Assessment Standard and Methods

Of Mathematical Classroom Teaching for China's Senior High Schools

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Based on China's National New Mathematical Curriculum Reform

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Abstract: In this paper, the essential assessment concepts, its standard and methods of the mathematics classroom teaching for China's senior high schools will be introduced on the basis of China's National New Mathematical Curriculum Reform. In particular, the paper will center on the multi-factor comprehensive assessment method for classroom teaching, which renders the judgment and evaluation of the mathematical teaching more objective and accurate.

Background

Since the new round reform of the mathematics curriculum in China, people have begun to focus on the assessment of the mathematical classroom teaching. Especially, the Mathematical curriculum reform for senior high school has already stepped into the critical stage indicated by the fact that 'The Curriculum Standard of Mathematics for Senior High School (Experiment)' was officially promulgated by Ministry of Education of the People's Republic of China in 2003. In particular, the updated educational conception having been introduced became integral part of the new curriculum standard, in which the new conceptual framework, the content system, the teaching methods and the educational function have already been developed. Under such conditions, many mathematical researchers and educators have commenced to explore how to effectively work on the assessment of mathematical classroom teaching.

Analysis on the main characteristics
Of mathematics classroom teaching based on the new curriculum

In term of the new curriculum standard (**Standard**), it puts, "mathematical teaching highlights the teaching of mathematical activities and the process of mutual development between the teacher and the student or among the students". It also offers the teaching suggestions that we should convert the new teaching concept and strategies being advocated into the teachers' teaching behaviors and the actual teaching effect, so that under the guidance of teachers, the students could learn how to learn, how to acquire knowledge, and how to develop skills and thinking in a vivid, vigorous, active and personally motivated way.

Analysis on the concept of mathematics classroom
Teaching assessment based on the new curriculum

In real practice, the teachers' teaching thought will not only exert great influence upon the designing & implementation of their teaching plans but also provide the instructions to the classroom teaching assessment. Therefore, we should, on the one hand, define what the instructive thought to the assessment will be under the new circumstance. On the other hand, we should advocate that the contemporary mathematics classroom teaching assessment should be undertaken on the teachers' teaching based on the students' learning on account of the fact that in the light of **the Standard**, one of the

main characteristics of the teaching is taking the students' development as the center. Conversely, the traditional assessment had been concentrated only on the teachers' performance by taking the teachers as the center of teaching activities, which had resulted in the inaccuracy to assess the classroom teaching effect without consideration of the students' learning. Thereby, it is required that some parts of previous assessment should be reformed so as to reach the end of taking the students as the center.

In sum, the updated assessment concept "assessing teaching relied on learning" (the research group of training matters in the course of the new curriculum put in practice, 2002) should lay the emphasis upon the fact that evaluating the teachers' teaching quality should be determined by the performance of students in the classroom teaching instead of adopting the traditional one "assessing teaching by teaching" based on the teachers' teaching performance by taking teachers as the center.

Present Assessment Standard
Of Senior High School Mathematical Classroom Teaching

The Teaching Targets

a. The Targets of knowledge and skills

● To thoroughly understand the concept, the axiom and the theorem of mathematics, and to perceive their most essential properties.

● To grasp the basic mathematical knowledge, skills and methods; to accurately operate the basic operations; to properly apply the basic methods; to express mathematically by criterion.

b. The process and the method targets

● To enable the students to experience the process of buildup and development of mathematical knowledge in the course of introducing, forming, deepening, consolidating, and improving the mathematical concepts.

● To develop their capabilities such as observation, analysis, conjecture, generalization and abstraction in the various performances;

● To penetrate the correlative mathematical thoughts and methods into their minds;

● To develop their mathematically communicative ability, and to render them to learn how to apply the symbolic language of various mathematical knowledge to express the same problems by means of the reflection, research and exchange on them.

c. The Emotion, the attitude and the value targets

● To enable the students to experience the success of acquiring knowledge, and to inspire their passion for the mathematics learning;

● To develop their cooperation consciousness and team spirit through the communications and interactions among the

students or between the teachers and the students;

● To develop their rigorous attitude towards the pursuit of theirs studies and the favorable thinking habits in the process of the exploration, digestion and exchange of mathematical problems.

