Exploring the Vertical Relationship between the Newly- Prepared Math Textbook for the 6thGrade and the Math Textbook for the 5th Grade*

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Abstract: The objective of present study is to explore the vertical relationship between the newly- prepared math textbook for the 6th grade and the same for the 5th grade. First, the theoretical principles and available researches are investigated. Then, the concepts of the two books in terms of the four items repetition, repetition with addition, new concepts, and the 5th grade-specific concepts are studied. The results reveal that among the concepts, 15.1% are of continuity, 39.9% are of sequence, 30.5% are new, and 12.6% are 5th grade-specific math textbook. The vertical relationship between the two textbooks is 56% which is of considerable nature. The sequences "from simple to complicated" and "spiral" have the most and "use field development" has the least usage. Some suggestions regarding the vertical relationship are recommended to amend the books.

Keywords: Vertical Relationship, Math Textbook, Continuity, Addition, Sequence

Introduction

One of the important tasks of the school is to organize activities and learning experiences properly in order to achieve the educational goals in the learners. Type of contents in the curriculum is an important factor in determining the learning process. In many cases, lack of the efficiency and effectiveness of the curriculum is not for inappropriateness of its contents but it is for the reason of setting up and organizing the contents which creates difficulties in the learning process (Taghipour, Zahir 2006).

In organizing learning activities, the relationship between these activities should be considered in terms of "subject" and "time". These two types of relationships are called respectively horizontal relationship and vertical relationship. The horizontal relationship refers to the proper learning activities and experiences in different subjects of a grade (Tyler, 2011, translated by Taghipour). The vertical organization or vertical relationship is the sequence of learning concepts and skills in a subject in different years (Maleki, 2010, p.158).

The vertical relationship of the contents will make to establish a longitudinal relationship between parts of contents so that in this way the learners would be able to learn the subject or the skills through more focusing at different times. Two criteria about providing the vertical relationship of the curriculum contents consist of continuity and sequence. The continuity is repeating the key elements of the curriculum contents (knowledge, concepts and

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skills) in the future periods of that program so that in this criterion the above-mentioned subject is raised frequently during the curriculum contents and the students get involved with it. In sequence or abundance it has been emphasized to the importance of regulating each experience compared to the previous experience so that the future experiences should be more than previous ones in terms of depth and extent (Sobhaninejad & youselyani, 2005). To organize the vertical contents of the curriculum there are different methods (Maleki, 2009) such as:

Whole to the part; this method of organizing is called the design of concepts in which organizing starts with the general concepts and then it proceeds to the partial concepts.

Part to the whole; this method first begins with introducing the partial concepts for realizing the general concepts understanding.

Spiral organization; in spiral regulating of the concepts some of the concepts, beliefs or basic issues is offered gradually throughout the curriculum without fully and regularly repeating of all learning areas.

Gradual development of the concepts; in this method some of the basic concepts are determined and gradually are designed in different environments from closest to the farthest environment. In this method, after determining the concept or concept that is supposed to be repeated it should be decided about getting broader and deeper of the concepts. For example, about knowing of the social environment one method is that the concept expands through developing and increasing the number of people in the social environment and another method is that the concept expands through developing the student acquaintance with the different aspects of it.

Simple to complex; in this type of sequence derived from the efforts of Robert Gagne the educational hierarchy requires beginning with the objective concepts and progress toward the mental contents.

by creating horizontal and vertical relationship students can reinforce their activities and learning experiences and can cause unity. On the other side, it will be possible to raise and to develop the concepts broader and deeper (Tyler, 2011, translated by Taghipour; zahir). About the sequence of content elements Piaget believes that organism will absorbs every new experience without any changes in the cognitive structure if it is completely similar to the cognitive structure. If it is different to the cognitive structure, it will change the cognitive structure. Accordingly, if the new experience cannot absorb to the cognitive structure at least to some extent, learning will not be done. To learn more effectively, the information should be capable in absorbing to the cognitive structure. However, they should have enough difference to the cognitive structure so that the changes in the cognitive structure would be necessary. Therefore, in establishing the sequence in the mathematics textbooks contents the new concepts should be similar to the previous contents and to some extent should be new so that their delivery lead to the imbalance, absorption, adaptation and finally proper learning (Seif,2012). In Azubel theory, the cognitive structure and the changes form the basis of the learning. The concept of "meaningful", is one of the basic concepts of this theory. According to Azubel if a concept can relate to the concepts which exist in the person cognitive structure, that concept will be meaningful. So if the learner can relate the new subjects to the previous ones, his/her learning will be done meaningfully. According to Schunk the learning process is meaningful when new subjects have a systematic relationship with the previous ones. It means that the new subjects expand or change the previous ones. Therefore, for meaningful learning

