ORIGINAL ARTICLE

Design and Application of Questions Based on Protocol-Guided Case Teaching

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Abstract: *As the core element of classroom teaching, questions play an essential role in constructing students' knowledge systems and cultivating their ability to discover, explore, analyze, and solve problems. Therefore, the design and application of appropriate questions is the key to the success of classroom teaching. Teaching based on protocol-guided cases advocates question-centric teaching. It is suggested that teaching activities should be carried out around the discovery and solution of questions, promoting the teaching concept to change from lecture to inquiry, stimulating students' interest and potential, and improving students' comprehensive quality. This article mainly discusses the design and application of questions in middle school protocol-guided learning and discusses the basis and requirements of question design in protocol-guided case. With typical cases as the forerunner, strategic guidance is put forward to apply questions to integrate teaching plans.*

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Introduction

THE question is the starting point and the driving force of thinking (Yao, 1995). In teaching, the question is the soul of the classroom, and its design reflects the teacher's understanding of the text and the grasp of the students' abilities, while the students' answers to the question, in turn, reflect the effect of teaching. Therefore, high-quality and appropriate questions can significantly improve students' learning (Wlen & Clegg, 1986) and produce motivation, communication, guidance, organization, and creativity (Gao, 2013).

Protocol-guided learning is the carrier of students' autonomous learning under the background of China's new curriculum reform (Zhou & Li, 2020). It is a strategy for elementary and middle school teachers to combine students' learning conditions and cognition according to curriculum standards and textbooks, with learning goals as the guidance and question as to the core, to achieve effective learning for students before, during, and after the class (Xia, 2017). In this learning strategy, question design is the most critical link. The primary purpose is to reproduce knowledge creation and restore it to a question to be solved to learn with the question and fully connect and assist the pre-class preparation and classroom teaching.

Based on protocol-guided case teaching, the question is also the central link. It encourages teachers to guide students to discover and raise questions in the preview, discuss and solve questions in the classroom, to cultivate students' question awareness and stimulate their innovative thinking through the discovery and resolution of questions. This article combines the practice of "question design" in the middle school protocol-guided case to deeply analyze the principles and requirements of question design and teaching application. Some specific methods for optimizing design and application questions in protocol-guided learning are proposed to provide reference and guidance for teaching based on the protocol-guided case.

Definition and Related Research

The ancient Greek philosopher and educator Socrates once advocated the use of questions to drive students' learning. This method not only motivates students to think but also deepens their further understanding of knowledge. Since then, the question has become one of the essential elements in teaching and has become the topic of extensive research by scholars. The research mainly covers the connotation, type, and design of the question in teaching.

Concept Study on "Question"

Karl Popper (1986) once regarded "question" as the conflict between the expectations inherent in the background knowledge and its new development, or it is the tension between our existing knowledge and ignorance, and the space after expectations and expectations fail. This is the process of revealing the emergence and resolution of the question from a philosophical perspective.

If "question" is placed in the teaching context, it becomes a specific element in the learning and teaching process. Regarding the concept of the question in this context, domestic and foreign scholars have given different meanings from different angles.

In the "*Dictionary of Education*," the "question" in teaching is explained as follows: by setting the situation, raising and solving questions for teaching (Gu, 1990). Therefore, the question has become the support for all aspects of teaching.

In the "*Encyclopedia of China (Education Volume)*," the "question" in teaching refers to a method for teachers to put forward questions in response to the difficulties and puzzles encountered by students in life and study, and lead students to analyze and solve them (Liang & Huo, 1995). This elevates the question from an essential element in teaching to a kind of method.

In the "*Western Education Dictionary*," "question" is further sublimated, and it is interpreted as: "It can not only help teachers understand what students are learning and what they can do, but also can be used as a part of teaching skills" (Lanthua, 1988).

