

Differences of Meaning Understanding among Teachers, Students, Parents, and Experts about Elementary Mathematics Textbooks*

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This study is to examine different views of teachers, students, parents and experts on existing mathematics textbook and ideas and alternatives for developing new textbooks. We interviewed deeply with 18 teachers, 18 students, 9 parents, and 4 experts and analyzed two analysis frame categories; Strengths and weaknesses of current textbooks and directions of mathematics textbooks that will be revised. We found that among teacher, student, parent and expert, there are some differences of meaning about mathematics textbooks, based on interview questions. The directions of new textbooks are as follows. First, 'the definitions of mathematics textbook concepts' shared and sympathized by teachers, students, parents, and experts should be considered in developing the textbooks. Second, the textbooks should be much usable in classrooms and be matched to the goals of mathematics subjects. Third, the contents and levels of difficulty of the textbooks should be based on the specific objectives and the analysis of curriculum and its contents. Fourth, understanding students should be presupposed as the external side of contents and the textbooks themselves should be associated with the image of joyful and fun mathematics. Fifth, the mathematics textbooks should reflect real daily life to their contents and be linked to other subjects.

Keywords : mathematics textbook, revised elementary mathematics curriculum, Korea cases

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Introduction

With the newly revised curriculum for elementary & secondary schools in 2007, the mathematics textbook publishing for elementary schools is currently in progress. Those newly developed mathematics textbooks shall be implemented on a step-by-step basis for use of 1st and 2nd graders of elementary schools in 2009. At this point of time, it is appropriate to investigate different views of students, teachers, parents, and experts on existing mathematics textbooks, so as to develop plans for the development of textbooks, as well as to seek guidelines and alternatives for developing better textbooks.

Furthermore, digital textbooks are in a developmental stage set to possibly replace paper-based textbooks, which is used as the main educational media in the school education system. The Ministry of Education Science and Technology, Korea, in accordance with the 'Commercialization Plan of Digital Textbooks (March 2007)', has commenced a full-scale development of digital textbooks. However, such digital textbooks being developed lack the systemization of development and verification as compared with paper-based textbooks.

This study intends to identify appropriate and sufficient guidelines for mathematics textbooks in the revised science curriculum, by examining different responses from students, parents, teachers, and experts to the strengths and weaknesses of the current textbooks in use. Conducting qualitative research on the meanings understood from mathematics textbooks, the study aims to provide pivotal ideas and alternatives for developing new textbooks. Furthermore, an outline of how to utilize the above results to future digital textbooks will be presented, providing valuable recommendations for the future school education system.

This study is to analyze meaning understanding differences among teachers, students, parents, and experts about elementary mathematics textbooks.

Research questions to guide this study:

- a) What is the revised curriculum of elementary mathematics and previous research?
- b) What difference exists in the meanings understood by teacher, students, parents, and experts about current mathematics textbook?
- c) What are ideas and directions of developing future mathematics textbooks?

Research methods of this study are as follows:

- a) Previous research analyses and literature reviews related to this study
- b) Development of interview questionnaire and deep interviews of 18 teachers, 18 students, 9 parents, and 4 experts
- c) Making a framework for interview result analysis and reporting
- d) Related expert reviews and advice

Revised Curriculum of Elementary Mathematics

The main characteristic of the newly proposed curriculum revision is that it is a partial revision to supplement and amend necessary parts while maintaining the philosophy of the 7th curriculum: learner-centeredness, unit school producing curriculum, national common basic curriculum, and selection centered curriculum. The curriculum of elementary school following this direction also has showed more changes in subject-specific curriculums such as the rationalization of the amount and level of learning contents, and the reduction of learning loads through careful selection of learning elements in subject.

The revised contents in mathematics curriculum are as follows.

