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An Analysis of the Science Curricula in Turkey with Respect to Spiral Curriculum Approach

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Abstract

This paper aims to analyze the science curricula which is being implemented in Turkey with respect to spiral curriculum approach. To carry out this analyze 3th, 4th, 5th, 6th, 7th and 8th grade education programs are analyzed correlatively based on qualitative research method. The research findings were analyzed in terms of iterative revisiting of topics in different grade levels and gradual sophistication of topics in different grade levels. According to the research findings, topics in each learning area do not appear to be represented in each grade level. Topics covered in the learning area of living beings and life are generally taught in two grade levels and not presented in more detail in higher grades. As the topics are repeated, they become more complex and detailed. In this research spiral curriculum approach is depicted based on the related literature and the science curricula in Turkey are analyzed with this respect. To understand implementation of the spiral approach in a curriculum is supposed to lead to enrich the comments to be made in this approach and also become a guide in light of these comments.
Keywords: Science education programs, content, spiral curriculum

1. Introduction

One of the necessary elements for the success of an education program is selection of a content in alignment with levels of students and presentation of it in a proper structure (Bruner, 1960) Selection of the content requires inquiring if information is significant/worth learning and if learning that content will make the individual a better adult (Bruner, 1960: 52). Furthermore, consistency of the content with scientific, artistic and philosophical information should be ensured (Demirel, 2010). Also, content and conditions of learning in an education program must be well-organized to achieve the goals. Even a satisfactory content will make learning difficult if not well-organized. Likewise, conditions of learning will not yield satisfactory results if not well-organized (Taba and Spalding, 1962: 290).

Content as in education programs is defined as 'a resource used to achieve educational goals (Varış, 1996: 114), 'a program dimension in which answers to the question 'what to teach to achieve defined goals' are sought' (Demirel, 2010:136), and 'an element serving to achieve goals' (Taba and Spalding 1962: 290). Based on these definitions, what must be done appears to be selection of a type of content that will achieve goals and presentation of that content in a organized fashion to achieve, again, the goals.

One of the most widely used approaches in organization of the content is spiral content organization. Also called 'spiral curriculum' in literature, this approach was first defined by Bruner (1960). Bruner mentions about existence of an important hypothesis underlying the spiral curriculum. This hypothesis is that "any child in some honest are expressed in the form" Bruner (1960) argues that learning crucial subjects in early ages will form a good basis for future learning, and expresses this argument as follows;

> "If the understanding of number,measure, and probability is judged crucial in the pursuit of science, then instruction in these subjects should begin as intellectually honestly and as early as possible in a manner consistent with the child's forms of thought. Let the topics be developed and redeveloped in later grades" (pp: 53-54).

However, he also adds, "curriculum ought to be built around the great issues, principles and values that a society deems worthy of the continual concern of its members". Duration of teaching we can offer to children is limited, which requires teaching of the fundamental structure of a subject area. When the fundamental structure of a subject is mastered, it will be possible to master many subjects associated with that subject. Therefore, learning the structure allows transfer of what is learned. In order to use these fundamental ideas, they must be used in sophisticated situations and deepened (Bruner, 1960, pp: 6-9). A program built around a spiral structure paves the way for proper presentation of many subjects to students in early ages. However, it is extremely important at this point to determine the essence and structure of the subject as its content to be presented to students will

expand significantly. As a matter of fact, Bruner (1961:35) stated that the structure of a subject might be characterized by its 'economy'.

Subjects in a curriculum built with a spiral structure progress from concrete to abstract, from simple to complex and from fundamental ideas to a sound comprehension (Dibasio, Clark and Dixon, 1999; Demirel, 2010; Gupta, et al, 2008). Bruner (1961:41) stated, "a teacher must consider ways of thinking of a growing small child while teaching him/her important ideas and styles, use the material by transforming it into a logical format and encourage student's progress" in the implementation of the spiral curriculum.

Bruner states that learning with tangible materials is the most fundamental learning and that it is intrinsically a proper way of learning if it is immediately followed respectively by use of visual materials and transition to symbolic materials. This way, necessary subjects can be taught in early ages by concretizing them. It may be suggested that, as the grade level increases, learning progresses from abstract to concrete in a learning spiral. Efland (1995, p:135) describes it with a model as follows:

Figure 1
Model of the Spiral Curriculum

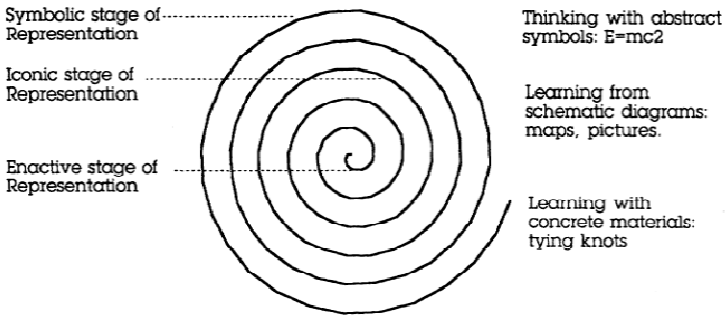

Figure 1. Model of Spiral Curriculum (Efland (1995, p:135). Directly cited from the source.