Based on the above concept analysis, the "question" discussed in this article refers to the tasks students need to solve in the learning process. This article believes that knowledge is the perfect solution to the question. The easiest way for students to acquire human knowledge is to restore the origin of knowledge, that is, to reset the process of knowledge construction through questions to learn more effectively with questions. Therefore, in the teaching process, teachers should restore the textbook's main knowledge points to learning tasks and guide students to understand and master knowledge through tasks.

Type Research of "Question"

Research on question design in teaching began in the 1950s and 1960s. The former Soviet Union educator Mahmutov (1975) have conducted systematic research on the essence, epistemological basis, psychological basis, and methodological system of "question" teaching forming a systematic question pedagogy theory, which provides a theory for the design of classroom questions.

Psychologist Rigg used empirical experiments to provide ample evidence for question design's fundamental principles and gave strategies for the frequency of questions in the classroom and questioning strategies.

Most domestic scholars in China focus on the design source of the question and think that the question should be designed by analyzing the material's source. For example, Chen (2015), combined with years of teaching practical experience, proposed

the question's design strategy, namely, Design questions where knowledge occurs, contradictions, and collation. Feng (2016) put forward the selection and construction of core questions in the "relationship" of teaching new and old knowledge, the "migration" of classroom teaching, the "difficulties" of students' cognition, and the "integration" of questions.

On the one hand, we can see that the domestic and foreign education circles attach great importance to the question design in teaching. Especially in China, classroom question design for various subjects has been researched. Nevertheless, in concrete terms, most studies only focus on classroom teaching questions and do not place questions in pre-class preparation and after-class consolidation, so they have not been formed into a complete learning process.

As a self-learning material for students, the protocol-guided case has attracted many domestic researchers' attention in its design and application. However, looking at the existing research on protocol-guided case design, most of its content is about theoretical discussions on the design principles and writing methods of subject protocol-guided case. There is a lack of substantive research on designing and operating at the specific implementation and operation level. The design of questions, how to design questions in protocol-guided learning material, and how to use these questions in classroom teaching need further studies.

Therefore, this article investigates and analyzes the status quo of question design in the middle school history classroom, and discusses the question design strategy of the middle school history classroom combined with the specific teaching links of the middle school history subject. Then carry out specific teaching case practice, but the research into practice and hope to provide practical strategies for further optimizing middle school history question design.

The Role of Question in Protocol-Guided Case Teaching

The protocol-guided case is a carrier of students' autonomous learning under the new curriculum reform background. Objective, question, learning method, teaching method, and practice constitute its essential elements. As the core of the protocol-guided case, question plays a crucial role in designing the protocol-guided case. Therefore, clarifying the question's role in the protocol-guided case is of great significance to the study of question design and application.

The Level of the Question Determines the Quality of the Protocol-Guided Case

The protocol-guided case is a program for students to learn independently and a program for teachers to guide students in learning. It focuses on questioning knowledge, proceduralizing ability, and subtly developing emotions, attitudes, and values. In this process, the key to designing protocol-guided cases is to question knowledge. It is the

primary basis for students' pre-class preview and independent study, in-class inquiry and discussion, and after-class expansion and consolidation, and it is also the primary basis for teachers to organize effective teaching. Therefore, the question level directly determines the protocol-guided case (Xu & Du, 2015).

Question Is At the Core of Classroom Guidance

Protocol-guided teaching is based on the carefully designed protocol-guided case or various questions generated during the teaching process. Its significance is that it can stimulate students' interest in thinking, guide students to better carry out independent thinking and cooperative activities, help students understand the content of learning deeply, expand students' vision and thinking space, enhance classroom teaching effects, and achieve stable results

Compelling Question Can Promote the Overall Development of Students

The protocol-guided case is a program for students to learn independently and a program for teachers to guide students in learning. The protocol-guided case's key is to question knowledge and then hierarchize the questions to achieve a knowledge update. This is the proletarianization of abilities, the subtly cultivating of emotions, attitudes, and values.

In teaching using the protocol-guided case, students complete the relevant questions in the protocol-guided case to clarify the learning goals and preview from the questions. In classroom teaching, based on discussion and exchange, teachers organize students to discuss relevant questions. Presenting key questions provides students with a way to discover and solve questions to explore knowledge in the process, cultivate their ability to solve questions and innovative consciousness, and promote students' overall development (Tian, 2017).