First, revisions in terms of the aims of mathematics education are made to adjust and supplement by changing expressions such as ‘the basic concepts of mathematics,’ ‘the phenomenon of objects,’ and ‘some questions out of real life’

into more inclusive expressions to cover the overall aims of mathematics education from elementary, middle, to high school, and to modify abstract expressions about the necessity of mathematics learning to more substantial ones. As for the teaching methodology, contents relating to level-differentiating instructions are eliminated.

Second, revisions with regard to the aims of elementary school curriculum are made to organize hierarchically phenomenon around the living surroundings, to amend the general aims of each school to be lofted up to elementary, fundamental, and developed ones, and to make it specified ‘positive attitudes towards mathematics’ in both the general aims and the school aims at each level.

Third, the contents for the first grade are changed to limit the range of numbers to 10 in the learning topics of breaking down a number into two or composing two numbers into one, while the curriculum of the second grade puts a restriction not to deal the concept of fraction in too much complicated context by suggesting at ‘the points of attention in teaching-learning’ that the introduction of a fraction concept as the equal division of continuous quantity is limited to figures and diagrams. The third grade sees the complementarization of the learning topic to develop senses of massiveness by estimating and weighing diverse weights, while the points of attention in teaching-learning for the fourth grade have an addition that too much complicated mixed calculations of natural numbers are not to be dealt. Six grade curriculums makes a change of attenuating teaching level by emphasizing basic understanding of how to calculate areas and volumes and how to appreciate the development figure of cones.

Fourth, the modified and supplemented contents in the methodology of teaching-learning includes the replacement of ‘compulsory learning elements’ by ‘achievement targets’ and the elimination of detailed mentions about complementary and intensive learning. Recommendable examples in teaching and learning are suggested as research learning, discovery learning, collaborative learning, individual learning, explanatory teaching, etc. The revision also refines the points to be attended to into separate sections such as the cases of mathematical

concepts, principles, and laws, those of mathematical thinking and inference ability development, those of problem-solving improvement, and those of promoting positive attitudes toward mathematics, with more concrete explanations (Kum, 2007).

Analysis of Previous Researches on Mathematics Textbooks

Researches about textbook developments and its improvement directions

- A Qualitative Study for the Improvement of Primary Mathematics Textbooks (Lee, 2001)
- Some Issues in Mathematics Textbooks under the 7th Curriculum (Kim, 2001)
- A Study on the 7th National Curriculum Implementation at the Elementary School Level (Choi & Hwang, 2004).
- Problem Diagnosis of Mathematic Curriculums and Exploration of Mathematics Education Trends for their Improvement (Lee, 2006).

Researches about Textbook analyses: textbook inside (content system) and outside (book design)

- A Study of Elementary and Middle School Teachers' Perceptions on the Amount and the Degree of Difficulty of Contents in the Textbooks (Kim & Park, 2003).
- A Study on the Reduction of Educational Content in the 7th National Curriculum: Focusing on the 3rd Graders' Textbooks of Social Studies and Mathematics (Kim & Lee, 2003).
- An Analysis of the 7th Korean National Elementary School Mathematics Curriculum: Focusing on the Continuity, Sequence, and Integration of Mathematical Content (Seo, You & Jung, 2003).

- A Study on Students' Opinions about Content Relevance in the 7th Mathematics Curriculum (Lee & Lim, 2005).
- A Study on the 7th National Curriculum Implementation at the Elementary School Level (Choi & Hwang, 2004).
- A Research of Visual Materials for Aesthetic Compositions on Textbooks (Hyun, 2004).

Researches about class uses of textbooks

- A Study on the Current Status of Korean Textbooks and their Improvement Strategies (Heo, 2004).
- An Analysis and Evaluation Research of Field Validity on Elementary School Course Books (of the 7th national curriculum) (Ryu, 2002).

