

## How Student Classroom Engagement Affects Students' Study Results in Mathematics Classroom

Hai-xia SI (Assistant Professor)<sup>1\*</sup>, Li-jun YE (Professor)<sup>2</sup>, Yan-fang ZHENG (Graduate Student)<sup>3</sup>

<sup>1</sup>Jing Hengyi College of Teachers' Education, Hangzhou Normal University, bejixingsi@126.com;

<sup>2</sup>Jing Hengyi College of Teachers' Education, Hangzhou Normal University, yeatsylj@126.com

<sup>3</sup>College of Science, Hangzhou Normal University, kilinzheng@126.com

(Received September 24, 2019; Revised November 9, 2019; Accepted December 20, 2019)

To improve students' classroom engagement is not only the demand of curriculum revolution, but also the reflection of learning democracy. Students' responses and thinking are the main manifestations of students' participation in classroom learning. To reduce the amount of questions and increase the opportunities and time for students to think, this study, by employing SPSS, makes attempts to analyze the data by using multivariate GLM analysis to explore the effects of students' responses and thinking on learning results. The results indicated the students learning effect will be promoted through reducing the quantity and increasing the quality of question and adding the thinking opportunities.

**Keywords:** Experimental study, Thinking, Learning effect

ZDM classification: C30

2000 Mathematics Subject Classification: 97C30

### I. INTRODUCTION

Since the 1980s, Chinese students have performed very well in several major international comparative studies on mathematical achievements (Fan, 2005). At the same time, people are well aware that Chinese students have paid too much time and energy to achieving outstanding performances, yet their study is not very efficient. And the phenomenon of "learning alienation" gradually appears in Chinese classroom teaching: the

---

\*Corresponding Author: bejixingsi@126.com

more teachers teach, the more passive the students are, the more knowledge and skills they have, the less understanding and application they have. The reason is that it is mainly influenced by the psychological view of the nature of learning and utilitarian understanding of learning values. The psychological view of the nature of learning holds that learning is a psychological phenomenon dominated by objective laws. And that learning objectives can be achieved by following certain technical procedures or mental skills rules. Utilitarian understanding of learning values despise the intrinsic value of learning and think that the aim of learning is examination and social promotion (Zhang, 2010). The phenomenon of "learning alienation" is manifested directly in classroom teaching as the participation of the students in the teaching activity is not high under the effective guidance of teachers (Shi, 2002).

## II. LITERATURE REVIEW

With the spread of public education, the phenomenon of non-participation of student has become increasingly serious. A large number of researches (Kong, 2003) have shown that many students have non-participation phenomena in their learning process and processes. Why do people pay so much attention to the phenomenon of non-participation of students? Newmann (1992) believes that if students do not have the willingness to seek professional help from teachers, but they are forced to do so, then the teacher's teaching cannot achieve the expected results.

The research on student participation is mainly conducted abroad. In the 1970s, researchers mostly conducted empirical research on student participation through classroom observation. Rand (1978) found, through classroom observations that compared with the tense teaching atmosphere, students in the relaxed teaching atmosphere had better test scores. Tjosvold and Santamaria found that if teachers create a competitive atmosphere in classroom teaching and encourage students to express their opinions in the classroom, they can better develop students' self-confidence. Subsequent research (Reid & Jeffrey, 1999) also showed that encouraging students to engage in purposeful and creative activities will help create a good classroom teaching environment.

The existing research also shows (Si & Ye, 2011; Nie, 2011) that students' participation in the mathematics classroom teaching is not good. In the "fast-paced" classroom teaching, teachers give less opportunities and time for students to think, so they become more passive in class interaction. "Fast-Paced" teaching method refers to that teachers often ask a series of questions in classroom teaching, then they will, given that students are unable to answer teachers' questions timely, give their students certain prompts, such as ask questions or reduce the difficulty level of questions, to help students figure out these questions, which

resulting in the teaching phenomenon of quick questions and more answers. In fact, the help of teachers often interrupts the thinking process of students. Then students will in a state of tension and exhaustion which resulted from lack of thinking time. In the long run, students will have feeling of not fully understand the knowledge. If things go on like this, it will inevitably reduce students' active participation, and is also not conducive to students' understanding and mastery of mathematical knowledge, which then give rise to the phenomenon of teachers tired of teaching and students tired of learning. Thus, to get out of the phenomenon of "learning alienation" not only means that we should go beyond the "objective law" of psychologist and put aside the utilitarian understanding of learning values.

