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The Changes of Teachers' Verbal Feedback in Mathematics Classroom within Chinese Context during Ten Years

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In the present study, the changes of mathematics teachers' verbal feedback between ten years ago and later were examined using a coding scheme on the types of teacher verbal feedback. Based on the analysis, it is found that teachers intend to use encouraging strategies to make responses to students ten years later. In addition, the duration used in communication between the teacher and individual student is being longer while the frequency of communication becomes less compared ten years ago. Meanwhile, the difference between good lesson ten years ago and common lesson ten years later is not so apparent. It can be inferred that the quality of teaching has being developed.

Keywords: teacher verbal feedback, changes, professional development, primary school mathematics
MESC Classification: D30
MSC2010 Classification: 97D30

1. INTRODUCTION

To create a communicative mathematics classroom, one of the most strategies used by mathematics teachers is questioning. The main modus is that teachers raise questions and assign students to give answers, and in some classrooms, teachers' questions are almost nonstop from the beginning of the lesson to the end. Teaching questioning, as a focus, has been focused by many researchers (Black, 2001; Carlsen, 1991; Herbal-Eisenmann &

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Breyfogle, 2005; Martino & Maher, 1999) while less more take teacher verbal feedback (Schleppenbach, Flevares, Sims, & Perry, 2007) into consideration. Just as Pimm (1987) noted that not only the way of asking is interesting, but also answering is particular interesting. As teachers ask questions with a high frequency in classroom instruction (Chin, 2007; Franke et al., 2009; Gall, 1970; Sahin & Kulm, 2008), it is meaningful to study the verbal feedback presented by mathematics teachers. Teacher verbal feedback is the focus in this study. The term "verbal feedback" means teachers' utterances aiming to deal with students' answers in classroom. Based on this definition, all the verbal feedback will be included in this study.

High-quality professional development is a central component in almost every modern proposal for improving education (Guskey, 2002). Many studies based on curriculum reform have considered the significance of teachers' professional development (Borko, 2004; Garet, Porter, Desimone, Birman, & Yoon, 2001). One of the principles for the professional development is an emphasis on inquiry-based learning (Clarke, 1994). If the classroom environment is inquiry-based learning, teacher questioning is essential. The teacher verbal feedback can also not be ignored. It can be concluded that the ability of mathematics teachers to deal with student's answers is also a vital aspect for teachers' professional development. Based on this, in this study, the research question is: what the changes are for teachers' verbal feedback with the development of teachers' profession?

In mainland China, at the beginning of the new century, a new circle curriculum reform was launched. An experimental mathematics curriculum standard was released in 2001. One of the most important changes is that the teacher should help students learn to pose questions from mathematics perspective, cooperate with others, and communicate mathematics thinking with others (Ministry of Education, 2001). It can be seen that mathematics classroom communication in primary school and junior secondary school was emphasized. Furthermore, it is clearly stated in the new version. Ten years later, the new version of mathematics curriculum standard was released, and the role of the teacher has been refined. The teacher should not only help students learn mathematics actively in classroom; pose questions and analyze them; cooperate and communicate with others; express ideas in a logical way; listen to and understand others' ideas and thoughts. They also should engage all students in speaking and thinking in classroom instruction as far as possible. They should guide students to choose appropriate strategies when students propose different methods for solving mathematics problems through interaction (Ministry of Education, 2011). Apparently, the national curriculum documents emphasize communication through interaction between teachers and students in mathematics classrooms. This study is considered to study within Chinese context.

2. LITERATURE REVIEW

In the past decades, special attention has been paid to communication in different contexts (Alrø & Skovsmose, 2004), such as school and classroom. The significance of communication in mathematics classroom has been considered by researchers (Knuth & Peressini, 2001; O'Connor, 1998; O'Halloran, 1998). Furthermore, the effectiveness communication as revealed in various studies. Baroody (1993) indicated that teacher-student communication is important for nurturing students' mathematical potential. Interactive communication influences mathematical knowledge construction, reasoning, self-confidence, and social-skills acquisition (Lanppan & Schran, 1989). Researchers investigated classroom discourse and reported that it could be a problem area for teachers when they did not realize how important it is (Van Zoest & Enyart, 1998).Thus, it is important for researchers and practitioners to pay attention to teacher-student communication occurring in mathematics classrooms.