Comparative researches of foreign countries' textbook

- Comparative Analysis of Korean and American Elementary Math Textbooks: A Case Study of Addition (Park, 1998).
- A Study on the Comparison and Analysis of School Mathematics Curriculums in England and Korea: Focused on the "Number and Algebra" Domain (Hwang & Shin, 2002).
- A Comparative Study of Korean and American Elementary Mathematics Textbooks: With Multiplication Case Studies Focused on Students' Performance Expectations (Lee, 2005).
- Comparative Analysis on Korean and the U. S. Mathematics Classrooms: Focused on the Case of Multiplication Unit of 2nd~3rd Elementary Level (Lee, 2004).

Researches about e-textbooks

'Digital textbook commercialization agenda' as of March 7, 2007 stated that the future digital textbook using new concepts of wire and wireless information

communication network will be developed and applied to school field from 2008.

Many researches has been conducted about such concepts of the digital textbook as the functions of digital textbook, the prototype developments of digital textbook, the side effects of digital textbook, and the directions of mathematics digital textbook (Son, 2004; Byun et al, 2002; Choi et al, 2004).

Differences of Meaning Understood of Teachers, Students, Parents and Experts

We use an analysis framework for the difference of meanings understood by teachers, students, parents, and experts as follows.

Table 1. Analysis framework

Category	Framework of analysis
Strengths and weaknesses of current textbooks	<ul style="list-style-type: none"> • Aspect of Current curriculums and teaching-learning • Aspect of the Contents of mathematics textbooks • Aspect of the Non-contents of mathematics textbooks • Aspect of the Use of mathematics education • Aspect of the Supporting of related mathematics textbooks
Directions of mathematics textbooks that will be revised	<ul style="list-style-type: none"> • Teacher's thinking on the meaning understanding of the textbooks • Content improvement items of mathematic textbooks that will be revised • Non-content improvement items of mathematic textbooks that will be revised • Supporting list in mathematical education that will be revised • The others

Aspect of Current curriculum and teaching-learning

- Teachers*
- It's impossible to change textbooks without a curriculum change because curriculum is a big picture and frame of education.
 - Be satisfied with the structure of current textbooks.
 - The biggest problem is deficit reality in the aspect of implementing at teaching and learning situations.
 - Current textbooks were made from the viewpoint of the thinking process of experts, rather than that of the understanding of students.
 - Parents and students' lack of understanding the textbook aims and intentions makes it impossible to run level-divided learning in class.
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- Some questions such as 'Why did you think so?', which could not be used at the real teaching situations, reveals the lack of the sense of reality.
 - The higher grade, the less interesting textbooks
 - Too much learning hinders teachers from using various strategies and impedes students who have deficit learning.
 - More rote learning of formulas rather than the increase of creativity and thinking power
 - Lack of high- level and difficulty questions for collaborate learning.

- Students*
- Be satisfied with the learning of using textbooks in lower grades
 - Not satisfied due to not sufficient learning of using textbooks in higher grades
 - Appreciate that textbooks include what should be learned regardless of grades and accept the necessity of learning them.
 - The higher grades, the more ignore textbook contents owing to much preceding learning.

Parents

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- Experts*
- Think the goal of the improvement of problem solving ability, one of the goals of the 7th national curriculum, is achieved to a certain extent.
 - The textbooks are well constructed for effective mathematical education practice.
 - Subject features are well reflected in textbooks, but making use of all the features of mathematics subjects shows a limit.
 - Deficit reflection of Social and cultural aspects; next time, the more should be included.
 - More development of creativity and thinking skills is suggested diversely in the 7th curriculum than in the 6th curriculum, but the more should be required.
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Aspect of the Contents of mathematics textbooks

