Designing the content of the third grade elementary math textbook based on the integrated curriculum and evaluating its effect on students' integrated learning: A mixed study

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Abstract

The purpose of the present two studies is to design an integrated content of the third-grade elementary math textbook using a quantitative approach in the first study, and in the second study, to assess the effect on students' integrated learning. In this study, the qualitative part used the qualitative content analysis method and the quantitative part applied the quasi-experimental method of pre-test and post-test design with a control group. In the qualitative section, a sample of 18 expert teachers from Izeh was selected using the purposive sampling method. In the quantitative section, a sample of 30 people was selected by a simple random sampling method. The statistical population of the quantitative section is all primary school male students in Izeh City. In this study, first a conceptual model was designed, then using qualitative content analysis and the interview tool, the participants 'opinions on the possibility of linking the content of the math textbook with three third-grade elementary textbooks were extracted and then the effect of this content on students' learning was compared with three third grade textbooks. The results show a kind of unity of sciences with a significant difference between integrated learning of students who have been trained with integrated content and students who have not been trained with integrated content, and the level of significance is less than 0.05, indicating that integrated content is based on integrated learning, with integration playing a very important role.

Keywords: Integrated Content Design, Integrated Curriculum, Integrated Learning, Elementary School
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1 Introduction

Curriculum includes one of the main components of an educational system as the nucleus of the mobilization of all the learning activities to serve students to learn and gain experience in their real life [11]. In the early 20th century, the curriculum was introduced as the heart of the educational system and gradually changed into a specialized controversial concept [19]. All educational systems curriculum planning are concerned with selection and organization of content, and this content organization should achieve educational goals and ultimately lead to effective education to create meaningful learning [20].

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The content organization includes vertical and horizontal arrangements which enriches links and learning [4]. Vertical design includes adaptation and relationship between topics and learning skills in different academic years, and horizontal design creates special relationship between and among teaching materials that integrate the education and curriculum processes [5]. The integrated design is the horizontal design method that deals with the relationship between lessons. The term *integrated* can be traced back to philosophers such as Plato and Aristotle, and in the Roman language is synonymous to the word composition [3]. Therefore, the integrated curriculum simultaneously coordinates several lessons. The integrated curriculum is classified into four separate categories, including discrete disciplinary, interdisciplinary parallelization, multidisciplinary and interdisciplinary [14].

Ahmadi [1] in the Integrated Curriculum, referring to the combination of the disciplinary structure, points to the principle of secondary function, meaning that the materials have capabilities that can serve the goals of other courses and help to achieve the goals of other courses.

Therefore, in this study, due to the principle of secondary function and attention to interdisciplinary integration, the conceptual model was designed with an integrated approach in Figure 1. The integrated approach was used in the design of the third -grade math textbook content.
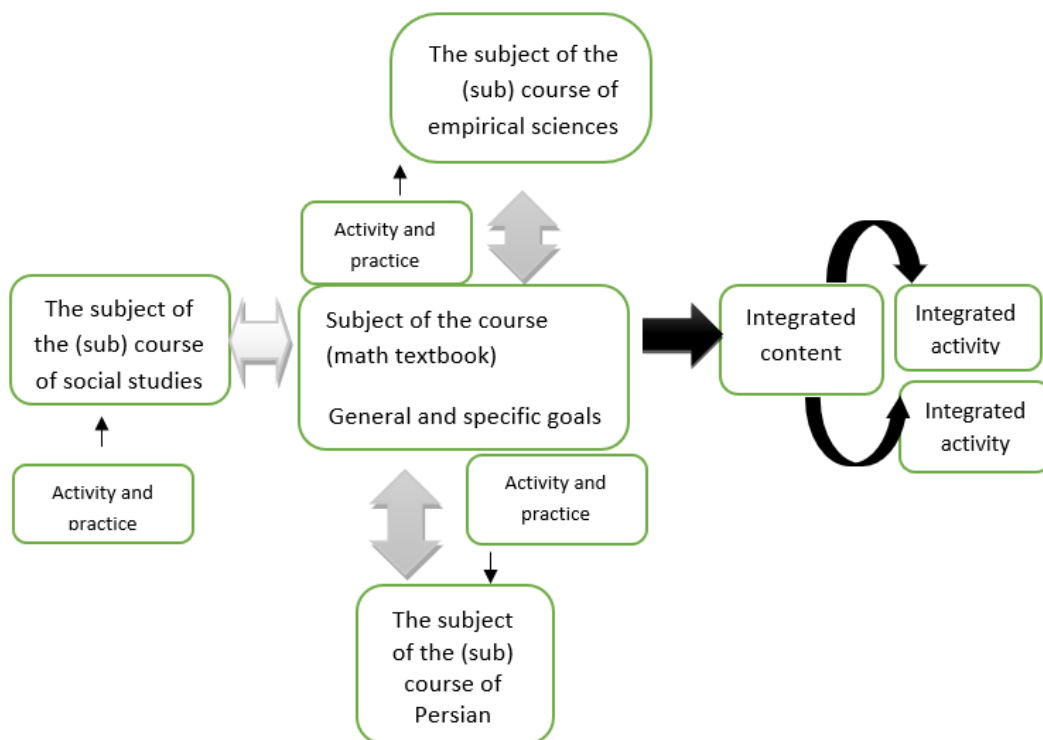