Several decades ago, teachers usually talk much more in classroom discourse as transferable agents. Classroom discourse typically follows a three-part exchange beginning with a teacher initiation, followed by a student response, and then the teachers' response (Cazden, 2001). In this discourse pattern, teachers, as the role of masters as classes, often hold a belief that their role is just to transmit knowledge to students. This role should be abandoned and transformed into a more focusing on students in classroom instruction. Besides knowledge of mathematics and its pedagogy as reflected in the NCTM version, teachers need to be sensitive to student learning (McClain & Cobb, 2001; Yackel & Cobb, 1996). Because the teacher plays a crucial role in shaping the discourse in their classrooms through the signals they send to their students what is valued about mathematical knowledge as well as ways of thinking and knowing about mathematics (Ball, 1991). Besides, teachers should encourage students to communicate their solutions and conjectures to their classmates (NCTM, 1991). By doing so, students can consolidate their mathematical understanding, improve their communication skills, and enrich their repertoire of problems solving strategies (NCTM, 2000).

Thus, it is very important for teachers to make a belief that student's active engagement with mathematical ideas will lead to development of specific competencies and identities (Walshaw & Anthony, 2008). These competencies and identities that are presumed to make a positive difference in students' life chances and their future civic participation (Ball, 2003)

However, Truxaw (2009) found that "simply engaging students more actively in classroom discourse is not a panacea for improving mathematical achievement" (p.18). He gave an example to illustrate that. A grade-eight teacher, Mr. Larson, used triadic ex-

changes are not limited to conveying a teacher's ideas, but they can also build students' understanding. This depends on the function of the discourse; either univocal or dialogic in nature (Olson, Knott, & Currie, 2009). Teachers play a crucial role in how to apply the function of discourse.

In the process of mathematics classroom discourse, students should "develop explanation, make predictions, debate alternative approaches to problems" and may can clarify or justify their assertions (Brophy, 2001). As students learn to make and test conjectures, question, and agree or disagree about problems, they are learning the essence of what it means to do mathematics (Stein, 2007).

Teacher verbal feedback is considered as a significant instructional behavior which can have considerable effect on students learning and system control (Zahorik, 1968). And he interpreted that the verbal feedback that teachers give following a pupil's behavioral output provides information for pupil relative to effectiveness of the behavioral output and using this feedback information the pupil can adjust and change his future output in terms of his goal. At the same time, the teacher can gain a measure of control over his behavior from teacher verbal feedback in classroom.

Recently, there is research concerning teachers' feedback based on the skills of video. Smith and Higgins(Smith & Higgins, 2006) think emphasis should be less on the questions teachers ask, and more on the manner with which teachers react to pupils' responses to questions in order to "open" classroom interaction. They gathered episodes of classroom interaction from video recorded literacy and numeracy lessons to support this argument.

Given these problems, more studies need to be done to improve teachers' verbal feedback in classroom instruction. One of the possible directions is to examine in more detail teachers' teaching practices so as to develop more knowledge about how teacher use verbal feedback. In a word, teachers' feedback has relation with students' learning in mathematics classrooms. So we can also present the hypothesis that teachers' responses have effectiveness on students' learning. Therefore, teacher verbal feedback is the focus of this study.

3. METHOD

In this study, four videotaped lessons of two teachers were chosen as the sample or as the case. Two video lessons were tapped around the year of 2000, and the other two were tapped in 2011. Teachers' verbal feedback is a kind of dynamic activities in mathematics classrooms, and video technology is a powerful way to analyze teachers' verbal feedback.

Recently, video has emerged as a popular-based medium (Seago, 2003). Since 1990s,

video technology has been applied in mathematics classrooms to analyze teachers' and students' behaviors. In this way, researchers can discover new teaching theories, which can be analyzed from many different perspectives (Martin, Mullis, & Chrostowski, 2004). Until now, there have been two large video studies internationally: the Third International Mathematics and Science Study (TIMSS) Video Study and the Learners' Perspective Study (LPS). The video study component of TIMSS is the first attempt made to use videotapes to study national probability samples of teachers at work (Stigler & Hiebert, 1997). The LPS study is led by Professor David Clark from the University of Melbourne, Australia and it involves at least ten countries (Mok, 2006).