The Design of the Question in the Protocol-Guided Case

"Protocol-guided case" is a learning plan and basis prepared by teachers to guide students' autonomous learning and inquiry. From teacher preparation, writing "protocol-guided case" is a creative work, and the key lays in question design. Therefore, to grasp the design requirements according to question design and design valuable, engaging, and creative questions that can stimulate thinking. The key to maximizing the protocol-guided case's benefits is to design the learning content near and break through the key and difficult learning points.

The Basis of Question Design in Protocol-Guided Learning

The case question design in protocol-guided learning and the questions appearing in classroom teaching are often preset in advance. They are questions that teachers can help and guide students to carry out better learning activities based on their knowledge and understanding of curriculum standards, textbook content, learning conditions, and achievement of goals.

- **Curriculum Standards**

Curriculum standards are the necessary quality requirements in a particular field specified by China at the national level. It is the basis for compiling teaching materials, evaluation, and examination questions.

The protocol-guided case design interprets the curriculum standards and deeply comprehends its requirements and suggestions for teaching to ensure that the goal comes from the curriculum standards. Therefore, a detailed analysis of curriculum standards is a prerequisite for clarifying the protocol-guided case question design's direction and ability requirements (Zan, 2015). Take the structure of curriculum standards as the basis for clarifying the dimensions of subject knowledge.

- **Textbook Content**

Textbooks are necessary teaching materials compiled by experts based on studying curriculum standards. It is the primary learning material and way for students to acquire knowledge. Therefore, the compilation of teaching materials should pay attention to the subject requirements and consider students' development characteristics, including science, representativeness, and universality.

Essentially, the protocol-guided case is a secondary development of the national curriculum (Zhang, 2013). Therefore, in the protocol-guided case, the textbook's content should be taken as the starting point as much as possible during the question design, and the content of the textbook should be analyzed in depth. Should refer to the knowledge points of the textbooks of various subjects, design the best question that cuts into the knowledge and has a reasonable structure.

- **Student's Physical and Mental State**

According to the Swiss psychologist Piaget's four-stage theory of cognitive development, he believes that young people between the ages of 11 and 16 still need to rely on the perception of specific things in their thinking. However, their dependence on specific and perceptible things has weakened, and they can use language to reconstruct them through brain imagination and thinking. For things and solving questions, they can already conclude by deductive reasoning based on concepts and assumptions. Therefore, when designing a protocol-guided case question, it is necessary to grasp middle school students' cognitive development characteristics accurately, and the question designed is appropriate to the students' actual life and stimulates learning motivation. At the same time, we must pay attention to the training of students' abstract thinking. The designed question can mobilize students' abstract thinking and practice.

- **Student's Learning Status**

The "Zone of Proximal Development (ZPD)" theory proposed by Vygotsky believes that students' learning should happen in the students' ZPD. For children in ZPD who need to solve learning tasks, they cannot complete the task independently, but they can do it successfully if they have a partner or teacher to help (Vygotsky, 2010).

Based on Vygotsky's ZPD theory, the design of the question in the protocol-guided cases should use the student's ZPD as an intervention space, so that the question formed is within the student's ZPD and based on the student's current level. Questions may be challenging for students and may not be solved by themselves, but they would solve them with teachers or other peers' help. It can be seen that mathematics classroom teaching based on core questions is beneficial to stimulate the development process in the ZPD, which can adapt to and promote the development of students' thinking.

The Requirements of Question Design in Protocol-Guided Learning

- **Ask the "True" Question That Stimulates Students to Think**

In teaching, open questions related to real-life background and strong structure can often arouse the desire to explore. In actual teaching, teachers often start from their teaching. The question design is either relatively straightforward or complicated, making some questions conclude without thinking, but some cannot get results after hard thinking. The question cannot make students think it is not the "true" question that we advocate here.