- Teachers*
- Desirable activity based content construction
 - It is positive that it tries to use real life stories, learning materials and play activities, but the contents are detached remotely from children's level and life.
 - Separate textbooks and practice books aimed for supplementary and intensive learning are not used well in real class situations.
 - Learning amount is enough for textbooks, but using practice books increases the burden and brings difficulty to teaching and learning.
 - Same contents are duplicated and repeated in both textbooks and practice books.
 - No difference in grades in case of 'search how to solve problems.'
 - Few that can be qualified as level-wise questions.
 - Poor consistency in learning contents.
 - Not much consideration for local students and difference of learner's ability in content construction.
 - Most are questions that use only complicate formulas and take a long time to solve rather than questions that need complex and inference thinking.
 - The contents of the textbooks are not sufficient to provide mathematic concepts and principle acquisition.
 - Lack of the balance of difficulty level among textbook contents, supplementary questions and deepening contents.
 - Examples or stories in textbook are hard to gain sympathy from students.
 - Difficult contents for self-study.
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- Students*
- Adequate level of difficulty to all grades
 - Some high grade students think mathematics textbook contents as the repetition and practice of what was learned already in private institutes.
 - Too easy for previous learners but too difficult for non- previous learners.
 - Positive to separate mathematics textbooks and practice books
 - Contents in practice books help to improve mathematic ability
 - The amount of questions in practice books is different significantly by unit
 - The important concepts in a unit are not saliently suggested.
 - Need to use appropriate pictures and graphics to let learning contents understood easily.
 - Problem solving or supplementary explanations about fundamental learning contents.
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- Parents**
- Because the units of problem solving are not learned thoroughly, problem solving ability goes down.
 - Considering connectivity from elementary school to middle school, the level of difficulty is low.
 - The whole learning amount is small, especially in the case of logical thinking.

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- Experts**
- Well constructed are the contents for learner-centered activities and the reflection of problem solving formulas.
 - Separate volumes (textbook, practice book) are effective to reduce the reliance to reference books, but not effective to learn by ability
 - Not large in learning amount, but lack of time, because of much activities.
 - Well structured and organized contents, but some part of contents need to be adjusted.
 - Too much detailed activities, lack of connection between grades, lack of relatedness to real life.
 - Need to revise artificial elements and parts responsible for lowering motivations.
 - Need to make a downward adjustment of 7 step contents in mathematics curriculum.
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Aspect of the Non-Content of mathematics textbooks

- Teachers**
- Whole textbook design is satisfactory.
 - A few pictures that is difficult for children to see in real life.
 - Difficult to make a proper use of a space in textbooks due to too small space to write answer in and too small font size to read for lower grade students.
 - Activity paper is appropriate to raise motivations.
 - Chances are that it is difficult to accomplish activities if the quality of activity paper material is bad.
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- Activity paper shows low accuracy.
 - Textbooks for teacher also should be designed and be made to use with interest as same as for students.
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- Students**
- Lower and higher grades alike are satisfied with overall designs of the textbooks.
 - Familiar configuration brings little feeling of resistance.
 - In case of the lower grades, more characters and caricatures help to support
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their learning.

- Use of too many pictures is not good.
 - Pictures which are not related to real life and do not match learning contents are an obstacle to learn.
 - In lower grades, activity toolbox in textbooks is used interestingly
 - Activity contents by grade are same, so they are boring and not interesting in reality.
 - Activity toolbox is inaccurate enough to impede learning.
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- Parents**
- Textbook designs, illustrations, pictures and font sizes are good.
 - Less quality than popular commercial books, but students are satisfied with current textbooks.
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- Experts**
- Still bound to traditional textbook images.
 - No reflection of students' level and the lineaments of the time.
 - More research on font size and design is needed
 - Preparations and activity paper are reinforced by reflecting field opinions.
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Aspect of the Use of mathematics education

- Teachers**
- Difficult to connect real life and learning contents.
 - No links to other subjects.
 - Textbooks show lack of basic understanding about children.
 - In the case of 'Funny play,' students beyond 3 grade are not interested.
 - Sudden increase in the level of difficulty is embarrassing to both teachers and students.
 - Poor utilization of textbooks to improve logical thinking and creative thinking
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- Students**
- Only economic activity of dealing with money is what is linked with learning contents.
 - Can't find out linking contents and do not know how to link to the other subjects.
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- Parents**
- Going on well for linking to the real life.
 - In lower grades, it needs to link to the course of the Korean language.
 - No link to science subjects.
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- Experts**
- Lack of link with real life.
 - Lack of link with science subject.
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Aspect of the Supporting of related mathematics textbooks