Starting from the classroom phenomenon of "learning alienation", the researchers try to explore how to improve students' classroom participation and gradually get out of the phenomenon of classroom "learning alienation".

Study students' participation in class needs to analyze the factors influencing learning from the perspective of students (Wang, 2011) Based on the above analysis, this study focused on students' participation that further manifested as students' response and thinking in classroom. The study is carried out in the way of teaching experiment. In the experimental class, teachers reduce the amount of questions in order to reduce students' response and increase the opportunity and time of students to think. Finally, by comparing the learning performance and effect of the students in the experiment class and the control class, the researcher explores whether the methods for teaching in the experimental class are helpful to the students' understanding and mastery of knowledge.

### III. RESEARCH METHODOLOGY

#### 1. RESEARCH PURPOSE

Some studies have shown that the degree of Students' active participation in mathematics classroom teaching is not high (Si & Ye, 2011). Teachers ask questions intensively, students respond questions in chorus. Students' cognitive level is low when they response. As for challenging problems, teachers are eager to help students, which undoubtedly reduce the opportunity and time for students to think and reduce the initiative of students to participate. For example, questions like whether a large number of responses can explain they have understood and mastered knowledge, whether reduce the number of questions and responses, and whether increasing students' thinking time will affect students' learning effect, are worthy of further study.

Due to the limited time of classroom teaching, increasing the opportunity and time for

students to think in classroom teaching is bound to require teachers to keep an eye on the frequency and depth of questioning in the teaching process. Therefore, the experiment, on the one hand, tries to reduce the amount of question in the classroom teaching, increase the chance and time of student's thinking to explore the influence of students' thinking time on students' mastering and understanding of the knowledge; On the other hand, the relationship between the response and the learning effect of the students in the classroom teaching is explored through the analysis of the students' participation in the classroom teaching.

## 2. RESEARCH HYPOTHESIS

1) Increasing students' thinking time is beneficial to students' understanding of knowledge. This means that classes that have a long time to think about the same question will have higher scores in the post-test.

2) Students' grades are related to their response and thinking, the more they response and think, the better their grades are verified by observing and analyzing the performance and learning effects of the students in the control class.

## 3. RESEARCH METHODS

Video analysis method: Use the camera to record the students' behaviors in the experimental class and the control class. Watch the video and count the time of students' thinking in the classroom. The amount of 'how student response and how long are their thinking time in the control class were recorded at the same time.

For example, when the teacher asks the question, the process before the student answers is recorded as one time. Also record how much time it took.

Test statistical method: Choose an ordinary middle school as the representative of Hangzhou Middle School. Select two parallel classes in this middle school as the experimental class and the control class. Both the experimental class and the control class were tested before and after the test in order to test their learning effect. (The test method is shown in 5. Pre-Test AND Post-Test)

## 4. PARTICIPATES

To explore the influence of students' thinking on learning effect, this current study choose two parallel classes in Grade 7 of Hangzhou W Experimental Middle School as research subjects. The student performance in this school is in the middle level in Hangzhou and is representative. The math classes in these two classes are taught by teacher L, in

which  $G_1$  is the experimental class and  $G_2$  is the control class. Teacher L selected for the research is an old teacher with rich teaching experience and can cooperate with experiments. Class  $G_1$  and  $G_2$  are at the middle level of the school.

To explore the relationship between students' scores and students' response and thinking: three students were selected from  $G_2$ . Each of the three students was selected from A, B and C level. Level A refers to 30% of the students in the first 30% of the class (total score of the pre-test and the post-test), C refers to 30% of the students after the class, and B refers to 40% of the students in the middle of the class. The response to questions is recorded by video analysis.

Experimental time: Teacher L teaches a math class with the same content in the experimental class and the control class. In traditional Chinese classroom teaching, the duration of a class is 40 minutes. Therefore, the study follows the traditional classroom arrangement and sets the experiment time to 40 minutes.

The contents of the class are: the "5.3 Application of one-dimensional unitary equation (2)" of the seventh-grade mathematics of the teaching edition of the Zhejiang, which is divided into a plurality of class hours, and the experimental course content is the second class of the "the application of one-dimensional unitary equation".

### 5. EXPERIMENT PROCEDURE

$G_1$ : During the course of teaching, the teacher reduces the amount of prompting questions, so as to increase student's thinking opportunity and time.

