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Issues Concerning the Curriculum Revision Process and Mathematics Curriculum in Korea

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The purpose of this paper is to diagnose the problems of the revision process of the curriculum, and identify the issues in relation to the 7th mathematics curriculum. From the review on the curriculum revision process in Korea, three issues were identified; timing and scale of curriculum revision, research and curriculum revision, and the relationship between the revision of the overall curriculum and that of a subject curriculum. Regarding the mathematics curriculum, the three issues were raised for further discussion; lack of philosophy behind the mathematics curriculum, optimization of mathematics educational content, and differentiated curricula for students of different abilities.

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I. INTRODUCTION

Korea has a uniform curriculum determined at the national level. The current curriculum is the 7th curriculum because the curriculum has been revised six times since the liberation of Korea from Japan in 1945. The 7th curriculum has brought more drastic changes both in terms of content and format than any other previous curricula. Therefore, it prompted a great amount of resistance and discussion among the education circle.

The 7th curriculum began taking effect from 2000 amidst significant concern, and since then, it has been gradually implemented to all the grades from this year. Hence, it is time to critically review the curriculum revision process and the current mathematics curriculum, and ponder upon the issue of how to improve the curriculum in the next revision.

II. ISSUES OF THE CURRICULUM REVISION PROCESS

From the brief review on the curriculum revision process in Korea, three issues were identified for discussion.

1. Timing and scale of curriculum revision

Upon looking at the history of revisions of the Korean school curricula, it could be found that the revisions took place in relatively regular intervals. In the beginning, the curriculum was revised almost every decade. From the 5th curriculum revision onward, the revision cycle has been shortened. The 5th curriculum was made 6 years after the 4th curriculum revision and the 6th curriculum revision took place 5 years after the previous revision, and the 7th curriculum was developed another 5 years after the 6th curriculum revision. The curriculum change has been made almost on a regular basis, which makes us wonder if the Ministry of Education launched curriculum revisions for the sake of revision in the intention of self-promoting tangible achievements.

In addition, the curriculum has been revised not because of an urgent need inside each school subject but mainly because of external factors. In the case of mathematics, it is true that a couple of curriculum revisions were brought by significant changes such as the "New Math" of the 3rd curriculum and the "Back to Basics" of the 4th curriculum. However, many revisions were made with just some superficial modifications to the previous curriculum. For example, some contents were simply transferred from one grade level to another. This was the case because the curriculum revision was not driven by internal needs of each subject, but was made mainly dependent on the changes in educational policies.

Moreover, when it comes to curriculum revisions, all the contents of curricula for all grades were 'entirely' changed. Many educators opinioned that overall revisions are time-consuming and inefficient, and would be more desirable to make minor modifications to problematic contents of curricula (Huh 2003).

2. Research and curriculum revision

The second issue concerns the relationship between curriculum revision and the related supportive research. Curriculum revisions may turn out to be shoddy modifications if the revisions were completed in just a short period of time without enough support of relevant research. The 7th curriculum in general (the overall curriculum) were developments for 10 months from March to December 1996, while developments for the curriculum for each subject (the subject curriculum) were performed during another 10-

month span from January to October in 1997[1]. Given such a short period of time for the development of curriculum, the researchers did not have sufficient time to come up with comprehensive blueprints based on extensive research such as identifying problems of the previous curriculum and understanding the trend of curricula in other countries. Curriculum revisions are supposed to follow the proper R&D (research and development) model, however the timeline for the development of a curriculum itself was already very tight without research activities (Gim 2002).

Contrast this with the curriculum revision process in the U. S. for example. Although the U.S. does not have a national curriculum, the documents *Curriculum and Evaluation Standards for School Mathematics* (NCTM 1989) and *Principles and Standards for School Mathematics* (NCTM 2000) may be considered as a corresponding national mathematics curriculum of the U. S. The revision process of the NCTM's document provides a significant implication for us. *Curriculum and Evaluation Standards for School Mathematics* was first published by the National Council of Teachers of Mathematics in 1989, and then the revised version of CESSM, *Principles and Standards for School Mathematics* was released in 2000.

