Information

Purpose, Function and Types of Mathematics Assessment in China
A Historical Perspective[1]

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Abstract: This paper takes a historical perspective to review the development of assessment practice in China, which is outlined with a focus on the purpose and function of different assessment practices. Specifically, civil examination in imperial China served the purpose of selection and had the functions of directing and propelling educational activities. Various examinations used in modern China have kept the similar purpose as civil examination but changed in other ways. Several other assessment methods developed in modern China have shown more promise for improving mathematics education than examinations, but further efforts are needed for their development. The value of reviewing Chinese assessment practice historically is then addressed in an international context. The accomplishment of this review itself suggests that focusing on the purpose and function of an assessment is a feasible approach for reviewing assessment practice in other educational systems.

Kurzreferat: *Zweck, Funktion und Arten mathematischer Bewertung in China. Eine historische Betrachtung.* Der Beitrag gibt einen Überblick über die Entwicklung der Leistungsmessung in China unter historischen Gesichtspunkten, wobei der Schwerpunkt auf Zweck und Funktion verschiedener Bewertungspraktiken liegt. Insbesondere dienten staatliche Prüfungen im imperialistischen China der Auslese und sie hatten die Funktion, Aktivitäten im Bildungswesen zu lenken und zu fördern. Verschiedene Prüfungen im modernen China haben einen ähnlichen Zweck wie die staatlichen Prüfungen behalten, haben sich aber auf andere Weise geändert. Einige andere Bewertungsmethoden des modernen China scheinen im Hinblick auf eine Verbesserung des Mathematikunterrichts erfolgversprechender zu sein als Prüfungen; für ihre weitere Entwicklung besteht jedoch noch Forschungsbedarf. Diese historische Betrachtung der Leistungsmessung in China wird dann in einen internationalen Kontext gestellt. Die Ausführung der vorliegenden Arbeit selbst zeigt, dass die Hinterfragung von Zweck und Funktion einer Bewertung ein geeigneter Weg ist zur kritischen Betrachtung von Bewertungspraktiken in anderen Bildungssystemen.

ZDM-Classification: A30, D10, D60

1. Introduction

The importance of mathematics assessment has been extensively reflected in recent reform proposals and documents in school mathematics worldwide (Mathematical Science Education Board, 1995; National Council of Teachers of Mathematics, 1995; Niss, 1993). Specifically, many nations have recognized the needs of changing traditional assessment practice in contemporary school mathematics. In order to align assessment practice with the reform efforts in school mathematics, the ways in which mathematical assessment practice might be changed have been an important topic to ensure the success of current mathematical education reform in different countries. Because different nations have developed various assessment practices, each nation can serve as an interesting case for other nations to examine and to learn from its assessment practice (Niss, 1993). With the recognition of the long history of Chinese education and examination (see Franke, 1960; Galt, 1951), this paper aims to review assessment practice in school mathematics developed in China.

To review assessment practice developed in China, I focus on the purpose and function of different types of assessment practice. In particular, I specify the purpose and function of assessment practice to show the relationship between the intention and the effects of an assessment method as two sides of a coin. Such specifications aim to provide a better picture about different assessment practice in China. For example, the university entrance examination in China not only serves the purpose of selecting students for higher education, but also has various positive and negative effects, such as causing competition among students and possibly misguiding instructional efforts. The call for changing assessment practice in China indicates the gap between the purpose or function of present assessment practice and emerging educational needs. The distance between assessment practice and educational needs does not necessarily mean that Chinese educators should simply discard previous assessment practice due to some deficiencies or abuses, nor guarantee that they can find or generate a suitable assessment method with expected functions. Therefore, a focus on the changes in the purpose and function of assessment practice can help to illustrate the movement of Chinese assessment practice along with the development of Chinese mathematics education. Moreover, because the call for reform in assessment practice in many nations has arisen from the gap between what

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present assessment practice can serve and the needs emerging in current school mathematics, a focus on the purpose and function of assessment practice can also provide a suitable ground for cross-national learning of assessment practice.