In parallel with Bruner's views, Taba (1962) argues with regard to content organization in curriculum development that students can have a 'cumulative progress' by way of a program that has increasingly sophisticated and difficult subjects and that such cumulative progress can be applied to all learning styles such as attitude, skill and thinking, and describes the importance of repetition, continued use of knowledge and reinforcement as follows:

> 'Such a cumulative spiral should provide continual reinforcement by continuing in use that which has been acquired, either through practice or through use in the new context, such as a continuity between learning and applying ideas and skills. there is no guarantee that anything learned at one time is acquired permanently, be it facts, ideas, skills, attitudes, or the power of think. reinforcement, repetition and continued use are usually needed.'(p: 297).

Beccue and Rariden (1997) that analyzed a higher education course in computer sciences in which the spiral curriculum understanding was employed defines the spiral curriculum as follows;

> 'The spiral approach to subject coverage is based on the idea that knowledge and understanding expands through multiple interconnected levels of understanding. Thus when a student is introduced to new material, it is taught in a context which relates it to other known material at the level at which that material is understood. As a result while various topics will receive a complete contextual treatment the first time they are introduced to the student, they may not receive a topically detailed treatment. The intent of this approach is to provide a framework and understanding preparatory for the time at which the topic will be revisited later in the curriculum.' (p:3).

A review of literature shows that the spiral curriculum is generally described as an approach of programming that is predicated on teaching of subjects repetitively, but in greater depth, complexity and sophistication as the grade level increases (Bruner, 1960; Harden and Stamper, 1999; Crawford and Snider, 2000; Dibasio, Clark and Dixon, 1999). A spiral curriculum's principal idea is that important information is presented to children at an earlier age in a from comprehensible for them and, as suggested by Bruner, what was learned previously will form a foundation for what will be learned later (Efland, 1995).

In Turkey, reformative program changes were introduced in elementary and middle education in 2004. Program development and implementation is supervised by the Ministry of National Education in Turkey that has a centralized education system. The Ministry of National Education defined the program developed in 2004 as a constructivist program. Also, programs are predicated on activities, and the content of the most were organized with a spiral approach. Science and technology course teaching program designed for 4th and 5th grades states, "an infrastructure has been created where the spiral principle is employed, many subjects are covered in every grade by a content that is progressively in greater depth to reinforce what is learned by way of iterative revisiting of topics in sufficient frequency' (MEB, 2005, p:11) In 2012, educational programs were also amended with the transition to the 12-year mandatory education system. In 2013, during the introduction of the amended programs, the new programs were said to still have a spiral structure, though not as much as they used to be (Please see: ERA Science Program Introduction video).

The purpose of the present study is to evaluate an application example in relation to the features of the spiral curriculum understanding. Science education programs implemented in Turkey were selected as the application example. This study was conducted to analyze the content structure of science education programs put into effect in 2005 and amended in 2013 in relation to some features of the spiral programming understanding. For this purpose, answers to the following questions were sought:

1. Are the topics revisited as the grade level increases?
2. Do the topics become more complex and sophisticated as the grade level increases?

2. Method

In the study, case study based on document analysis was used as the research method. Documents studied were 3th, 4th, 5th, 6th, 7th and 8th grade education programs (MEB, 2013) for science course in 2013. Being one of the qualitative research methods, case study is a holistic research approach that contains in-depth analysis of one or more cases (Yıldırım and Şimşek, 2011).

3. Findings

The research findings were analyzed in terms of iterative revisiting of topics in different grade levels and gradual sophistication of topics in different grade levels.

1. *Findings on iterative revisiting of topics in different grade levels*

The following table depicts the learning areas and syllabus distributions of the Science course. Learning areas and syllabi obtained from the Science Education Program published by the Ministry of National Education were analyzed.