After publishing the CESSM, NCTM organized a committee to conduct a series of research on mathematics curriculum, and based on 9 years research by this committee, the draft of PSSM was published in 1998. A printed version of the draft was widely distributed and a soft copy was set up on the web to invite for comments. NCTM collected various opinions about the draft from teachers and researchers all over the world, and the draft were revised based on those opinions. In fact, as a result of this consultation process, there are huge differences between the draft of 1998 and the final version of 2000. Korea needs to refer to this case; it needs to organize the committee for the mathematics curriculum in advance, launch the fundamental studies about mathematics curriculum, and provide the opportunities for debates about mathematics curriculum to collect ideas.

3. The relationship between the revision of the overall curriculum and that of a subject curriculum

How the curriculum of a particular subject is revised in relation to the revision of the overall curriculum is another issue of concern. In devising the 7th curriculum in Korea, there is the discrepancy between the general principle of the overall curriculum and the subject curriculum. In the curriculum revision process, the general principle of the

[1] The national curriculum consists of two parts; the overall curriculum and the subject curriculum. The overall curriculum provides the background philosophy of curriculum, and specifies the distribution of unit for each subject in each grade. The subject curriculum states the detailed contents for each grade in each subject.

overall curriculum is first developed and the subject curriculum is mapped out based on the overall curriculum.

Those responsible for the overall curriculum are usually general educators while those engaged in the subject curriculum are experts in either subject or subject education. (In the case of mathematics, they are mathematicians or mathematics educators.) As a consequence of such disjoint composition of the two research teams, the researchers of both teams could not have enough opportunities to collaborate with one another. As curricula are modified consecutively (first, the overall curriculum and then the subject curriculum) and researchers of the two teams are separated, it is not surprising that there has been the recurring issue of discrepancy between the overall curriculum and subject curriculum when curriculum revisions were made[2].

As the overall curriculum is first developed, feedback from the researchers who will later develop the subject curriculum is not heard or heeded by the researchers of the overall curriculum. In order to improve such a communication block, discussions that are made during the course of developing curriculum for each subject should be reflected in the overall curriculum (bottom-up), as well as the ideas of the overall curriculum cascading into each subject curriculum (top-down). In other words, the subordinate relation between the overall curriculum and each subject curriculum should be changed from 'one independent variable and the other dependent variables' to 'two parametric variables'. To this end, research and development for both the overall curriculum and each subject curriculum should be interactively performed. Furthermore, a dynamic process should be created where the results of research are exchanged and used for interaction between all research teams.

There were some occasions that curriculum revisions have caused a serious discrepancy between the overall curriculum and subject curriculum. For example, the main features of the 1st and the 2nd overall curriculum are 'content-oriented' and 'experience-based' respectively (MOE 2000a). However, the 1st and the 2nd mathematics curriculum focused on 'mathematics in daily life' and 'systematic learning' respectively (MOE 2000b). Roughly speaking, 'content-oriented' couples with 'systematic learning' and 'experience-based' matches with 'mathematics in daily life.' This is a typical example of the mismatch between the overall curriculum and mathematics curriculum (Park 2003).

Additionally, the 7th curriculum shows a large discrepancy as well: one of the core ideas of the overall curriculum is to reduce 30% of the educational content but this idea is not sufficiently represented in the mathematics curriculum. Further discussion will

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[2] In fact, this consecutive revision procedure has a positive aspect as well. Since the subject curriculum should be based on the previously developed overall curriculum, the subject curricula tend to be coherent and consistent. This is strength of consecutive revision procedure.

follow later.

III. ISSUES OF THE MATHEMATICS CURRICULUM

Regarding the mathematics curriculum, the following three issues were raised for further discussion.