The Teaching process

● To create the mathematical learning conditions favorable to the health of the students' body and mind and to the attainment of the teaching targets oriented by the problems and on the basis of the mathematical knowledge;

● To select the learning contents adaptive to the mathematical cognitive development level of the students and to the characteristics of their age and development of mathematical thinking; to fully supply with the materials relevant to the learning activities; to choose the proper teaching means and make full use of the multimedia teaching and other information resources such as the networks; to offer every student the equal opportunity of participation in the activities; to give each of them different instructions and to introduce the various kinds of assessment methods in their learning activities in time;

● To make a timely adjustment of the teaching process and the difficulties based on the feedback information and to reasonably deal with the sudden events during the teaching;

● To enable the students to pay much attention to the situations of problem and take an active part in the learning activities;

● To increase the number, the ways and the time, of students participating in the activities;

● To enable the students to pose the significant problems and air their views on them; and to enable them to accurately operate as required;

● To instantly practice and review what the students learned, such as the classroom-based test, quiz and so on;

● To generalize, reflect and improve what they have learnt.

The teaching effects

a．**The degree of targets' achievement**

● To see if the students have acquired the well-formed basic mathematical knowledge and developed some essential strategies in learning to how to learn and solve the mathematical problems.

● To see if they have demonstrated the experience of the positive emotion, which represents their eager, happy and skillful aptitude to learn the mathematical knowledge, and if they have developed the right values.

● To see if they have taken initiative to participate in the assessment of classroom teaching and dare to express their own opinions and make an inquiry about what they have learnt;

b. The flexibility in the problem solving

● To see if the students are able to flexibly and successfully solve the problems in the teaching tasks;

The Qualities of the mathematics teachers

● To see if the teachers can grasp the mathematical knowledge, ideas and methods, and attach the importance to the development and integration of the mathematics teaching resources;

● To see if they can possess the strong organizational and problem-solving abilities, the reformative and creative spirits, and the unique & favorable style of the teaching;

● To see if they can skillfully and by standard apply the modern teaching technology to the mathematics teaching at the right time and place;

● To see if they can employ the exact, refined and inspired language in the teaching practice, and if they can be a good drawer in the blackboard-writing and layout while teaching;

● To see if they can proficiently speak the standard Chinese mandarin;

● To see if they can respect the personality of students, create a lovely and ordered classroom climate, and keep the course of leaning flexible;

Selection of the methods of the mathematical classroom Teaching assessment for the senior high school

There are various kinds of the methods for evaluating mathematical classroom teaching for the senior high school, from which the most commonly used one is that after a lecture is attended, its overall assessment will be made, that is, pointing out the advantages and disadvantages, and making some suggestions for the improvement, of the classroom teaching. Moreover, there are several principal assessment methods including the scale assessment, the appraisement based on internet, the court-like argument, the behavior follow-up, the multi-factor comprehensive assessment, and so on. (Shen Yushun, 2006). Here in this paper, the discussion will focus only on the multi-factor comprehensive assessment method for classroom teaching (The Experiment Group of Qingpu Teaching Reform 1992) in Chinese senior high school.

The brief Introduction of Multi-Factor Comprehensive Assessment Method for Classroom Teaching

a. Attending a lecture and taking a note

To well assess a lecture, the attending teachers should be familiar with its contents and attentively listen to it. While listening, they should take detailed notes and write down the appraisal opinion to the lecture by applying some shorthand signs. Those notes should record not only the main teaching activities of the classroom teacher but the learning conditions of the students and the classroom teaching atmosphere as well, which can provide the real and reliable evidence of the analysis and appraisal of the lecture.

b. The appraisal meeting

After the lecture is finished, the attending teachers and the classroom teacher should make its complete recollection and overall analysis and hold the appraisal meeting in time. During the meeting, the classroom teacher will first make an analysis of the lecture by himself/herself, and all of them will then make a discussion, and air their opinion about it.