In this paper, I take a historical perspective to review assessment practice developed in China. This perspective can help us to have a better understanding of the current state of mathematics assessment in the People's Republic of China (hereafter referred to as PRC). Such understanding can inform us about the possible advantages and disadvantages of Chinese mathematics assessment practice within its historical and cultural context. In recognizing that many countries are facing similar problems in improving assessment practice in mathematics education (Niss, 1993), such a comprehensive review of Chinese assessment practice related to school mathematics can provide an important case for mathematics educators in other countries, to reflect on their own practice in assessment. A historical review of assessment practice thus becomes important since the paper aims to present Chinese assessment practice in an international context. Although a specific assessment method can presumably serve the same purpose and carry the same function across nations, we should be aware that a nation's assessment practice is embedded in its specific historical and cultural context. Therefore, a specific assessment method may work well in one nation but not in others. How and to what extent educators in different nations can utilize such information may depend on how well the educators can re-situate assessment practice from one nation to another.

The history of China could be divided in different ways for different purposes. In a discussion of the educational history in China, many scholars, such as Borthwick (1983), Hu (1984), Wang (1992), Zhu & Monroe (1991), adopted a dichotomous division of the pre-modern and modern eras. In contrast to a common usage of "Modern China" as referring to the establishment of current PRC in 1949 (e.g., Zhu & Monroe, 1991), the dichotomy of pre-modern and modern eras of Chinese education in this paper is made in terms of educational reform. Dramatic changes in education happened when modern Western mathematics was broadly introduced into Chinese formal schooling at the beginning of this century (Li & Du, 1987; Wang, 1992). The changes in Chinese education history at that time were also closely related to the political upheavals of demolishing the last dynasty in Chinese history with the Republican revolution in 1911. Therefore, the term "pre-modern China" can be used interchangeably with "imperial China" (Hu, 1984). In the following sections, the development of Chinese assessment practice and school mathematics is reviewed and discussed along these two time periods.

2. Examination and school mathematics in pre-modern China

The predominant and well-known assessment in imperial China was the "civil service examination"[2], which served the purpose of selecting state officials through fair competitions in the form of taking examinations. The beginning of civil examination in China can be traced back to 2200 BC, and it was abandoned in China in 1905 (Franke, 1960). The long history of civil service examination exerted dramatic influence on Chinese people's life and people's respect of knowledge and education in imperial China.

2.1 The value of education in pre-modern China

The role of education in China has long been acknowledged as an important factor in forming the Chinese conception of living and reputation. As J. Leighton Stuart wrote in the Forward for Galt's book, *A History of Chinese Educational Institutions,* "The History of Chinese Education is almost the History of China. For perhaps in no other country has the educational process had such influence in shaping the national life" (Galt, 1951, p. ix). Because education in imperial China was a more important way of obtaining moral virtue and becoming government officials than by wealth, Chinese people developed a tradition of paying great respect to knowledge, teachers, and scholars. Respect for knowledge provided Chinese people with high motivation for being successful in education and permeated all levels of social classes in ancient China.

Perception of educational value in pre-modern China was further enhanced by an increasingly elaborate and strict system of civil service examination. As stated by Weber (1968), "for twelve centuries social rank in China has been determined more by qualification for office than by wealth. This qualification, in turn, has been determined by education, and especially by examination" (cited in Hu, 1984, p.7). Consequently, "studying hard and passing the civil examination" was gradually recognized by Chinese people as the way to obtain a better social-economic status. Therefore, to a great extent, civil service examination had a unique power of selecting state officials through fair competitions and propelled the development of Chinese education in imperial China.

2.2 The high-stakes civil examination in pre-modern China

Due to the fact that test results were used as the basis for making the selection of state officials, the most important characteristic of Chinese civil examination is its critical importance for selection purposes. Lee pointed out that in the history of Chinese education, especially started in the latter half of the Tang dynasty (618-907 AD):

> "The civil service examinations as a whole not only embodied the entrenched Chinese belief in the meritocratic principle, they also theoretically provided a chance for commoners to ascend in a society where there were few alternate routes to obtaining honor and privilege." (Lee, 1985, p. 13)

Moreover, because all examinees were required to go through the same test procedures for a specific group of civil service positions, the standardized format of civil examination had provided a feasible ground for fair competitions.

Meanwhile, the high-stakes nature of civil service examination had greatly influenced the purpose and con-

[2] The civil service examination is thought to be the origin of selection testing that thrived in Europe and the United States in the first half of the 20th century (Glaser & Silver, 1994).

tent requirements of imperial Chinese education as well as the way of teaching and learning in different time periods (Lee, 1985). Specifically, because the recitation of Saints' books was often the main and popular requirement in civil examination, memorizing Chinese classics, including mathematics, became routine in formal schooling for examination preparation in imperial China. Therefore, the high-stakes nature of civil service examination had actually directed all relevant education activities in formal schooling.

