An Analysis of Science Curriculum Within the Context of Engineering and Design Skills in Turkey

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1.INTRODUCTION

With the developing technology and scientific applications, a lot of scientific knowledge is obtained, and the applications of various methods are adopted with the intention of having students acquire this scientific knowledge. For this purpose, countries implement different curricula within the process to reflect these new methods and techniques with the philosophy of their own curricula.

* The performances of the countries in the international assessments (PISA, TIMSS etc.) are effective in the changes made in the curricula. It can be said that the low performance of the students, especially in these international assessments, is effective in changing the curriculum in Turkey.

* Considering the vision of the science and technology curriculum, which has been implemented in Turkey since 2005 and included constructivism as its basic philosophy, the aim of the curriculum is to "raise all individuals as science and technology literate" (MEB, 2005). In the later period, although minor changes were made in the names and practices of science curricula, the basic philosophy was based on constructivism.

* The change in science curriculum in Turkey continued with the revision made in 2013. With this curriculum, the name of the course changed and became "Science Course" and this curriculum was implemented from the 3rd grade of primary school to the 8th grade of secondary school (MEB, 2013).

* As a result of the integration of technology more into the daily life, there was a transition to a science curriculum in which science and technological applications were at the forefront. The science curriculum currently applied in Turkey is the curriculum prepared in 2018 (MEB, 2018).

* **Constructivism and Science Education**
* In constructivism, students' prior knowledge is of great importance because students build new knowledge upon the foundation of previous knowledge. In this respect, it is important that students' prior knowledge should be determined, possible conceptual misconceptions should be revealed and thus teaching should be shaped accordingly.

* It is known that various teaching practices based on the constructivist approach are included in teaching environments. Learning circle, 5E, 7E learning models, inquiry-based teaching practices are some of these practices based on the constructivist approach. The basic approach of the Science Curriculum in existing practice in Turkey is constructed on inquiry-based learning.

* **Inquiry-based Learning and STEM Practices**
* The rapid developments in the industrial revolution made technological development and digitalization even more effective. In this process, it is of great importance for students to adapt to technological applications. In this respect, students are expected to have critical thinking skills. With critical thinking, students want to learn, see the knowledge from many perspectives, become sceptical, analyse, and make logical decisions.

* Thus, curricula should have a holistic perspective. In addition to critical thinking skills, science, technology, engineering, and mathematics applications should be linked together and thus they must be discussed together. STEM is the integration of science (S), technology (T), engineering (E), and mathematics (M) which relates to both workforce and daily life experiences. STEM education is important because people may encounter many different problems throughout their lives (Hafni et al., 2020).

2.PURPOSE OF THE RESEARCH

The study examined the science curriculum, which was put into practice in Turkey in 2018, in terms of content within the context of engineering and design skills. The philosophy of the curriculum which examined according to the theoretical foundations was explained and the reflection of this philosophy on learning outcomes was discussed at class levels.

* **3.FINDINGS**
* **1) Findings Related to the Philosophy of Science Curricula**
* It is regarded that a holistic perspective is adopted in the science curriculum. Students actively participate in the teaching environment, and it can be stated that strategies based on inquiry and knowledge transfer are adopted.

* In the process, students look at problems from an interdisciplinary approach and the learned subjects are integrated with science, mathematics, technology, and engineering applications. Thus, this philosophy aims at contributing to students' high-order thinking, product development, invention, and innovation skills (MEB, 2018).

* **2) Findings for the Analysis of Science Curriculum in terms of Engineering and Design Skills**
* The 2018 science curriculum was examined in terms of units and outcomes from the 5th to the 8th grade. However, only the units of the curriculum for the 5th and 6th grades and their outcomes are included in Table 1 (MEB, 2018).