Figure 1: Conceptual Model of Research

Many field research has also focused on the role of a integrated curriculum in students development and learning along with the theories, which has shown that students have a deep understanding of the curriculum through the integrated curriculum and the improved students' attitudes, habits, the spirit of collaboration, communication, and nurtured use of various resources and life skills [2, 3, 22].

A study to examine the effect of integrated curriculum approach on the students academic achievements showed that the implementation of the Integrated Curriculum has increased the student's academic achievement score in mathematics, social studies, and Persian literature [12]. Many researchers and numerous experts confirmed the application of the integrated approach and the benefits of integrating the subjects in elementary school, including Nikitina [17]; Kontamara et al. [13] and Evers [10].

According to the research, there is a research vacuum on the design of integrated content. On the other hand, the elementary school is the most appropriate school time to adopt integrated approach, specifically the math textbook that receives special attention by teachers and families. In some cases other courses are ignored on behalf of math and the lack of attention to the integration has led the teachers to have a subject -focused look at textbooks without attention to the integrated content and the integrated teaching methods. Now, according to the evidence and studies,

it should be examined whether the integrated design of math textbook content provides students with integrated and meaningful learning of knowledge?

1.1 Research objectives

The purpose of the present two-study research is that in the first study, teachers and heads of elementary education in the city of Izeh design the third grade math textbook content based on an integrated approach, and in the second study evaluate the effect of the designed content using quantitative design.

2 Research questions

2.1 Qualitative questions

1-1 How do the elementary school teachers and heads of elementary education describe to establish horizontal connection of the third grade elementary school math textbook with the third grade elementary school Persian textbook?

1-2 How do the elementary school teachers and heads of elementary education describe to establish horizontal connection of the third grade elementary math textbook with the third grade empirical science textbook?

1-3 How do the elementary school teachers and heads of elementary education describe to establish horizontal connection of the third grade elementary math textbook with the third grade social studies textbook?

2.2 Quantitative question

1. Is there a significant difference between the integrated learning of students who were trained with integrated content and students who were trained with conventional (normal) content?

3 Research methodology

In this research, an exploratory design model has been used to determine the effect of integrated content on students' integrated learning. For this purpose, a conceptual model and in other words, a road map was designed based on the theoretical foundations of the research, using the qualitative method and qualitative content analysis. In fact, the theoretical framework helps to formulate the research plan, and based on that, the phenomenon in question is studied regularly [15].

In the following, based on this conceptual model and with the participation of 18 teachers and heads of primary education groups in the region and with the purposeful selection of 4 subjects including: Statistics, Basic Multiplication, the concept of Division and Addition of Numbers, as a targeted sample of the content of the third grade math textbook, using qualitative content analysis. In addition, a semi-structured interview with the participants, opinions of teachers and heads of educational groups was conducted to establish the connection between the content of the math textbook and other textbooks, extract and designe the content of the textbook in an integrated approach, and then the effect of this content on the students' learning was analyzed using the quantitative method and independent groups t-test. Figure 2 shows the research stages.
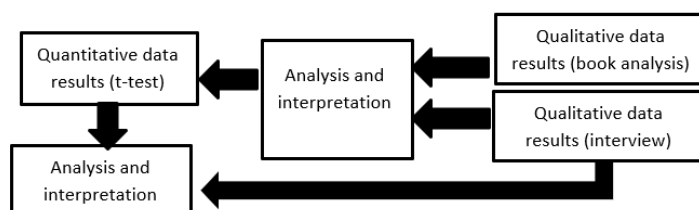

Figure 2: Data collection model of research (mixed pattern- exploratory design)

4 Research Findings

Qualitative Findings: First, according to Table 1, a description of the status of the topics discussed in the mathematical book was presented to examine the views of teachers and heads of primary education to integrate the content of the third grade elementary math textbook with Persian, science and social studies textbooks, using the qualitative content analysis method. Then the textbooks were integrated in line with the horizontal connection of the third grade elementary math textbook with Persian, science and social studies, along with qualitative analysis. The book and the extraction of the educational subjects and goals discussed in the interview process were obtained by using these results in accordance with Tables 2 to 4, questions (4.1) to (4.3).