In summary, civil service examination served the purpose of "selection" and carried the functions of propelling and directing relevant education activities in imperial China. Their relationship can be summarized in Table 1.

Table 1:
The purpose and function of the civil service examination

Purpose	Function
Selection	Propelling/directing educational activities

2.3 The development of mathematical knowledge and skills in pre-modern China

Ancient Chinese mathematics was developed from the study of astronomy and from daily life. For example, the well-known book, *Nine Chapters on the Mathematical Art* (or *Jiuzhang suanshu,* 25-220 AD), was compiled with various word problems from the real world and the rules used to obtain these problems' solutions. There are a total of 246 problems organized into nine chapters with specific titles. For instances, Chapter One is entitled *Fang tian* (Field measurement), and Chapter Three is called *Cui fen* (Distribution by proportion). The following problem is a typical problem concerning "series" included in Chapter three:

"A girl skillful in weaving doubles the previous day's output of cloth. She produces five feet of cloth in five days. What is the result of the first day, and successive days, respectively?" (Swetz, 1972)

If we represent the problem's quantitative relationship with an unknown, as is done today, the problem can be transformed into solving "$x+2x+4x+8x+16x=5$" for the value of "x". The form of problem-and-solution used in this book is essentially an inductive approach and historically has "an immense influence on later mathematical works in China" (Li & Du, 1987, p. 33).

Moreover, ancient Chinese mathematics had developed its own representational system and methods and had a great influence on several nations in East Asia. As indicated by Martzloff, traditional mathematics of imperial China constitutes:

"A typically Chinese traditional science relying almost wholly on algorithmic or algebraic rules rather than on logico-deductive reasoning. The language in which these mathematics was expressed – Classical Chinese – was understood everywhere in the sinicized world, and for this reason Korean, Japanese, Tibetan, Vietnamese and Mongol mathematics have been strongly influenced by it." (Martzloff, 1994, p. 93)

2.4 The status and requirements of mathematics in civil examination in pre-modern China

Although ancient Chinese mathematics had dramatic development and earned international reputation in certain periods, the status and requirements of mathematics in formal schooling and civil examination in imperial China were totally different from the prominent achievement and practical nature of ancient Chinese mathematics. The status of school mathematics in imperial Chinese education did not have the importance that school mathematics has in modern Chinese education.

Basically, in formal schooling, educational focus was directed by examination requirement in ancient China. As Hu wrote:

"The writing of examination essays became almost the exclusive concern of all who had reached the tertiary level of formal education, and collected essays by successful candidates in previous examinations, appearing in ever increasing volume and variety, formed the single most important body of literature for all aspiring scholars." (Hu, 1984, p. 12)

The concentration on literature in civil examination reflected the perceived importance of moral superiority and virtue in formal schooling and in selecting state officials, whereas, practical knowledge and skills were treated as incompatible for fostering moral superiority. Specifically, "arithmetic had been scorned as belonging to shopkeepers, ... " (Hu, 1984, p. 20). Therefore, mathematics was not an important or even necessary subject in pre-modern Chinese education history despite the existence of the civil service examination.

The specific requirements of school mathematics in formal schooling and civil examination varied across the long history of imperial China. For example, during the Sui (581-618 AD) and the Tang (618-907 AD) dynasties, only a few state officials were trained and selected with special expertise in mathematics. They were minor clerks in civil service positions related to taxes, astronomy, or civil engineering (Jami, 1994). In the Song dynasty (960-1279 AD), mathematics was not a subject required in regular civil examinations (Lee, 1985). However, mathematics had been a popular subject in schooling since the late Ming dynasty (1368-1644 AD) (Jami, 1994).

The above discussion has shown the insignificant status of mathematics and its varied requirements in selecting state officials in pre-modern China. The civil mathematics test, when it was existed in different periods, served the same purpose of selection and had the same function of directing students' learning as other examinations. However, the status and requirements of mathematics in civil service examination did not propel the development of mathematics learning in formal schooling and the development of ancient Chinese mathematics. The purpose and function of civil mathematics test can be summarized in Table 2.

Table 2:
The purpose and function of the civil mathematics test

Purpose	Function
Selection	Directing mathematics learning activities

3. The development of assessment practice and school mathematics in modern China

3.1 The high-stakes examinations, school mathematics, and their relationship in modern China

3.1.1 A brief historical account of the high-stakes examinations used in modern China

Throughout Chinese history, the civil examination had unique importance through fair competition in selecting state officials. The practice of high-stakes examinations has been retained in modern China, but is found in school education rather than in the civil service system. Specifically, the "selective" function has been kept in high-stakes examinations that continue to influence Chinese education and people's lives in a fundamental way. In contrast to the civil examination in pre-modern China that was used to select state officials, high-stakes examinations in modern Chinese education have been used in differentiating and selecting students for further learning opportunities.