When designing a question, it is necessary to create an open dialogue situation to guide students to "how to think" and make the question inspiring. According to the characteristics of each knowledge point and students' psychological features, start with questions that students are interested in to be active and open-minded, and can radiate from their knowledge (Peng, 2018).

Let us take the ninth grade physics "digital protocol-guided case" as an example published by the People's Education Edition. In the third subsection, "Resistance" of Chapter 16, in order to stimulate students' interest in thinking, the question is first raised in the preview navigation: "Mostly, the wire is made out of copper or aluminum. Iron is also a conductor, and it is both abundant and cheap. Why do we not use iron as the conductor material?". Use this daily question to trigger students to think about the difference between iron and copper and aluminum and conclude that different conductors have different resistances. This question starts from a familiar life situation, allowing students to think and explore their knowledge to connect textbook knowledge with life to think frankly.

- **Core Questions Should be Raised for Teaching Materials and Student Development**

Teachers should carefully study the syllabus and textbooks before class, dig out the internal connections between various knowledge points, and carefully design questions according to students' actual situation. The questions can focus on teaching goals and closely follow the key to teaching.

(i) In-Depth Study of Teaching Materials and Focus on Key Points

The question's design should be based on the teaching objectives and focus on the problematic points to implement the critical teaching tasks. Focusing on vital and challenging points embodies the teacher's student-oriented thinking and requires teachers to think and design questions from the students' perspective. As for the questions dynamically generated by students in self-study, they must be rationally processed and optimized. These questions may squeeze the limited dialogue time, may also generate redundant information, and interfere with the achievement of teaching goals. This requires teachers to regulate and integrate them into core questions centered on students' inquiry.

(ii) Starting from the Students' Perspective

The question designed by the teacher should suit the age characteristics of the students, and develop its "ZPD" according to their cognitive level. The design of questions encourages students to integrate their own life experience into text interpretation. To allow students to have a real and effective dialogue with the text, it is necessary to shift the perspective of the "question" to the student and become an intermediary between the world of text and life. The question should connect with the students' knowledge background and life experience and belong to the lack of cognition or blankness and guide them to use the experience as the growth point of new knowledge. This requires reforming the question structure to allow students to fully integrate, thus opening up ideas, using their perceptual accumulation as a teaching resource, and constructing independently in the process of integrating and refining text information.

Only by designing questions that conform to the essence of the text can we truly respect the subject in the classroom, guide, experience, organize, communicate, promote and improve, so that the classroom's teaching and learning can show the abundance of life.

• The Question Must Be Hierarchical

In Bloom's taxonomy theory, thinking is divided into three levels. Similarly, in the question design should also pay attention to its hierarchy.

First of all, some questions are often lacking in levels and cannot stimulate and guide students to study well. Question design should reflect the hierarchy, easy first and then tricky, pay attention to the gradient, and the question arrangement's logical connection.

Question design should be comfortable first, then intricate, in line with students' actual knowledge and imagination. Questions should start from the shallower to the deeper, asking questions layer by layer, interlocking. As the advanced teacher, Menglong Qian said: "First ask some questions that are easier to understand, so that students can taste the fun of solving the questions, and then gradually increase the difficulty. In this way, the students are like climbing a mountain. After a peak, another peak is in front of them. So the more fun they have in "climbing," the more active the classroom atmosphere" (Cao, 2018). Therefore, when designing the question, attention should be paid to the closed and open coordination, and the convergence and divergence of thinking complement each other. In the sequence of question settings, pay attention to the logical sequence in between.

Take the People's Education Press version of "Digital Protocol-guided Case" Grade 9 Math as an example. When teaching the chapter "Practical Questions and Quadratic Functions (3)," the protocol-guided question design in this chapter ranges from easy to difficult. First, find out the quantitative relationship in the actual question, solve the question using the image and nature of the quadratic function, and combine the two simple parabolic questions in the textbook preview navigation to find the quadratic function relationship actual question. Later, in the classroom interaction, the protocol-guided cases contained two difficult parabolic questions, requiring students to learn to use quadratic functions to solve whether cars can pass through one-way and two-way arch bridges. This allows students to gradually establish function models in arch bridge questions and transform reality into mathematical questions.

