Analysis of the cognitive and affective outcomes of the educational programs of the Royal Botanical Garden, Edinburgh

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ABSTRACT

This study aims at assessing the educational programs of the Royal Botanical Garden, Edinburgh with respect to cognitive and affective domain outcomes. For this reason, content analysis of schools' education programme, teachers' packs, and worksheets was done with the taxonomy of educational objectives by Ministry of National Education, Turkey. The results showed that the programs made use of cognitive and affective domain outcomes in various respects. Suggestions to both schools and informal learning institutions were made according to the program design and evaluation criteria.

Keywords: Informal education. Science education. Botanical garden. Curriculum. Program evaluation. Cognitive domain. Affective domain.

Uma análise de resultados cognitivos e afetivos dos programas educacionais do Jardim Botânico Real de Edimburgo

RESUMO

Este estudo tem como objetivo avaliar os programas educacionais do Jardim Botânico Real (*Royal Botanical Garden*) de Edimburgo no que se refere aos resultados do domínio cognitivo e afetivo. Por esse motivo, a análise de conteúdo do programa de educação escolar, dos pacotes de professores e das fichas de trabalho foi feita com a taxonomia de objetivos educacionais pelo Ministério da Educação Nacional, Turquia. Os resultados mostraram que os programas utilizaram os resultados do domínio cognitivo e afetivo em vários aspectos. As sugestões para escolas e instituições de aprendizagem informal foram feitas de acordo com os critérios de design e avaliação do programa.

Palavras-chave: Educação informal. Educação Científica. Jardim Botânico. Currículo. Avaliação de programa. Domínio cognitivo. Domínio afetivo.

INTRODUCTION

Human learning is a very complex procedure and is related to the cognitive characteristics of a person. We can learn from our conservations with other people, by observing nature, reading books, watching TV, searching on the Internet, listening music, copying the behaviours of sport instructors as well as taking course in our school. In short, neither learning is confined to school nor it is confined to a place or a person.

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Received for publication on 9 Jun. 2017. Accepted, after review, on 10 Aug. 2017.

Although formal and informal are the terminology[1] to classify learning according to the place it takes, the major distinction is made between formal and informal ones. While formal learning refers to school-based learning, informal learning refers to the learning out of school by means of Internet, TV-radio, museums, science centres, botanical gardens, zoos, etc. As said by Falk (2001) the distinction between formal and informal learning was created by both the international development specialists who wanted to differentiate between the countries with a compulsory education system from those who do not have any and the museum professionals and environmental educators who wanted to differentiate themselves from the others working in schools.

Learning environment is the surrounding where educational activities occur and which was formed by communication and interaction in teaching and learning processes (ALKAN, apud BAYKAN, 2007). Falk (2001) suggested that informal learning environments should be considered as formal ones, because all students and teachers are the same, just the learning environment is different. Wellington (apud RAMEY-GASSERT, 1997) too critiqued school science to be distant from the natural world and pointed out the potentiality of playgrounds, kitchens, sports fields, shop windows, back gardens, or rubbish tips in investigatory experiences. On the other hand, Ramey-Gassert (1997) thought that any interaction with the natural world generates science learning.

After defining the current status of learning especially of science in school environment, it would be better to compare the informal with the formal: It has been stated that informal learning has more advantages over formal learning like increasing curiosity and motivation, and developing attitudes, engaging students through participation and social interaction, and enrichment (RAMEY-GASSERT; WALBERG; WALBERG, apud RAMEY-GASSERT, 1997). It should be noted that to increase curiosity is important for learning here because it increases also the desire to learn (RAMEY-GASSERT, 1997). As indicated by Resnick (apud RAMEY-GASSERT, 1997), while formal learning is likely to be solitary, based in symbols and the abstract and separate from real-world experiences, with little or no connection with the real objects or events, informal learning likely involves the completion of a task by a group by using real elements that allow learning to take on greater meaning.

The potential of informal learning environments to better achieve student learning has formed the cooperation between schools and informal learning institutions. Although this cooperation has not needed to be professional, visits to informal learning places has been always the case. This interpretation could be supported when field trips are regarded as a science teaching method. Field trips are journeys made for educational purposes by schools. And well-conducted field trips develop students' not only attitudes toward science but also understanding related to the concept taught and the learning objective (PRATHER, apud RAMEY-GASSERT, 1997).

Informal learning institutions may have education departments to keep up in contact with schools. Unfortunately, field trips although it is not in the level it should have been. Teachers' unawareness of how to incorporate the materials of informal learning environments into their science curricula or unfamiliarity with science education resources result with the scare use of these places (RAMEY-GASSERT, 1997).