Table 1: Learning Outcomes Related to the Engineering and Design Skills in the 2018 Science Curriculum (5th and 6th grades)

Names of 5th Grade Units	Outcomes for the Development of Engineering and Design Skills	A Total Number of Skills
The Sun, The Earth, and The Moon	-F.5.1.1.2. Prepares a model to compare the size of the Sun with the size of the Earth. -F.5.1.4.1. Prepares a model that represents the relative motions of the Sun, Earth, and Moon.	2
The World of Living Beings		
Measurement of Force and Friction	-F.5.3.1.2. Designs a model of dynamometer using simple tools. -F.5.3.2.3. Generates new ideas to increase or reduce friction in daily life.	1
Matter and Change	-F.5.4.3.2. Interprets the results by doing experiments on heat exchange by mixing liquids with different temperatures. -F.5.4.4.2. Relates examples from daily life to expansion and contraction phenomena	2
Light Emission	-F.5.5.4.2. Explores the variables that affect the full shade by experience.	2
Humans and Environment	-F.5.6.2.2. Offers suggestions for the solutions of an environmental problem in his/her immediate surroundings or in our country. F.5.6.2.3. Makes inferences for the environmental problems that will occur in the future due to human activities.	2
Elements of Electric circuit	-F.5.7.1.2. Make a diagram of the electric circuit that he has drawn	1

Names of 6h Grade Units	Outcomes for the Development of Engineering and Design Skills	A Total Number of Skills
Solar Systems and Eclipses	-F.6.1.1.2. Creates a model by ranking the planets in the solar system according to their proximity to the Sun. -F.6.1.2.3. Creates a model representing the Solar and Lunar eclipses.	2
Systems in Our Body	-F.6.2.2.1. Explains the functions of the structures and organs that make up the digestive system with models. -F.6.2.3.1. Explains the functions of the structures and organs that make up the circulatory system with models. -F.6.2.3.5. Evaluates the importance of blood donation regarding the society F.6.2.4.1. Explains the functions of the structures and organs that make up the respiratory system with models. -F.6.2.5.1. Summarizes the functions of the structures and organs that make up the excretory system by showing on the models.	6
Force and Motion	-F.6.3.2.2. Shows the relationship between distance, speed, and acceleration on a graph.	1

	[illegible]	
Matter and Heat	-F.6.4.2.2. Calculates the density of the various types of matters as a result of the experiments designed -F.6.4.3.2. Determines the criteria for the selection of thermal insulation materials used in buildings. -F.6.4.3.3. Develops alternative thermal insulation materials. -F.6.4.3.4. Discusses the importance of thermal insulation in buildings in terms of family and country's economy and the effective use of the resources. -F.6.4.4.2. Discusses the effects of different types of fuels used for heating purposes on humans and the environment. -F.6.4.4.3. Researches and reports the precautions to be taken regarding poisoning from stove and natural gas.	6
Sound and its Properties	-F.6.5.4.2. Makes predictions to prevent the propagation of sound and tests predictions. -F.6.5.4.4. Gives examples to acoustic practises. -F.6.5.4.5. Designs a setting that will set an example for the propagation of sound and acoustic practices.	3
Systems in Our Body and Their Health	-F.6.6.1.1. Explains the nervous system and the functions of the central and peripheral nervous system on a model. -F.6.6.1.4. Based on research data, discusses what should be done to be able to overcome adolescence period healthily. -F.6.6.2.1. Explains the structures of sensory organs on a model. -F.6.6.2.4. Discussed the precautions to be taken to protect the sensory organs' health.	4

* 4.RESULTS AND DISCUSSON

* It is seen that the learning outcomes based on inquiry in the science curriculum include practices that make the students active and bring their exploratory skills to the forefront. The basic philosophy of the curriculum has already included the constructivist approach. Students are required to design, acquire life skills, and develop entrepreneurial skills in the curriculum in which STEM applications are integrated with the subject content.

* Students are supported by some state institutions (TÜBİTAK and etc.) to present their studies carried out under the guidance of their teachers throughout the year. Students present the materials they have prepared in the lessons at the science festivals that are requested to be held at the end of the semester.

* Thus, everyone becomes aware of the studies carried out at every grade level and social constructivism, a dimension of constructivism, is put into practice. In general, it can be stated that the science curriculum reflects the philosophy of constructivism and there are sufficient outcomes in terms of engineering and design skills.

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