$G_2$  is the control group of the experiment which Employs traditional teaching method. Three students are selected to analyze the students' response and think the relationship between the students' achievement.

Figure 1 is the research design of the teaching experiment (Wiersma, 1977). The specific experimental design is as follows:

Experiment Subject	Pre-Test	Experiment Processing	Post-Test
$G_1$	$O_1$	Increase students' thinking time ( $X_1$ )	$O_2$
$G_2$	$O_3$	Traditional Teaching (1)	$O_4$

**Figure 1.** Experiment design diagram

$G_1$  is the experimental class and  $G_2$  is the control class.  $O_n$  ( $n=1, 2, 3, 4$ ) indicates the student's score in the pre-class and post-class tests. Teacher increases students' thinking time in the experimental class  $G_1$ , the traditional teaching method adopted in the control class  $G_2$ , without increasing the students' thinking time. Finally, students' test scores are compared before and after the class. Readers may be combined with the Pre-Test and Post-

Test made to understand Figure 1.

## 6. PRE-TEST AND POST-TEST

The research first analyzes the teaching materials. Then set the pre-test and post-test in class according to the knowledge points contained in this lesson and the student's academic situation. Finally, communicate the questions with experts and lecturers to get the final questions.

Both the pre-test and the post-test were conducted in the experimental class and the control class. The pre-test and post-test both included three closed questions and one open question. The pre-test questions are mainly selected from the same type of question as the previous lesson '*5.3 the Application of Unary first order equation (1)*' ('the Application of linear equation with one unknown'). The three closed questions are itinerary problem (such as the following example), economic problem and digital problem. The open question asked the students to work out a practical application question according to the equation  $4x+12=5x$ .

Example 1 (itinerary problem): a car and an electric car travel opposite each other from two places 298 kilometers apart at the same time. The speed of the car is 6 times faster than the speed of the electric car, 15 kilometers more than the speed of the electric car, and meet half an hour later. Ask for the speed of two cars.

The pre-test was carried out after the students learned '*5.3 the application of linear equation with one unknown (1)*' and before '*5.3 the application of linear equation with one unknown (2)*'. The experimental class and the control class were tested at the same time for 20 minutes.

The post-test exercises select the application (2) of the one-dimensional unitary equation of the experimental course. The three closed questions are: the distribution problem (see the following example), the geometric problem and the stroke problem. The open question is to ask the student to prepare an actual application problem according to the equation  $15-x = 3(x + 3)$ .

Example 2 (distribution question): there are 100 color TV sets in store A and 88 sets in shop B. A new shop C has transferred 50 sets of color TV sets from stores A and B so that the remaining color TV sets in stores A and B are equal. How many color TV sets have been transferred from each of the two stores?

After the students have learned '*5.3 the application of linear equation with one unknown (2)*', the post-test was carried out before learning the new content, and the experimental class and the control class were tested at the same time for 20 minutes.

The above closed questions are similar to those in teaching materials, which examine students' familiarity with knowledge and skills. The open question, by giving a known

equation, allows students to make a practical application based on it. As mentioned above, in the open question, the students can give different types of application questions through the understanding of the two-side formulas, such as the equation, which gives the students an opportunity to explore the nature of the one-time equation of the one-time formula (Liu, 2008) and is designed to examine the degree of the students' understanding of the knowledge.

## 7. DATA COLLECTION

### 1) *Research Variables*

Independent variable: in this study, we defined students' thinking as students' behavior between the teacher's "question" and the student's "answer" in the classroom teaching, and this period is defined as thinking time.

Dependent variables: scores of pre-test and post-test.

### 2) *Data Handling*

Coding score: In the pre-test and post-test, the purpose of the first to third questions (closed questions) is to examine the students' mastery of the acquired knowledge. It analyzes whether the problem-solving process is standardized, whether the answer is correct, and whether the solution is conventional, the specific points are as follows:

**Table 1.** Coding score

Score	Whether the problem is standardized (Procedure)	Right or wrong answer (Answer)	Whether the solution is normal (Method)	Open question
0	Did not do	Did not do	Did not do	Did not do
1	"Set, unit, answer" both missing	Column error	Formula	Wrong expression
2	"Set, unit, answer" missing two	Miscalculation	Assume the unknown number	Correct
3	"Set, unit, answer" missing one	Incomplete problem solving	—	—
4	Complete	Correct	—	—

The research data were individually counted by three researchers based on video. After the statistical data is verified by triangle argument, the final data results are obtained for data analysis.

