom observation, reasonably design the observation framework according to the research theme, develop the observation scale combined with the classroom teaching design, reflect on the observation requirements, and make further adjustments to the teaching methods.

Table 1. Overall teaching design of teachers

Stage Content	Content
Preparatory stage	1. Determine the subject, content, tools and methods of classroom observation; 2. Make a preliminary analysis of the observed objects and arrange the corresponding division of classroom observation
Observation stage	1. Collect classroom observation time information 2. Collect classroom phenomena between teachers and students; 3. Adjust teaching strategies according to the actual teaching situation
Post-test phase	1. Organize the observation data and analyze the observation results; 2. Test and interview the observers; 3. Reflect on the whole teaching steps, put forward reasonable improvement suggestions

Pre-class testing can excavate students' learning ontology cognition, analyze students' mathematical cognition mode and evaluate students' existing knowledge level. Mathematics

knowledge is related, and students' existing ontology knowledge may produce positive or negative transfer to new knowledge (Zongxiang, 2014). Therefore, pre-class testing can help teachers better grasp the learning basis of students and carry out teaching design more pertinently.

The designated observation scale is designed in combination with classroom teaching, and the teaching method is further adjusted according to the observation requirements. Adjust and optimize classroom teaching based on classroom observation. By analyzing the classroom teaching records after class, students at all levels can be observed more deeply. Teachers can also examine their own teaching operations through this process, reflect on deficiencies, and promote professional development.

After-school testing is obviously a test of classroom learning. It can help teachers timely reflect on some problems in teaching design and practice by means of testing, questioning, homework and interview, and also help students reflect on their own learning and make timely adjustments. Only by understanding students deeply can teachers better guide students' learning styles.

RESULT AND DISCUSSION

Based on reflective teaching theory design of middle school mathematics proposition course. The propositional course is a kind of course based on the study of mathematical axioms, theorems, laws, formulas and properties, which is an important and basic type of mathematics course (Zhongying, 2003). The proposition course plays a very important role in developing students' mathematical thinking, improving their mathematical literacy and solving mathematical problems (Zhiwei, 2019). Next, based on the reflective teaching theory, a lesson on the decision of congruent triangle is designed.

Draw an interview outline, which is divided into three stages: before class, during class and after class

Table 2. Interview outline

Before class	Outline of teacher interview before class	1. What is your teaching objective of this lesson? What is the plan for the students to learn? 2. What is the basis for your teaching goals? (Curriculum standards/Textbook content/Characteristics of students in this class/ requirement of teaching and research groups) 3. How do you judge whether the goal is achieved? What are your key and difficult points in this lesson? How to conquer classroom observation?
In class	Observe the scale in class	

*Reflective teaching design and case analysis of mathematics proposition course.....
Zou et al.*

After class	After class Student interview outline	1. What did you learn in this lesson?
		2. What are the difficulties in this class? How did you conquer it?
		3. Do you have any comments or suggestions for the teacher in this class?
Outline of teacher interview after class		1. How was the lesson different from what you expected? Is there any unexpected harvest?
		2. What problem do you have in this class?
		3. What do you think the students have learned? How to judge the achievement of students' goals?
		4. What do you think are the advantages of this lesson? What needs to be improved?

Draw the classroom observation scale

Development of scales based on students' participation in classroom learning

In classroom teaching, students, as the subject of teaching activities, must participate in the learning process of constructing knowledge and developing cognitive ability to achieve teaching objectives. In Figure 1, from the perspective of "interaction, listening and autonomy" in the dimension of "student learning", four observation points are set, namely "questioning, discussion, listening concentration and independent learning". Each observation point is set with 2-3 observation elements, among which the depth, breadth and validity of students' participation in classroom learning are implied.

Observation dimension: student learning/interaction/listening/autonomy										
Observation point	Ask questions			discuss lectures			Listen to lectures and focus on		Independent learning	
Each link to observe the elements	The question/questioner	Respondent/response situation	Reasoning situation	Topic/discussion situation	Number of participants	Discussion time	The number of people listening carefully and its main behavior	The number of students who do not attend classes and their behavior	Behavior expression	Number of participants
Teaching Process/Content 1:									Performance 1:	
Teaching Session/Content 2:									Performance 2:	
*****									*****	

Figure 1. Scale of students' participation in classroom learning

Development of scale based on teachers' reflective teaching

Whether the teaching content of teachers is complete and full, whether the teachers have professional teaching skills. We designed the scale shown in Figure 2. From the perspective of "presentation/guidance" in the dimension of "teacher teaching" and "resource/implementation" in the dimension of "curriculum nature", 13 observation points such as "validity of explanation" are set up (Zongxiang, 2014). By Xiaohui and Tianming (2016) recording the performance information of

each observation point in detail, the observer collects the correlation basis between the teaching links, teaching means and teaching key points shown by teachers in teaching, so as to facilitate teachers' after-class reflection and improve their professional development (Min, 2018).