Teachers	<ul style="list-style-type: none">• The use of online contents and multimedia, but no data given related to textbooks.• Urgent need to revise and change the guidebooks for teachers that contain incomplete and form's sake contents• A little use of Evaluation tool in the guidebooks for teachers.• Lack of teacher trainings related to mathematics.• Lack of research material supporting mathematics classes, especially, the absence of reference library is to be resolved.• The online services or contents provided by the government are not helpful or attractive enough to be used in teaching-learning and students' learning.• No support of specific teaching-learning activities, which are at only teacher's discretion.• Little use of the guidebooks for teachers because of deficit contents.• Lack of the guidelines for facilitating and evaluating logical thinking and diverse thinking.• Lack of teacher trainings and research seminars among teachers for improving the class.• Lack of opportunities sharing materials, opinions and experiences among teachers.
Students	<ul style="list-style-type: none">• Depend on private institutes, private tutoring, and learning papers.• Often use cyber home learning as an online media, or use teachers' favorite non-free sites like 'TINARA.'
Parents	<ul style="list-style-type: none">• Use other exercise books, because using only textbooks is not enough for home education.• Send children to private institutes for preceding learning because of a feeling of uneasiness.• Textbooks are difficult for self- study and for parents to help the children's learning.• Use internet and cyber home learning systems• Lack of understanding of online learning and information• Negative opinions on mathematics learning using computers
Experts	<ul style="list-style-type: none">• Need to develop various supporting media for mathematics education• Recognize the need to develop digital contents, mathematics software, and digital textbooks for learning motivations and effectiveness.• Reinforce teacher education in field and the sharing of various concepts among teachers.• Give essential information in the guidebooks for teachers.

Ideas and Directions of Developing Future Mathematics Textbooks

Teachers' suggestions

Meaning understanding of textbooks	<ul style="list-style-type: none"> • Textbooks are data for achieving the goals of curriculums • Textbook to deal with all contents in school • Textbook to consider teachers and students • Textbook to be able to help clear and efficient teaching
Curriculums and teaching-learning	<ul style="list-style-type: none"> • Storytelling type textbooks • Textbook to be usable well in class and to support learning by level • Textbook to include teaching and learning strategies facilitating creative and logical thinking • Textbook to support the development of students' thought by themselves
Contents of mathematics textbooks	<ul style="list-style-type: none"> • Textbook to have contents of reality in accordance with students' understanding • Textbook to be selective and concentrating but to diminish the overall learning amount • Textbook to be able to find how to think and support such exercises • Textbook to consider the overall consistency and connectedness
Non contents (external forms)	<ul style="list-style-type: none"> • Textbook to consider students' characteristics by grade • Textbook to have durable and accurate activity papers • Guidebook for teachers which are attractive as much as the textbooks for students
Use of mathematics subjects	<ul style="list-style-type: none"> • Textbook to strengthen the connection of real life • Textbook to premise broad understanding for children • Textbook to clarify the connection with other subjects
Supporting mathematics textbooks	<ul style="list-style-type: none"> • Need to revise and change the overall contents of the guidebooks for teachers • Education tool development of supporting teaching and learning activities using mathematics textbooks • Preparing to share and build their materials and networks among teachers and to build training systems

