TÜRK FEN EĞİTİMİ DERGİSİ
Yıl 14, Sayı 4, December 2017

Journal of
TURKISH SCIENCE EDUCATION
Volume 14, Issue 4, December 2017

http://www.tused.org

Turkish Early Childhood Education Curriculum from the Perspective of STEM Education: A Document Analysis

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Received: 23.12.2016 **Revised:** 01.04.2017 **Accepted:** 20.04.2017

The original language of article is English (v.14, n.4, December 2017, pp.16-34, doi: 10.12973/tused.10210a)

ABSTRACT

The current study aimed to examine Turkish early childhood education curriculum prepared for 36–72 month children relative to science, technology, engineering, and mathematics (STEM) education. To that end, 240 developmental features, 65 objectives, and 230 indicators under developmental fields in the curriculum and 40 sample activities in a teacher activity book were analyzed by adopting content analysis. The data were analyzed in the light of "A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas" developed by the Committee on a Conceptual Framework for New K–12 Science Education Standards within the National Research Council. Analyses revealed that the curriculum and teacher activity book included core ideas and concepts related to STEM education and it had most of the characteristics of STEM education. Finding out the existence of STEM education-related aspects of the early childhood education curriculum inspires conducting further studies that will help early childhood educators', academicians', and policy makers' focus on integrating and implementing STEM education practices not only in Turkey but also in countries adopting similar early childhood education curriculums.

Keywords: STEM education, early childhood curriculum, policy.

INTRODUCTION

The STEM acronym is used to focus on an understanding of the integrated nature of the disciplines of science, technology, engineering, and mathematics as well as their importance in the long-term academic success of children, economic well-being (Quigley & Herro, 2016), and development of communities (Han, Rosli, Capraro & Capraro, 2016). STEM education embraces grades from preschool to the post-doctoral level and learning settings of formal (e.g., classrooms) and informal (e.g., afterschool programs) education (Gonzalez & Kuenzi, 2012). To illustrate, STEM education has been recognized in the U.S. as an important educational reform and described as an instructional approach to prepare children for the current century's global economy (Yakman & Lee, 2012).

Raising innovative minds underlies the future wealth of countries, and STEM education helps societies raise children who have innovative mentalities (Corlu, 2012). STEM education

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© ISSN:1304-6020

eliminates the complications of a widely used education system that segregates these four disciplines separately into a transdisciplinary curriculum (Guyotte, Sochacka, Constantino, Walther & Kellam, 2014). On the contrary, STEM integrates these four disciplines through the use of real-world practices (Vasquez, Sneider & Comer, 2013). Concordantly, Stohlmann, Moore, and Roehrig (2012) emphasize that current research conducted in the field of curriculum development highlights that much of the latest and most worthwhile knowledge necessitates more than one discipline. In this regard, STEM education is of capital importance in the sense of facilitating transformation of theoretical knowledge to practice and product (Akgunduz et al., 2015) by being an integrated approach (Stohlmann et al., 2012). Consequently, educators, including STEM educators, might set goals of providing learning experiences that are realistic, collaboration-initiating, and thinking-oriented and that foster real-world problem solving (Siew, Amir & Chong, 2015).

An efficient STEM instruction benefits from children's early desire to investigate and experience (National Research Council [NRC], 2011). Hence, the base of STEM education goes back to early childhood years (Moomaw, 2013). Indeed, each young child is an eager STEM investigator who is inclined to find out and invent. In the early years, the growing child is more interested in the magic of mathematics and science. For example, s/he may wonder about how people get an idea on how the weather will be a few days later (Wynn & Harris, 2012). In addition to being the first adopters of technological devices (STEM Smart Brief, 2013), they are endowed with curiosity, creativity, critical thinking, and cooperation, which are the essential characteristics of learning in STEM education (Chesloff, 2013). While constructive play like block play lay the foundations of engineering in early years, the main principles of earth sciences are learned by means of some activities such as the observation of weather and experiences with water and mud. In addition, young children start to learn some skills such as number sense, critical thinking, scientific inquiry, and problem solving, which are the basics for gaining STEM concepts, in their early childhood years (Aldemir & Kermani, 2016). Indeed, research indicates that 50% of cognitive development, which is a foundation for problem solving, scientific inquiry, and critical thinking skills (Clements & Sarama, 2000), progresses until the age of four (Shonkoff & Phillips, 2000). In these early years, experiences have an extreme impact on a wide range of skills that children learn and improve later in life (Aldemir & Kermani, 2016; Fidan & Erden, 1993; Ministry of National Education [MoNE], 2013; National Association for the Education of Young Children [NAEYC], 2010; Oguzkan & Oral, 2003). For instance, future academic achievement of children is directly associated with language; early literacy; mathematics; and social, emotional, and cognitive skills gained through early childhood education (ECE) programs (NAEYC, 2009; Entwisle & Alexander, 1998). Therefore, to gain not only necessary skills but also necessary knowledge, attitudes, and habits, an education program that is a guide for a well-planned education and guidance services has great significance in helping children in early ages (Aral, Kandır & Yaşar, 2001).

