

From “Two Basics” to “Four Basics” in Chinese Mathematics Curriculum Standards: Development, Reflection and Prospects

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Abstract: This paper is an attempt to trace the route of changes from the “Two Basics” to the “Four Basics” in the Chinese context of mathematics curriculum reform. These obvious changes in the new curriculum standards orient the development of mathematics education in a new era. “Four Basics” contain very rich connotations and it reflects the “top-to-bottom” model of the national concern about what is the value of education and mathematics as a very important subject. These changes also relate to the methods to be used to fulfill the educational purpose; that is, how to foster the development of students in this globalized and knowledge-based society.

Keywords: Two Basics, Four Basics, Mathematics Curriculum Standards, Key Competencies

1. Introduction

Cross-national studies, such as the large-scale (e.g. FIMS, SIMS, TIMSS, IAEP and PISA) and small-scale, in-depth studies (e.g. Cai & Lester, 2005; Clarke, Keite, & Shimizu, 2006; Geary, Bow-Thomas, Liu, & Siegler, 1996), provided sufficient evidence showing that Chinese students from mainland China, Hong Kong, and Taiwan, are better performers on tasks measuring basic mathematical knowledge and skills in mathematics (Cai & Nie, 2007). The principle of basic knowledge and basic skills (Two Basics) is most typically observed in mainland China (Zhang, Li & Tang, 2004). Actually, the emphasis on building a solid foundation for mathematics education has a deep root in traditional Chinese culture (Rong, T., & Wei, S., 2010; Zhang, Li, & Tang, 2003).

After a decade of the new century’s implementation and practice, the revision of the 2001 Curriculum Standards documents, is expanded not only from the basic look, but also with greater adjustments, changes, and amendments to the various parts of the curriculum standards. On December 28, 2011, the Ministry of Education promulgated National Curriculum Standards of Mathematics for Basic Education (2011 Edition) (hereinafter referred to as the Curriculum

Standards). The most obvious changes are from the “Two Basics” to the “Four Basics” curriculum objectives initiatives (Stephens & Xu, 2014). Specifically, the changes are extended from the development of basic knowledge and basic skills to the “basic ideas” and the “basic experience acquired through mathematical activities”. Furthermore, it puts forward the integration of mathematical literacy with “Four Basics”, which can be clearly reflected in the Curriculum Standards (2011) effort “to master the basic mathematical knowledge, to train the basic mathematical skills, to understand the basic mathematical ideas, and to accumulate the experience acquired through mathematical activities” (Ministry of Education, 2011, p. 8). Definitely, these changes put forward higher requirements for mathematics teachers. The changes require that mathematics teachers should provide the essential basic mathematical foundations for students’ learning and developmental direction, mathematical preparation and personal development. In short, they should try their best to promote the students’ overall and sound development. This serves the rationale of the Curriculum Standards (2011), which aims that “everyone acquires good mathematical education, and different students get different development in mathematics learning” (Ministry of Education, 2011, p. 2). This rationale of the curriculum emphasizes the place of

mathematics education, which is dedicated to the goals of compulsory education, open to all students and adapted to the needs of students' personality development. The basic function of compulsory education is to let children of the right age acquire a good education and do essential preparation for becoming future qualified citizens. It is very obvious that the most important value of the compulsory mathematics education lies in the development of students' key competencies (or 21st century competencies) through mathematic learning (Stephens & Xu, 2014). Good mathematics education consists of not only making students understand and utilize some mathematical concepts (and master some methods), but more importantly letting them learn some basic mathematical ideas, accumulate some experience through mathematical thinking, and participate in practical activities.

In order to better grasp these changes, some issues need to be considered about why the discourse of the "Two Basics" was further developed to the "Four Basics" in the update of the *Curriculum Standards (2011)*? What is the background for making these big changes? What is the connotation and denotation of the "Four Basics"? What is the significance of the "four basics" for fostering talents and developing key competencies in the Chinese context of basic mathematics education?

2. The Developmental Track from "Two Basics" Toward "Four Basics"

The "Two Basics" Mathematics Education in China has borne the time-honoured tradition formed for many years (Zhang, Li, & Tang, 2004). It also has the most representative features to enhance "Two Basics" in mathematics curriculum and instruction, which stresses the development of students' very good mathematical foundations in classroom teaching, and this is also the symbols of excellent achievement in mathematics learning. However, with the development of society, especially the rapid growth of human knowledge, it is very clear that only concentrating on the "Two Basics" has been unable to meet the developments of the society, and that further developments must be made on "Two Basics". In the 1980's, the mathematics education circle had been exploring mathematics curriculum and instruction reform on how to strengthen the fostering of students' capabilities, how to focus on the non-intelligence factors and how to cultivate students' sense of innovation and practical abilities (Gu, 2001). Looking through the *Curriculum Reform Guidelines for Nine-year Compulsory Education*, which was issued by the Ministry of Education in June 6, 2001, we see that it regulated a three-dimensional objective to which the overall curriculum should be attained (that is, knowledge and skills, processes and methods, as well as affective demeanour and value). Therefore, as an initiative and guideline for curriculum reform, the curriculum goals for compulsory mathematics should be in accordance with the above three-dimensional objectives. At the same time, it should be more specific and combined with

the nature of mathematics.