To be both motivational, engaging, enjoyable, and nonthreatening and hands-on, experiential, and personal are the characteristics of informal learning environments for science education (RAMEY-GASSERT, 1997). The first characteristic seems related to both extrinsic and intrinsic motivation and means that informal learning environments provide relax and interesting atmosphere for students and this leads to the improvement of students' affective characteristics and their better learning. The second characteristic seems related to the investigatory capacity of these environments by sparking students' interest toward nature. Since this second characteristics is important in increasing conceptual science learning directly when compared to the first one, it will be more emphasized.

Informal learning environments help students to discern their own prior knowledge, connect new information with daily life, and construct a new and scientific thinking (CARR, apud RAMEY-GASSERT, 1997). During visits to these environments students may also find connections to things that discussed in class (SELETSKY, apud RAMEY-GASSERT, 1997). Pushing students to relate informal science learning with real world is one of the teaching skill in which new teachers should be trained (HOMUNG, apud RAMEY-GASSERT, 1997).

Informal learning environments are mentioned to support both cognitive and psychomotor learning. Interactive exhibits are appropriate for science subjects because they invite people to play and while people play with them they use experimental strategies, form and test hypotheses, reject and retain some ideas and test (FEBER, apud RAMEY-GASSERT, 1997). On the other hand, science museums emphasize psychomotor domain with their gadgets and technology by developing manipulating equipment, manual dexterity, and hand-to-eye coordination (WELLINGTON, apud RAMEY-GASSERT, 1997). Active participation or personally interacting with new material enhances the acquisition and retention of information (MADDEN, apud RAMEY-GASSERT, 1997).

Informal learning environments offer many science learning programs to students and teachers, such as kits of museum objects that can be borrowed for class investigations; field trip and extracurricular planning packets; overnight, Saturday, and summer programs; programs for gifted, minority, and female students; pre- and in-service teacher programs (GARTENHAUS; ST. JOHN, apud RAMEY-GASSERT, 1997) and afterschool math and science programs (SEIDMAN; SHROYER; RAMEY-GASSERT; HANCOCK; WALKER; MOORE, apud RAMEY-GASSERT, 1997).

What is emphasized in these programs may differ according to the informal learning institution where the activity takes place and its' facilities, and to the aims and participated group expected of the activity. Out of these activities, the ScienceQuest will be given as an example here. ScienceQuest was a hands-on informal science program which aimed to improve students' and teachers' scientific attitudes and understanding; help students to identify and solve problems; develop higher cognitive processes and skills. This program combined science processes and concepts equally; went beyond the mere possession of information to the application of concepts; and included societal issues. The teachers in the program become very enthusiastic about science teaching that they made science fun, interesting, and exciting for students in their classes (KYLE; BONNSTETTER; SEDOTTI; DVARSKAS, apud RAMEY-GASSERT, 1997), which is an accomplishment of one of the goals of informal science education programs (RAMEY-GASSERT, 1997).

EVALUATION OF INFORMAL SCIENCE LEARNING PROGRAMS

As it was emphasized in the previous part, evaluation in informal learning environments has being done by the researchers with using the research methodology on the formal learning. Therefore, it is possible to assess informal education programs from the point of formal education program evaluation procedures, because the informal educational institutions have already made use of these principles when planning their own exhibitions and programs. Many museums and science and technology centres has already used Science for All Americans[3] (SFAA) and Benchmarks, which is an expansion of science literacy goals of SFAA into learning goals for the end of grades 2, 5, 8, and 12, in developing exhibits and support materials for teachers (NIELSEN, 1997). "Museum to Go", for example, was an outreach program by the Franklin Institute Science Museum, Philadelphia. This program was in the form of science kit and these kits were sent to elementary science teachers in order to be reviewed according to the Benchmarks and be places in appropriate grades. After then, the institute could include performance assessment options, more inquiry-based activities, and questions that would stimulate students to reflect on what they had learned in line with Project 2061 (NIELSEN, 1997).

Even though informal learning institutions try to engage interest, develop understanding, and support inquiry in schools, a survey showed that 75 % of the informal learning institutions have a program for schools but more than half of the programs are not selected by the schools, i.e., the teacher workshops are not filled, curriculum kits are not checked out, classroom demonstrations remain unreserved. The research also showed that some programs are not paid for by schools—they are reimbursed for either by grants procured by the informal science institutions or through the general operating budget of the informal science institutions (THE CENTER FOR INFORMAL LEARNING AND SCHOOLS, apud BEVAN; SEMPER, 2006). This means that despite the well-documented need to strengthen classroom science (NATIONAL ACADEMY OF SCIENCES, apud BEVAN; SEMPER, 2006); these local resources are not consistently prioritized or utilized by many school systems (BEVAN; SEMPER, 2006).