- **The Number of Questions Should Be Appropriate**

How many questions are designed for a text that should be based on its level of difficulty? Questions should be carefully designed according to the key and difficult teaching points, the number of questions set should be appropriate, and the course's teaching objectives should be focused. If the question is set too many and too complicated, students will not grasp the essentials and not have a profound grasp of the knowledge points, so the classroom teaching efficiency will not be too high. If there are too few questions, students will not think enough, and course resources may be wasted. Therefore, before teaching, teachers should be familiar with the teaching materials, clarify their ideas, and be very clear about what questions are and how many questions control the classroom and enhance the teaching effect.

Take the seventh-grade Chinese "digital protocol-guided case" as an example. In the protocol-guided case of the subject, four modules are set up in each chapter: "preparatory navigation," "interactive classroom," "picking shells in the ocean of wisdom," and "natural achievements." Three to five questions are set for each module, and the total number of questions is guaranteed to be within the acceptable range of students, avoiding too many and complicated questions to reduce the classroom teaching effect.

- **The Description of the Question Should Be Scientific**

The presentation of the question is inseparable from the expression of language or text. In terms of presentation, the question's description should be simple, clear, and precise, and should not be vague or equivocal.

Questions in class cannot be separated from language, and the accuracy of language is paramount. The so-called accurate language means that the language of the question cannot be ambiguous or make mistakes. At the same time, the language should be concise, not verbose, and repetitive. However, some unsatisfactory questions often appear in classroom questions, which need to be paid attention to and avoided.

This means that the question language must be clear, specific, concise, and clearly expressed; and the question must be meaningful and stimulate students' positive thinking. It is often aimed at essential concepts, theorems, formulas, rules, and ideas and techniques for solving problems from a legal perspective. In terms of content, it should focus on keywords, climactic conditions, and vital variable relationships. Conversely, if the question is not practical, unclear, too simple, or too complicated, it will not achieve the classroom questioning's expected effect. For example, it is not clear enough to ask, "What did we learn in the last class?" It is too simple to ask "$2x = 6$, how much x is equal to" and why "double negatives make positives" is too difficult.

How to Use the Questions in Protocol-Guided Case for Teaching Practice

"Questioning" is the most common teaching method of mathematics and the most direct teacher-student bilateral activity. Therefore, how teachers use the questions in the protocol-guided case for teaching practice, and through guidance, let students actively discover questions and solve them in multiple ways is the focus of classroom teaching.

Guide Students to Discover Questions through Independent Learning

Under the guidance of teachers, students understand the learning requirements and prepare for class. Through the structured learning of knowledge with relevant materials, students will be familiar with the course content and briefly understand and analyze it. From the perspective of personal "learning," the formation includes memorization, understanding, analysis and synthesis, appreciation and evaluation, expression and application, inquiry and derivation, migration, and application, thus generating various levels of "question." This is the "discovery question" of independent learning by students (Xie, 2004).

Based on pre-class learning, students combine the learning goals and requirements of the teacher's guidance to quickly and independently study and think about the new class's knowledge and generate personalized questions that meet the requirements of expression from the problematic and perplexed during the preview process.

Ask Questions for All Students

Classroom questions should focus on the key and difficult points of knowledge and lead all the teaching content from point to point. The teaching content's overall goal requirements will make it easy for teachers to neglect to set up questions closely related to the content of the teaching materials. Questions should be raised on the essential and challenging points, transitions, and places that arouse students' thinking (Gu, 2017).

Classroom questioning is an essential means for teachers to understand students' learning situation and stimulate their desire for knowledge. Therefore, classroom questions should be oriented to all students, become a platform for information exchange between students and teachers, and not become a "special platform" for a few top students. In actual teaching, the phenomenon of letting the top students "occupy the whole field" and putting students with learning difficulties aside often happens. Over time, students with learning difficulties are bound to be distracted in class.