1. Philosophy behind the mathematics curriculum

One of the characteristics of mathematics curricula in Korea that which can be observed is that the background philosophy of the mathematics curricula usually follows those of foreign curricula. The concept of "mathematical power" that is emphasized in the 7th mathematics curriculum (MOE 1997) was first described in the *Curriculum and Evaluation Standards for School Mathematics* (NCTM 2000). Furthermore, the 7th curriculum tries to implement mathematics education focusing on the application to daily life, rather than the merely theoretical mathematics that encompasses mostly mathematical formulas and symbols. This coincides with the Realistic Mathematics Education (RME) of the Netherlands (Freudenthal 1983). In addition, a 30% reduction of educational content, which was proposed in the 7th curriculum, is similar to the idea of the 1/3 reduction in Japan, China, and Singapore (Zhang 2002). Therefore, it is difficult to avoid mentioning that there is no proprietary educational philosophy in our mathematics curriculum. Recently, mathematics curriculum is more modeled after western curriculum rather than that of Japan. This is because of the generation change of those who are primarily involved in the curriculum revision from a generation that is more familiar with the Japanese language to one that is more familiar with the English language.

It is inevitable that in revising the curriculum, we make reference to the curricula in other countries. But there is a danger of adopting a curriculum by 'shopping around' because the curriculum is for nurturing the next generation to live and function in the culture of the place. A common approach in curriculum reform is to send a group of people abroad to learn about the latest developments and changes in other countries. However, the adoption of foreign ideas without critical evaluation can be detrimental to an education system. The curriculum must always be a reflection of the cultural values of a place. In looking at the curricula in other countries, we need to evaluate them from the position of our own culture.

In Korea, attempts are being made to introduce to mathematics classes the social process of creating knowledge. Class activities using cooperative small group learning are also being encouraged in an effort to let more students participate in discussion and the social negotiation process. The widely-discussed method of small group cooperative learning, which is based on 'social constructivism' (Ernest 1991), doesn't seem to sit well with Korean students (in general, East Asian students under the influence of Confucian tradition where harmony and compliance rather than confrontation and independence is stressed). This is because they are taught not to doubt the teachings of their ancestors and the great men of past generations, let alone argue against it.

However, contemporary western cultures encourage students to express their own opinions and reach a compromise with those with different opinions. Therefore, students of the West have been trained at an earlier age to actively engage in and take advantage of small group cooperative learning. In contrast, small group activities do not make much sense to students in Korea or in East Asia, who do not receive this type of training. As for teachers in Korea or in East Asia, they are left with a sense of guilt for not being able to apply such prevalent educational theories to their own classrooms (Yim 2000). This is a typical example that western philosophy could not be transplanted in Korea or in East Asia smoothly.

One interesting observation, however, is that the East makes efforts to follow its western counterpart while the West endeavors to take after the East. One of the major export items of Singapore that has been continuously ranking its first position in TIMSS (Third International Mathematics and Science Study) and TIMSS-R (Repeat) is the mathematics textbook. Educational experts in the U.S. are importing Singapore's mathematics textbooks in order to discover what is securing Singapore in a top position. Furthermore, western scholars are amazed by Japanese mathematics textbooks. As if exhibiting Japanese national characteristics of 'pursuing smallness in everything,' core ideas are so economically displayed in a thin textbook. Human beings tend to admire what others have rather than appreciating what they have. Likewise, both the East and the West are benchmarking each other in the mathematics education field.

In conclusion, it is necessary to strive to find out what is most optimal for us rather than indiscreetly following the western mathematics curricula. To this end, a philosophy of mathematics education which incorporates our own way of thinking and culture should be first established.

2. Optimization of mathematics educational content

One of the most important objectives of a curriculum revision is to determine the appropriate amount and the level of difficulty of educational content. In order to arrive at the 'optimal' content, the curriculum may be revised in the following manner:

(a) Add in new topics because of the advancement of the discipline and related fields, or

(b) Delete existing obsolete topics that are no longer relevant because of the change in the different fields and/or students population.
    Usually (a) is greater than (b), and coupled with the increasing demands because of the introduction of extracurricular activities and new disciplines (such as environmental education, information and communication technology etc.), thus there is a need to delete or reduce the content in the existing curriculum even when they are still 'relevant'. One way of achieving this is through

(c) 'Rationalization and streamlining' of existing content including the lowering the difficulty level or depth of treatment of existing contents.