Table 1. Learning areas and distribution of syllabi according to grade levels

		Learning Areas			
		Living Beings and Life	Matter and Change	Physical Phenomena	Earth and Universe
Grades	3	1. Syllabus: 5 senses 5. Syllabus: Journey to the World of the Living Beings	3. Syllabus: Let's Get to Know Matter	2. Syllabus: Let's Get to Know Force 6. Syllabus: Electrical Appliances in Our Life	7. Syllabus: Let's Get to Know Our Planet
	4	1. Syllabus: Living Beings and Life 5. Syllabus: Microscopic Beings and Environment	3. Syllabus: Let's Get to Know Matter	2. Syllabus: Effects of Force 6. Syllabus: Simple Electrical Circuits	7. Syllabus: Movements of Earth
	5	1. Syllabus: Let's Solve the Puzzle of our Body 5. Syllabus: Let's Travel and Learn about the World of Living Beings	3. Syllabus: Change of Matter	2. Syllabus: Measuring Magnitude of Force 4. Syllabus: Spreading of Light and Sound 6. Syllabus: Indispensable Part of Our Life: Electricity	7. Syllabus: Mystery of Earth's Crust
	6	1. Syllabus: Systems in Our Body 5. Syllabus: Reproduction, Growth and Development in Plants and Animals	3. Syllabus: Granular Structure of Matter 6. Syllabus: Matter and Heat	2. Syllabus: Force and Motion 4. Syllabus: Light and Sound 7. Syllabus: Transmission of Electricity	8. Syllabus: Our Earth, Moon and Our Life Source: Sun
	7	1. Syllabus: Systems in Our Body 5. Syllabus: Man and Environment Relationships	3. Syllabus: Structure and Properties of Matter	2. Syllabus: Force and Energy 4. Syllabus: Reflection in Mirrors and Absorption of Light 6. Syllabus: Electricity	8. Syllabus: The Solar System and Beyond
	8	1. Syllabus: Reproduction, Growth and Development in Men 5. Syllabus: Living Beings and Energy Relationships	3. Syllabus: Structure and Properties of Matter	2. Syllabus: Simple Machines 4. Syllabus: Light and Sound 7. Syllabus: Electricity in Our Life	8. Syllabus: Earthquake and Weather Events

The following may be suggested in general for the table. The same learning areas are presented over and over every year. Descriptions and order of presentation of the syllabi are similar. Leaning areas and syllabus titles reflect the features of a spiral understanding. However, when we look at the topics in the syllabi, each topic does not appear to be taught each year. Table 2 depicts iterative revisiting of topics according to grade levels:

Table 2 depicts the topics included in four learning areas. When we look at the part depicting how topics taught in the learning area of Living Beings and Life are represented in different grade levels, they appear to be generally covered in two grade levels. One topic (Controlling and Regulatory Systems) appears to be taught in 7th grade and never repeated again. The topic of man and environment is repeated almost every year. What we understand from here is that the focus is not to learn the topics in the learning area of living beings and life in the program over and over, but to render them as a foundation to better learn the topics taught in higher grades, and therefore that these topics are repeated one time. In this respect, the science programs appear to include iteration based on the the principle of the spiral curriculum that 'previous learning forms the foundation for future learning". However, it is worth answering the questions, 'to what extent less iteration affects the rate of remembering what was previously learned and does it form an effective basis for more complex conditions of learning in higher grades? '

On the other hand, the table shows that topics covered in the learning areas of matter and change and physical phenomena are repeated more in different grade levels. Particularly, of the topics in the learning area of physical phenomena, 'force', 'light and sound' and 'electricity' are taught over and over every year. In the learning area of earth and universe, only 'structure of earth' is covered in every grade except for 7th grade. Other topics, on the other hand, are to be covered at one time in different grade levels.

Table 2. Distribution of Topics According to Grade Levels

Grades	Sense Organs and Their Duties	Support and movement	Blood circulation	Respiration	Nutrients and digestion	Excretion	Cells	Controlling and regulatory systems	Reproduction, growth and development in men	DNA and genetic code	Man and Environment	Properties of matter	States of matter and change of states	Pure matter and mixtures	Heat and temperature	Physical and chemical changes	Fuels	Density	Periodic system	Chemical bond	Acids and bases	Chemical changes	Force	Light and Sound	Electricity	Mirrors	The structure of earth	Water and soil	Sun	Moon	Earthquake and weather events
3	✓										✓	✓	✓										✓	✓	✓		✓				
4		✓	✓	✓							✓	✓	✓	✓		✓						✓	✓	✓	✓		✓				
5					✓	✓					✓	✓	✓		✓	✓						✓	✓	✓	✓		✓	✓			
6		✓	✓	✓			✓					✓	✓		✓	✓	✓	✓				✓	✓	✓	✓		✓		✓	✓	
7	✓				✓	✓		✓			✓	✓		✓									✓	✓	✓	✓			✓		
8							✓		✓	✓	✓			✓		✓			✓	✓	✓	✓	✓	✓	✓		✓				✓