Because higher education was in the stage of establishment in modern China before 1949 and its accessibility to the masses was limited (Du, 1992; Gu, 1984), high-stakes school entrance examinations were enforced sometime in late 1920s and early 1930s (Du, 1992) but did not become an issue to the public before Mao's era (1949-1976). After the success of Mao's revolution in 1949, mass education was greatly developed at the elementary level. Because mass education at the elementary school level did not mean equal opportunities for all students at the higher levels of education, entrance examinations were used to determine which students could enter the higher levels of education. The competition among students was tight. Now, there are entrance examinations for high schools and for colleges or universities. There are also mid-term and final examinations in ordinary school semesters. A detailed discussion about these examinations is given in later sections.

Although school entrance examinations in modern China and civil service examination in imperial China share similar purpose of "selection" and similar function in "guiding" classroom instruction (see above Table 1), there are some important differences between them, such as who is able to take the examinations and the content of examinations. In imperial China, although civil examination was open to everybody, the cost of education and of taking tests naturally limited the scope of candidates. Whereas in modern China after 1949, education opportunity has been provided free to all children at eligible ages. All students can take entrance examinations for getting higher education. Moreover, the content and requirements of the examinations are also different. For example, in imperial China, mathematics was a minor subject in formal schooling and civil examination; whereas in modern China, mathematics is a major subject required in formal schooling and entrance examinations.

3.1.2 The status, content, and requirements of school mathematics in modern China

Changes in school mathematics happened with the introduction of Western mathematics into China. The first wave of introduction can be traced back to the end of the sixteenth century, when Western missionaries came to China and brought in Western mathematics and science for fulfilling their religious purposes (Li & Du, 1987). Some important Western mathematical knowledge and skills, such as *Elements of Geometry,* trigonometry, and calculations using pen and paper, were introduced in China. However, Western mathematics did not have tremendous influence on Chinese mathematics and schooling until the second wave of Western influence that happened in the nineteenth century. The second wave of Western mathematics introduction was accompanied by the establishment of new types of schools and the translations of Western mathematics textbooks. Such Westernized movement expanded in China at the beginning of the twentieth century.

With the changes in Chinese schooling and the uses of translated Western mathematics textbooks, the status, content and requirements of school mathematics in Chinese education started a new era. Mathematics became an important subject to all students in new schools, and the symbol system and recording format from Western mathematics were adopted. As described by Li & Du (1987), "the textbooks used in the various kinds of Western school [in China] were changed again and again until finally there was essentially no difference between them and the mathematical textbooks used all over the world" (p. 256, square brackets added). Before China started to build up a complete system in mathematics education with its own character in the early 1960s (Zhang, 1992), the content and requirements in Chinese school mathematics textbooks were basically presented and organized with a model taken directly from other countries.

3.1.3 The relationship between school mathematics curriculum and examinations in modern China after the 1960s

In PRC after the 1960s, especially since the 1980s, the Ministry of Education developed a national mathematics syllabus that serves as a national guideline for various aspects of school mathematics, including the curriculum materials, instructional activities, and assessment practice. In general, curriculum development and classroom teaching are based on the requirements stated in the national Syllabus. Examinations, which are used to select students for higher levels of education or provide feedback about students' learning and teachers' teaching, have been guided by the national Syllabus. In particular, the National University Entrance Examination (hereafter referred to as NUEE) in China also follows the content scope and requirements specified in the Syllabus.

Consequently, school mathematics instruction and examinations in contemporary China have been aligned under the national Syllabus. The development and use of the national Syllabus make educational expectation and requirements virtually stable. In comparison, requirements for civil examination in imperial China were unclear in advance of the examination. Therefore, the relationships between what might be learned from curriculum materials and what would be tested in examinations present two different pictures through comparing the practice in modern China with that in imperial China.

3.2 Various types of assessment practice used in school mathematics in modern China

Because examination is the dominant way to assess the outcomes of students' learning and teacher's teaching in Chinese mathematics education, some educators, such as Lee & Zhang (1991), claimed that there exists an "examination culture" in Chinese education. The following sections will discuss several types of examinations and instructional assessment that are developed and used in current Chinese education system for different purposes.