Deletion of topics

In Korea, the 4th, 5th, and 6th mathematics curriculum has been revised under the basic principle of 'reduction of the amount' and 'lowering the difficulty level' in order to accomplish the optimum amount and difficulty of educational content. Furthermore, the 7th curriculum specifically instructed a reduction by 30%, which the mathematics curriculum was unable to fully comply with. The amount of educational content was definitely reduced, but it only reflects the reduction of mathematics class hours for the 5th, 6th and 9th grades[3].

Meanwhile, there are some topics that should not necessarily have been deleted in the 7th mathematics curriculum. For example, Euler's Formula is the only topological content that students generally enjoy learning without being much pressured. The subject has been cancelled from the 7th mathematics curriculum in the name of the optimization the amount of educational content. The same is true with quinary. Quinary was eliminated because it is not repeatedly occurred and enriched in the senior years and therefore has little or no effect on the following contents. On the other hand, equations and inequalities, as shown below, are untouchables when it comes to reducing the educational content, even though they seem to be emphasized and taught more than necessary.

- linear equation (7-A) ⇒ quadratic equation (9-A, 10-A) ⇒ cubic and biquadratic equation (10-A) ⇒ fractional, irrational equation (Mathematics II)
- systems of linear equations with 2 unknowns (8-A) ⇒ systems of linear equations with 3 unknowns, systems of quadratic equations with 2 unknowns (10-A)
- linear inequality (8-A) ⇒ linear inequality with absolute values, quadratic inequality, systems of linear inequalities (10-A) ⇒ cubic and biquadratic inequality, fractional inequality (Mathematics II)

[3] The mathematics class hours per week for the 5th and the 6th grades was reduced from 5 to 4. And that of 9th grade was reduced from 4 to 3.

One of the reasons that the topics of equations and inequalities cannot be discarded is due to its hierarchic nature. Since one deletion will affect the hierarchy following, canceling topics on equations and inequalities should be meticulously determined. Accordingly, in the next mathematics curriculum revision, the topics to be deleted should be determined based on more comprehensive perspective and systematic consideration rather than considering only conveniences. At the same time, the next mathematics curriculum revision should be more proactive in reducing the amount and lowering the level of difficulty of educational content.

Rationalization and lowering of the difficulty of the content

As mentioned before, the 7th curriculum revision intended to reduce the 30% of mathematics contents. It is true that monitoring whether or not the 30% reduction of educational content is strictly accomplished is not an easy task since it is difficult to quantify the amount and the level of difficulty of educational content. When looking at the amount of content, we should consider not only 'the number of educational topics' but also 'the depth' of each topic (Huh et al 2000).

The difficulty of a topic is also affected by how it is introduced in the curriculum. Thus, it is necessary to separate 'psychological difficulty' that can vary depending on various circumstances from 'absolute difficulty.' For example, if students informally touch upon one topic in one year and learn the same topic in depth in the following year, they feel the topic is relatively easy compared to those who are introduced to the topic for the first time. That is, the same topic with a certain level of difficulty can cause different psychological difficulty levels depending on whether or not students have learned the topic before.

There are mathematics topics that used to be introduced in the 5th or 6th grades of elementary school and then taught in depth in the 7th grade in junior high school (*i.e.*, negative number, operations of integers, variable, set, element, subset, union, intersecttion). However, in the 7th mathematics curriculum, these topics are introduced in the 7th grade for the first time. Thus, the psychological difficulty has risen while the amount of their educational content and the difficulty levels have not changed, which increases the burden to students.

In pursuit of the optimization of educational content, we cannot help but encounter some kind of dilemma. What is a truly optimal level of school mathematics? By how much should we reduce the amount and how much should we lower the level of difficulty? Even if we agree with the fact that the majority of students find mathematics difficult and we reduce the amount and lower the difficulty level, there will likely still be complaints that mathematics requires much work and is difficult. This is mainly because of the abstract and deductive nature of mathematics, still needs to be discussed in depth.

3. Differentiated curricula for students of different abilities

In lowering the difficulty level of the content during a curriculum revision, we need to consider the needs of the mathematically superior students as well. In order to cater for the needs of the mathematically able students who aspire for more challenging contents, and the majority of students who need a less rigorous curriculum and easier mathematics, a way out is to move away from the inflexible practice of imposing the same amount and level of difficulty of mathematics to the entire population of students.