Students' suggestions

Meaning understanding of textbooks	<ul style="list-style-type: none"> ▪ Textbook as a basic book for learning ▪ Textbook that contains clear and accurate concepts to need to be learned
Contents of mathematics textbooks	<ul style="list-style-type: none"> ▪ Textbook considering differences among students ▪ Textbook enabling to guide students to pay more attention to class learning at school ▪ Textbook thinking about the gap difference between students for even those who have not received private education to make the most of it in learning ▪ Textbook containing activities of new and striking contents as well as drawing characteristic distinction between grades ▪ Textbook constituting a well-structured story ▪ Textbook allowing a good linkage with other subjects
Non contents (external forms)	<ul style="list-style-type: none"> ▪ Friendly design and cover, and warm color tone which can appeal to children's characteristics ▪ Textbook make good use of illustrations and pictures to help children's understanding ▪ Be moderate no to utilize too much of illustrations and pictures ▪ Textbook considering each grade's characteristics to make proper use of fonts and space configuration

Parents' suggestions

Meaning understanding of textbooks	<ul style="list-style-type: none"> ▪ Textbook as teaching-learning material at school ▪ Laying the foundation and groundwork ▪ Not only assisting students to learn but also allowing parents to guide children's learning
Contents of mathematics textbooks	<ul style="list-style-type: none"> ▪ Textbook fully containing learning contents ▪ Textbook constructed in consistent in difficulty for each grade ▪ Textbook allowing students to be able to do self-study ▪ Textbook allowing a good linkage with other subjects

Non contents (external forms)	<ul style="list-style-type: none"> ▪ Curriculum to bring a friendly image on the mathematics as an interesting and easy subject ▪ Textbook as a more solid textbook to strengthen rudiments ▪ Textbook to introduce new methodology of mathematics education ▪ Holding a positive perspective on new concepts like digital textbooks
Supporting mathematics textbooks	<ul style="list-style-type: none"> ▪ Need for a supporting system to involve parents in assisting children's learning in person ▪ Support for textbook development itself to make a nationally-sponsored textbook competitive enough worth self-study in learning ▪ Support for e-learning to raise students' interest and learning effects ▪ Revitalization of after-school class which is different from conventional in-classroom learning ▪ Development of better textbooks than commercial study books through consulting with such books in market ▪ Textbook enable to arouse the joy of thinking and the delight of discovery

Experts' suggestions

Meaning understanding of textbooks	<ul style="list-style-type: none"> ▪ Textbooks are a kind of material that teachers use for teaching mathematics in classrooms ▪ Ideal textbooks considering teachers' and students' points of view ▪ Textbook development as a changed concept about textbooks ▪ Textbooks to meet teachers' and students' needs
Contents of mathematics textbooks	<ul style="list-style-type: none"> ▪ Contents constructed to achieve desirable affective objectives ▪ Make use of scenes to link naturally to overall contexts ▪ Contents to facilitate mathematical thinking and to consider the sophisticated hierarchies among contents ▪ Reinforce contents to link with real life, especially, deep linkage to science
Non contents (external forms)	<ul style="list-style-type: none"> ▪ Designs to raise not a hard but cozy feeling about textbooks ▪ Easily accessible designs to make mathematics interesting and felt as an easy subject ▪ Collaborative developing systems by experts to consider the external elements of textbooks

Supporting mathematic textbooks	<ul style="list-style-type: none">▪ Teacher training and support for textbooks and teaching material research▪ Support research and development of various mathematics contents and digital textbooks▪ Support the development of high quality software for mathematics education▪ Support for ordinary and continuous research▪ Prepare education agendas for mathematics teachers through considering pre- teachers' and newly appointed teachers' characteristics▪ Support learning environments for mathematics learning to be naturally acquired both in classrooms and in real life environments
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Conclusions and Recommendations

Directions of good mathematics textbook development

The directions for the development of desirable textbooks in accordance with the new curriculum should generally conform to the textbooks that are based on agreed definitions of concepts, are constituted with proper contents and organization compatible with the aims of the mathematics curriculum, are able to improve the image of mathematics into fun subject while securing students' understanding, and are connected with other subjects as well as real life. The following are more details to accomplish such directions:

First, 'the definitions of mathematics textbook concepts' shared and sympathized by teachers, students, parents, and experts should be considered in developing the textbooks. It will resolve the above problems to develop textbooks only after establishing common grounds for the concepts for the right textbook among the four different participant groups constituting the educational environment..