Therefore, when asking questions, all students should be targeted. First, when designing the question, it is necessary to pay attention to the hierarchy so that students with learning difficulties can follow the teacher's questions and think positively. Second, give priority to students with learning difficulties to answer or play with the board, so that eugenics will never do for questions that they can answer after thinking so that they can also have the opportunity to express themselves and feel the joy of successfully answering. Third, students with learning difficulties should be encouraged to speak boldly and affirm the answers promptly. Do not blame for wrong answers, so as not to discourage their enthusiasm for answering questions.

Guide Students to Solve Questions through Multiple Channels

Under the teacher's clear teaching guidance, the students take the group as a unit, according to the learning goals and requirements, in the group to carry out cooperative and mutual-aided inquiry learning. Put forward the "question" generated in the process of independent learning, rely on group collaboration and collective wisdom to conduct analysis and discussion, so that the question can be solved as much as possible (Ouyang, 2016).

In this process, the teacher adopts the method of patrolling and raising points to give targeted rather than universal reminders and tips on the organization of each group's learning process, exploring ideas and solutions. In particular, focus on whether the cooperative learning of each group is orderly and effective? Are group members active in participating in assembly learning? Does the "question generation" of each group meet the course objectives and teaching requirements? Are the ideas and methods of "question solution" correct and effective? Each group member's learning status must be reminded in time, and strict requirements and the "guidance" of the group question learning will end at an appropriate time point.

In cooperative inquiry and learning within the group, each group will still have problems solving problems at each node, requiring expanding the scope of assistance and borrowing from within the group to outside the group. The borrowing method can be a clear and complete oral statement, a written statement with a sticker, blackboard

writing, and a physical projection to other groups for help. The group that accepted the request formed a more complete and accurate solution idea, process, and result through the group members' discussion. This can be done through one-to-one assistance or a solution for the whole class.

Pay Attention to the Display and Communication of Results

Display and communication are indispensable part of classroom teaching. It can allow teachers to understand and control students' actual situation and effectively control the teaching process and teaching methods and stimulate students' desire to explore and encourage students to explore in-depth. The students' mouth, hands, and brain show the results after the question is solved. It aims to achieve the purpose of active thinking, exercise courage, cultivate abilities, and shape personality; let students "move" freely, "speak" freely, actively seek knowledge in a state of zero interference in the classroom, and promote teaching through learning (Jia, 2016).

When the teacher's self-generated questions and the questions preset by the teacher are solved through cooperative inquiry learning, each group can send representatives to briefly display the main learning results of the group through projection, blackboard, written, oral and other forms. This includes teacher preset questions, the group generated questions, and challenging questions from other groups, emphasizing question research and solutions. Teachers must seize the opportunity again, extend learning on time, supplement the context of the question, guide students to expand the depth and breadth of thinking further, strengthen crucial and difficult points so that students' learning achievements can be improved, sublimated, consolidated, and strengthened.

Teachers' Timely Guidance and Evaluation

Timely guidance and evaluation can promote effective classroom teaching. It is the primary way for students to obtain a proper evaluation, insufficient guidance, learning confidence and praise and encouragement, and strong support for students to construct knowledge, summarize learning experience, summarize question learning methods, and cultivate good learning habits in classroom teaching. Therefore, as the organizer and guide of teaching, teachers' evaluation and guidance are critical (Li, 2012).

This link should run through the entire classroom teaching process. In the process of students discovering and solving questions, communicating and displaying results, teachers provide timely guidance. Teachers guide students through learning, especially in solving questions, adopting guidance, and enlightenment methods. For difficult questions asked by groups for help, they can give hints and guidance on their exploration ideas and solutions, but they must not do all of them. Supplement, improve, or correct the ideas, processes, and results of questions explored by other groups. For the essential and challenging points of this course that each group ignores, we will add certain question situations again to guide the cooperation and exploration between groups.