mathematical concepts, the new mathematical concepts should be enough meaningful for the learner to relate them to the previous ones. About content there is the textbook which is of great importance and valuable in all educational systems in all over the world. The importance of textbook in designing, implementing, evaluating and developing of the educational activities is undeniable (Arik & Kezerb, 2010). In Iran education and educational programs systems the textbook is of great importance so that most of educational activities are done through the textbook and its content (Sobhaninejad & youselyani, 2005). The textbook content is actually part of the objective manifestations of the curriculum and includes knowledge, skills, attitudes and values that must be learned. In selecting and organizing the content of the textbooks it should be considered the principles and criteria that one of them is considering the vertical relationship of the content. The learning opportunities should be organized in which the learned subjects during different years support and reinforce each other and on the other hand the distribution and classification of learning activities in different grades should not be indigestible (Maleki, 2009). The sequence means that the content and learning experiences should be regulated to facilitate the learning process according to the growth and development of the learner particularly his or her mental and cognitive development. Moreover, they should be the basis for all subsequent learning (Taghipour, zahir, 2006). On the other hand, in today society, the role of mathematics in providing the necessary skills to play an effective role in the society as a useful member is undeniable. Because the mathematics deals with observing, measuring, calculating, analyzing, deducing, proving and predicting and as a communicational system helps accurate understanding of data, models and reasoning. Mathematics lead to the growth of order, the ability to classify data, the growth of criticism power, the growth of creativity and analysis power and free the individual from the memory. It has been done some researches about studying the books vertical relationship. According to Rahimnejad findings in 1999 the vertical relationship in junior high school mathematics textbook and guidance school mathematics textbook was poor at that time.

Seiedmousavy (1999) revealed that the vertical relationship between the first to the fourth grade primary school math books was moderate and the vertical relationship between the fifth grade math book and the previous math books was poor. In a study which is carried out by (Fotovat, Moradi, 2007) the results showed that in general all the five primary school math books in terms of sustainability was poor and in terms of the sequence was relatively good.

Schmidt, Chi Wang & McKnight, (2005) studied the content of teaching math and science in the United States through the standards of forty countries which had been obtained by international mathematics and science study (TIMSS). Through studying of TIMSS findings they found that in this study most countries which their scores was better than the United States has observed the cohesion in their educational content. By cohesion they meant to regulate the sequence based on the logical structure of a particular discipline. Considering the importance of analyzing the content of textbooks and the role of mathematics in the various aspects of life, studying of the mathematics textbooks in terms of adapting to the needs and goals and the principles of organizing would be essential. Particularly, the primary school sixth grade book has recently written and it is possible to change this book and the fifth grade book. The results of this study can assist the planners and the textbooks authors in revising and

editing these two books in terms of rational vertical relationship. Thus, the analysis of mathematics textbooks (particularly in centralized educational systems in which a book is written for a lesson to all parts of the country) is raised as a requirement from different aspects and different goals and objectives.

Research questions

1) What percentage of the main concepts has continuity (repetition) in the fifth and sixth grade mathematics textbooks?
2) What percentage of the repeated concepts has a kind of abundance in the sixth grade math book in relation to the fifth grade math book?
3) What percentage of the main concepts has come in the new written sixth grade math book in relation to the fifth grade math book?
4) What percentage of the concepts has raised only in the fifth grade math book and has not come in the sixth grade math book?
5) How much has been used from each sequence criteria in the vertical relationship between the fifth and sixth grade math books?
6) How much is the vertical relationship between the fifth and sixth grade math book?

The method of study performance

The present study is descriptive and content analysis. At first, behavioral goals was extracted from the content of both the fifth and sixth math book. Then these goals were recorded in the goal-content table of each concepts. After writing the goals coding operation was done. First, for each behavioral goals, it was written in front of each goal sample or samples from the fifth grade mathematical book exercises and sample or samples from the sixth grade mathematical book exercises and then according to this samples in one part of the "repeat" section was marked "repeat with abundance", "new" and " for fifth grade". Putting marks in the abundance section was done based on sequence criteria from simple to complex, the sequence of application development and spiral sequence.

Society and sample

In the present study the population includes the contents of the fifth and sixth grade math textbooks which was taught in the academic years 2012-2013 in Iran high schools. Due to the limited content, the population and the sample are the same.