Table 1: Describe the status of the topics raised in the third grade elementary school math textbook

Math textbook subjects	Extracted from the text and images of the book
Statistics	Weekly Program - Sports Fields- Trees Types- Seasons of the Year
Basic Multiplication	Birth of the Holy Prophet -Qur'an
Division	charity - congregational prayer- tailoring and flowering jobs
Addition	Shopping, intercity distances- vote- march

1- How do the elementary school teachers and heads of elementary education describe to establish horizontal connection of the third grade elementary school math textbook with the third grade elementary school Persian textbook?

Table 2: Horizontal content of the third grade elementary school math textbook with the third grade elementary school persian textbook

Math textbook subjects	The content selected from the Persian textbook in horizontal connection with the math subjects	The extracted objectives from the Persian textbook while teaching the math subjects	Interview -analysis code
Statistics	Text Ps. 20 and 22 (Sports)	Introduction to sports disciplines	(C1, C2, C3, C5, C6, C12)
	Text P. 10 (Praise)	Knowledge of God's blessings	(C1, C4, C8, C11, C14, C15)
Basic multiplication	Vocabulary P.40 (Song of the Sparrow)	Knowledge of personal hygiene	(C2, C3, C4, C7)
	Text P. 56 (Good deeds)	Knowledge of God's good deeds	(C9, C11, C13)
Division	Image P. 55 (poem: like rain)	Knowledge of iranian ethnicity	(C14, C17)
	Text and Image P.57 (Good deeds)	Knowledge of God's good deeds	(C1, C5, C11, C16)
Addition	Text P.23 and 44 (Sport class)	Knowledge of sports	(C1, C2, C3, C4, C5, C10, C13)
	Text P.51 (self-scarified people)	Knowledge of self -scarified people	(C3, C7, C8, C13)

According to Table 2, the viewpoints of teachers and heads of elementary education on the establishment of an integrated connection between the third grade elementary school math textbook and the Persian textbook were examined and the results showed that the content of the Persian textbook can be used in teaching math subjects such as: statistics, basic multiplication, division, addition, and subtraction so that students trained in math concepts with topics such as: sports, good deeds, self -sacrifice, personal health, and Iranian ethnicity.

The following regression pattern is used:

$$FD_t = c_0 + c_1 Y_t + c_2\, Inv_t + c_3\, Inf_t + c_4\, EPU_t + c_5\, Tr_t + e_t.$$

The dynamic error correction model offers a short-term dynamic with long-term balance without losing long-term information. The following is the interruption of the variables:

$$Y_t = aX_t + bX_{t-1} + cY_{t-1} + U_t. \tag{4.1}$$

In small samples to reduce the bias of the coefficients, we use a pattern that provides more interruptions for variables.

$$\emptyset(L, P)\mathrm{y}_t = \sum_{i=1}^{k} (L, q_i)\, X_{it} + \acute{C}W_t + U_t. \tag{4.2}$$

In the above relation y_t variables and x_t are independent variables, l interrupt operators and w -fixtures such as constant interruption outsourced variables and q are the number of interruptions used for independent variables (x_t), p number of interruptions used for variables . This pattern is called a self -regulating pattern with extensive interruptions in which we have:

$$\widehat{\emptyset}(L, p) = 1 - \emptyset_1 L - \emptyset_2 L^2 - \cdots - \emptyset_p L^p$$
$$b_i(L, q_i) = b_{i0} + b_{i1} L + \cdots + b_{iq} L^q \qquad i = 1, 2 \ldots, k \tag{4.3}$$

In this relation, the K is the explanatory variables, the model can be selected by Shwartz Bayesion Criterion, Akaike Information Criterion, Hannan Quinn Criterion, or the modified R defined coefficient Long -term coefficients of x variables are calculated from the following relation: [21].