As Ong et al. (2016) emphasized, every child should be exposed to STEM opportunities from their early ages, participate in inquiry-based learning in collaboration with their peers, and have the opportunity to solve real-life problems. On the other hand, in literature, it is stated that early childhood educators have got a common question: what should be learned to help young children become ready for school and be successful at school as well as be good academically? As proposed, all these outcomes can be reached after implementing a certain curriculum (Katz, 2010). In preference, an answer for the stated question of the teachers might be provided for early childhood educators via focusing on STEM education. It is claimed that well-planned, stimulating, and developmentally appropriate STEM activities help preschoolers to have high levels of STEM understanding (Aldemir & Kermani, 2016).

In recent years, STEM education in early childhood years has become one of the major research areas in early childhood education (Aldemir & Kermani, 2016; Aronin & Floyd, 2013; Bagiati & Evangelou, 2015; Beede et al., 2011; Katz, 2010; Lindeman, Jabot & Berkley, 2013; Moomaw & Davis, 2010; Ong et al., 2016; Sharapan, 2012; Sullivan, Elkin & Bers, 2015; Xu, 2008). Studies concerning STEM education conducted in Turkey mostly aimed to introduce STEM education (Corlu, Capraro & Capraro, 2014; Navruz, Erdogan, Bicer, Capraro & Capraro, 2014; Sahin, Ayar & Adıgüzel, 2014; Yamak, Bulut & Dündar, 2014) and to reveal STEM conceptualizations of teachers (Akaygun & Aslan-Tutak, 2016; Corlu & Corlu, 2012). All in all, to our best knowledge, a limited number of studies have been carried out on early childhood STEM education in Turkey (Soylu, 2016). When STEM education initiatives are investigated in Turkey, it is observed that STEM practices vary depending on school grades (elementary education, secondary education, and high school), types of schools, and teacher characteristics (Corlu, Capraro & Capraro, 2014). Moreover, some community-based activities are encountered such as the STEM project initiated in 2014 by the Kayseri Provincial Directorate for National Education and the STEM project targeting disadvantaged students, particularly girls, prepared by İstanbul Aydın University. However, these projects mostly focus on elementary and higher grades rather than preschool children. What is more, Turkey National Contact Points in the Scientix project (General Directorate of Innovation and Educational Technologies (YEGITEK)) have performed some promotion activities (Scientix Science and Mathematics Education Conference, MoNE, performed Scientix workshops, social media online promotions, online webinars, etc.). In this project, Turkey takes place under the liability of the General Directorate of Innovation and Educational Technologies (MoNE, 2016). Even if all these initiatives are crucial to the development of STEM education in Turkey, as Soylu (2016) emphasized, there is a need for projects, initiatives, and scientific research that integrates STEM into ECE curriculums. In a similar way, as Corlu (2014) stressed, coming leading research subject areas that would be conducted within the scope of STEM education in Turkey might be the examination of the contents of the curriculum and textbooks. In addition, offering a route map and implications concerning STEM education in Turkey, Akgunduz et al. (2015) stressed that national standards about how STEM education might be integrated into the current curriculum should be determined. Respectively, in the STEM Policy Report revealed by MoNE (2016), it is stated that an emergent STEM action plan should be started. The proposed plan is composed of the following five steps:

1. Establishing STEM education centers
2. Conducting STEM education research with the cooperation of universities at these centers
3. Training teachers in a way such that they can adopt the STEM education approach
4. Updating curriculum in a way such that it could involve STEM education
5. Creating teaching environments for STEM education and providing course materials to schools (MoNE, 2016, p. 31).

Although the first two steps have been partly accomplished by some initiations, there is still a need for developing a policy to train teachers and update the curriculum as well as the need for a policy to create learning environments and materials for STEM education.

In line with the policy goals and needs of Turkish MoNE, STEM education research revealed that STEM education is scarcely integrated into early childhood curriculum (Aldemir & Kermani, 2016). Moreover, present data on young children’s school readiness and their achievements in the fields of science and mathematics signify that we are failed to satisfy required support our children for being “STEM Smart” (STEM Smart Brief, 2013). According to Aldemir and Kermani (2016), the reasons for the bare integration of STEM education and low achievement in STEM disciplines might be partly related with inadequate professional development of teachers in relation to STEM education since the quality and effectiveness of teachers have a great effect on students' educational experiences (Epstein & Miller, 2011; Nathan, Tran, Atwood, Prevost & Phelps, 2010). By considering the Turkish government's policy attempts on STEM education while at the same time referencing the needs of early childhood educators about how to focus on STEM education in their learning environments, it is found crucial to examine currently applied ECE curriculum in terms of the possibility of adapting it to STEM education before any curriculum integration policy developed in early childhood STEM education.