## 8. DATA ANALYSIS

This current study employs multivariate analysis of variance to analyze data (which called GML). The total scores of three dimensions of closed questions and open question of pre-test and post-test were analyzed respectively. In the test, take the pre-test and post-test as a variable, the experimental group and the control group as another variable, If the interaction is significant, there is a difference between the experimental group and the control group.

## IV. RESULTS AND DISCUSSION

### 1. INCREASING STUDENTS' THINKING TIME IS HELPFUL TO STUDENTS' PERFORMANCE IN OPEN QUESTIONS AND TO STUDENTS' UNDERSTANDING OF KNOWLEDGE

Through the analysis of the teaching video of the experimental class and the control class, the statistical results of the students' thinking are obtained (as shown in Table 2): In the teaching of the experimental class G<sub>1</sub>, the teacher increases the opportunity and the time for the students to think by reducing the amount of the prompting questions.

**Table 2.** Number and time of thinking for students in the experimental class and the control class

	Number of thoughts (times)	Time of Thinking (s)
G <sub>1</sub>	33	195s
G <sub>2</sub>	13	63s

Table 3 presents the results of pre-test and post-test multivariate GLM analysis with the control class and the experimental class as the main contrast factors. It can be seen that the Sig. value of the closed questions are measured before the standardization of the problem-solving, the correctness of the answer and the regularity of the problem-solving process. The values were between 0.259 and 0.676, all of which did not reach the significant level of 0.05.

This shows that there is no significant difference between the experimental class and



the control class in the performance of the three dimensions. Put it more concretely, the experimental conditions has no significant effect on the performance of the students in these three dimensions.

While the pre-test Sig. value of the open question was 0.098 ( $p < .05$ ), belonging to the edge significant (Lin, 2007). Under the experimental conditions, the post-test Sig. value was 0.007 ( $p < .05$ ), reaching a significant difference. This shows that under the experimental conditions, there is a significant difference in the scores of open questions between the control class and the experimental class.

**Table 3.** Multivariable GLM analysis of Pre-Test and Post-Test

Source	Variable	Sig. ( $p < .05$ )
Student	Normative Pre-test	0.353
	Normative Post-test	0.259
Student	Answer Pre-test	0.457
	Answer Post-test	0.667
Student	Routine Pre-test	0.676
	Routine Post-test	0.535
Student	Open Pre-test	0.098
	Open Post-test	0.007
Student	Pre-test Score	0.754
	Post-test Score	0.449

Both of the total score of open question in the Pre-test and Post-test are 2 points. The data in Table 4 show that the open question's average score of the pre-test in the experiment class is lower than that in the control class, and the open question's average score of the post-test is higher than that in the control class. Under the experimental conditions, the students in the experiment class perform better than the control class in the open questions, and the differences are significant. The experimental conditions promote the performance of the students in the open questions.

**Table 4.** Average score Pre-test and Post-test of open questions in control class and experimental class

	Control group	Experimental group
Pre-test	1.15	0.90
Post-test	1.03	1.35

The above experiment results show that, on the one hand, under the condition of increasing thinking time and times, there is no significant difference between the students in the experiment class and the control class in the three dimensions of problem solving, the correctness of the answer and Problem-solving process. If students want to make progress in these three aspects, they need long-term training and learning, yet the students cannot make significant changes by increasing the number and time of thinking in one class. On the other hand, although the performance of the students in the experiment class is not as good as that in the control class (Table 4), the performance of the students in the experiment class in the open questions is obviously better than that in the control class, under the experimental conditions. In the experimental class, after improving the students' thinking time, the students' post-test scores are significantly higher than the pre-tests. It indicates that the hypothesis of "increasing students' thinking time is beneficial to students' understanding of knowledge and improving students' learning effect" is basically true. It provides students with abundant response and thinking time, which promotes students' understanding of linear equation with one unknown equation to a certain extent.

## 2. STUDENTS REDUCE THEIR HURRY TO RESPOND AND INCREASE THEIR THINKING OPPORTUNITES FOR THEIR UNDERSTANDING OF KNOWLEDGE

In order to study the relationship between the student's response and the academic achievement, the researchers divided the students into three groups: A, B, and C (it is shown in 4. PARTICIPATES) and the response is divided into a separate response, a partial response, and a collective response based on the number of student who responds. High separate answer means that only one student answers the teacher's question, and the partial answer means that only some of the students answer the teacher's question, and the collective answer means that almost all of the students are answering the teacher's questions.