Therefore, instead of indiscreetly reducing the amount and lowering the level of difficulty, it is recommended to divide the contents in two — core contents and optional contents. In fact, the 7th curriculum attempts to divide the contents into core and optional one, and these are explicitly stated in the curriculum document. However, optional contents tend to function as core contents for all the students because in Korea, the topics in curriculum are considered as a 'minimum essential'. Hence, it is necessary for the next revised curriculum to clearly mention that optional contents are for mathematically superior students and strictly differentiates optional contents from core contents (Park 2003).

Ever since the introduction of differentiated curriculum in the 7th curriculum, the drawbacks of employing differentiated curricula which provide different educational contents depending on the different levels of students have long been discussed. Judging from the overall political philosophy of the current government, such a differentiated curriculum system is likely to be discarded or minimized in the next curriculum revision. Even if the next curriculum adopts some kind of differentiated system, it is likely to focus on improving the learning of those who are underachieved rather than favoring the education for excellent students.

As a matter of fact, the idea of adopting differentiated curricula for different levels of students has been criticized for not adhering to the East Asian tradition portrayed in 'Collective We-ness.' The East Asian culture believes in orthodoxy, and students are expected to adhere to a uniform curriculum despite their individual differences. In the western culture however, the individual is of paramount importance. Hence the curriculum must be adjusted to the needs of the individual rather than the individual adjusting to an orthodox curriculum (Leung 2001; Park & Leung 2002).

Therefore, it is believed that implementing differentiated curricula for different levels of students is more suitable for western schools that have a tradition of appreciating individual differences. This is evident in the fact that differentiated curricula and tracking have long been applied in western schools without much difficulty and resistance. A system is usually closely related to the values of the members of the society. Hence, that the differentiated curriculum is not taking root in Korea proves that it discords with the

Korean (or East Asian) tradition.

Nevertheless, if the differentiated curriculum that is first applied in the 7th curriculum with much expectation ends with no significant results and does not continue later, it may cause even more confusion. Therefore, it is better to maintain the differentiated curriculum in the next revised curriculum and attempt to gradually stabilize it. One way to consider this is introducing a multiple track system that applies a slow track, regular track and fast track levels. With the normal speed in regular track, students learn one level per semester. Slow track and fast track programs can be designed accordingly based on this normal speed.

For instance, students in the slow track learn two levels in three semesters while those in the fast track can learn three levels in two semesters. A multiple track system is based on the idea of meeting the individual needs of learning speed in different students. However, complex and sophisticated operational methods must be designed with which students in one track can be transferred to another when it is necessary.

A more practical alternative is to apply differentiated curriculum through textbooks. Different textbooks can teach the same topics but at different levels of difficulty. Especially in Korea, textbooks play more important role in the class than in western class. Therefore, using textbooks that vary in difficulty levels to cater for the different needs and interests of the students can be an effective way of implementing differentiated curriculum. It is true that many different types of textbooks are published and used in Korea. However, the amount and the level of difficulty of the contents are nonetheless similar.

Therefore, it would be better to diversify textbooks to accommodate various levels of individual ability. For example, a textbook with mathematical strictness in mind that teaches abstract concepts in various depths and a textbook that uses various manipulatives and considerably encourages students' activities can be used to provide differentiated curricula to different levels of students. The former textbook contains higher-level problems to challenge and motivate the more able students, and the latter textbook provides repetitive and exploratory problems for lower ability students.

IV. CLOSING REMARKS

The curriculum revision discussed in this paper brings out a number of issues concerning the process of curriculum revision as well as issues on the content of the curriculum. This paper has focused on the 7th curriculum in Korea and diagnosed the three problems of the revision process of the curriculum. And three issues have been identified and discussed in relation to the 7th mathematics curriculum. One of the most significant implications from this study is the fact that we need to be open-minded but also cautious, be collaborative but also critical, and above all, develop a realistic curriculum that is in accordance with our cultural values. I hope that the discussions in this paper can provide some basics for determining the direction of future curriculum revision process and mathematics curriculum in Korea, and prompt related discussions.

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