In this way, this qualitative study was conducted with the aim of examining the content of the ECE curriculum prepared by the Turkish Ministry of Education (MoNE, 2013) in detail in terms of similar and different characteristics with the STEM education approach. In addition, this study intended to investigate the availability of Turkish ECE curriculum for STEM integration. Providing an analysis document reached by scientific methods for experts who study STEM education in early childhood years signifies the importance of the current study. For the mentioned purposes, the answer to the below mentioned research question (RQ) was searched:

RQ: Does the Turkish ECE curriculum (curriculum booklet and curriculum activity book) include characteristics overlapping with the STEM education approach?

a) Common Characteristics of the Turkish ECE Curriculum with STEM Education

The ECE curriculum applied in Turkey intends to enhance the welfare of Turkish citizens and society and support and accelerate economic, social, and cultural development by raising citizens whose personality and traits are promoted evenly and healthily in physical, mental, moral, psychological, and emotional terms. It also aims to raise individuals who are able to think freely and scientifically as constructive, creative, and productive individuals in order to make the Turkish nation a prominent member of contemporary civilization (MoNE, 2013). For detailed information about the major characteristics of ECE curriculum applied in Turkey, please see Table 1.

According to the program, early childhood education is built on some basics that focus on the development of children's imagination and creative and critical thinking skills as well as the ability to express their feelings (MoNE, 2013). The above-mentioned skills are found relevant with the characteristics of preschool STEM education. Indeed, Katz (2010) stated that resources and opportunities that lead young children to explore, investigate, and develop their existing abilities should be provided to children. Similarly, in STEM education, each child is an active learner who constructs his/her knowledge by experiencing their environment and engages with solving real-world problems (Yakman & Lee, 2012). STEM education defends that each child is born an investigator (NRC, 2007), and exploration, experimenting, problem solving, and measuring are indispensable parts of their learning (Sharapan, 2012).

The Turkish MoNE 2013 ECE curriculum is prepared taking into consideration the necessity of appropriate learning environments including whole child, family, school, and community contexts. In the program, schools are expressed as primary agents, providing developmentally appropriate learning environments for children and creating parental involvement environments (Demircan & Erden, 2015). Moreover, the program is spiral in terms of approach and eclectic in terms of model. It has a progressive characteristic since it aims to develop children in all developmental areas with respect to their developmental levels, interests, and needs (MoNE, 2013). In a similar way, hierarchical structures, which depend on prior knowledge to identify future understanding, mostly provide a basis for STEM subjects (STEM Smart Brief, 2013). Since individuals may continue to learn scientific subjects throughout their lives, learning can progress from early childhood to 12th and higher grades. Indeed, such progression relies on earlier understanding and promotes increasingly sophisticated knowledge (NRC, 2012).

Table 1. *Major characteristics of Turkish ECE curriculum*

Curriculum Documents	Main Characteristics	Explanation
Curriculum Booklet (111 pgs)	Developmental Characteristics and Objectives and Indicators	The program aims to promote social, emotional, motor, cognitive, language, and self-care aspects. For each developmental area, it is aimed that children are supported through objectives which are necessary to reach and through indicators which are the observable form of these objectives.
	Setting and Learning Centers	Learning centers include different materials chosen regarding objectives and indicators of activities in daily plan. According to the program, the main learning centers in an early children classroom are the block center, dramatic play center, art center, book center, music center, and science center.
	Activities	Structured, semi-structured, or non-structured Turkish language, art, drama, music, movement, play, science, mathematics, and preparation for reading and writing are the types of activities proposed to be conducted in classrooms. These activities can be conducted in an integrated way individually or in small or large groups. Both the outdoors and the indoors can be used as a setting for the activities.
	Monthly Education Plan	It serves as a guide for teachers since it is a plan including special occasions, parent involvement activities, assessment processes, concepts, objectives, and indicators that will be used to prepare integrated activities.
	Daily Education Flow	The plan in which teachers give information regularly about what to do on that day. It includes routine activities such as starting time for the day, play time, activity time, assessing the day, nutrition, and relaxation time.
	Assessment of Children	Development observation forms and development reports are offered as some sorts of assessment of young children. Moreover, teachers are offered to prepare a Development File that covers children's works selected by them and letters coming from parents, children's developmental observation forms, and developmental reports.
	Assessment of the Program	Activities made during the school day and the daily education process are assessed through activity-related speeches, work sheets, presentations, memory cards, drawings, exhibitions, posters, and photographs. Moreover, a monthly plan and activities that are prepared and applied by teachers are essential for assessing the program. These daily assessments shed light on assessing the monthly plan.
	Self-Assessment of Teacher	Self-assessment of teachers is expected to be conducted by teachers, which promote their motivations and improve their creativity and strength.
Curriculum Activity Book (91 pgs)	40 Activities for 48–72 month children	In the booklet, there are integrated and exemplary activities for 36–48, 48–60, and 60–72 month children. For each activity, related objectives, indicators, materials, new words, concepts, learning process, suggestions for assessment of children, parent involvement ideas, and adaptation for children with special needs in the classrooms are stated.

