

# Comparative Study of the New and Experienced Teachers' Differences in the General Teaching of Mathematics

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*In the classroom teaching, teachers use weak generalization to introduce new knowledge and strong generalization to consolidate it. The experienced teachers pay more attention to the weak generalization's teaching than do the new teachers, and they focus on the explanation of the new knowledge. But they all spend more time on strong generalization's teaching than on weak generalization's teaching. Both place special emphasis on teacher's explanation of the weak generalization's teaching and place special emphasis on students' engagement in strong generalization's teaching. It has been concluded that not only is the strong generalization's teaching strengthened by the refined explanation and exercise but also the new knowledge's introducing by the weak generalization's teaching conducive to achieve the positive transfer of learning.*

**Key words:** general teaching, new and experienced teachers, comparative study

Learning transfer means the impact of one study on another. According to Judd's theory of generalization (1903), the key for the learners to achieve learning transfer is whether or not they can generalize the common principles of two studies. Appropriate teaching methods will increase the possibility of positive transfer. Developing the ability of generalization is important in mathematical teaching. It is conducive to achieve the positive transfer of learning if the students can generalize the common principles of two studies. In this study, we used the concept of generalization according to Judd's general theory. In order to explore how to help students execute the positive transfer in classroom teaching, we studied new and experienced teachers'

differences in the general teaching of mathematics from the perspective of teaching.

This study tried to find out the characteristics of the general teaching of mathematics and explore the relationship between teacher's teaching and the students' achievement through the comparison of new and experienced teachers' differences in the general teaching of the same mathematical content.

## **Method**

The TIMSS Video Study and Video Case Study were used for reference in this study. Teachers' teaching process of on-site observations and video recordings of the teaching in 4 classrooms were coded and classified, thus drawing some conclusions and inspiration.

## **Procedure**

### **Definition**

Several concepts that refer to this research have been defined: new and experienced teachers, three types of general teaching on ordinary mathematical object, and three mathematical objects.

(1) There is no uniform definition of the concept of new and experienced teachers. The researchers define it according to their own understandings. In this study, we chose three criteria that have been defined as the standard for experienced teachers: the first one is that the teacher should have ten years' experience in teaching, the second one is that the teacher should have a senior professional title, or have received teaching honors; the third one is that the teacher should have a good reputation for teaching performance and have received public praise. In this study, the new teachers all graduated from normal university and have one to three years' experience in teaching.

(2) Three types of general teaching on ordinary mathematical objects: it includes strong generalization, weak generalization and generalized generalization. According to Judd's general theory, we defined the new knowledge which was taught in the classroom as strong generalization, weak generalization and generalized generalization.

(3) In the classroom teaching, it is defined as strong generalization's teaching if the teaching process complies with: new rules' teaching  $\rightarrow$  special case's teaching; it is called weak generalization's teaching if the teaching

process follows: exceptional teaching→new rules' teaching; it is called generalized generalization's teaching if the teaching process can be summarized as: new rules' teaching→new rules' teaching.

### **Participants and Settings**

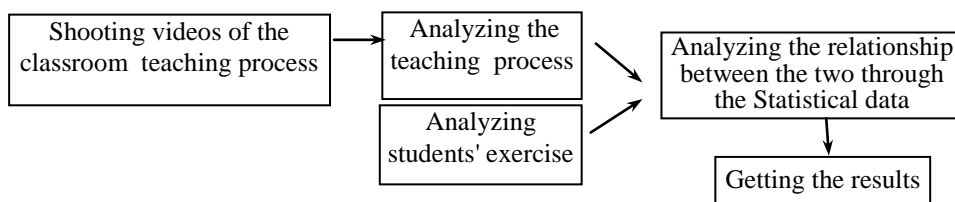
We chose two mathematical teachers who taught in an experimental high school in Tongxiang as participants for this research. Teacher A is a middle school second-class teacher who has three years' experience in teaching. Teacher B is a middle school senior teacher who has nineteen years' experience in teaching. According to the standard of new and experienced teachers that has been defined in this article, teacher A is a new teacher, and teacher B is an experienced teacher. The two classes taught by the two teachers respectively were selected at random at the beginning so that the achievement and quality of the students in the two classes are almost the same.

In this study the content of their teaching is "3.3 Three views" which was taught in eighth grade and published by Zhejiang Education Press. Before this lesson, the students had learned some basics, such as the definition and nature of right prism and its spreading picture. After this lesson, students will learn to "Represent geometry through the three views". The "three views", as important content, not only serves as a connecting link between these chapters, but also develops students' ability of spatial imagination.