$$\theta_i = \frac{\widehat{b}_i(L, q_i)}{1 - \widehat{\emptyset}(L, p)} = \frac{\widehat{b}_{i0} + \widehat{b}_{i1} + \ldots + \widehat{b}_{iq}}{1 - \widehat{\emptyset}_1 - \widehat{\emptyset}_2 - \cdots - \widehat{\emptyset}_p}, \qquad i = 1, 2, \ldots, k \tag{4.4}$$

The most important issue in the ARDL model is the determination of optimum interruptions. Pesaran & Shine [18] have shown that if the interruptions are suitable for the ARDL model, OLS estimates are compatible with short -term parameters and the estimates of the ARDL model in the long run. After the dynamic model estimation, we should test the presence or absence of a long -term relationship. The following hypothesis is tested to examine that the long -term relationship from this method is not false.

$$H_{0:} \sum_{i=1}^{p} \emptyset_i - 1 \geq 0$$

$$H_{1:} \sum_{i=1}^{p} \emptyset_i - 1 < 0$$

The null hypothesis expresses the absence of both accumulation or long -term relationship. In order to prove that the dynamic pattern tends to be a long-term equilibrium pattern, the sum of the coefficients of interrupted variables that appear as an explanatory variable in the model, should be smaller than one defined as follows:

$$t = \frac{\sum_{i=1}^{s} \hat{\alpha}_i - 1}{\sum_{i=1}^{s} Se\hat{\alpha}_i}$$

where, $\widehat{\emptyset}i$ is coefficients related to values with dependent variable and $s\emptyset I$ is the standard deviation of that coefficients. The above statistics are compared with the critical quantity presented by Banerjee, Dolado and Mestre [6], which if the absolute value of the above statistics is greater than the critical quantity, the hypothesis is rejected and thus proves that the dynamic pattern will be toward the long -term equilibrium pattern.

The error correction pattern connects the short -term and long -term behavior of the two variables and states that dependent variable changes are a function of deviation from the long -term relationship (which is expressed by the correction component) and the changes of other explanatory variables. This error correction pattern is obtained in terms of interruption levels and the first order difference of the variables:

$$Y_t = \alpha + \sum_{i=1}^{\rho} \widehat{\gamma}_i \Delta y_{t-i} + \sum_{i=1}^{\rho} \widehat{\beta}_i \Delta x t - i + \sum_{i=1}^{\rho} \widehat{\delta}_i \Delta z_{t-i} + \mu \Delta ECM_{t-1} + u_t \tag{4.5}$$

The error correction component is calculated from the following relation:

$$ECM_{t-1} = Y_t - \widehat{\alpha} - \widehat{\beta}_i \Delta x_t + \widehat{\delta}_i \Delta z_t. \tag{4.6}$$

The sign of error correction is usually negative that indicates the speed of correction of the error and the desire for long -term balance. In fact, this coefficient shows that at each period a few percent of the imbalance of the dependent variable is adjusted and approaching the long -term relationship Banerjee, Dolado and Mestre[6].

2- How do the elementary school teachers and heads of elementary education describe to establish horizontal connection of the third grade elementary math textbook with the third grade empirical science textbook?

Table 3: Horizontal content of the third grade elementary school math textbook with the third grade elementary school empirical science textbook

Math textbook subjects	The content selected from the empirical science textbook in horizontal connection with the math subjects	The extracted objectives from empirical science while teaching the math subjects	Interview -analysis code
Statistics	Text P. 10 to 13 (Science)	Getting to know the types of foods	(C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, 13, C14, C15, C16, C17, C18)
	Text P. 18 (materials measurments)	Materials measurments	(C1, C6, C7, C8, C11, C12, C13, C14, C17,C18)
Basic multiplication	Text P. 12 (Science)	Healthy food	(C1, C4, C6, C9, C12, C15, C16)
	Image P. 15 (Food)	Food type groups	(C2, C5, C13, C11, C15, C18)
Division	Text P. 11 (Science)	Food types	(C1, C4, C6, C9, C12, C15, C16)
	Image P. 29 (Materials measurments)	Liquid measurments	(C2, C3, C4, C10, C15)
Addition	Image P. 15 (Food)	Food groups	(C1, C5, C6, C8, C10, C15)
	Text P. 33 (materials measurments)	Measurment tools	(C1, C2,C5, C6, C7, C8, C9, C10, C11, C16, C17, C18)

According to the viewpoints of teachers and heads of elementary education on the establishment of an integrated connection between the third grade elementary school math textbook and the science textbook in Table 3, the results showed that for teaching the aforementioned mathematical concepts and topics, the science textbook content, images and activities can be used to teach students math concepts, subjects such as: foods, healthy nutrition, material measurments, material mass, measuring tools, healthy foods and the role of water in life.