Note: The appendix of the program book is comprised of a development observation form, a development report, a format for the monthly education plan, a format for the activity plan, a situation chart related to allow for concepts in monthly education plans, a situation chart related to allow for objectives and indicators in monthly education plans, a list of special occasions, a format for halftime daily education flow, a format for fulltime daily education flow, an exemplary halftime daily education flow, and points to take into consideration in supporting children with special needs.

In addition, the curriculum gives great importance to play-oriented learning, which helps children think critically, make plans, test their practices, express themselves, ask questions, make investigations, and solve problems and discuss them to obtain results. Similarly, approaches like play-based learning, which supports firsthand experiences, active participation, and learning through experience, can be offered as appropriate ways of STEM implementation in early childhood education (Soylu, 2016). Indeed, play can be transmitted into a learning experience if teachers purposely plan STEM experiences concentrated on core concepts and skills, allow children to explore and reflect their theories, and explore more by means of open-ended questions posed by them (STEM Smart Brief, 2013).

As previously mentioned, the Turkish ECE curriculum and STEM education adopt some common principles. This study offers a response to the question of to what extent these principles coherent with STEM education were reflected in the content.

METHODS

a) Research Design

In the present study, the Turkish ECE curriculum (curriculum booklet and curriculum activity book), which guides early childhood education practices in Turkey, was examined within the scope of STEM education by using the content analysis method. Content analysis is a research technique that enables researchers to investigate human behaviors indirectly by analyzing their products such as textbooks, articles, newspapers, advertisements, songs, political statements, novels, pictures—virtually all types of communication. Moreover, through the examination of professional and general publications, content analysis facilitates investigating changing trends in education (Fraenkel, Wallen & Hyun, 2012). Similarly, in this study, the MoNE early childhood education curriculum revised in 2013 was investigated with regards to STEM education.

b) Data Collection

The data were collected in the light of "A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas" developed by the Committee on a Conceptual Framework for New K–12 Science Education Standards (2012) within the National Research Council. Indeed, during the data collection process, some steps were followed. Even if all four researchers were English speaking, their native language is Turkish. Therefore, as a first step, the framework was translated into Turkish by the researchers to strengthen the possibility of researchers' consensus on the meaning and indicators of practices, crosscutting concepts, and disciplinary core ideas. Secondly, codes were assigned to each of the practices, crosscutting concepts, and disciplinary core ideas according to their titles and subtitles. For instance, "asking questions and defining problems" under the title of "Scientific and Engineering Practices" was named "8Main1," while "cause and effect: mechanism and explanation" under the title of "Crosscutting Concepts" was named "Inter2" (see Table 2). Then, each code was searched in the curriculum booklet and curriculum activity book and marked in the related parts of the documents. Lastly, codes found in the curriculum booklet and curriculum activity book were counted separately for each of the documents.

In this way, all developmental features, objectives, and indicators toward five developmental fields; each information under the headings of planning and practicing early childhood education (learning centers and activity types) and assessment of early childhood education (assessment of children, assessment of program, and self-assessment of the teacher), which can be a guide for early childhood educators in the curriculum; and sample activities in the teacher activity book constituted the units of analysis of the study. In this context, 240 developmental features, 65 objectives, and 230 indicators under five developmental fields (cognitive development, socio-emotional development, language development, motor development, and self-care skills) in curriculum and 40 activities in the teacher activity book were examined using the prepared codes.

c) Data Analysis Procedure

As in data collection, the framework ("A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas") (NRC, 2012) guided the data analysis process of this study. The framework, prepared by 18 members who are known worldwide in their special fields (Next Generation Science Standards [NGSS], 2013) by examining various science standards at the national and international levels (Schweingruber, Quinn, Keller & Pearson, 2013), defines a new understanding of science education established on scientific evidence. In addition, the framework sketches the knowledge and skills that should be obtained by all students from kindergarten to the end of 12th grade (NGSS, 2013). In this regard, the aim of the development of this framework is to assure the appreciation of all students toward the beauty and fascination of science and their possession of enough knowledge about science and engineering to address public discussions on relevant issues. Moreover, this framework aims to ensure that all students carefully use scientific and technological knowledge connected with their daily life, maintain their learning in relation to scientific issues outside school, and have the competences to begin careers preferred by them containing STEM disciplines (NRC, 2012).

In this study, there were two major reasons for choosing this framework as a guide for the study. Firstly, the framework was developed by adopting some principles overlapping with the main characteristics of the Turkish ECE curriculum. For instance, the framework views children as innate investigators. In fact, from their earliest years, children construct their own ideas related to the social, biological, and physical worlds and those worlds' ways of working. According to the framework, by listening to them and paying attention to the students' ideas, an early childhood teacher can utilize what his/her students already know or can do in order to form a base for their future learning and understanding. In addition, the framework defends that experiences establish, expand, and refine knowledge. Therefore, not only knowledge but also practice is very important for children's learning in science and engineering (NRC, 2012). In a similar manner with those two principles, originating in what the child knows and enabling the child by experimenting is also one of the main principals of the Turkish ECE curriculum (MoNE, 2013). Correspondingly, the framework adopts that a successful science education is based on capturing and keeping children's attention and interests. This can be achieved through learning experiences connected with their own interests and their daily lives and curriculums considering children's needs and interests (NRC, 2012). Indeed, the fourth and fourteenth principles of the Turkish early childhood curriculum touched on the same point. According to these principles, learning activities should be prepared by taking children's needs and interests into consideration, and the curriculum should be prepared by considering the characteristics of the surrounding environment (MoNE, 2013). On the other hand, the framework is established on an education insight that defends that education should encourage children to ask questions or identify problems; seek for answers or solutions; plan investigations; and obtain, assess, share, and discuss information (NRC, 2012). Providing maximum amount of learning opportunities for children by means of planning, designing, interrogating, investigating, communicating, and producing is also one of the characteristics of the Turkish ECE curriculum (MoNE, 2013). By considering these common points, this framework was selected as the base for this study.