In this lesson, it mainly involves two points. One is the definition of three views, and the other is the rule of drawing three views. As a new lesson, we studied the general teaching of mathematics through the teaching process of new concepts and rules.

We found out the teachers' and students' basic background through interviews. Combining this information with the three types of mathematical object, we quantified and coded and classified the video recordings of the teaching in the two classrooms, and compared with the data in different ways which was then analyzed.

The procedure of our research contains three aspects, See figure 1.

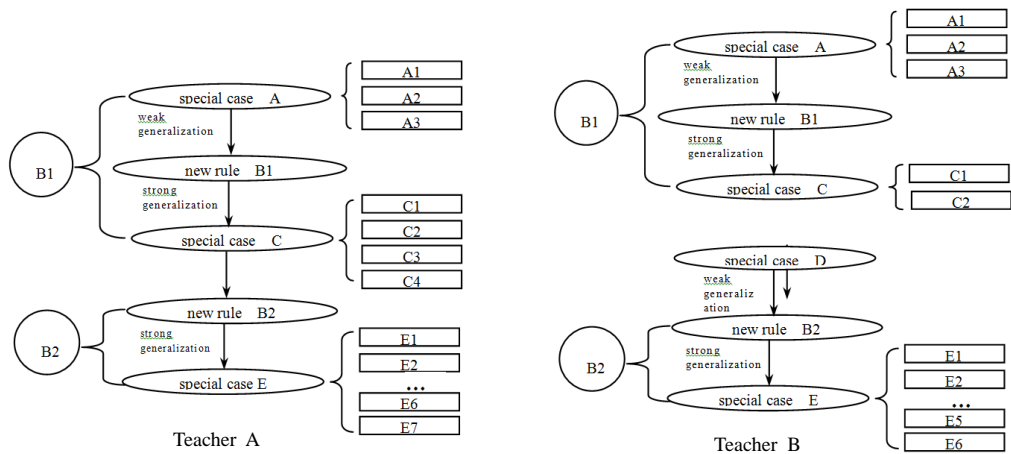


**Figure 1.** *Several research aspects.*

(1) Step one: Shooting videos of the classroom teaching process. We have shot videos of the classroom teaching in one of Tongxiang experimental high school for a long time. Consequently, both the teachers and the students have adapted to having lessons videotaped in the classroom, so that we can show normal classroom teaching as much as possible.

(2) Step two: analyzing the teaching process and the students' exercise. "New rules" and "Concrete problems" and "Special case" are mentioned in strong generalization, weak generalization and generalized generalization. Combined with the teaching process of "three views", we divided the process of teaching as follows: Explain the special case A—Introduce the new rule B1—Practice in special case C and explain it—Explain the special case D—Introduce the new rule B2—Practice in special case E and explain it. We recorded the beginning and the ending time of each part. The teacher used special case A to introduce the new rule B1. The concept of three views contains main view and left view and top view. Asking students to do some exercise of the three views is special case C. The new rule B2 is the rule of drawing three views: "the length to positive, the height is parallel, the width is equivalent." Using special case D to introduce the new rule B2 and the special case E is the exercise of the new rule B2. In that case, we recorded the beginning and ending time of the teaching process and the teaching methods. In order to find out the teaching effectiveness of "three views," we used statistic to count students' homework of this lesson. When we gathered statistics, we not only counted the right or wrong condition of every subject, but also took pictures of every error that students made.

(3) Step three: Analyzing the relationship between classroom teaching and student's exercise. According to the statistics from the last procedure, we analyzed the direct relationship between classroom teaching and the student's exercises.



**Figure 2.** The teaching process of two teachers.

## Conclusion and Implication

### Conclusion 1

Classifying the teaching process and content of teacher A and teacher B, we found that the two teachers probably experienced the following teaching links in lesson "Three views." See figure 2.

In figure 2, A1, A2, A3, C1.....E6, E7 are special cases which correspond to A, C, E. The quantity of special cases that different teacher chose is not identical.

The experienced teacher experienced the teaching from strong generalization to weak generalization when explaining the new knowledge. But the new teacher paid less attention to the weak generalization's teaching than the experienced teacher and didn't experience the weak generalization's teaching but explained the new rule B2 directly. Overall, both kinds of teachers placed special emphasis on the strong generalization's teaching and used a large number of special cases, especially teacher A, who used three more special cases than teacher B. The experienced teacher placed special emphasis on the new knowledge's introduction and consolidation, while the new teacher paid less attention to the new knowledge's introduction than the experienced teacher, and placed special emphasis on the new knowledge's consolidation.