3- How do the elementary school teachers and leaders describe to establish horizontal connection of the third grade elementary math textbook with the third grade elementary school social studies textbook?

Table 4: Horizontal content of the third grade elementary school math textbook with the third grade elementary school social studies textbook?

Math textbook subjects	The content selected from the social studies textbook in horizontal connection with the math subjects	The extracted objectives from social studies while teaching the math subjects	Interview -analysis code
Statistics	Text p. 10 (Apply)	The months of the year	(C1, C4, C5, C9, C12)
	P. 12 (family members lesson)	Introduction to the Family Institution	(C1, C4, C6, C13, C11, C18)
Basic multiplication	Text 14 (I love family)	Appreciate Parents	(C6, C11, C18)
	Page 42 (Apply)	Introduction to the Concept of Recycling	(C1, C2, C3, C4, C8, C10, C12, C17)
Division	Text and Picture p.26 (sharing tasks)	Family members roles	C17, C13, C8, C5, C1)
	Figure 40 (Recycling Lesson)	Introduction to the Concept of Recycling	(C1, C2, C5, C6, C9, C11, C18)

According to Table 5, the viewpoints of teachers and heads of elementary education on the establishment of an integrated connection between the third grade elementary school math textbook and the social studies textbook, the results showed that for teaching the aforementioned mathematical concepts and topics, the social studies textbook content, images and activities can be used to teach students math concepts, subjects so that students can learn about topics such as: months of the solar year, family institution, Iranian ethnicity, types of waste, waste recycling, respect for elders and proper consumption.

5 Findings of the quantitative section

In this section, for a deeper understanding, two quantitative questions were formulated and researcher-made tests were conducted to answer them.

A) Descriptive findings of the research variables: This section includes the description the research variables features. The information is presented in Tables 1 and 2.

According to table 5, the mean total scores of the pre-test academic performance of the experimental and control group students are 10.75 and 10.15, respectively, and the mean total post-test scores of the experimental and control group are 14.08 and 10.70, respectively. The total standard deviation of the pre-test is 2.20 and the total standard deviation of the post-test is 2.17. These results show that the mean scores of the pre-test academic performance of

Table 5: Frequency, mean, standard deviation, minimum and minimum pre -test scores showing academic performance among students and post -test and control group.

Test	Group	Frequency	Mean	SD	Min score	Max score
Pre-test	Experiment	15	10/75	2/22	8	15
	Control	15	10/15	2/18	7	14/50
	Total	30	10/45	2/20	7/50	14/75
Post-test	Experiment	15	14/08	2/16	9	18
	Control	15	10/70	2/18	9/5	15
	Total	30	12/39	2/17	9/25	16/5

the students in the experimental group are close to the pre-test scores of the students in the control group and do not differ much, but the mean scores of the post-test academic performance of the students in the experimental group are higher than the post-test scores in the academic performance of students in the control group.

Research question: Is there a significant difference between the integrated learning of students who were trained with integrated content and students who were trained with conventional (normal) content?

Table 6: The difference between the mean academic performance of all the students of the experimental and control groups using the t-test method of independent groups.

Stages	Group	Frequency	Mean	SD	Degree of freedom	T value	Sig.
Pre- test	Experiment	15	10/75	2/22	28	1/36	0/17
	Control	15	10/15	2/18			
Post-test	Experiment	15	14/08	2/16	28	6/10	0/001
	Control	15	10/70	2/18			

According to Table 6, the difference between the mean of the academic performance of the entire academic performance of the experimental group and the students of the control group is 1/36 and 0.17, which is not significant at the level of 0.5. These results indicate the academic performance of all the students of the experimental group and the students of the control group did not differ significantly before using the experimental variable. But the difference between the mean post -test of the academic performance of the total performance of the experimental group and the students of the control group is 6.0 and p ¡0.001, which is significant at the level of 0.5.

These results show that there is a significant difference between the post -test of the academic performance of the entire experimental group and the students of the control group, meaning that integrated content has influenced the academic performance of the total students of the experimental group.