3.2.1 School entrance examinations

China is a developing country. The limited resources for all people to obtain higher education require the educational system to have a certain means of selection. The extreme power of entrance examinations has been accepted by the Chinese education system after 1978 since it is believed that examinations ensure a fair competition. Mathematics, as a basic subject in Chinese education, is required for all students throughout their schooling and in all school entrance examinations.

The entrance examinations for high schools are usually conducted at a county or city level. Students can take these examinations for entering key schools[3] when they graduate. In general, students are divided geographically at either county/city level or the level of districts within a county/city. Different schools have a different admission score line for accepting new students based on their student resources and the schools' reputations.

The only entrance examination at the national level is the NUEE (i.e., National University Entrance Examination). In order to give a better direction for developing and administering the NUEE, the Chinese State Education Commission published a *Directions* in 1991 to describe the content, format, and structure of the NUEE. In general, the *Directions* matches the national Syllabus in terms of mathematics content coverage and the cognitive requirements for developing students' abilities. For example, college-bounded students are divided into two streams, i.e., (a) students toward humanity- and social-oriented major, and (b) students toward scientific- and technological-oriented major, and there are some differences in mathematics requirements in the NUEE for students in these two streams. The differences in the NUEE are consistent with the different requirements envisioned in the mathematics Syllabus. Specifically, the requirements for the students in the first stream are the basic mathematics requirements for all high school students, whereas the requirements for the students in the second stream are the advanced mathematics requirements for high school students.

In addition to the same intended content coverage and emphasis between curriculum and the NUEE, the *Directions* also provides further specifications about the types of problems that may be used in the NUEE and related problem difficulties. There are three types of problems given in the *Directions,* that is, "Multiple-choice" ($\sim$ 45%, in terms of point proportion), "Fill-in-the-blank" ($\sim$ 15%, in terms of point proportion) and "Problem-solving" ($\sim$ 40%, in terms of point proportion). Different types of problems are assumed to have different functions in assessing students' mathematics competency. In the category of "Problem solving", for example, students are asked to write down the procedures of their solutions or proofs that is not required in solving Multiple-choice problems. Students can get credit for each step in solving these problems. Some examples are also given in the *Directions* to illustrate the three types of problems with an indication of each problem's difficulty. As a matter of fact, the problems suggested for use in the NUEE are also similar to the problems presented in mathematics textbooks in terms of their forms and structures.

The above discussion shows that school mathematics curriculum and school entrance examinations in PRC are intended to be aligned, under the guidance of the national Syllabus for all grade-level students, in terms of content topic coverage, requirements, and performance expectations. Such alignments are envisioned in the content requirement and mathematical problems under consideration. Therefore, although entrance examinations still serve the purpose of "selection", they carry the function of assessing the outcomes of teaching and learning school mathematics. This function was not carried by civil service examination in imperial China. Specifically, many educational administrators and the public in contemporary China often use students' marks and the proportion of students who pass entrance examinations to evaluate the quality of a school and classroom instruction (e.g., Wang, 1992).

Undoubtedly, the pressure from these high-stakes entrance examinations has put a heavy load on teachers and students through all grade levels, especially for students and teacher at the grade level that precedes the next higher level of schooling. Struggling to get "high marks" and "high rate of passing" in entrance examinations has grabbed teachers' and students' attention and required their efforts throughout all levels in Chinese education system. Specifically, "studying for examinations" has become a popular phenomenon in contemporary Chinese education. Therefore, current entrance examinations also carry the function of "directing" school mathematics instruction efforts. However, as compared to the case in imperial China, the directive effects of the high-stakes examinations on mathematics instruction in modern China have been much constrained under the national Syllabus. In summary, the purpose and function of school entrance examinations in modern China can be summarized in the following Table 3.

Table 3:
The purpose and function of school entrance examinations

Purpose	Function
Selection	Assessing mathematics instruction, directing/guiding mathematics instruction

[3]Key schools are the schools that are perceived by the public to offer a high quality education and to be more selective in admission.

3.2.2 Examinations used in regular school studies

To ensure students' mathematics attainment through day-to-day classroom instruction, mathematics teachers often make their own decisions in generating and administering chapter tests or quizzes. These tests are often closely related to what teachers have taught in their mathematics classrooms. Such tests are also aimed to reinforce what was taught in the past chapter and have little weight on students' final grades for the term. Comparatively, the mid-term examination is more regularly scheduled and has a heavier influence in determining students' term grades. The final examination is often the most important examination in a school term for all students.