From the above, it is easily to find that video technology is very useful in analyzing teachers' activities in classrooms. To analyze teachers' responses, teachers and students will be observed carefully and the ways teachers deal with students' answers to their questions will be recorded. Unlike live observation, videos offer a lasting record of classroom activities, and the medium allows the opportunity to pause, re-play, analyze and re-analyze the same episode of practice. We can observe teachers and students' behavior more carefully than before and will not miss the vital details. So the video technology will be adopted in this study.

3.1. Background of the data

Teachers. The two teachers are from the same school which is a major primary school in the local district. Ten years ago, there were new teachers and now they are competency teachers in the school, namely they are considered as good teachers now. It means that the environment for their professional development is almost the same.

Video lessons. Two video lessons were chosen from each of two teachers. One lesson was taped before the year of 2000, and the other taped on 2011. Before the year of 2000, for limiting time and resource, most of lessons were taped to show the teaching skills contests. The result is that the two lessons taped on 1997 and 1998 respectively were also used for competition in teaching skills. The two lessons were considered as "high quality" for them on that time. Ten years later, they are the backbone teachers in the school and seldom take part in teaching skill contest. Instead, they are usually as the guider to help new teachers prepare for some contests. It is difficult to get the video lessons used for competition currently. Considering that, two lessons were taped naturally on 2011. However, there is one thing to be paid attention that the lesson of LH tapped on 2011 was used to be observed by other mathematics teachers. The teacher must have prepared more carefully than natural lessons, so the lesson cannot be considered as a natural lesson. Other details of the chosen lessons are shown in Table 1.

Table 1. Video Data

Name Code	Video Time	Course Name	Course Duration
ZW	1997	Introduction of Right Angel	42min
ZW	2011	Distributive Law of Multiplication(**Natural**)	42min
LH	1998	The Transformation Between Percent fractions and decimals	42min
LH	2011	Oral calculation of double-digit divided by single digits	42min

Although for the limited resource, data collection was made just as the mentioned above, this choice has other advantages. The teachers showed their best teaching behaviors in the "good quality" lesson while they show natural teaching performance in the classroom instruction. If there still appear some changes between them, it means that teachers' teaching behavior has changed increasingly. Through comparing current lessons to "good quality" lessons ten years ago, some behavior occurred in the classroom will be shown. About the teaching content, 3 lessons involve algebra content and one involves geometry content. The difference of content can be dismissed. The reasons can be found in the part of result of this study.

4. DATA ANALYSIS

After data collection, these four videotaped lessons were observed entirely to find the main types of classroom communication and some details need to be paid attention. The teachers' response to student group work and individual exercises were in audible. In most of classrooms all over the world, the dominant way is still teacher lecturing. As a result, only teachers' responses to individual students during whole class discussion were coded.

To analyze the behavior of teacher verbal feedback, the next step is to develop a code scheme for it. Based on Li's (2009) questionnaire on mathematics teachers' professional development, a framework was established (Table 2).

In order to guarantee the validity of the code scheme, the scheme was used to analyze the four lessons by the first author's colleagues firstly. After making an agreement with the four types of teacher verbal feedback, the first author analyzed the four lessons based on the scheme.

This study aims to show an overview of the changes in teacher verbal feedback in a quantitative method. NVvio 10, as the software tool, was used in this study to analyze videotapes. The software yields the frequency and duration in analyzing some special teachers' behavior (Table 3).

Table 2. The coding scheme of teachers' verbal feedback

The type	Description
Not accept	The teacher ignores, or gives up students' ideas and contributions; the teacher interrupts when students are answering the question, instead, the teacher herself/himself answer the question： 1. The answer is wrong ; 2. The answer or idea is correct but not the teacher anticipate; 3. The answer is wrong, but the teacher asks the student to make an explanation.
Accept but keep neutral attitude toward students' idea	The teacher accepts and assesses the student's idea. But there's no encouragement, nor criticism and sarcasm： 1. The teacher says "Ok." and then moves on to a new topic; 2. The teacher satisfies with the answer but no substantial suggestions are provided.
Accept and encourage	The teacher accepts and encourages students' ideas. Even if the student's idea/thought is not totally correct, the teacher still acknowledges the merit of this idea, and encourages and guides the student to refine the answer (or idea).
Investigating or applying	The teacher accepts and encourages students' ideas. What's more, exploring their ideas and trying to use them in the teaching process. 1. Applying students' ideas in the actual teaching; 2. Even if the student' s idea/thought is not totally correct, the teacher still acknowledges the merit of this idea, and encourages and guides the student and other students collectively to refine the answer (or idea).