The above research also showed that informal science institutions generally do not assess the impact of their school programs on school-based issues, i.e. teacher practice, curriculum implementation, or student experience rather they get participants' feedback on program design (BEVAN; SEMPER, 2006).

Similarly, a research on cognitive and affective components of informal science education programs can help both informal learning institution and schools on determining the standpoint for the rationale of such programs and the estimated impact of the programs for formal education gains.

RATIONALE

When we think of 85 % of our learning hours we spent outside of school including intensive years of schooling (BRANSFORD, apud FRANCZYK; BURCH, 2009), we can conclude that that schools are not the primary learning environment for children (FRANCZYK; BURCH, 2009). Nevertheless, how much students learn in school and enjoy science courses there are under examination. Trends in International Mathematics and Science Study (TIMSS) showed that although English students had improved in performance but declined in enjoyment (STURMAN; RUDDOCK; BURGE; STYLES; LIN; VAPPULA, apud FRANCZYK; BURCH, 2009) and this lack of enjoyment was related to teachers also (FRANCZYK; BURCH, 2009). On the other hand, Turkish students, who are close to the international average prefer teacher-oriented activities and achievement increases in line with the level of these activities, i.e. the more teacher-oriented activities are implemented, the higher scores students get from the test.

Sometimes educational facilities in terms of resources and laboratory instruments may hinder the success of curriculum and teachers. In physics, as an example, most of the teachers are not happy with the out-of-school opportunities or half of the teachers do not have enough opportunities for hands-on experiments (IPSOS MORI, apud FRANCZYK; BURCH, 2009). Moreover, teachers' inability to apply practical work due to time, health and safety concerns and their preference to emphasise on topics, which is covered in examinations (DILLON, apud FRANCZYK; BURCH, 2009) is probably a common situation across the world, besides the UK.

Since informal learning environments engage students with a topic, develop interest and motivation to learn more (FRANCZYK; BURCH, 2009), their importance is undeniable. As in all educational processes, like museums in all other informal learning environments the nature of learning should be understood, learning processes should be carefully planned and evaluated (HOOPER-GREENHILL, 1999). However, many research studies has found that school teachers are not aware of the learning potential in a museum, gallery, or site visit and hence learning opportunities are missed; the activities in museums do not always accompany school curriculum and the visit becomes an opportunity for learning only rather than that for developing learning process (CLARKE, apud HOOPER-GREENHILL, 1999). Children generally confuse the function of visit whereas teachers sometimes do not determine educational aims and generally see the field trip experience as self-prophesying experience (HOOPER-GREENHILL, 1999).

In order to maximize learning capacity of informal learning environments, when the literature (FALK; MARTIN; BALLING; FALK; BALLING, apud HOOPER-GREENHILL, 1999; HOOPER-GREENHILL, 1999) were evaluated, it can be concluded that to know where will be gone, what will be done there, how they will be done, why they will be done, and who will do beforehand will help schools and informal learning institutions. To determine the educational value of informal education programs can be one way to serve this purpose and inform school administrators, teachers and students on what they will gain at field-trip and decrease their anxiety resulting from unfamiliarity with the informal contexts. It also helps those to choose the most appropriate program among the alternatives or even stay with school curriculum. On the other hand, to know the outcomes of their own educational programs will help informal learning educators to design more efficient programs and assess the effectiveness of those and develop continually. Finally for both stakeholders, to determine and know educational outcomes of informal science programs will result with more cooperation.

PURPOSE

The aim of this study is to determine the educational objectives of the science education programs given by the informal learning institutions with respect to cognitive and affective domains. To give an overview of these programs was also aimed with this study.

CONTEXT

The Royal Botanical Garden, Edinburgh is one of the 130 botanical gardens all around the UK (JOHNSON, 2004). It is located in Edinburgh. It has a garden, and a glasshouse. It offers *"outdoor exhibits"* (RAMEY-GASSERT, 1997) for its visitors. The educational activities are given by the Education Department. The department has its own building where an office room and communal kitchen area for the staff and a class that serve either as a laboratory for secondary school students or a class for teachers, a tree house for kindergarten students, a large hole, which can serve as a visitor information point for the educational activities or community activities such as horticulture organisation, in which case it serve as a plant sale area, a class when the middle part is surrounded with folding screens and a laboratory corner when a table, which is located at the left according to the main entrance and lean against the wall, has covered with small pots made of various food packing and the plants representing the main food of that wrapping, i.e. potatoes grown in potato chip packet, and two rooms used as store cabinets for the materials. The educational department has also a garden for the educational activities so that children with the help of adult volunteers, who would likely to be a member of the horticulture federation, grow plants. The Royal Botanical Garden, Edinburgh is also cooperating with various institutions throughout the World. Although these co-operations are mostly on preserving and conserving biodiversity, some of them are on educational area. The Garden has that kind of alliance with a botanical garden, which is called Nezahat Gökyiğit Botanical Garden, in Turkey.