6 Discussion and conclusion

Nowadays, what can eliminate the external boundaries between science and create unity of science to better understand scientific and social issues is actually realized in the context of a integrated curriculum. This curriculum combines a variety of ideas, synergy and meaningful learning in the educational environment. In other words, knowledge disciplines are generally organized in separate lessons, and the subjects must be selected and organized to reinforce each other [9].

In this study, the content of the third grade elementary math textbook was designed based on the integrated curriculum, and based on the results and findings of this research, it can be said that the integration of the content of the third grade elementary math textbook with other textbooks is classified into subject -centric content. The design of the integrated math textbook content has created a comprehensive, coherent and meaningful look at other third grade textbooks, in other words between the content of the third grade math textbook with Persian, social studies and sciences textbooks.

There was an intensity of science, and on the one hand the content of the math textbook was a secondary reinforcement role for learning the content of other third grade textbooks, and on the other hand, the use of other textbooks in the form of text, image and practice also led to the secondary enhancement role for the deep and meaningful learning of the math textbook.

These findings are consistent with Hashemzadeh & et al., [12], Becker & Park [7] and Costley [8], indicating the main role of horizontal connection between textbook contents in meaningful and profound learning experiences.

However, Maleki [14] results showed that discrete disciplinary advocates criticize this approach stating that each discipline has its unique structure and follows a specific methodology that is ignored by interdisciplinary approach, so it is inconsistent with these results.

In another part of the findings in describing the status of the topics raised in the third grade math textbook in Table 1, it showed that the third grade math curriculum is subject- oriented, and the discrete content of the lessons and the lack of deep link to other textbooks places the textbook in a very low integration with other textbooks contents and is far from the research pattern, which is consistent with Mohammadi [16] research results. On the other hand, the results obtained in questions 1 to 3 of the research showed that, according to Figure 2, based on the horizontal relationship of the subject matter, the third grade elementary math textbook content can be integrated with the Persian, empirical sciences and social studies textbooks content.

Accordingly, a sample of integrated activity has also been suggested, which can play the role of secondary reinforcement for integrated learning among students, which is consistent with the results of Ahmadi [1], which refers to the principle of secondary reinforcement in integrated content.
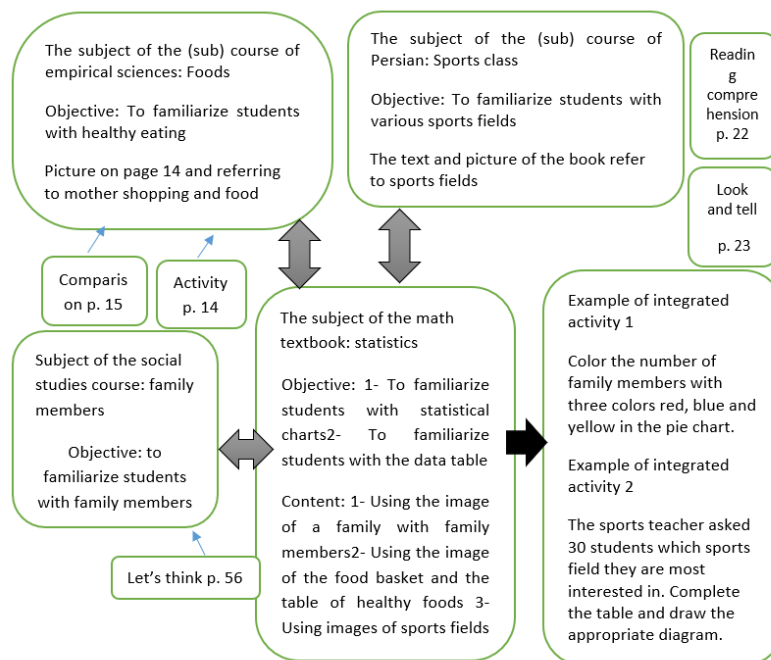

Figure 3: Horizontal relationship between the third grade elementary school math textbook content and other third grade elementary school textbooks and production of integrated content

Accordingly, another important results of this study is that elementary teachers and human resources are familiar with the concepts of integration and the role of integration content in learning and teaching, and can be a prelude to the underlying changes in the context of the curriculum, especially the math curriculum.

Practical suggestions

1- Establish a thought room with an integrated curriculum in the field of education in each district or city.
2- Use the capacity and experience of teachers, educational groups and in-service training courses to design sample content of first to sixth grade elementary school textbooks.
3- Hold knowledge-making, awareness and justification sessions for elementary school teachers.
4- Establish the school-level curriculum integration council to inform parents and use the comments and criticisms of all elementary schools in the area or city.

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