Data analysis

For data analysis it was used descriptive statistics (frequency, percentages, tables and charts). After coding, the frequency of each four parts of the goal - content table was calculated in mathematics and geometry sections and this frequency was converted to the percentages and graphs by dividing the total number of behavioral objectives. The amount of vertical relationship was calculated through the sum of frequency goals percentages in two parts of repeating and repeating with abundance. Also, by determining each of the sequences abundance and by turning them into percentages and graphs the application of each sequences were determined.

Data collection tool

In this study for collecting the data it was used the goal- content table.

The validity or reliability of measurement tools

For studying the validity the above-mentioned tool was inspected by three curriculum experts and all three experts confirmed the validity of this tool for studying the vertical relationship.

The reliability of measuring tool

The composed reliability formula was used for reliability determining:

$$\textbf{Composed reliability} = \frac{N\ (Average\ agreement\ between\ judges)}{1+[N-1][Average\ agreement\ between\ judges]}$$

Twenty behavioral goals were selected from the fifth and sixth Mathematics books. After teaching four encoders about vertical content relationship criteria asked them to encode these twenty goals in the goal- content table. After encoding, the percentage agreement between all encoders and the average percentage of agreement between them were calculated. This average was 70 percent. By putting the average agreement percentage between all encoders the composed reliability was obtained 0.93 which indicates suitable reliability for data measuring tool in this study.

Research findings

Table 1 Shows the frequency status and the status of 80 percent behavioral goals in the vertical relationship study of the fifth and sixth math books.

The first question: What percentage of the main concepts has continuity (repetition) in the fifth and sixth grade mathematics textbooks?

According to the table 1, from 84 goals of the study, 13 goals; 15.1 percent of total goals in both books have repeated accurately.

The second question: What percentage of the repeated concepts has a kind of abundance in the sixth grade math book in relation to the fifth grade math book?

According to the table 1, from 84 goals of the study**,** 34 goals; 9/39 percent of the total goals in addition to repetition had also abundance.

The third question: What percentage of the main concepts has come in the new written sixth grade math book in relation to the fifth grade math book?

According to the table 1, from 84 goals of the study**,** 25 goals; 30.5 percent of the total goals were new and were particular for the sixth math book.

Table 1- the frequency status and the status of 80 percent behavioral goals in the vertical relationship study of the fifth and sixth math books

For fifth grade		New		Repetition with abundance		Repetition		The number of goals	The title of concept	Row
Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency			
1.1	1	-	-	9.5	8	3.5	3	12	Canonical fraction	1
-	-	-	-	-	-	1.1	1	1	Divisibility	2
1.1	1	-	-	4.7	4	4.7	4	9	Decimal Number	3
-	-	5.9	5	-	-	-	-	5	Approximate number	4
-	-	1.1	1	2.3	2	3.5	3	6	Ratio and proportion	5
-	-	1.1	1	1.1	1	-	-	2	Percentage	6
3.5	3	-	-	-	-	-	-	3	Composed numbers	7
-	-	10.7	9	-	-	-	-	9	Statistics and Probability	8
-	-	1.1	1	9.5	8	-	-	9	Correct numbers	9
-	-	5.9	5	1.1	1	-	-	6	Coordinates and symmetry	10
-	-	-	-	4.7	4	-	-	4	Level measurement	11
-	-	2.3	2	3.5	3	-	-	5	Measuring the volume	12
2.3	2	2.3	2	3.5	3	2.3	2	9	Measure the length and angle	13
2.3	2	-	-	-	-	-	-	2	Gram and kilogram	14
2.3	2	-	-	-	-	-	-	2	Measure the circumference	15
12.6	11	30.5	25	39.9	34	15.1	13	84	Sum	16

The fourth question: What percentage of the concepts has raised only in the fifth grade math book and has not come in the sixth grade math book?

According to the table 1, from 84 goals of the study**,** 11 goals**;** 12.6 percent of the total goals were particular for the fifth math book and they has not mentioned in the sixth math book.

The fifth question: How much has been used from each sequence criteria in the vertical relationship between the fifth and sixth grade math books?

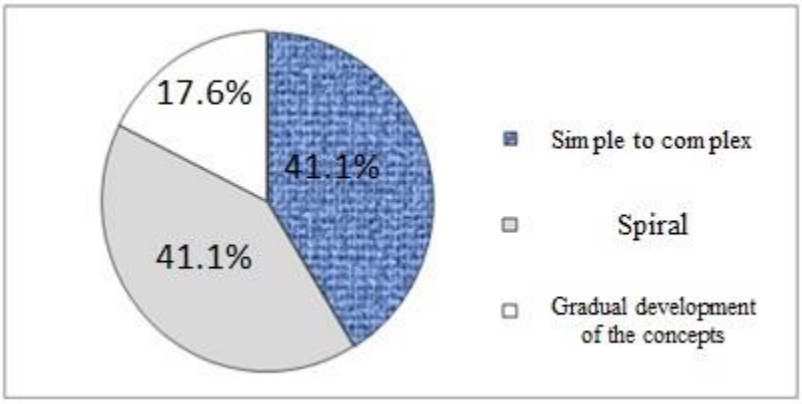

Diagram 1. The percentage of using three types of sequences in establishing of the vertical relationship of the new written fifth and sixth math books