2.1. The "Two Basics" in the Past and Expectations in the Future

In the past, whenever the "Two Basics" were mentioned in mathematics education, it usually referred to basic mathematics knowledge and skills. Basic mathematics knowledge includes mathematical concepts, features, rules, formulas, axioms, theorems, and their embedded mathematical ideas and methods. Basic mathematics skills refer to computation, data processing (including the use of calculators), simple reasoning, drawing and making tables and figures (Ministry of Education, 2001), which are conducted in certain steps. The "Two Basics" teaching is defined as the teaching activity during which teachers help students learn and grasp the "Two Basics". Nevertheless, the conception of the "Two Basics" was always developing and extending. Basic knowledge was defined in the *Curriculum Standards (2001)* as the mathematical basic concepts, formulas, nature, axioms, theorems and mathematical ideas and methods, which are reflected in the curriculum contents. The basic skills refer to the conducting of the computation, drawing and simple reasoning. Therefore, it is obvious now that the definition of "Two Basics" is closely related to thinking, computation abilities, and space conception.

In the era of knowledge explosion, for some mathematics content, "Two Basics," such as complex calculations and the minutiae of proof techniques, need to be deleted. As for estimates, algorithms, number sense, symbols awareness, collection and processing of data, basic probability, statistics, and mathematical modelling, they should be further promoted. This is what we call "going with the times" for the "Two Basics" contents of mathematics.

2.2. Reasons for the Expanding of "Two Basics"

As the development of the times and the imperatives of mathematics curriculum itself, "Two Basics" are obviously not enough to meet the requirements. It appears that a new set of "Two Basics" needs to be formed. To be more specific, we need to dig into the reasons why another "Two Basics" need to be added. There are several reasons. The first reason is that considering three-dimensional objectives in the *Curriculum Reform Guidelines for the Nine-year Compulsory Education*, "Two Basics" is only involved with the first objective, the knowledge and skills. Whereas initiative of another "Two Basics" is closely related to the other two objectives: process and methods, affective demeanor and value. Second, in reality, some teachers sometimes partially understand the "Two Basics", that is they often pay more attention to the basis in the curriculum implementation, and neglect students' actualities. Education must be student-oriented and designed for students' overall development, and the new basics of mathematical thinking and experience through activities directly related to students, also are in line with the concept and reform orientation of enhancing "quality education". Third, the current "Two Basics" are also unable to cultivate full

innovative talents, and they are used just as a foundation to cultivate such innovative talents. Therefore, it requires that a student should not only master the knowledge and skills, but also that they need to develop mathematical ideas and experience in activities. It is the requirements for the multi-dimensional mathematics educational objectives that shift students from the “Two Basics” to the “Four Basics”. The cultivation of knowledge and skills is part of the overall mathematics education goals, which is usually recognized, measurable and easy to operate. People usually focus on the so-called knowledge, and emphasize the training of skills in mathematics teaching and assessment. Equally, as is often the case, assessments tend to concentrate on the performance of students’ mathematics knowledge and skills, but neglect the other aspects. Nevertheless, apart from knowledge and skills, mathematical goals include developing students’ diversified capabilities such as mastering mathematical ideas, accumulating experiences through participating activities, and fostering affective demeanour and attitudes. Therefore, it is not enough to stress only on knowledge and skills. At the same time, the other aspects of mathematical literacy are also included, such as basic ideas and basic experience acquired through activities, which constitute the most important parts of students’ mathematical literacy.

3. Integrating “Four Basics” into Key Competencies of Mathematics

3.1. About Mathematical Ideas

Mathematical ideas are the essence of mathematics curriculum and instruction, and are fundamental for students’ development as well. Basic mathematical ideas should be connected with the process of mathematics learning. Equipping students with basic mathematical ideas should be regarded as one of the main goals of mathematics curriculum. Mathematics curriculum itself is sure to teach students lots of conclusions, but it should not only aim at teaching such as theorems, formulas, and calculation procedures and the problem-solving approach. Letting students acquire mathematical ideas while learning the foregoing is more significant.