2. Findings on Sophistication of Topics in Different Grade Levels

When we examine the topics in the Science Education Program, the topic 'Sense Organs and Their Duties' covered under the '5 Senses' syllabus in 3rd grade is taught in greater detail and more broadly under the title of 'Sense organs' in the Syllabus of 'Systems in our Body' in 7th grade. 'Support and movement', 'respiration', 'blood circulation in the body' topics taught in 4th grade appear to be covered in greater detail in 6th grade. The topics of 'Nutrients and Their Properties', 'Digestion of Nutrients', 'Excretion in our Body' taught in 5th grade are seen to be covered again in 7th grade in greater detail under the titles of 'Digestive System and Excretory System'. Furthermore, the 5. Syllabus covering man and his/her relationship with the environment are seen to be taught almost in every grade level.

A topic covered in the learning area of 'matter and change' is repeated more than topics covered in the learning area of 'living beings and life' in different grade levels. These repetitions appear to be a little more complex progressively in each grade level. Topics starting with the definition of 'circuit elements' in initial grades under the subject of 'electricity' covered in the learning area of 'physical phenomena' become more complex with teaching how to build a new and complex circuit and factors affecting functioning of circuit components as the grade level increases. Below, objectives of some repeated topics are provided in tables that show how objectives become more sophisticated as the grade level increases.

Table 3. Objectives of Sense Organs course

	3. grade	7. grade
Sense Organs	1. Identifies sense organs. 2. Describes fundamental duties of sense organs. 3. Describes what to be done to protect the health of Sense Organs.	1. Shows and explains structures of sense organs on a model. 2. Shows the relationship between sense of smell and sense of taste with a self-designed experiment. 3. Gives examples of defects in sense organs and technologies used to eliminate such defects. 4. Discusses measures taken to protect the health of sense organs. 5. Researches the professions for sense organs and their health and discusses the importance of these professions in terms of society.

When we look at the objectives of the sense organs topic, those that are at the recognition level in 3rd grade become more detailed by covering examination of the structure of sense organs in 7th grade. As stated previously, this topic was represented in two grade levels. A topic with fundamentals taught in 3rd grade is covered in detail in 7th grade.

Table 4. Objectives of the Subjects of Characteristic Properties of Matter and States of Matter

	3. grade	4. grade	5. grade	6. grade
Characteristic Properties of Matter and States of Matter	1. Describes the fundamental properties of matter using five sense organs. 2. Realizes that touching, tasting and smelling some matters may harm the body of a living being. 3. Assumes responsibility of taking necessary safety measures while working on matters individually or as a group. 4. Classifies matters in his/her surrounding area according to their states.	1. Describes the fundamental properties of matter using five sense organs. 2. Identifies states of matter and gives examples of different states of the same matter. 3. Compares the basic properties of the states of matter. 4. Measures and compares mass and volume of different matters. 5. Describes matter using its measurable properties. 6. Designs and conducts experiments on heating and cooling of matters. 7. Conducts experiments on how matters change state with heat and interprets results. 8. Describes matter and object and explains their differences.	1. Conducts experiments on how matters change state with heat and draws conclusions based on results. 2. Identifies melting, freezing and boiling points among the distinctive features of pure matters as a result of experiments he/she conducts.	1. Understands granular, porous and mobile structure of matters. 2. Understands that porosity and mobility between particles of matters change depending on the change of state.

Table 4 shows the objectives of some subjects in the learning area of matter and change. These objectives are represented in 4 grade levels. Different facts and concepts appear to be presented from simple to complex in each class level. States of Matter and Characteristic Properties of Matter covered in 3rd grade are presented in greater detail under the same title in 4th grade.

4. Conclusion and Discussion

According to the research findings, topics in each learning area do not appear to be represented in each grade level. Topics covered in the learning area of living beings and life are generally taught in two grade levels and not presented in more detail in higher grades. Many topics in the learning area of earth and universe are also taught only in one grade level. Also, topics such as electricity, states and properties of matter and light and heat are seen to be taught in every grade level. As the topics are repeated, they become more complex and detailed. Topics in programs developed with a spiral programming understanding are repeated, each time becoming more complex as the grade level increases. It may be suggested that science education programs implemented in Turkey do not have a perfect spiral structure; in other words, have a partial spiral structure.

In this research a curriculum was analyzed with respect to spiral curriculum approach. Similarly, it can be carried out some research and comparative analyzes about spiral curricula of different countries. In addition, it can be recommended for future researchers to analyze the effectiveness of the spiral curriculum approach in achieving the objectives of a curriculum.

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