c. Marking by the Judges

Based on what they heard in the classroom and what its appraisal was, the judges will fix the value on every factor of appraisal to the lecture. Here, first of all, the remarks will be classified into following five groups according to the qualities or characteristics of the lecture: **excellent, good, fair, poor and bad,** which represent the degree of the remarks. And then the value will be ascertained to them respectively which can be in term of the traditional scaling methods to have each judge to first determine the group of remarks suitable to the lecture, then to collect the results from the enough number of the judges, and finally to fix the value on each group of the remarks by the frequency percentage. Considering that the number of special judges is not too many, the mental information of each judge should be demonstrated as thoroughly as possible. Otherwise, the other method called the class judgment multi-level measurement may be tried to fix the value on the group of the remarks, such a method will be briefly defined as follow:

● **Quantifying the degree of the Judges' Remarks**

To quantify the degree of the remarks pertaining to the lecture from score 0 to 10 based on the comparison of the judgment, and to score it by reference to the descriptive adverbs, the relationship between the description adverb and mark is as follows:

absolutely affirmative ------10 sores

much affirmative ------8 scores to 10 scores

mostly affirmative ------6 scores to 7 scores

Neither affirmative nor negative------5 scores

mostly negative- ------3 scores to 4 scores

much negative-------1 score to 2 scores

absolutely negative ------0 score

● **Marking the Remarks**

While marking, the judges can give the score of remark most suitable and closest to the degree chosen from the above-said five groups. Following this, the dual comparisons can be made between the neighboring groups to be marked. Likewise, the same procedures will be applied to all group judgment. So a certain group of score can be explained on the basis of the descriptive adverbs. For example, a certain judge might give the marks (6，9，3，1，0) for the degree of "the organizing capability"　(one of the appraisal factors). Then, score "6" indicates that he affirms very

much the teaching aims &demands (TAD) of the lecture defined as **"good"**; Score "9" shows that he is mostly affirmative about TAD rated as **"excellent"**; Score "3" and "1" make it clear that he is much or mostly negative about TAD classified as **"fair"** and **"poor"; and** Score "0" makes it know that he is absolutely negative about the group **"bad"**.

● **Normalizing the marks**

While normalizing all the above–said marks (6，9，3，1，0), they can be done as（.3158，.4737，.1579，.0526，.0000）. While there is more than one judge, each of them should first give the marks to the lecture in question, then normalize his own, and finally take the mean number from the normalized ones. One of the Marking Tables (**Table 1**) as follows:

Table 1:   Appraisal Factors' Scale

the appraisal factors				weight	the appraisal groups				
					Excellent	Good	Fair	Poor	Bad
100 scores	The behaviors of teacher (40 scores)	U1	The organizing capabilities	15					
		U2	The degree of focusing on the students' development	5					
		U3	The teaching attitude	5					
		U4	The teaching tact	5					
		U5	The teaching bourn	10					
	The behaviors of students (60 scores)	U6	The participative condition	14					
		U7	The emotion condition	10					
		U8	The communicative condition	14					
		U9	The thinking condition	12					
		U10	The psychological condition	10					

After having been scored according to the five groups of remarks, seven appraisal factors of the lecture can be arrayed as the matrix R of single appraisal factor. Therefore, we can figure out the matrixes of the four lectures (La, Lb, Lc and Ld) respectively, among which we attempt to make a comparison. Then, the matrix of lecture La **R(La)** is as follows,

$$R(La) = \begin{bmatrix} .1567 & .3601 & .3331 & .1241 & .0260 \\ .1436 & .3522 & .3601 & .1410 & .0031 \\ .2190 & .3559 & .2964 & .1098 & .0189 \\ .1443 & .3165 & .3466 & .1709 & .0217 \\ .1281 & .3112 & .3480 & .1673 & .0454 \\ .1060 & .2890 & .3306 & .2088 & .0656 \\ .1657 & .3370 & .3392 & .1364 & .0117 \\ .2500 & .3500 & .2000 & .1500 & .0500 \\ .2609 & .1739 & .3478 & .1739 & .0435 \\ .2692 & .1923 & .1538 & .3462 & .0385 \end{bmatrix}$$

Here, the matrixes of lecture **Lb R(Lb)** , **Lc(Lc),** and **L d(Ld)** are left out..

d. Data operation

If marking the weight distribution of each factor as "A", then the comprehensive appraisal of a lecture noted as "B" is
$B = A \bullet R$