The connotation and denotation of mathematical ideas are very abundant. For instance, taking as a starting point, from the mathematical angle of viewing a problem, mathematical ideas proceed like simplified and quantitative thinking, thinking problems thoughtfully, rigorously, and systematically, as well as the establishment of a mathematical model of thinking, and holding a reasonable ground with strategies. A person, after entering the social community, while not working in math-related fields, will find that what they learned in mathematical theorems and formulas may be mostly less connected. In the process of learning mathematical knowledge for mathematical thinking, such learning is sure to have a lifetime benefit. According to *the Curriculum Standards (2011)*, what defines “basic ideas” of mathematics, rather than the “basic ideas and methods of mathematics”, is a wise and

proper way of thinking and description. For if it defines the term “basic ideas and methods of the mathematics,” it may let people think about specific methods, such as substitution, and allocation methods, and it would also make the key word “ideas” less prominent. Furthermore, it does actually contain these methods in the “Two Basics”. The mathematical method is different from mathematical thinking. Mathematical thinking often reflects comprehensive, universal, profound and general concepts. But mathematical methods often include operational, special, specific, procedural and skilful meanings. Mathematical thinking is often embodied by mathematical methods, whereas mathematical methods often reflect a kind of mathematical thinking. Mathematical thinking is the core and essence of the mathematics teaching. When teachers teach mathematical methods, they should strive to reflect and embody mathematical thinking, to enable students to appreciate and comprehend mathematical thinking. This also serves the significant methods of improving students’ mathematical literacy and developing their key competencies.

3.2. Gaining Experience Through Participating Mathematical Activities

Students gain experience through participating in basic activities of mathematics, and indeed it should be also aimed as an important objective of the mathematics curriculum. Mathematics teaching is essentially the teaching of mathematics activities, in which teachers and students are engaged, so students can acquire related experience through participating in mathematical activities. In particular, students gain experience in the process of classroom studying and participation. Although some contents can be explained in details, in order to make students better understand what they have been taught, the priorities for teachers should be to let students actively participate in mathematics activities themselves. However, *the Curriculum Standards (2011)* does not begin to expound what the connotation and denotation of the basic activities of mathematics experience are, which of course leaves room for teachers and researchers to discuss. The experience acquired through participating in mathematical activities and experiences are inseparable. These activities will be closely linked with active work by hand, with expression and with thinking. It includes the actual mathematical activities which are closely related with and carried out in real life, or it can be best reflected in those carefully designed activities in the curriculum instruction. Activity is a process, therefore it reflects that the learning outcome and process are all about the curriculum objectives. Secondly, the experience of activities and experience are also inseparable. Of course, they are inextricably linked with people. Students need to acquire experience through participating in activities, which will be summed up as experience. Either it will be the experience students acquired through participating in activities, or it can also be the experience which can be gained by reflecting on it. It could be the experience students find in their own way, or it can be inspired by others through the lessons learned. It could be also the experience which was acquired either through a sole event,

or through a reciprocal comparison of experience gained in a number of activities.

Particularly, the critical point which we should make clear is that only that which is regarded as students' acquired experience is transformed and constructed to something that belongs to the students. It also should be noted that what we called "mathematics activities" must have clear mathematical connotation and purpose, and in itself must reflect the nature of mathematics, which is an integral part of the mathematics teaching. Teachers' classroom instruction and students' classroom learning are the main mathematics activities. Such teaching and learning environments should be a gradual, heuristic inquiry, and should also be interactive. In addition, there are other forms of mathematical activities, such as students' autonomous learning, investigative research, independent thinking, collaboration and communication, group discussion, exploring and analysis, on-the-spot visiting and practice, as well as computational tools for operational exercises and other assignments, in which students' key competencies will be developed.

It should also be stressed that, while conducting the process of mathematics activities, students will not only acquire the experience of logical reasoning, but also the experience of plausible reasoning. For example, the students will learn the experience of predicted results based on conditions and the experience of exploring causes in accordance with the results. Both experiences are also very important for the cultivation of innovative talents. The educational significance of mathematics activities lies in the fact that students are able to gain a characteristics-rich personality through perceptual and emotional experience, as well as mathematical awareness, mathematical ability and mathematical literacy through the personal experience of the mathematics activities process.

3.3. The Connections Between the "Four Basics"

To help students acquire experience through participating mathematical activities means to cultivate their thinking abilities from the angle of mathematics, and to get some results in activities intuitively and reasonably. That is the essence of mathematics creation and the main access to new results. Mathematics activities experience is not just the practical experience, and not just the problem-solving experience either. More important is the experience of thinking, and the experience in mathematical activities. Innovation depends on thinking, which is what we called the creative thinking in mathematics activities. The way of thinking is to rely on the accumulation of experience in long-term activities, and the quality of thinking is to depend on the effective and wide range of mathematical activities to improve. It is surely not just to rely on the teachers' instruction. Albert Einstein once said that "independent thinking is the basis for innovation" (Einstein, 1936, p. 2). The most important factor of acquiring experience in mathematics activities is the accumulated experience of discovering and posing, as well as the analyzing and solving of problems. In short, it is the experience of the overall process of thinking and solving problems.