According to the diagram from 34 abundance goals, in 14 goals; 41.1 percent of these goals it has been used the spiral sequence criterion, in 14 goals; 41.1 percent of these goals it has been used the simple to complex criterion and in 6 goals; 17.6 percent of these goals it has been used the development of the application criterion. This means that the two criteria spiral sequence criterion and the simple to complex criterion have the most application in establishing of two books sequences. This result is aligned with Jafary results (2011) which indicate that in the vertical relationship of the primary school empirical books spiral sequence criterion and the simple to complex criterion align with each other and have the most application.

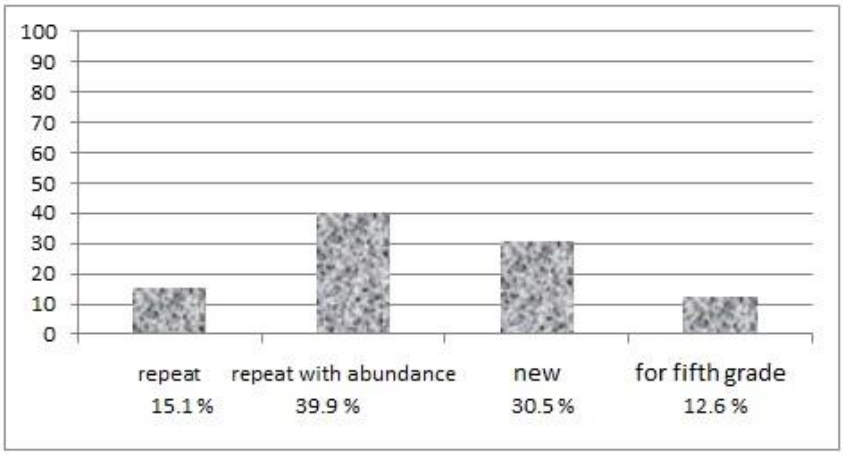

Diagram 2. The percentage of the fifth and sixth grade math books vertical components. The vertical relationship of new written fifth and sixth grade math books obtains through the sum of the first and the second components

The sixth question: How much is the vertical relationship between the fifth and sixth grade math book?

Diagram 2 shows the percentage of the fifth and sixth grade math books vertical components. The vertical relationship of new written fifth and sixth grade math books obtains through the sum of the first and the second components.

According to the diagram from 84 goals, 47 goals or 56 percent of the total goals have been repeated in the sixth grade math book or have repetition with abundance.

Conclusion

In the conclusion section of this study it should be considered curriculum legitimacies and their learning theories behind it.

In the curriculum legitimacy section it is raised the subject of content cohesion. According to the amount of the vertical relationship of between fifth and sixth math book and the results of previous researches it can be admitted that the contents of these two books in the vertical relationship section have considerable cohesion. As previously mentioned, TIMSS international study showed that most of countries which had high scores in this study in their educational contents that the textbook is also a part of it had observed the principle of cohesion. So, the cohesion between these two books can be positive to move towards international standards.

In the learning theories there are Piaget theory and Azubel theory. According to them the subjects should be organized so that they are absorbed in the cognitive construction of organism. According to Piaget the new subjects should be neither too similar to the cognitive construction which does not make any changes to it nor should they be too far from cognitive construction which does not absorb in it. As it has mentioned in the answering to the questions, some of the concepts of these two books (about 15 percent) which were basic concepts for new learning only had been repeated. This repetition as Taylor says is considered as one of the main and effective factors in organizing the content in terms of being vertical and it consolidates the learnings. After this repetition, a considerable amount of concepts (about 40%), will be repeated and will have enough abundance. This means that they are not quite similar to the learner's cognitive structure nor are they too far from it. Thus, according to the results it seems that the new written sixth grade book largely establishes the necessary link with the students' previous knowledge. Of course, there are concepts which have mentioned in the fifth grade math book but they are not mentioned in the sixth grade math book. On the other hand, some concepts are also mentioned in the sixth math book which has not presented any rudiments about them in the fifth grade math book. Due to the sequence criteria and goal-content table, these concepts are called new concepts. In order to increase the vertical relationship of these two books it is required to make changes in these new concepts.

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