Table 3. The results of codes show in NVvio 10

Node Coding	References	Coverage
Code\provide the correct answer	2	0.47%
Code\ignore the wrong answer	1	0.14%

If just the frequency of teacher verbal feedback is counted, misunderstanding would appear. For example, if one teacher just provides 2 times of verbal feedback, but spends nearly ten minutes while another teachers gives 6 times, but spends about 4 minutes. Judging from the amount, the first teacher may not pay close attention to students' answers while judging from the duration, the second teacher may better in understanding students' thinking. Therefore, both of the two results are counted.

5. RESULTS

Before based on the statistical numbers, the changes between ten years ago and later will be presented in an overall perspective firstly. Then the changes in individual teach-

er's own self will be shown. The last part will discuss the changes between past "good lessons" and current ordinary lessons. At the same time, some episodes occurred in the classroom instruction will be presented to explain the actual behaviors of the teacher and students.

5.1. Algebra and Geometry

In both years, student free-listed more positive aspects than negative aspects for the class equipped with small group discussions and presentations. In 2014, students listed freely more suggestions for an effective way for such class than those of 2011.

The students' free listing on the positive and negative aspects of the class equipped with small group discussions and presentations, and also the suggestions for more effective running of this kind of class are exhibited in Tables 4–6. The items that students free-listed were categorized as in Tables 4–6. The tables summarize the responses of the students.

Table 4. The comparison between Geometry and Algebra

Content	Not accept (Times)	Accept but keep an neutral attitude (Times)	Accept and encourage (Times)	Investigating or applying (Times)
Geometry	8	36	10	4
Algebra	10	37	11	4

Based on the data, there is no apparent difference between the two (tapped ten years ago). Thus, the two kinds of lessons can be used in this study.

5.2. Ten years ago and later (Overall)

Firstly, to have a look the changes taken place during the ten years, the mean of the two teachers' verbal feedback in frequency and percentages is calculated. The frequency of teacher verbal feedback is listed in the table 5 and percentages which take up a whole lesson are shown in the following Figure 1.

Table 5. The change of frequency

Time	Not accepted (Times)	Accept but keep an neutral attitude (Times)	Accept and encourage (Times)	Investigating or applying (Times)	Total (Times)
Ten Years ago	9	36.5	10.5	4	60
Ten Years later	9	23	12.5	6	50.5