In this formula, the inner product of A and R applies the general matrix multiplication operator, so,

$$B(La) = A \bullet R(La) = (.1563,.1875,.2188,.1563,.2188,.1563,.0781,.0787,.0781,.2344) \bullet \begin{bmatrix} .1567 & .3601 & .3331 & .1241 & .0260 \\ .1436 & .3522 & .3601 & .1410 & .0031 \\ .2190 & .3559 & .2964 & .1098 & .0189 \\ .1443 & .3165 & .3466 & .1709 & .0217 \\ .1281 & .3112 & ..3480 & .1673 & .0454 \\ .1060 & .2890 & .3306 & .2088 & .0656 \\ .1657 & .3370 & .3392 & .1364 & .0217 \\ .2500 & .3500 & .2000 & .1500 & .0500 \\ .2609 & .1739 & .3478 & .1739 & .0435 \\ .2692 & .1923 & .1538 & .3462 & .0385 \end{bmatrix}$$

$= (.2824 \ .4752 \ .4717 \ .2829 \ .0504)$

To easily reflect the results of comprehensive appraisal, the class matrix $C = (1, .75, .50, .25, 0)$ can be used to figure out the value of comprehensive appraisal of a lecture as "W" $W = B \bullet C^T$

(C^T is the transpose matrix of C)

So, $W(La) = B(La) \bullet C^T = (.2824,.4752,.4717,.2829,.0504) \bullet \begin{bmatrix} 1 \\ .75 \\ .50 \\ .25 \\ 0 \end{bmatrix} = .9454$

The value of comprehensive appraisal of Lb, Lc, Ld can be worked out in the same way,

$W(Lb) = .9708, W(Lc) = .8511, W(Lc) = .6340$

Known from the aforesaid operation as follows, $W = (A \bullet R) \bullet C^T$, the Matrix multiplication can satisfy the associative law, so $W = A \bullet (R \bullet C^T)$.

Note $D = R \bullet C^T$ $\quad D = \begin{bmatrix} d_1 \\ d_2 \\ \vdots \\ d_{10} \end{bmatrix}$.

Hereinto, $d_1, d_2, \ldots d_{10}$ denotes the value of appraisal of single factor.

Furthermore, known from the above-said, the comprehensive appraisal value of one lecture is actually the weighted mean of appraisal value of single factor.

$$D(La) = R(La) \bullet C^T = \begin{bmatrix} .1567 & .3601 & .3331 & .1241 & .0260 \\ .1436 & .3522 & .3601 & .1410 & .0031 \\ .2190 & .3559 & .2964 & .1098 & .0189 \\ .1443 & .3165 & .3466 & .1709 & .0217 \\ .1281 & .3112 & .3480 & .1673 & .0454 \\ .1060 & .2890 & .3306 & .2088 & .656 \\ .1657 & .3370 & .3392 & .1364 & .0217 \\ .2500 & .3500 & .2000 & .1500 & .0500 \\ .2609 & .1739 & .3478 & .1739 & .0435 \\ .2692 & .1923 & .1538 & .3462 & .0385 \end{bmatrix} \bullet \begin{bmatrix} 1 \\ .75 \\ .50 \\ .25 \\ 0 \end{bmatrix} = \begin{bmatrix} .6244 \\ .6231 \\ .6616 \\ .5977 \\ .5773 \\ .5403 \\ .6222 \\ .6500 \\ .6087 \\ .5769 \end{bmatrix}$$

Likewise, we can figure out the appraisal value matrix of single factor about Lb, Lc, Ld.

$$D(Lb) = \begin{bmatrix} .7307 \\ .6532 \\ .7024 \\ .6489 \\ .7326 \\ .6718 \\ .6057 \\ .6388 \\ .6388 \\ .6576 \end{bmatrix}, \quad D(Lc) = \begin{bmatrix} .6208 \\ .5984 \\ .6458 \\ .6912 \\ .5619 \\ .5804 \\ .4778 \\ .5937 \\ .4383 \\ .5313 \end{bmatrix}, \quad D(Ld) = \begin{bmatrix} .5445 \\ .5495 \\ .6398 \\ .5478 \\ .6803 \\ .6528 \\ .6224 \\ .6290 \\ .5972 \\ .6459 \end{bmatrix}$$

e. The judgment and analysis

Advantages

A reasonable judgment and analysis can be made from the marks by judges and the data operation on basis of the

appraisal meeting of a lecture.