It can be seen from Table 5 that in the response of the 3 students, the single answer is the least, mainly in part of the answer and the all answer. Student B answered most in the class, and the student C answered the least, while the student A had the best academic performance, but he answered not the most positive. After an after-school interview with the 3 students and watching the teaching video after class, the researchers found that the student A generally did not answer a relatively simple question, and they would not be anxious to answer a difficult question, but rather to think and answer after the answer. Student B will answer more actively, no matter how difficult the question is. If there is an answer, it will respond positively to the teacher and they will all respond collectively.

Student C is relatively passive in class, and his eyes are often in a free state, which cannot keep up with the rhythm of the teacher's class.

**Table 5.** Number of classroom responses and the scores of Pre-Test and Post-Test for the students in the control class

Student	Pre-test Score	Post-test Score	Times of Answer(times)		
			Single	Part	All
A	16	16	1	2	5
B	11.5	12.5	1	4	12
C	3.5	4	0	0	2

Through the above-mentioned analysis of student A and student B, the hypothesis of the experiment-related "If students think and respond more, and they will have a good score" is not true, and the response is not directly proportional to the achievement, and the student's response is only valid under a certain thinking. Although in the daily classroom teaching, the teacher left little the students' thinking opportunity and time, but the students A can get rid of the teachers' "control", consciously reduce the response quantity, and to "arrange" time to think about the problem, he is superior to Student B and Student C. Although student B's answer is positive, there is not enough to think about the problem, His understanding of the problem is not deep enough. As shown in the following snippet:

*Teachers' ask: If  $x > y$ , please compare  $2-3x$  with  $2-3y$ .*

*Student B:  $2-3x > 2-3y$*

*Student C keeps silent.*

*Wait for 15 seconds .*

*Student A: We can compare the magnitude of  $-x$  and  $-y$  first, according to the basic properties of the inequality  $-3x < -3y$ , so  $2-3x < 2-3y$ .*

In classroom teaching, students' response does not mean that they have a high degree of understanding of knowledge. Teachers should strive to create a space for students to think independently, provide opportunities to train their abilities of abstract thinking and deeply understand knowledge, and remind students not to answer questions in a hurry, so as to improve the "quality" of students' response and improve students' learning effect.

### 3. CLASSROOM Q & A QUALITY REDUCTION IS BENEFICIAL FOR STUDENTS TO CREATE AN ACTIVE AND PARTICIPATORY SPACE

Although the fast-paced question and answer in classroom teaching trains students' ability to respond quickly to a certain extent, it also makes some students form the habit of responding to teachers' questions without thinking, which is not conducive to promoting students' understanding of knowledge. This was verified by performance of middle school students in the control class, because most students cannot think about teachers' questions like students A in classroom teaching. It is particularly important for teachers to reduce the quality of questioning in classroom teaching and to provide students with a sufficient opportunities and time to think.

Teachers' teaching is to promote students' learning, and their questions are to promote student to thinking, not just to get "correct" answers. Especially for those difficult questions, fast-paced question are not conducive to teachers' teaching is to about the problem, let alone understand it, because students do not have enough time to internalize and analyze knowledge in class. As the old saying goes "learn and think, think about it, get it, use it later, and you don't know enough after use." Suhomlinsky, a soviet educator, agrees: "deep thinking is the most important stage in class (Sukhominsky, 1984)." Thinking is the basis for understanding, mastering and applying knowledge, especially for subjects as logical, cognitive and methodological as mathematics. As can be seen from the above experiments, when teachers provide more opportunities and time to think autonomously in classroom teaching, students have a better understanding of the unitary equation.

If the teacher wants to hear the real sound of the students in the classroom teaching, they should provide the students with a good platform to participate in the mathematics classroom teaching when the students have the willingness to participate in the teaching 오류! 참조 원본을 찾을 수 없습니다., and provide the students with the opportunity to experience and think in the limited classroom teaching time. In order to cultivate the students' consciousness of active participation in the classroom teaching and to improve their learning efficiency, the students can improve the ability to participate in the classroom teaching effectively.