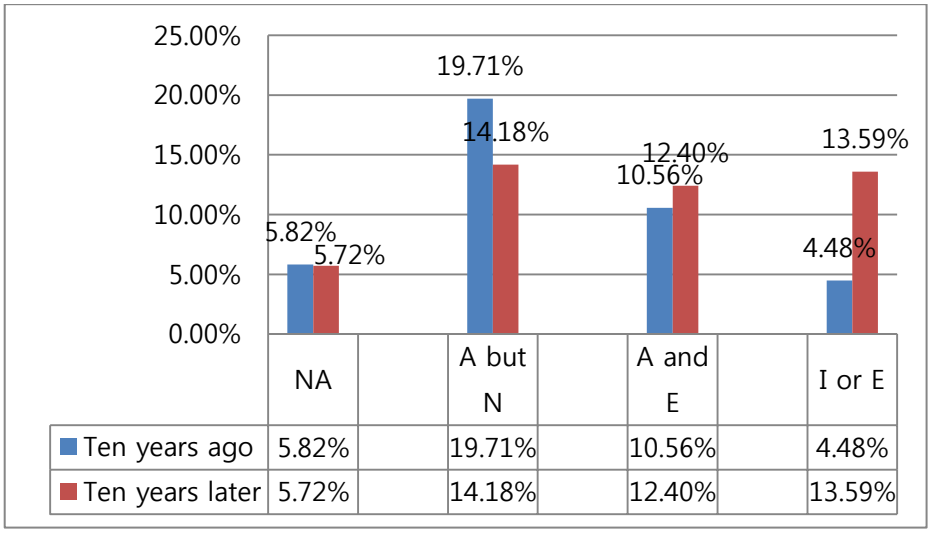

Figure 1**.** The change of percentages

It can be found that great changes have been occurred in the fourth type in the past ten years. Although the two lessons were tapped in nature ten years later, the percent of whole class time used in investigating students' ideas has increased drastically while the frequency is just increased twice. This shows that the two teachers paid much more attention to individual student's ideas and created opportunities for students to express their ideas in class after ten years. The teacher applied students' some ideas in actual teaching (see the following episode of classroom practice).

Episode (**ZW2011**):

Background: One student posed different view for Multiplication Distributive Law after doing several exercises.

1T: If you have other ideas, speak it out.

2S: I think the Multiplication Distributive Law, namely is (a + b)c = ac + bc. I think the left algebraic expression is much easier than the right.

(*The teacher just required the students to do some exercises on simplification of expression and these exercises were all much easier if simplified the form as the left.*)

3T: You mean that if we simplify algebra expressions like this, i.e., the sum of two numbers and then multiply one number. If we simplify such as this form is much easier. It is not easy if simplifying the form of two products and then to make some trouble for oral arithmetic, isn't it?

4S (*Show anxiety and provide a respondence to the teacher*): Sometime it is not easy. If we not deliberately add two numbers together to make round off, the left of the for-

mula is not easy while the right is easy. Thus, in such a situation like that, the formula of right is easier than the left. We should choose the form of simplification depends on the form.

5T: He said excellent words that depending on the form. In fact, the form means what we should observe before simplifying an algebra expression?

6Whole class: 'Good friends'. It means the common factor. The teacher used such interesting name to help children remember the term.

7T: This point is observing the characteristics of numbers. Very good! About what he said just now, some students have understood while some did not understand. Who else could explain it more clearly?

The student mentioned above was always much active for any questions and could express his own different ideas even though some ideas were not very perfect. However, the teacher was good at integrating the student's ideas into real classroom teaching. This indicates that the teacher could tolerate opinions from students which are different from her in classroom instruction.

5.3. The Changes (Individual)

Based on the following table 6, it is not difficult to find that the most significant changes in teacher communication behavior in applying students' ideas during the ten years. The percentage rise sharply while the frequency just adds 3 times, it means that the duration increased, from 40s/time to 64s/time. On the other hand, no matter what the percentage or frequency decreased apparently for the type of "accept but attitude neutral". It can be concluded that the teacher had intention to reduce some simple and robust responses to students. Instead, she would like to pay more attention to finding some good ideas presented by students.

Table 6. The change of frequency of individual teacher (LH)

Time	Not accepted (Times)	Accept but keep an neutral attitude (Times)	Accept and encouragement (Times)	Investigating or applying (Times)	Total
LH1998	10	37	11	4	62
LH2011	9	21	9	7	44