Firstly, more than one lecture can be compared by the value of the comprehensive appraisal. For example, the above said lectures can be ordered by magnitude, that is $W(Lb) > W(La) > W(Lc) > W(Ld)$;

Secondly, by use of such a method, we can separately make the comparison between the comprehensive appraisal values of single factor of some lectures, which can help us to easily find out where the advantages and disadvantages of each lecture will be, to directionally accumulate the teaching experience and to improve the teaching practice. For instance, Lb is appraised as **"good"**, and especially good at "the organizing capabilities", but weak at "the emotion condition". "the thinking condition" of Lc is weak but leaves much to be desired. 'The organizing capability" of Ld is not well performed but well done at other factors.

Limitations

The method is applicable to the lectures among which there is much similar appraisal result of each factor, but not to those with several highly scored factors in the appraisal or those with much low scored in the important factors while other factors are classified as group "fair" (as above-mentioned Ld). That is because the weighted mean may balance these differences resulting in an unreasonable appraisal, but in another way, the above disadvantages can be made up by *the Ranking Judgment Appraisal Method*, which will later be introduced in detailed.

f. The comments

The multi-factor comprehensive assessment method for classroom teaching is a mode of the quantified appraisal of a lecture. The confirmation of the appraisal factor and its weight therein attaches a great importance to its appraisal. Certainly, they will vary with the regions, the times, the characteristics and personalities of the teachers and the students, the types of subject and the teaching perspectives. Therefore, how to obtain a relatively steady-going lecture appraisal requires the teachers' and the researchers' great efforts. And in the meantime, it is necessary for the judges to be professionally trained so as to render the judgment and evaluation more objective and accurate.

In addition, each appraisal factor can be further evaluated in the teaching research and practice from time to time. Here, any one of them can be divided into several sub-factors (refer to the following **Table 2**), which may be weighted in the same manner as mentioned above, and the overall assessment can then be made. Such a multi-level comprehensive assessment method for classroom teaching may enhance the accuracy of a lecture appraisal.

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Table 2: Appraisal Sub-factors' Scale

The appraisal factors		the appraisal sub-factors	weight	the appraisal groups				
				Excellent	Good	Fair	Poor	Bad
The behaviors of teacher in the classroom teaching (40 scores)	The teaching organizing capabilities (15 scores)	If or not fully organizing the teaching materials	5					
		If or not effectively organizing the teaching activities	6					
		If or not skillfully applying the teaching language	4					
	The degree of focusing on the students' development (5 scores)	If or not focusing on the students' mental development	3					
		If or not acquiring the timely feedback from the students' learning activities and making their adjustment	2					
	The teaching attitude (5 scores)	If or not showing the respect & creditability to the students	3					
		If or not making Inspiriting appraisal for the students' performance	2					
	The teaching tact (5 scores)	If or not making the flexible adjustment of the teaching process	3					
		If or not properly dealing with sudden event in teaching	2					
	The teaching bourn (10 scores)	If or not teaching the students in accordance with their aptitude and personalities	4					
		If or not enhancing the student's overall development	3					
		If or not enabling the students to develop by themselves in every respects	3					
The behaviors of students in the classroom teaching (60 scores)	The participative condition (14 scores)	the forms of students' participation in the learning and the teaching	4					
		To what extent of students' participating in the learning and the teaching both in and out of the classroom	10					
	The emotional condition (10 scores)	To what extent of the students' adapting to the teaching atmosphere	6					
		To what extent of self controlling and adjusting the attention and the emotion to the learning activities	4					
	The communicative condition (14 scores)	Communicative elements	6					
		To what extent of making effective cooperation	8					
	The thinking condition	If or not taking active thinking in learning	6					

		To what extent of the students' thinking development	6					
The psychological condition		If or not having sense of accomplishment	4					
(10 scores)		To what extent of making mental adjustment by the students	6					