The second reason for selecting this framework for serving as a base for this study was related to the emergence of the STEM approach in the United States. Indeed, STEM was first introduced by the National Science Foundation in 2000 in the United States, but over time, it has begun to be recognized worldwide. Indeed, this framework has been utilized in the United States, the place where STEM education was born, as a guide for taking steps in the improvement of STEM education. For instance, K-12 science standards were determined (NGSS, 2013) and a large number of curriculums were developed in light of this framework (e.g., Corvo, 2014; Facchini, 2014). On the other hand, in Turkey, even if integrating STEM education into Turkish education curriculums is one of the aims of the five-year progress plan, unfortunately no national framework for adaptation has been developed yet. Indeed, for the sake of developing worldwide Turkish national science education standards, the use of a globally used framework like “A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas” might be considered as a starting point. Without doubt, for early childhood STEM learning, use of the framework will be a starting point to create a Turkish national framework. Therefore, the framework that has been widely used in the United States was used as a guide for this study.

The framework includes three main dimensions regarded as scientific and engineering practices, crosscutting concepts, and core ideas concerning science education (NRC, 2012, p. 3). In the present study, data were analyzed by searching the codes in light of these dimensions in the Turkish ECE curriculum. Indeed, these three dimensions and their sub-dimensions in the framework constituted of coding categories (see Table 2). For the teacher activity book, basic scientific skills were investigated because the booklet includes development areas and outcomes that are related to skills planned to make young children gain. In a similar way, crosscutting concepts were investigated for the teacher activity book because crosscutting concepts can be easily investigated in exemplary cases like activities. In both the teacher book and activity book, basic scientific skills are investigated because they are considered as cores of STEM learning (see Table 2).

Three researchers who are early childhood education specialists and have focused their studies on STEM education in early childhood examined the data independently. Then, those three researchers who coded the teacher activity book and an objective researcher put the codes in their final form by coming together. The same process was followed for the curriculum. At the first meeting of the coders, a consensus was built on the codes at the ratio of 75% for the curriculum and 66% for the teacher activity book. Since an agreement of over 70% was not reached between the coders for the teacher activity book, they had a discussion on the differences. After their discussions, they reviewed the data and came together again. At the second meeting, a consensus was reached between the coders at the ratio of 79%. Lastly, by using the Statistical Package for Social Sciences (SPSS, version 22.0 for Windows) program, the frequencies and distribution of each coding category on the coded materials were obtained.

Table 2. *Three dimensions of the framework that constitute coding categories*

Coding Categories	*Codes*	*Coded Document*
1. Scientific and Engineering Practices		
Asking questions and defining problems	8Main1	Curriculum
Developing and using models	8Main2	
Planning and carrying out investigations	8Main3	
Analyzing and interpreting data	8Main4	
Using mathematics and computational thinking	8Main5	
Constructing explanations and designing solutions	8Main6	
Engaging in argument from evidence	8Main7	
Obtaining, evaluating, and communicating information	8Main8	
2. Crosscutting Concepts		
Patterns	Inter1	Curriculum & Teacher Activity Book
Cause and effect: Mechanism and explanation	Inter2	
Scale, proportion, and quantity	Inter3	
Systems and system models	Inter4	
Energy and matter: Flows, cycles, and conservation	Inter5	
Structure and function	Inter6	
Stability and change	Inter7	
3. Disciplinary Core Ideas		
Physical Sciences	DP	Teacher Activity Book
Matter and its interactions	DP1	
Motion and stability: Forces and interactions	DP2	
Energy	DP3	
Waves and their applications in technologies for information transfer	DP4	
Life Sciences	DL	
From molecules to organisms: Structures and processes	DL1	
Ecosystems: Interactions, energy, and dynamics	DL2	
Heredity: Inheritance and variation of traits	DL3	
Biological evolution: Unity and diversity	DL4	
Earth and Space Science	DES	
Earth's place in the universe	DES1	
Earth's systems	DES2	
Engineering, Technology, and Applications of Science	DET	
Engineering design	DET1	
Links among engineering, technology, science, and society	DET2	

FINDINGS

a) Findings regarding the ECE Curriculum Booklet

The present study aimed to examine the content of the Turkish ECE curriculum (MoNE, 2013) prepared for 36–72 month children in terms of STEM education. As summarized in Table 3, eight scientific and engineering practices were given place in the curriculum. However, "asking questions (for science) and defining problems (for engineering)," and "using mathematics and computational thinking" (17.3%) were the two most touched principles in the curriculum. On the other hand, "planning and carrying out investigations" (8.6%) (NRC, 2012, p. 3) was the principle that was given the lowest place. The distribution of and some examples signifying the existence of the eight main scientific and engineering practices in the curriculum are presented in Table 3.