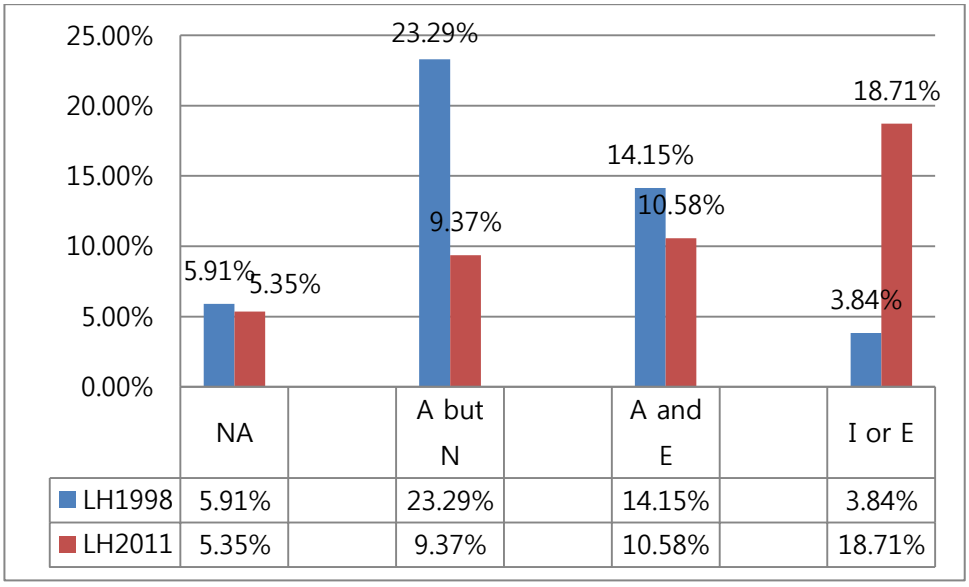

Figure 2. The change of percentages of individual teacher (LH)

The following episode could help explain the above findings.

Episode (LH2011):

Background: The question was posed by the teacher: What's the way you could use to calculate 36/3?

1S_1: Representing 36 as the additive form of 30 + 6 and dividing 30 with 3 to obtain, simultaneously 6 with 3 to obtain 2, consequently we obtain 36/3=12.

(*The teacher wrote the procedures on the blackboard.*)

2T: Who else has other ideas?

3S_2: I could use sticks to solve.

4T: How could you use sticks to show the solution?

(*The student stood up and showed an oral explanation firstly. The student's thought is familiar with former student's. The teacher then asked the student to demonstrate his solution the projector.*)

5S_2: Firstly, putting 3 bundles of sticks into 30 (sticks) and 6 (sticks).

6T: Pause. 36 = 30 + 6, what does the step written on the blackboard show this procedure?

7S: The first step. (*Students chorus.*)

8T: How many sticks in one bundle?

(*The teacher picked out one handle which was laid out blow the projector by S2.*)

9S: 10. (*Students chorus.*)

10T: Good, go on.

(*The teacher said to S2*.)

11S_2: Then dividing the left 6 sticks in to 3 equals, that 6 divided by 3 equals 2.

12: Which step is?

13S_2: The third step.

14T: Do you agree with it? (*Asking whole class.*)

15S: Yeah. (*Student chorus*)

16S_2: The last step is 10+2=12.

(*The whole class gave heavy applause automatically*.)

17T: It is very good for the student's explanation with the aid of sticks. Who else has other ideas?

5.4 The Changes between common and good quality lessons

The reasons for comparing the changes between common lesson and good quality lesson (ten years ago) are not only because most lessons are videotaped and persevered were thought good quality at that time (ten years ago), but also because teachers' belief concerning communication can be induced through comparing the two. The "good quality" lesson was prepared by the teacher with other experienced teachers. Therefore, some teaching behaviors enacted by the teacher in mathematics classroom can indicate some typical beliefs. Furthermore, the "good quality" lesson can represent the kind of best lessons taught on that time. Namely, the teacher was believed have acted the most effective teaching in class. The lesson tapped 2011 just presented the teacher's natural behaviors without other teachers' help. Through comparing the two lessons, the teacher's professional development can be investigated.

Table 7. The change of frequency of individual teacher (ZW)

Time	Not accepted (Times)	Accept but keep an neutral attitude (Times)	Accept and encouragement (Times)	Investigating or applying (Times)	Total
ZW1997	8	36	10	4	58
ZW2011	11	25	12	5	53