METHODOLOGY

Population and Sample

The educational programs of the Royal Botanical Garden, Edinburgh were the population of this study. As indicated by the Schools' Education Programme, there are seven Primary only, five Secondary only, three Primary and Secondary, and 18 Continuing Professional Development programs in 2009-10 year. While the primary and secondary programs are for students, the continuing professional development programs are for nursery, earl years, primary, and teaching staff (ROYAL BOTANICAL GARDEN EDINBURGH, 2009). Amongst these activities, Teddy Bears' Picnic was selected for Primary Schools, World of Plants (Biology Based) was selected for Secondary Schools, and Active Learning Outdoors (Summer) was selected for the Continuing Professional Development program as sample. Data were collected when the researcher was attending schools' program on May 5-7, 2010. The Programme Book, Teachers' Pack and worksheets were given by the educational staff of the garden during this time.

Instruments

As the education programmes of the Royal Botanical Garden, Edinburgh were a companion to school science, in this study, cognitive and affective domain outcomes were analysed by using the rubric developed by the Turkish Ministry of National Education. These taxonomies can be found in the Appendix.

Data Analysis

The programme, teaching packs, and worksheets of the Royal Botanical Garden Edinburgh were content analysed to find out their probable aim to develop cognitive and affective domain outcomes. For this reason the text of these documents were read by the researcher and aims, teaching/learning activities and evaluation were classified into the relevant categories of these outcomes. When analysing Teddy Bears Programme only programme book and teachers' pack were used. The classroom applications of this programme and real field trip experiences were not included in the data analysis in order to limit this research with documents. For World of Plants, programme book and worksheets were used. However for some parts when the tasks in the worksheets were not clear, observation notes were used to fill out this information gap. And analysis of Active Learning Outdoors was done with the help of programme book and teachers' pack. Data were recorded in the tables so that a table shows whether the programme included the outcome or not. It means tables show only the availability of the outcome not the frequency of it.

RESULTS

1 Teddy Bears' Picnic

Knowledge and science process were the common cognitive processes both in the program book and teachers' pack. On the other hand, comprehension type cognitive process was found only in the teachers' pack. A detailed evaluation of these cognitive processes revealed that "to learn about the wonders of nature" in the program book and "to learn new things about the natural world" in the teachers' pack stated the same meaning and could be classified as knowledge of concepts. On the other hand, "to discover how living things obtain the necessities of life" in the program book and "to explore what those needs (the needs of living things) are" in the teachers' pack were regarded as collect information and data skill of science process. Besides these aims, "to understand of how living things obtain their necessities of life" statement was considered to be identification of criteria in given information of comprehension. The result of this analysis was outlined in the Table 1.

TABLE 1 – Cognitive Processes for Teddy Bears' Picnic.

Cognitive Process	Program Book	Teachers' Pack
knowledge	+	+
comprehension	-	+
science process	+	+

Source: This research.

The evaluation of this program was also done by using affective domain outcomes. Although no affective domain outcome could be found in the program book, the teachers' pack contained two outcomes: "To respect for the natural world", which was regarded as valuing, and "to make positive contributions towards caring for their environment", which was regarded as developing life style. The result of this analysis was outlined in the Table 2.

TABLE 2 – Affective Domain Outcomes for Teddy Bears' Picnic.

Attitudes and Values	Program Book	Teachers' Pack
sensing	-	-
reacting	-	-
valuing	-	+
organising	-	-
developing life style	-	+

Source: This research.

2 Biology Based World of Plants

Biology Based World of Plants programme has no mention of cognitive processes in the program book; worksheets however included all cognitive processes of knowledge, comprehension, and science process. The result of this analysis was outlined in the Table 3. Contrary to Teddy Bears' Picnic, this program did not include any attitudes and values outcomes.

TABLE 3 – Cognitive Processes for Biology Based World of Plants.

Cognitive Process	Program Book	Worksheets
knowledge	-	+
comprehension	-	+
science process	-	+

Source: This research.