Table 3. *Distribution of eight main practices across the curriculum*

Curriculum	*Eight Main Practices*	*n*	*f (%)*	*Sample Citations (MoNE, 2013)*
	• Asking questions (for science) and defining problems (for engineering)	8	17.3	Children should be able to develop and test their hypotheses, to reason and solve problems (Types and explanations of activities, Mathematics activities, p. 43)
	• Developing and using models	5	10.8	…be able to do three-dimensional works (Types and explanations of activities, Art activities, p. 45)
	• Planning and carrying out investigations	4	8.6	S/he offers diverse solutions to the problem, chooses one of these solutions, and says the reason for his/her choice (Objectives and indicators, Cognitive development, Objective 14)
	• Analyzing and interpreting data	5	10.8	Preparing a weather condition board (Types and explanations of activities, Science activities, p. 48)
	• Using mathematics and computational thinking	8	17.3	S/he does additions and subtractions by using objects (Objectives and indicators, Cognitive development, Objective 16)
	• Constructing explanations (for science) and designing solutions (for engineering)	5	10.8	S/he produces solutions to the problems (s/he offers various solutions to the problem, selects one of the solutions, says the justification of the selected solution, selects another solution when s/he does not come to the solution, offers creative solutions to the problem) (Objectives and indicators, Cognitive development, Objective 19)
	• Engaging in argument from evidence	6	13.0	S/he explains the cues concerning her/his prediction, examines the real condition, and compares the prediction with the real condition (Objectives and indicators, Cognitive development, Objective 2)
	• Obtaining, evaluating, and communicating information	5	10.8	S/he pays her/his attention to object-condition-event and explains in detail (Objectives and indicators, Self-care skills, Objective 1)
Total		46	100	

When objectives and indicators that presented each developmental field were examined, results indicated that the eight main practices mostly accumulated on the cognitive development field. In fact, all of the eight main practices took place in the cognitive developmental field (95.9%), while only "constructing explanations (for science) and designing solutions (for engineering)" (NRC, 2012, p. 3) was included in self-care skills (4.1%). However, none of the language, social–emotional, motor, and self-care skills developmental fields are associated with the eight main practices of the framework (see Table 4).

Table 4. *Distribution of eight main practices in the developmental fields.*

Curriculum	Eight Main Practices	Developmental Fields				
		Cognitive	Language	Social–Emotional	Motor	Self-Care Skills
	• Asking questions (for science) and defining problems (for engineering)	5	0	0	0	0
	• Developing and using models	4	0	0	0	0
	• Planning and carrying out investigations	4	0	0	0	0
	• Analyzing and interpreting data	6	0	0	0	0
	• Using mathematics and computational thinking	11	0	0	0	0
	• Constructing explanations (for science) and designing solutions (for engineering)	7	0	0	0	2
	• Engaging in argument from evidence	5	0	0	0	0
	• Obtaining, evaluating, and communicating information	5	0	0	0	0
Total		47	0	0	0	2
f (%)		95.9	0	0	0	4.1

In addition, results indicated that crosscutting concepts were also involved in the curriculum. The most mentioned concepts were "scale, proportion, and quantity" (20.4%) and "stability and change" (20.4%), while "patterns" (6.8%) (NRC, 2012, p. 3) was the least mentioned concept. Table 5 summarizes sample citations and distribution of crosscutting concepts on the data obtained in the curriculum.

Table 5. *Distribution of crosscutting concepts in the curriculum*

Curriculum	Crosscutting Concepts	n	f (%)	Sample Citations (MoNE, 2013)
	• Patterns	3	6.8	S/he creates patterns by using objects (Objectives and indicators, CD, Objective 14)
	• Cause and effect: Mechanism and explanation	5	11.3	S/he says the reasons and results of other people's feelings (Objectives and indicators, SED, Objective 4)
	• Scale, proportion, and quantity	9	20.4	S/he says the proportion of objects or entities (Objectives and indicators, CD, Objective 5)
	• Systems and system models	7	15.9	S/he completes the missing pieces in a picture by looking at the example (48–60 month developmental features, CD)
	• Energy and matter: Flows, cycles, and conservation	5	11.3	Examining natural and unnatural materials (Types and explanations of activities, Science activities, p. 48)
	• Structure and function	6	13.6	S/he says the intended use of objects and entities (Objectives and indicators, CD, Objective 5)
	• Stability and change	9	20.4	S/he makes balanced movements (Objectives and indicators, MD, Objective 2)
Total		44	100	

When the distribution of crosscutting concepts in each developmental field and their objectives and indicators were examined, results indicated that, as in the eight main practices, crosscutting concepts were mostly concentrated in the cognitive development field (90.9%). On the other hand, signs of "cause and effect: mechanism and explanation" were found in social–emotional development (3.6%) and "stability and change" were found in motor development (5.4%) (see Table 6).