The final examination at the end of a school year also serves the purpose of determining whether a student is eligible for promotion to the next higher grade level. Students who pass the exam will be promoted to the next higher grade. The final examination at the end of the third year of middle school or the third year of high school is also treated as graduation examination. Those who pass the exam are eligible for graduation and promotion. Those who have not passed the exam must take and pass a make-up examination before graduation. Students' performances in these various examinations are usually used as definite evidence in determining their success or failure in formal schooling.

Therefore, the examinations used in regular school studies often carry the purpose of "grading" or "judging" students' learning and have the function of "assessing" students' learning. Through these examinations, teachers know how well each individual student has learned, make judgments about students' learning, and plan for further instruction. Moreover, such examinations also affect students' attitude and motivation in their further mathematics learning. The purpose and function of classroom examinations can be summarized in the following Table 4.

Table 4:
The purpose and function of classroom examinations

Purpose	Function
Grading / judging	Assessing students' learning, affecting students' learning

3.2.3 Mathematics competitions

Although mathematics competitions are not a regular part of school mathematics in modern China, they do have some significant effect on Chinese mathematics education. In many schools, there are after-school mathematics interest groups at different grade levels especially beyond elementary school level. These mathematics interest groups of students are volunteer groups and are selected and organized by students' mathematics teachers. One time per week or once every other week, the mathematics teacher will organize these students together for tutoring on advanced mathematical topics, such as number theory. Students' performance in several different mathematics competitions is often taken by the public and educational community as one of the indicators of the success in mathematics instruction in a certain school. There are various mathematics competitions organized at different levels like a school, county, or province. Specifically, there are three nationwide mathematics competitions: Hua Luogeng Golden Cup Competition (ages 11–13), Junior School Mathematics Competition (age 13–15), and Senior School Mathematics Competition (ages 16-18). As indicated by Zhang (1992), about 15% of all Chinese students at relevant grade levels take part in various mathematics competitions, and about 30,000 students participate in each of the three nationwide mathematics competitions.

Since 1986, China has participated in the International Mathematics Olympiads (IMO) and made great successes in this international mathematics competition (Wang, 1992). Such results have fired the enthusiasm of both students and mathematics educators in China. It is believed by the public and many mathematics educators in China that these successes indicate the healthy development of mathematics education in the nation (Wang, 1992; Zhang, 1992).

Apparently, mathematics competitions not only serve the purpose of "competition" but have also functioned to promote students' interest in learning mathematics (see Table 5). With massive student participation in various mathematics competitions and their successes in different mathematics competitions, mathematics competitions in China have been significant in the development of people's value and interest in learning school mathematics.

Table 5:
The purpose and function of mathematics competitions

Purpose	Function
Competition	Promoting students' interest in learning school mathematics

3.2.4 Instructional assessment

With an awareness of the functions of assessment in improving mathematics instruction, some mathematics educators in China have tried to make use of assessment as a vehicle for improving mathematics teaching and learning (e.g., Wei & Zhang, 1993; Cheng & Lu, 1993). These exploratory efforts have fundamental differences as compared to the purposes and functions of the various examinations mentioned above. Basically, these assessment methods were developed upon some specific educational or assessment theories and combined with teacher's instructional practice. They differ from the traditional uses of mark-dominated examination practice.

Wei and Zhang (1993) have presented an innovative project using assessment to improve mathematics teaching at Fuxin city, Liaoning province, PRC. The teaching process has been characterized as consisting of (a) objectives of teaching and learning, (b) content of teaching and learning, (c) methods or ways of teaching and learning, and (d) results of teaching and learning. Assessment was viewed as including aim, measurement, and evaluation. It was believed that assessment can and should be integrated into each step in the teaching process to improve teaching and learning through obtaining feedback and regulation. Specifically, because the teaching objectives are one of the basic variables that can be used to assess the effectiveness of teaching process, the researchers identified and classified teaching objectives into "types" and "levels" to describe and measure teaching objectives more accurately.

To serve different purposes at different times in teaching activities, several types of assessment methods, such as pre-test(s), on-going assessment of class instructional process, assessment focusing on individual units, and summative assessment on students' learning outcomes, were adopted. Besides assessment in the cognitive domain, assessment in the affective domain has also been used to explore changes in students' attitudes, study habits, etc. Moreover, the relationship between students' achievement and teacher's teaching is also evaluated. To assess the complex teaching process, they suggested that various assessment methods need to be combined appropriately in this process. "In a word, assessment of the teaching process is for improving and developing teaching practices, and centers around the accomplishment of the teaching objectives." (Wei & Zhang, 1993, p. 190).