Observation dimension: teacher teaching/presentation/guidance: curriculum nature/resources/implementation													
Viewing Angle	present				Guide			resource			implementation		
Observation point record analysis	Validity of interpretation	Blackboard content	Multimedia presentation content	Problem solving tips	Deepen understanding and guide	Discipline thought method education	Cooperative inquiry guidance	Text resource utilization on	Utilization of experimental resources	Use of other teaching resources	Application and relevance of teaching methods	Knowledge application consolidation measures	Detection and evaluation means

Teaching Content/Link 1:

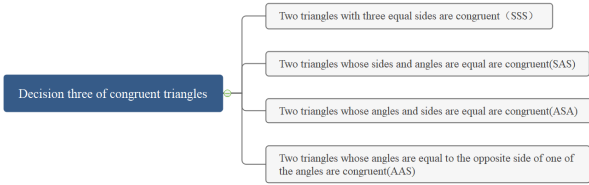
Teaching Content/Link 2:

Figure 2. Scale of teachers' reflective teaching

Taking the lesson "The Judgment of Congruent Triangle" as an example, explore the reflective teaching plan and extract effective teaching guidance strategies

Table 3. Decision teaching design of congruent triangle

Teaching link	Instructional design		Design intention
The first step: problem import	1.	Ask a student to tear a triangle into two parts and ask which part can restore the triangle?	Introduce questions and situations to stimulate students' curiosity and interesting thinking. At the same time grasp the cognitive level of students, to provide the basis for the overall teaching program.
	2.	How many elements of a triangle does the part that restores the triangle contain? Can any three elements determine the shape and size of a triangle? What three elements determine the shape and size of a triangle?	
	3.	Teachers give examples and students imitate and explore.	
Step 2: Introduce new knowledge	1.	Any given $\triangle ABC$, and then draw $\triangle A'B'C'$, $A'B' = AB, B'C' = BC, C'A' = CA$, let the students draw good cut out $\triangle A'B'C'$ on $\triangle ABC$, explore their full etc.?	Students can have a deeper understanding of the four methods of congruent triangle judgment through hands-on operation; Teachers are good at observing students' operation and confusion, communicating with students timely, and adjusting strategies timely according to the observation scale.
	2.	Make 'again, after the completion of, $A'B' = AB, B'C' = BC, \angle A' = \angle A$ then let the students draw good $\triangle A'B'C'$ cut down on the $\triangle ABC$, explore their full etc.?	
	3.	After the completion of the to make $A'B' = AB, \angle A' = \angle A, \angle B' = \angle B$, let students to draw good cut out $\triangle A'B'C'$ on $\square \triangle ABC$	
	4.	Do it when you are done $A'B' = AB, \angle A' = \angle A, \angle C' = \angle C$, Have the students draw it again cut out $\triangle A'B'C'$ on $\triangle ABC$, Are they all equal to explore? In each exploration, teachers should observe students'	

Teaching link	Instructional design	Design intention
	operation and confusion, and communicate and discuss with students timely.	
The third part: discrimination exercise	Determine whether the two triangles in each group are identical or not, and indicate the basis for the decision (3 sets of simple type questions)	Through practice, judge how well students have mastered knowledge, and supplement, adjust, explain, demonstrate and other strategies according to the actual situation.
The fourth part: inductive reflection	1. Teachers draw mind maps to form cognitive systems.  2. Students refine what they have learned from this lesson, and reflect on the problems they have encountered in this lesson and their solutions.	Draw a mind map to help students generalize and form a cognitive structure of congruent triangle decision. At the same time, both teachers and students should reflect on the teaching and learning of this lesson to find out the problems in teaching and learning and promote their own development.

CONCLUSION

What is the ideal state of reflection in teaching is worth thinking about. Reflection is only a means and process, its essence lies in "finding problems" and "solving problems", and promoting the development of teachers' and students' literacy. In this sense, reflection is not the more the better, but the right amount. At present, many scholars have conducted in-depth research on the theoretical basis, teaching strategy and teaching significance of reflective teaching, but the research on specific teaching practice, such as the concept course and the proposition course of mathematics, still needs to be perfected.

REFERENCE

- Jinli, W. (2011). Application of Reflective Teaching Concept in Classroom Teaching. *Educational Theory and Practice*, 31(27), 41-42.
- Min, H. (2018). Development of Problem-based Classroom Observation Scale. *Contemporary Pedagogy*, 10, 21-31.
- Pereira, J., Tang, J., Soares, B., Prihandini, R.M., Wijaya, T.T. (2023). Exploring the Accuracy of Mathematics Students on the Final Semester Assessment Based on Racsh Model Analysis in Timor-Leste. In: Al-Sharafi, M.A., Al-Emran, M., Al-Kabi, M.N., Shaalan, K. (eds) *Proceedings of the 2nd International Conference on Emerging Technologies and Intelligent Systems. ICETIS 2022. Lecture Notes in Networks and Systems*, vol 573. Springer, Cham. https://doi.org/10.1007/978-3-031-20429-6_38

- Tang, J., Pereira, J., Tan, S., Wijaya, T.T. (2023). The Research on Design and Application of Dynamic Mathematics Integrable Ware Design Model in Junior High School. In: Al-Sharafi, M.A., Al-Emran, M., Al-Kabi, M.N., Shaalan, K. (eds) *Proceedings of the 2nd International Conference on Emerging Technologies and Intelligent Systems. ICETIS 2022. Lecture Notes in Networks and Systems*, vol 573. Springer, Cham. https://doi.org/10.1007/978-3-031-20429-6_37
- Weiping, G. (2005). Discussion on Reflective Mathematics Teaching. *Higher Science Education*, 2, 23-27.
- Wen, Z., & Hongmei, P. (2013). Practice and reflection on Improving teachers' Teaching With through Classroom Observation. *Chemistry Education*, 34(07), 25-27.
- Xiaohui, L., & Tianming, G. (2016). The development of classroom observation tools in primary and secondary schools: Problems and countermeasures. *Contemporary Education Science*, 6, 41-44.
- Zhiwei, J. (2019). The strategy of applying APOS theory to the teaching of mathematics proposition course in high school. *Extra-linguistic Learning (late High school Edition)*, 1, 45-46.
- Zhongying, W. (2003). Research on Reflective Mathematics Teaching. *Educational Theory and Practice*, 20, 38-39.
- Zongxiang, L. (2014). Reflective Teaching Theory and Strategy Analysis. *Teaching and Management*, 6, 14-16