Table 6. *Distribution of crosscutting concepts in the developmental fields.*

Curriculum	*Croscutting Concepts*	*Developmental Fields*				
		Cognitive	*Language*	*Social–Emotional*	*Motor*	*Self-Care Skills*
	• Patterns	5	0	0	0	0
	• Cause and effect: Mechanism and explanation	7	0	2	0	0
	• Scale, proportion, and quantity	11	0	0	0	0
	• Systems and system models	9	0	0	0	0
	• Energy and matter: Flows, cycles, and conservation	6	0	0	0	0
	• Structure and function	7	0	0	0	0
	• Stability and change	5	0	0	3	0
Total		50	0	2	3	0
f (%)		90.9	0	3.6	5.4	0

b) Findings regarding Curriculum Activity Book

The codes related to crosscutting concepts were searched not only in the curriculum but also in the curriculum activity book. According to the results, the activity book included a great number of findings concerning STEM education. However, it was found that the distribution of these concepts was quite scattered among the activities. Indeed, the "scale, proportion, and quantity" concept constituted more than half of the distribution (52%), while there were a limited number of activities addressing "energy and matter" (2%), "stability and change" (3%), and "systems and system models" (4%) (NRC, 2012, p. 3) (see Table 7).

Table 7. *Distribution of crosscutting concepts in the activity book*

Activity Book	*Crosscutting Concepts*	*n*	*f (%)*	*Sample Citations (MoNE, 2013)*
	• Patterns	8	8	Children sort the balls from big to small, from soft to harsh, and from light to heavy (Activity 12).
	• Cause and effect: Mechanism and explanation	18	18	Children say the reason for their predictions (Activity 3).
	• Scale, proportion, and quantity	52	52	Children talk about magnitudes, shapes, and similar and different aspects of foams (Activity 1).
	• Systems and system models	4	4	Taking photographs of the created shadows and drawing the bounds of a friend's shadow at different times of the day. Then, communicating about the lengths of the shadows in the taken photographs and created drawings (Activity 15).
	• Energy and matter: Flows, cycles, and conservation	2	2	It talked about how water put in a deep freeze will change (Activity 5).
	• Structure and function	13	13	Children respond to the teacher's questions such as what for, why, and how we use (Activity 8).
	• Stability and change	3	3	It draws attention to the appearance of the staff when looked from above (Activity 18).
Total		100	100	

When the activity book was examined in terms of discipline core ideas taking part in the framework, it was found that there was a large body of findings concerning physical sciences. In addition, the number of findings relating to life sciences and earth and space science was equal to each other, while there were a limited number of findings concerning engineering. When we consider that there are 40 sample activities in the activity book, it was revealed that the number of activities, including crosscutting concepts, is limited. While "physical sciences" (48.7%), especially "matter and its interaction" (25.6%), was mostly touched, "life sciences" and "earth and space science" (20.5%) evenly took place in the curriculum. On the other hand, the frequency of activities in "engineering, technology, and applications of science" (10.25%) (NRC, 2012, p. 3) was quite little when compared with other core ideas. Indeed, any activity related to the "heredity: inheritance and variation of traits" subtitle of "life sciences" and the "Earth's place in the universe" subtitle of "engineering, technology, and applications of science" (NRC, 2012, p. 3) core ideas was not come across in the teacher activity book (see Table 8).

Table 8. *Distribution of discipline core ideas in the activity book*

Activity Book	*Discipline Core Ideas*	*n*	*f (%)*	*Sample Citations in the Activity Book*
	Physical Sciences	19	48.7	
	• Matter and its interactions	10	25.6	Put colorful water in ice bar molds and put into deep freeze by immersing ice cream sticks or toothpicks in it (Activity 5)
	• Motion and stability: Forces and interactions	3	7.6	Children try to manipulate objects by blowing them (Activity 9)
	• Energy	4	10.25	By means of a light source, shadows are cast upon paper (Activity 15)
	• Waves and their applications in technologies for information transfer	2	5.1	Photographs of the created shadows by means of a light source were taken by children (Activity 15)
	Life Sciences	8	20.5	
	• From molecules to organisms: Structures and processes	2	5.1	Children examine worms, insects, and leaves existing in the soil (Activity 31)
	• Ecosystems: Interactions, energy, and dynamics	4	10.25	The children are told that the ice of the glaciers has melted due to the climate change and that this melting prevents the polar bears from reaching their homes (igloo). Children discuss their solutions to this problem (Activity 26)
	• Heredity: Inheritance and variation of traits	0	0	
	• Biological evolution: Unity and diversity	2	5.1	Children examine worms, insects, and leaves existing in the soil omitted from the hole (Activity 31)
	Earth and Space Science	8	20.5	
	• Earth's place in the universe	0		
	• Earth's systems	1	2.5	Children make observations in the garden. Diverse objects are examined. Children talk about how their garden seems, what is in the garden, and think about what we can do to make our garden more beautiful (Activity 11)
	• Earth and human activity	7	17.9	Children think about what we can do to make our garden more beautiful (Activity 11)
	Engineering, Technology, and Applications of Science	5	10.25	
	• Engineering design	4	10.25	Children create an image of their classroom by placing materials such as Lego (Activity 18)
	• Links among engineering, technology, science, and society	0	0	
Total		39	100	