The forming of students' wisdom, cannot just rely on acquiring a wealth of knowledge. It must also depend on the practice and experience gained in practice. Mathematical thinking is formed not only in deduction. It also needs to be formed on the basis of accumulated experience in mathematics activities.

The Curriculum Standards specifically designed the contents of the "using and applying mathematics" part, which emphasize the aim of problems as the carrier and help students acquire mathematical experience of activities through the integrated use of knowledge and skills and solving problems in practice. So in this process of acquiring the experience of exercises, it is sure to improve students' attitudes and values. In this way, the "Four Basics" fully embodies and coincides with the requirements of the three-dimensional objectives in the *Curriculum Reform Guidelines for the Nine-Year Compulsory Education* (Ministry of Education, 2001).

4. Some Reflections and Prospects on the "Four Basics" in the Curriculum

Although the "Four Basics" consisted of four parts, it should not be viewed merely as a simple mixture. It should be regarded as an organic whole, which is interrelated and mutually reinforced.

Basic knowledge and skills represent one goal of the teaching of mathematics, for which more classroom time is needed. Mathematical thinking is the essence of mathematics teaching and it should be viewed as a priority in classroom teaching. Mathematics teaching activities is an essential form of instruction and process. Since two new "Basics" are added in the *Mathematics Curriculum (2011)*, teachers, while facing the teaching plan and conducting teaching, should consciously set aside the appropriate time for the teaching and training of mathematical thinking. The teaching of mathematical thinking should not be conducted without a clear target. It should first be based on carrying mathematical knowledge and then pay attention to the integration of mathematical knowledge and mathematical ideas. While explaining mathematical thinking, teachers should avoid being stiff, farfetched, and long-winded. On the timing arrangements of classroom mathematics activities, emphasis should be placed on the heuristic instruction and extra time should be arranged for students' independent thinking and self-exploration under the guidance of teachers. Appropriate time should also be spent on the other forms of mathematical activities.

In addition, since two new "Basics" are added in the curriculum, then, as for the assessment perspective, it should put mathematical thinking and mathematics activities in the appropriate places.

There is a restrictive attributive phrase like "to acquire the necessities of adapting to the social life and future further development" (Ministry of Education, 2011, p. 8), which is placed before the description of the "Four Basics" in the curriculum. The purpose is so obvious that it avoids inappropriately expanding teaching contents under the name

of “Four Basics.” On the one hand, it stresses the practical and long-term significance for the students’ acquired mathematical “Four Basics.” Its practical significance circles around the purpose of students’ adapting to social life and it is a necessity for students’ further development. If mathematics curriculum enables students to acquire basic mathematics knowledge and skills, basic ideas and basic experience through activities for social life and future development, it will definitely create a very good condition for cultivating well-rounded development and innovative talents.

5. Conclusion

At the coming of the 21st century, most countries and international organizations (such as UNESCO, OECD, and the UN) kept on thinking about what and how to cultivate students through curriculum reform in this globalized and fast-changing societies. The Ministry of Education in China first used the term of “key competencies” and defined key competencies clearly as the characteristics of personality and core capacity adapting to personal lifelong development and societal development, which will be fostered through students’ receiving the relevant grades in the educational process (Ministry of Education, 2014). The emphasis of “Two Basics” is the traditional products of education and value of mathematics education in China. It is embedded with the real consideration of going with the times. The development from “Two Basics” to “Four Basics” is the great achievement for the mathematics curriculum reform in the first decade of the new century. The newly raised another “Two Basics” reflects the “top-to-bottom” model of concern about what is the value of mathematics education as a very important subject. Specifically, it is in fact reflecting the concern about the inquiry of the educational purpose; that is, what and how to foster students in this globalized and knowledge-based society in accordance with current social and economic development. This update also reflects China’s educational stages from purely teaching knowledge and skills to cultivating student’s key competencies (21st century competencies) in school. It emphasizes the role of active experience by students, and students are recognized as legitimate creators of knowledge and thus expected to contribute to each other’s learning. The current exploration of “Four basics” focus mainly on the dimension of intended curriculum (policy documents and curriculum standards). As for the implemented curriculum perspective, it remains to be seen how and in what ways “Four Basics” as an organic whole will be translated into practice-in the classroom, in textbook compilation and in assessment. On the other hand, as the China policy of fostering students’ “key competencies” imperative through the integration of core subjects, it needs to be further identified the relationship between “Four Basics”, subjects’ competencies and key competencies. These questions

will be explored in our next research.

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