## Conclusion 2

Analyzing the time proportion of the two teachers' teaching link, we get table 1. As seen in table 1, Teacher A and teacher B spent 75.86% and 72.22% time respectively in the strong generalization's teaching more than weak generalization's teaching. Both of the two teachers spent much time on special cases, especially on the knowledge consolidation, and spent little time on the teacher's explanation; Teacher B spent 2.4% less time than teacher A. This shows that both of them placed special emphasis on special cases' teaching and knowledge consolidation in the classroom teaching.

Teacher A spent 15.2% more time than teacher B in the new rule B1's teaching. But teacher B spent 15.2% more time than teacher A in the new rule B2's teaching. Compared with the experienced teacher, the new teacher paid more attention to the first new rule. The experienced teacher placed special emphasis on difficult knowledge. For example the teacher B placed special emphasis on drawing.

*Table 1*  
**The Time Proportion of the Two Teachers' Teaching Link**

	Teacher A (Total time : 39'59")		Teacher B (Total time : 41'21")	
	time s	Percentag e ( % )	time s	Percentage ( % )
Special case A	2'44 "	6.84	1'35 "	3.83
New rule B1	1'56 "	4.83	2'18 "	5.56
Special case C	6'41 "	16.71	1'34 "	3.79
Special case D	0'00 "	0.00	1'30 "	3.63
New rule B2	2'15 "	5.63	3'01 "	7.30
Special case E	26'23 "	65.99	31'23 "	75.89

### Conclusion 3

When analyzing the teaching links, we found that teacher A and teacher B taught the same content about new rule B1 and new rule B2, but their teaching methods are different. Both of them placed special emphasis on teacher's explanation in the new rules' teaching, especially teacher A, who spent less time on student interaction than teacher B. The teacher B would like to ask students questions appropriately to strengthen students' communication.

Teacher A pays more attention to training students' manipulative ability than does teacher B. Teacher A asks students to draw in five special cases' teaching. But teaching B only asks students to draw in two special cases' teaching. Others are completed through teacher's explanation and student's response.

Both of the teachers places special emphasis on teacher's explanation in the weak generalization's teaching. The experienced teacher places special emphasis on students' communication and enlightens the students appropriately. And the new teacher lays special emphasis on student engagement and exercise in the strong generalization's teaching.

### Conclusion 4

Because of the different assignments given by teacher A and teacher B, we chose two typical questions which we named Q1 and Q2 from the two classes' assignments. Q1 is related to new rule B1 and Q2 is related to new rule B2. Then we analyzed the students' answers to the two questions. Significant differences can be found in table 2.

*Table 2*  
**The Comparison of the Two Classes' Exercises**

	Q1		Q2	
	Correct rate ( % )	Error rate ( % )	Correct rate ( % )	Error rate ( % )
Students of class A ( Total number : 48 )	97.98	2.02	56.25	43.75
Students of class B ( Total number : 50 )	100.00	0.00	78.00	22.00

Table 2 shows that students have good understanding on the new rule

B1. The rate of students' exercises between class A and class B on this knowledge point are 97.98% and 100% respectively. The exercises of the two classes on new rule B2 shows significant differences. The rate of students' exercises of class A is 21.75 percent points more than class B's.

Combining figure 2 with table 1, we conclude that teacher A used more special cases and spent more time on the new rule A than did teacher B. Teacher A's students have lower correct rate than teacher B' students about the new rules B2. Although teacher A used multiple special cases in strong generalization's teaching on new rule B2 while teacher B did not, we can't see any difference from the results of the students' exercise. This shows that the strong generalization's teaching through refined explanation and exercise is conducive to the positive transfer of learning.

Compared with teacher B, teacher A didn't use the weak generalization's teaching on the new rule B2, but just instructed the students directly regarding the new rule B2 to. According to the statistical analysis of students' exercises from the two classes, we found that teacher B's students grasped the new rule B2 much better than teacher A's. It shows that the teacher who used weak generalization to introduce new knowledge was able to achieve the positive transfer of learning.

The results show that both teachers spent more time on strong generalization's teaching than that on weak generalization's teaching, and used a large number of special cases in classroom teaching. However, significant difference also exists, such as the new teacher paid less attention to the weak generalization, while the experienced teacher paid more attention to the explanation of new rules. Students' exercises show that these differences impact the students achieving the positive transfer of learning to some extent.

### Reference

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