## V. CONCLUSIONS

As one of the psychological characteristics of students' efficient mathematics learning (Wang, 2005; Wang, 2012; Gu, 2012; Hu, 2012; Wang & Wang, 2012; Xing & Shan, 2012; Yuan, 2012; Yang, 2012; Wu & Chen, 2012) students' active participation in classroom teaching is not only one of the demands of the current mathematics classroom teaches reform, but also the manifestation of students' learning democracy. Students' participation in the classroom is mainly manifested as students' response and thinking (Shi, 2002), and thinking are the basis of response. Only when students actively engage in learning and think

actively can they promote the construction of knowledge, realize the transformation of students from "learning" to "learning", cultivate students' active participation in learning, and gradually get out of "learning alienation" in the implementation of teaching process.

There is still room for improvement in research on students' participation in classroom learning. For example, the scope of video analysis can be extended to geometry lessons and probability lessons or to analyze the similarities and differences of students' participation in different classes and grades. In the experimental research on the characteristics of student participation, we only considered the thinking variables and did not conduct in-depth research on other students' participation behaviors. This is where I need to continue to pay attention and research in the future.

## REFERENCES

- Fan, L. (2005). *How do Chinese learn mathematics*. Nanjing: Jiangsu Education Press.
- Gu, P. (2012). How to develop "double base" into "four bases" in mathematics basic Education. *Journal of Mathematics Education*, 21(1), 14 - 16.
- Hu, D. (2012). Mathematical empiricism and its enlightenment to mathematics education. *Journal of Mathematics Education*, 21(2), 1-4.
- Kong, Q. (2003). *Student participation in the process of mathematics teaching*. Shanghai: East China Normal University Press.
- Lin, Z. (2007). *Multivariate analysis: Operation and application of SPSS*. Beijing: Peking University Press.
- Liu, Z. (2008). Investigation and research on the present situation of open mathematics teaching in Guangdong area under the new curriculum standard. *Journal of Mathematics Education*, 17(1), 63-66.
- Newmann, F M. (1992). *Student engagement and achievement in american secondary school*. New York: Teachers College Press.
- Nie, D. (2011). An investigation and research on the interaction between senior two students in mathematics classroom teaching. *Journal of Mathematics Education*, 20(6), 40 - 43.
- Rand, G. a. R., Per. (1978). The effects of working atmospheres on creativity. *Scandinavian Journal of Educational Research*, 22(3), 91-106.
- Reid, L. G., Jeffrey N. (Ed.) (1999). *Reflective activities: Helping students connect with texts: Classroom practices in teaching English*. Urbana, National Council of Teachers of English.
- Shi, X. (2002). Interaction between teachers and students in the process of mathematics learning. *Journal of Mathematics Education*, 11(4), 24 - 26.
- Si, H.& Ye, L. (2011). On video case analysis of junior middle school mathematics classroom student participation. *Journal of Mathematics Education*, 20(4), 10 - 12.
- Sukhominsky, B. A. (1984). *A proposal to teachers*. Beijing: Education Science Press.

- Wang, G. (2005). Attach importance to mathematics teaching efficiency and improve mathematics teaching quality. *Journal of Mathematics Education*, 14(3), 43-46.
- Wang, S. (2012). Talking about mathematics and style of study. *Journal of Mathematics Education*, 21(1), 1 - 2.
- Wang, X. & Wang, F. (2012). Analysis of the elements of high-efficiency mathematics teaching. *Journal of Mathematics Education*, 21(3), 20-25.
- Wang, X. (2011). A survey of behavioral participation of independent college students in higher mathematics learning. *Journal of Mathematics Education*, 20(3), 51 - 53.
- Wiersma, W. (1997). *Introduction to education research methods*. Translated by Yuan Zhengu. Beijing: Education Science Press.
- Wu, B. & Chen, M. (2012). Orientation and orientation of mathematics teaching design. *Journal of Mathematics Education*, 21(3), 89-90.
- Xing, Q. & Shan, Y. (2012). Influencing factors and inspiration of external representation of mathematics application problems. *Journal of Mathematics Education*, 21(5), 19 - 20.
- Yang, Z. (2012). A brief discussion on "the consciousness of using mathematics" and its cultivation - the association caused by the inscription "mathematics fun" by mathematical master Chen Shengshen. *Journal of Mathematics Education*, 21(1), 76-79.
- Yuan, Z. (2012). A review of the study of the subject teaching knowledge of the whole-in-the-art technology. *Journal of Mathematics Education*, 21(6), 13-18.
- Zhang, H. (2010). Learning philosophy. *Global Education Outlook*, 6, 13 - 17.