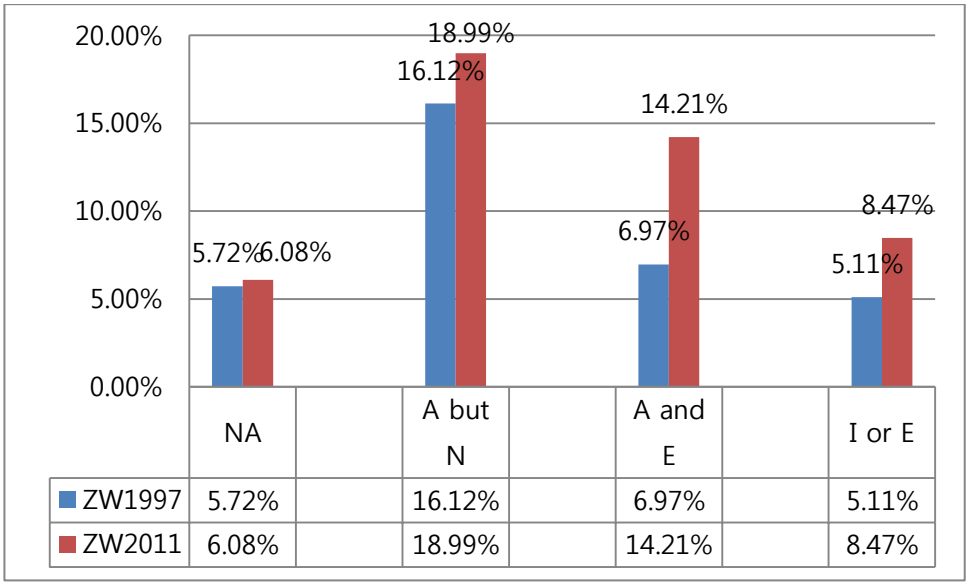

Figure 3. The change of percentages of individual teacher (ZW)

As can be seen, the 4 kinds of percentages are all increase. That indicates the time the teacher used in communicating with students became longer. Comparing the other two, the changes in the other two kinds of "acceptance of encouraging" and "inquiry" are much more obvious. Although the number of times are just increase one and two respectively, due to the whole class time was longer (about 8 minutes) than normal class, the time used in individual was longer.

Ten years ago, although questioning was the frequently adopted by the teacher, most of the time, the teacher pursuit of a junk active classroom form and didn't pay much deliberate attention to students' thinking while focused on the correctness of answers.

Episode (ZW1997):

The teacher asked students to take out the triangle plate and find out the right angle on it. For a while, the teacher asked a student to demonstrate the right angle under the projector. The student demonstrated the right angle exactly.

T: Since you find it so accurately, could you explain how did you find the right Angle?

S_1: The right angle always exists in the vertex position.

T: (*Teacher smiled and continued asked*) Who else want to explain?

S_2: The right angle is the angle without characteristics in the triangle plates.

T: (*Teacher didn't speak*) Who else have other explanation?

S_3: It can be stuck exactly between… (*The students put out index finger and thumb to form an approximate shape of right angle and he described it not very clearly in verbal language*.)

T: (*The teacher didn't make any comments and continued look for other students who may give correct the answer*.) Who else could give other explanations?

(*At the same time, S3 seemed suddenly had other ideas and raised his hand immediately. The teacher looked at him and continued to look for others*.)

The teacher saw the student (S3) raising hand, but she still pretended to ignore and designated other students to make explanations. The result was their answers were also not correct. The teacher finally gave the explanation which she thought was perfect. If the teacher would make a follow-up, the student could show some new ideas. However, the results were also not difficult to imagine. If the answer was not correct completely, the teacher also rejected it.

6. CONCLUSION AND DISCUSSION

The duration used in communication between the teacher and individual student is being longer while the frequency less. It is may indicate that the teacher pay more attention to the content of communication rather than forms or the correctness of answers. However, the phenomenon of students' thinking ignored by the teachers is still existed. Due to the size of class, there are more than 50 students in one class so that it is reasonable for the teacher could not care about every student carefully. All in all, mathematics teachers encourage students to present the diversity of answers and apply these answers in actual teaching as possible as they can after ten years of teaching. Even these answers are not perfect, the teacher also like to make an effect to guide the students obtain the correct answers.

Apparently, when the students express their ideas or thoughts in classroom instruction, some unexpected correct or incorrect answers are probably provided by them. The teacher must have considered the situation.Shi (2012), as one of the membership of the committee for drafting the mathematics curriculum standard, proposed that the teacher should create chance for students to exhibit their ideas fully as possible as they can, so the teacher could have full understanding for students' ideas. At this time, for teachers, "delaying show judgment for student's answers" as teaching strategies must be followed. To do this, the teacher can adopt the way of asking the students to explain why they did like this as the feedback to student. For example, when a student show a correct answer, the teacher should encourage other students to give their ideas about the correct answer and when there is something wrong with the student's view, the teacher could via the

sentence, such "how about in another case? " to guide the student to reflect on their ideas.

Although the teacher seems to have perceived the importance of classroom communication and students have much chance to express their ideas and thought, rarely students could pose questions actively in Chinese mathematics classroom. Thus, students' participation may be a study perspective in the future.

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