Cheng and Lu's paper (1993) presents their considerations and practices of mathematics assessments for improving mathematics teaching and learning. Based on a conception of "finding problems from reality, inventing alternative ways of measurement for solution, and applying these alternative ways of measurements back to reality", they adopted a process of "sampling-surveying-summarizing-revising-complementing-perfecting-popularizing" to improve assessment practice for solving "problems" in the reality of educational practice. In particular, a three dimensional model of assessment was developed from their practices, which includes subject (self assessment, peer assessment, teacher-centered assessment), domain (cognitive domain, affective domain), and type (diagnostic assessment, formative assessment, summative assessment). Through training teachers to use assessment methods and getting students involved into assessment practice, their trials have resulted in three changes, that is, "Teachers have moved from mark-domination into objective management, from emphasizing only teaching to both teaching and learning, and from final-examination feedback into a frequent and timely three-dimensional form of feedback" (Cheng & Lu, 1993, p. 201).

The instructional assessment methods discussed above are examples of exploratory efforts in changing the previously dominant practice of examinations in China. Although such exploratory efforts are still in need of further study and improvement, they do show some considerations that Chinese mathematics educators have made in terms of the purpose and function of assessment practice and the relationships between assessment and instructional practice. The purpose and function of these assessment practices can be summarized in Table 6. In many ways, these trials share similarities with reform efforts in changing assessment practice in other nations. However, with the long history of examination practice in China, there is a long way to go before such assessment practice can become popular in China.

Table 6:
The purpose and function of instructional assessment

Purpose	Function
Assessment/improvement of mathematical instruction	Improving mathematical teaching and learning

3.2.5 The nationwide survey of mathematical teaching and learning

There is no nationwide assessment tool in China to measure students' educational achievement periodically, as does National Assessment of Educational Progress (NAEP) in the United States. In 1987, a nationwide survey of mathematics teaching and learning was carried out as part of the survey that included three school subjects (Chinese language, Mathematics, and English language). Approximately 3,000 teachers and 50,000 students at grade nine (0.4% of all students nationwide at this grade level) from about 600 middle schools in fifteen provinces participated in the mathematics survey (Tian, 1990). The purpose of this survey was to gather data for investigating the current state of mathematics education at grade nine and to provide possible suggestions to policy makers for improving mathematics teaching and learning. The assessment of students' mathematical achievement was one of the main components in this comprehensive study.

There were several main considerations in designing the tests used in the survey, which included (a) the alignment between tests and the requirements given in mathematics Syllabus, (b) the coverage of about 1/3 to 2/3 of the basic mathematics knowledge taught in middle school, (c) the similar weights between the percentage of points assigned to different test items and the percentage of instructional time devoted to teaching corresponding content areas, (d) the differentiation in test items' difficulties, (e) the order of test items in terms of their difficulties, and (f) the inclusion of mathematical problems from the real world. Specifically, the test included two parts:

Part I (60 minutes, 100 points in total, including 30 fill-in-blank items and 10 multiple-choice items). The aim of this part of the test was to assess students' mastery of basic knowledge and skills.

Part II (100 minutes, 100 points in total, including 10 problem-solving items). The aim of this part of the test was to assess students' ability of analyzing and solving mathematical problems.

The results showed that

– most Chinese ninth graders performed well in solving problems in part I.
– many students performed either well or very poorly in solving the problems in part II.

This survey also showed some interesting results that were previously unknown to Chinese mathematics educators. For example, the average score in geometry for all surveyed students was higher than their average score in algebra. Moreover, the average score of the students from rural schools was higher than the average score of the students from schools in urban or town areas. Such results are in contrast to people's common perceptions.

Although the first nationwide survey of mathematical teaching and learning served the purpose of assessing the current conditions of mathematics instruction, the results are very useful to educational policy makers. Similar to the NAEP in the United States, the survey had the functions of diagnosing and improving mathematical instruction in China (see Table 7).