Simultaneously, teachers should focus on the difficulty, importance of each group question, and matching degree with the preset difficulties. To pay attention to whether the solution results of these difficult questions are correct and complete, and pay attention to the study and solution of the critical and challenging questions in this lesson. The point is that teachers must combine the questions presented in the process of "student-student mutual guidance," grasp the right time and display the questions preset by the teacher for all students to study in-depth, to grasp the key points, and break-through the difficulties. The purpose is to ensure that all students participate in the activities, encourage students to externalize their thinking process, prompt them to evaluate each other, and achieve the three-dimensional teaching goal.

Focus on Training and Consolidate Results

The practice is an essential means to feedback students' learning effects and consolidates classroom learning results. Therefore, classroom teaching emphasizes not only the optimization of the process but also the consolidation of results. By strengthening the training during and after class, students can accelerate the internalization of knowledge, promote the self-construction of their cognitive system, and consolidate classroom teaching results.

On the one hand, habitual training strategies should be adopted. Based on strengthening classroom teaching, it is necessary to guide students to form habitual accumulation and effectively digest their knowledge. The exercises and testing must be given feedback in place; the teacher grasps the real situation, and at the same time, guides the students to learn to reflect on learning.

On the other hand, it is necessary to emphasize training methods centered on real-world applications. In the after-school training, teachers should guide students to actively integrate reality, consolidate knowledge, and form language skills and subject literacy with application value (Chen, 2014).

Case Study

Take the eighth-grade mathematics class "Determination of Congruent Triangle Triangles" in a middle school in Jiangsu Province as an example. This course's learning goal is to explore and master the congruent conditions of triangles and learn to apply the congruent conditions flexibly to solve related questions. Mastering this lesson's knowledge is very important for students to understand the real world better and develop spatial concepts and reasoning ability.

Before starting the course, the teacher guides students to use the protocol-guided case corresponding to the grade and subject for self-study. It is required to review congruent triangles' definitions and properties and understand that two triangles that can completely overlap are congruent. The three sides of a congruent triangle correspond to the same, and the three angles correspond to the same. On this basis, teachers design classroom teaching questions based on the feedback of self-study effects, especially questions that puzzle students during self-study before class, and conduct

classroom teaching around these questions that most students cannot solve. In this process, the teacher asks the students a certain amount of hierarchical questions prepared before class and guides them to guide them to solve the questions in various ways.

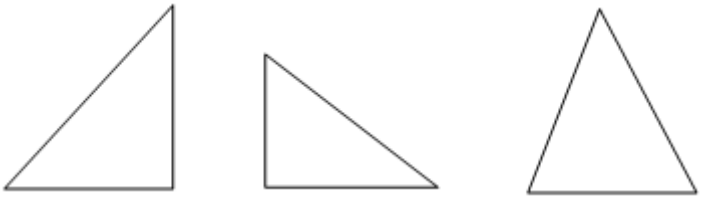
For example, the teacher in the class asks a question about triangles' judgment: Do △ABC and △DEF have to satisfy AB = DE, BC = EF, AC = DF, ∠A = ∠D, ∠B = ∠E, ∠C = ∠F? What about these six conditions? If one, two, or three of these six conditions are met, are the two triangles congruent?

- One condition can be divided into a set of equal sides, and a set of angles is equal.
- Two conditions can be divided into two sides are equal, two angles are equal, or a group of sides and a group of angles are equal.

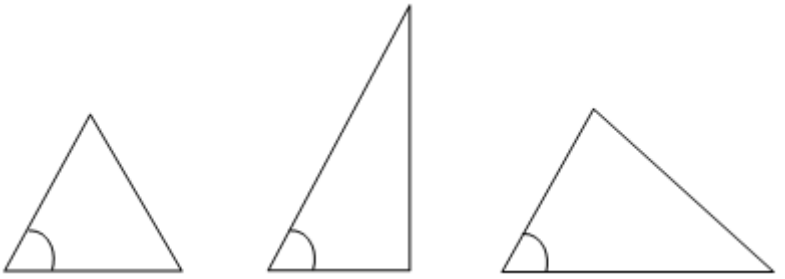
The students discussed according to the question and gave the following studies:

1. *Give only one condition (a group of corresponding sides is equal or a group of corresponding angles is equal).*

(1) Only one side:

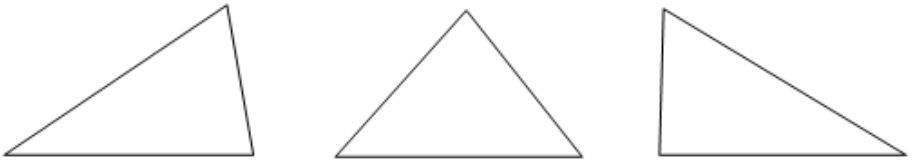


(2) Only one angle:

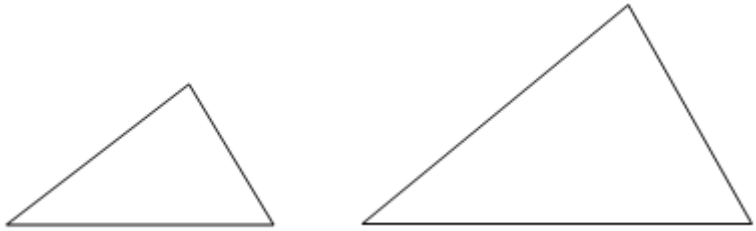


2. *Give two conditions.*

(1) One side and one inner corner:



(2) Two inner corners:



(3) Two sides:

The teacher immediately asked the third question: If two triangles meet three of these six conditions, can they be guaranteed to be congruent? How many situations are there when three conditions are met?

Under the guidance of the teacher, the students discussed it again. In the end, four conditions must be met for two triangles to be completely equal: (i) three sides are equal; (ii) three angles are equal; (iii) two angles and one side are equal; or (iv) two sides and one angle are equal.

In this process, teachers provide timely guidance and evaluation to help students understand the question, think about it, and solve it.

Conclusions

Teaching the protocol-guided cases is considered the most effective way to cultivate and improve students' ability to solve questions, learn independently, and innovate and practice. The reason is that the protocol-guided cases focus on students' guidance of independent learning methods and combines the setting of ladder questions to explore essential and challenging points. All are designed to make students think with questions, clarify goals, focus on critical points, and stimulate students' learning motivation through the drive of protocol-guided cases. Step-by-step questions can guide students to open up thinking channels in related questions.

This process embodies the guidance of protocol-guided cases, the autonomy of learning, the cooperation of groups, and students' display. Simultaneously, the design and guidance of the question are different according to the subject and content. Several links can be integrated at the same time, which can be divided into independent classes, demonstration classes, feedback classes, training classes, and comprehensive classes; it can also be based on one of them so that the question can be solved to ensure that the learning and teaching goals are successfully achieved.

Meanwhile, in the process of protocol-guided case teaching with questions, the teacher's question design and classroom organization ability occupy a pivotal position.

A study pointed out that in the guidance of questions, if the teacher designs questions in a class: too much too low cognitive level, too random, and purposeless, then such questions is not suitable for teaching (Zhu, 2009).

Besides, students' learning ability is also an essential factor influencing the effectiveness of classroom teaching. In the question guidance, if students do not learn independently and do not cooperate, this will cause the entire teaching to be ineffective or inefficient. Therefore, in-classroom guidance based on the question, we must strengthen students' independent learning and cooperation ability. Only when students acquire a certain degree of autonomous learning ability can the entire teaching process be made more fluent and effective.

The protocol-guided question's primary purpose is to master relevant concepts and knowledge flexibly and cultivate further students' ability to understand, analyze and solve questions, obtain experience in solving real questions, and finally form the consciousness and ability of independent learning. Therefore, question teaching based on the protocol-guided case is the primary practical means to realize school innovation and student development. However, no matter in the design and application of the question, it is necessary to pay attention to localization to avoid formalization and inefficiency caused by inconsistent with the existing foundation of students and teachers.

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