Second, the textbooks should be much usable in classrooms and be matched to the goals of mathematics subjects. Mathematics textbook is a pivotal medium to

fulfill the ultimate goals of mathematics education. It should clarify the goals of mathematics education and conform to them by connecting the theoretical discussions and the reality in classrooms.

Third, the contents and level of difficulty of the textbooks should be based on the specific objectives and the analysis of curriculum and its contents. The textbook should be able to satisfy a variety of learners including both those who have received prior leaning and those who have not with a sense of alienation while allowing teachers to make flexible use of it in class at their own discretion. Such a textbook should be desirable that does not block creative thinking by forcing simple memorization of formulas and solutions, but provides opportunities of expanding the width of thinking by gratifying students' curiosity and bring in open questions.

Fourth, understanding students should be presupposed as the external side of contents and the textbooks themselves should be associated with the image of joyful and fun mathematics. Consideration for design is to be made for students' preferences, for the intellectual and cognitive levels of students, for friendly approach to them, and for making a fun and favorable impression on mathematics. It should overcome the ideological and stereotypic boundaries of government designated textbooks for experts from various fields to be able to pour out their ideas, talents, and skills in making the contents of the textbooks effectively delivered.

Fifth, mathematics textbooks should reflect real daily life to their contents and be linked to other subjects. They should be systematically linked to the educational environment enough to put learning contents and students' practical experience in connection while utilizing what is learned in mathematics into other subjects' learning.

Supporting the strategies of good mathematics textbook development

Influence on mathematics education is not exerted only by the textbooks. All

influencing powers are the teachers primarily in charge of mathematic education, teaching-learning medium and materials such as textbooks, students' motivation and levels, parents' interest and guidance, classrooms and school atmosphere, and national concerns and enthusiasm. It is essential to construct a new environment adapting to changes while considering such diverse factors. To attain better mathematics education with reference to the textbook development for mathematics, therefore, this study suggests the following strategies applicable at the national level.

- School and teacher support: it is important to understand and support the school as the environments where learning is held and the teacher as one of the subjects who take part in learning. It is also necessary to actively provide teachers' trainings.
- Student and parent support: it is required to support both students using the textbooks for themselves and their parents guiding them at home.
- Expert research support: it is essential to provide consistent support for expert researches from curriculum development, textbook development, to actual applications in classroom.

Recommendations for future studies

The following are the suggestions to further studies in relation to this research.

First, it needs to take a synthetic view on other subjects with the development of mathematics textbooks in accordance with new revised curriculum. Cross-curriculum analysis of the curriculums of each subject and the curriculums for each grade should be performed while public hearings should be held to collect diverse opinions from students, parents, teachers, and experts.

Second, diverse research methods should be conducted and the research results be reflected actively in textbook development. Quality research methods through in-depth interviews with representative group, Action research to be directly

applied to fields for reform, Quantity research methods through surveys on randomly selected subjects out of schools all over the country, etc. should be utilized to observe and review the public opinions. The results must be reflected in revising and supplementing the textbooks..

Third, various foreign case studies with regard to elementary education and its textbooks need to be made.

Great efforts should be made for not only discovering outstanding cases through diverse channels overseas but also taking every opportunity of publicizing excellent textbooks domestically developed in order to receive global recognition.

Fourth and lastly, unceasing concern and research on digital textbooks should be held. It is high time to develop diverse mediums for expected ubiquitous social environments. Consistent research is to be carried out for the development of digital textbooks and the learning effectiveness in order to find out which learning area in mathematics curriculum should be included in digital textbook and what kinds of effects could be expected.

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