Table 7:
The purpose and function of the national survey in Mathematics

Purpose	Function
Assessment of mathematical teaching and learning	Diagnosis and improvement of mathematical instruction

4. Summary: The purpose and function of assessment practice in China

Table 8 summarizes the purposes and functions of different assessment practice discussed in this paper. As shown in this table, the first four types of examinations all served the purpose of differentiating individual person's academic competency (i.e., for selection or grading). Their functions have been developed from mainly directing educational activities in imperial China to assessing instructional efficiency in modern China. However, such development did not eliminate the examination function of "directing mathematical teaching and learning", which might be a positive effect in imperial China but unlikely a favorable effect in modern Chinese education. The bottom three types of assessment practice in modern China have different purposes and functions. Although they are relatively new endeavors in Chinese education, they presented more positive effects than examinations for improving Chinese mathematics education.

Table 8:
The purpose and function of different assessment practice in China

		Purpose	Function
Imperial China	Civil service examination	Selection	Propelling/directing educational activities
	Civil mathematics test	Selection	Directing mathematical learning activities
Modern China	School entrance examinations	Selection	Assessing mathematical instruction, directing/guiding mathematical intruction
	Classroom examinations	Grading/judging	Assessment of students' learning, affecting students' learning
	Mathematics competitions	Competition	Promoting students' interest in learning school mathematics
	Instructional assessment	Assessment/improvement of mathematical instruction	Improving mathematical teaching and learning
	National survey in mathematics	Assessment of mathematical teaching and learning	Diagnosis and improvement of mathematical instruction

5. Final remarks

The above review has outlined the historical development of Chinese mathematics assessment practice. In particular, the specifications on the purposes and functions of different assessment practices highlighted their differences and changes. As an interesting case in the international context, Chinese assessment practice shows us something important, something worth thinking about, and something problematic. With the spirit of exchanging valuable experiences across nations, the purpose of the paper is reached if it helps mathematics educators learn about Chinese assessment practice in mathematics and reflect on their own assessment practice.

Some assessment practices in China may work well in its specific cultural context, but not in other educational systems. For example, mathematics competitions can involve many students and have significant effects in promoting their interest in learning mathematics. Such effects may not be available in the United States due to different cultural emphasis on learning mathematics. Moreover, studying hard and passing examinations have been taken by Chinese people as a natural way to get a better education, which may not be true in other educational systems.

The dominant type of assessment practice developed and used in China is examination. Similar to the purpose of civil service examination in imperial China, entrance examinations are adopted as a fair means for selection in contemporary China. The use of the entrance examinations certainly provides a basis for comparison and then selection of students. However, it can also embody some drawbacks. In particular, because students' results from taking the entrance examinations are often used as the only criteria for selection, it can be questioned whether examinations are good enough to serve the purpose of selection. Relevant questions can include "what should and can be counted as the basis for selection?" and "how to count it?" In fact, such questions once emerged in China in the 1960s when the competition for higher education became tight between students from former poor families and ones from the former upper and middle classes. The criteria for university admissions even became the Party leaders' argument at that time. The debate over admission criteria was ended in 1966 by Mao's decree on the abolition of the university entrance examination, which had been implemented for ten years since then (Unger, 1984). The replacement of entrance examination with a combination of recommendation and selection from 1966 to 1976 clearly was due to some political considerations other than educational development. Since 1976, the political changes in China have helped to resume the pursuit of educational development and formal procedures for entrance examinations. However, the resumed use of entrance examinations does not automatically resolve the questions stated above. As a matter of fact, because the en-

trance examination serves as only one of possible means, the questions stated above also remain to be answered in many other education systems where entrance examinations may or may not be used.

There are also many limitations in Chinese assessment practice. For example, there are few efforts to evaluate mathematical teaching except by examining students' learning outcomes. Although relating teaching and students' achievement is not inappropriate in itself, it may be inappropriate to use students' test results as the only information resource to evaluate instructional quality. The limited information resource makes the evaluation of mathematical teaching questionable. Consequently, the examinations can easily mislead mathematics instruction in classroom. As addressed by Silver & Kenney (1995), various sources of assessment information are needed for improving mathematics instruction. Although some educators realized that assessment should and can serve more purposes than "grading" or "selecting" students (e.g., Wei & Zhang, 1993; Cheng & Lu, 1993), further efforts are dramatically needed to develop assessment practice to obtain more evaluative information for improving mathematical instruction.

Finally, a focus on the changes in the purposes and functions of Chinese assessment practice, as presented in this paper, has illustrated the historical development of Chinese assessment practice. The accomplishment of this review itself suggests that focusing on the purpose and function of an assessment is a feasible approach for reviewing assessment practice in other educational systems.

6. References

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