DISCUSSION and SUGGESTIONS

According to the results, eight main practices that encourage the understanding the production of scientific knowledge and engineering solutions better (NRC, 2012) took part evenly in the curriculum. This finding signifies that STEM might be integrated into the current ECE curriculum. However, a clear, balanced distribution of the eight main practices in the developmental fields was not encountered. Indeed, the eight main practices taking part in the referenced framework accumulated highly in objectives and indicators of the cognitive development field both in the curriculum and activity book. On the other hand, the notion of "practices" is preferred in the framework to refer inquiry and not only cognitive but also social and physical practices in science (NRC, 2012). Indeed, in early childhood years, STEM activities enable children to find out materials by using their senses. In this way, they can comprehend significant scientific and mathematical associations like the concepts of more or less and speedy or slow from an early age. Moreover, STEM serves children by improving their vocabulary, encouraging their collaboration, and transmitting their learning into their future experiences (Moomaw & Davis, 2010). Getting in contact with science and beginning to learn scientific language increase their acquisition of science and direct them to think as a scientist. This interest gained by children who are willing to investigate what is happening around them can be increased in the rest of their lives. (Andersson & Gullberg, 2014). Therefore, objectives and indicators in the curriculum related with other developmental fields like language, socioemotional, and motor development can be enriched by considering STEM practices, and activities can be planned in the direction of these objectives and indicators.

When the curriculum and activity book were examined in terms of crosscutting concepts, findings revealed that "patterns," "cause and effect," "scale, proportion, and quantity," and "structure and function" were mentioned in the curriculum less than the activity book. In addition, in a similar way with the eight main practices, crosscutting concepts did not distribute evenly in the five developmental fields and mostly accumulated in the cognitive development field. In this regard, by considering the sample activities in the activity book, enrichment of objectives and indicators in the curriculum in terms of crosscutting concepts may be one of the implications of this study. Since crosscutting concepts are essential to the comprehension of science and engineering and serve as a bridge for children that attaches knowledge from differing disciplines to the logical and scientific understanding of the world (NRC, 2012), activities should touch on them evenly, especially if these activities are sample activities that teachers practice in their classroom. For instance, a preschool teacher can introduce the "stability and change" concept in a music activity by drawing children's attention to the fluctuating sounds in a classical music composition or the "pattern" concept by means of songs of plush birds, which sign in different patterns (Moomav & Davis, 2010)

Besides, findings in relation to discipline core ideas revealed that physical sciences occurred frequently in the activity book. By considering the requirement to be involved in a wide variety of play-based developmentally appropriate learning experiments in physical, life, and earth sciences which lay the foundation of later understanding and "big ideas" (Hoisington & Winokur, 2015), this can be considered as a positive finding in terms of the Turkish ECE curriculum. On the other hand, a limited number of findings were found in relation to engineering, technology, and applications of science. Indeed, no activities linking engineering with technology, science, and society was encountered. However, engineering, including determining a problem, producing solutions, and testing them out (Sharapan, 2012), takes place naturally in preschool children's activities constructive and dramatic play (Hoisington & Winokur, 2015). By considering that preschool teachers may lack pedagogical knowledge related to integration of engineering with technology and other disciplines (Bers, 2008), the teacher activity book may give sample activities that integrate engineering with other disciplines and provide opportunities for their classroom implementation. In addition, even the crosscutting concepts were often mentioned, there was a limited emphasis on discipline core ideas. This finding can be a sign of adequate basis for interdisciplinary activities but an inadequate interdisciplinary activity number. Within this context, giving wide coverage to interdisciplinary activities in which the crosscutting concepts were distributed evenly is the other follow-up point of this study.

Even when each STEM discipline takes place in the curriculum, the integration of these disciplines into the curriculum and their application in various activities may be increased as the awareness about STEM education increases. Hence, future studies aimed at improving STEM awareness may examine the reflection of this integrated curriculum on classroom practices.

The Turkish Industry and Business Association (TUSIAD, 2014) highlights the emergency of establishing a STEM education strategy. For the association, in Turkey, students should take STEM education and employment opportunities in this area should be increased (MoNE, 2016). Moreover, teacher education and curriculum integration were stated as policy goals of STEM education in Turkey. In this process, it is very important to consider that any curriculum used in early learning centers is going to be implemented by the teachers. That is why the first policy to foster in Turkey in terms of STEM education after curriculum analyses might be offering STEM education training for teachers.

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