2.1 Flowers and Pollination

For Flowers and Pollination part; except the third one, all activities had one main cognitive process, i.e., comprehension (Activity 1, 2, and 6) or science process (Activity 4 and 5). Activity 3 had both Knowledge and Comprehension processes. The result of this analysis can be found in the Table 4.

TABLE 4 – Cognitive Processes for Flowers & Pollination.

Cognitive Process	Activities					
	1	2	3	4	5	6
knowledge	-	-	+	-	-	-
comprehension	+	+	+	-	-	+
science process	-	-	-	+	+	-

Source: This research.

Note: 1: Flower Structure, 2: Methods of Pollination, 3: Self and Cross Pollination, 4: Wind and Insect Pollination, 5: Pollen, 6: Bee Tracks.

In addition, cognitive domain outcomes of Flowers and Pollination worksheet showed a dispersion of various knowledge and skills. Activity 1 asked students to relate flowers parts to function when both the parts were named and functions were explained. Activity 2 asked students to give examples to flowers and their pollinator animals. Activity 3 asked students to name self- and cross- pollination. Activity 4 asked students to compare and classify the parts of insect or wind pollinated flowers. Activity 5 asked students to draw pollen grains from wind and insect pollinated flowers, therefore related to record data skills. Activity 6 both asked students to draw the pictures of flowers seen under white and ultraviolet light conditions after looking at the original photographs and fill in the blanks. This activity in fact wanted students to predict which flower part is visible to bees when they are assumed to be able to see in the UV light.

2.2 Fruits and Seeds

Fruits and Seeds program, except the last two activities, had one main cognitive process, i.e., science process (Activity 1, 2, and 5) and comprehension (Activity 3 and 4). The last two activities implemented at least two processes. Activity 6 included all processes, whereas Activity 7 had comprehension and science process. The result of this analysis can be found in the Table 5.

TABLE 5 – Cognitive Processes for Fruits & Seeds.

Cognitive Process	**Activities**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
knowledge	-	-	-	-	-	+	-
comprehension	-	-	+	+	-	+	+
science process	+	+	-	-	+	+	+

Source: This research.

Note: 1: Conditions of germination, 2: Temperature and germination, 3: Fruits, 4: Seeds, 5: Seed travel, 6: Flower, 7: Seed and fruit.

A detailed look to cognitive domain outcomes of Fruits and Seeds worksheet showed that although most of the activities required a distinct knowledge and skill, a few needed a potpourri of those even in the same cognitive process. For example, Activity 1 and 2 asked students to interpret data of two experiments related to germination (one is on the effect of some conditions on germination; the other is on the effect of temperature on germination rate). Additionally Activity 3 and 4 measured students' comprehension skills (Activity 3 asked students to relate some fruit characteristics such as colour and seed coat with eating habits of animals and their effect on seed dispersion. On the other hand, Activity 4 asked students to identify how some seeds can disperse by using animal models.). Furthermore, in Activity 7, where both comprehension and science process skills were quarried, students were asked to identify the concepts of seed coat and fruit in the real models and compare and classify some fruits according to their ovary walls. The remaining two activities asked students to use more than one knowledge and skills in one process: Activity 5 asked students to measure how far a seed can travel and record these data in the given table, then interpret data and conclude. And Activity 6 measured students' knowledge of terminology, i.e., female and male sex cells, pollen tube, stigma, ovary, and ovule, knowledge of sequences (fertilisation) and identify the knowledge on fertilisation in either text or figure format or both. It also asked students to measure the length between stigma and ovary in some flowers.

2.3 Asexual Reproduction

Asexual Reproduction program, except the last activity, addressed at least two separate processes, which were knowledge and comprehension, however one of them (Activity 1) included science process in addition to these processes. The last activity included only science process. The result of this analysis can be found in the Table 6.

TABLE 6 – Cognitive Processes for Asexual Reproduction.

Process	Activities			
	1	2	3	4
Knowledge	+	+	+	-
Comprehension	+	+	+	-
Science Process	+	-	-	+

Source: This research.

Note: 1: The Advantage of Asexual Reproduction,
2: Asexual Reproduction (Natural structures),
3: Artificial Propagation (Grafting),
4: Artificial Propagation (Cuttings).

Cognitive domain outcomes of Asexual Reproduction worksheet showed a dispersion of various knowledge and skills in the same domain, except Activity 3. Activity 1 asked students to measure how fast Azolla plant grows and estimate the rate of it's' growth. It also asked students to comment on offspring and name offspring scientifically. Activity 2 asked students what tuber and runner mean, give example to each and to identify these structures on the incomplete drawings and complete the drawings. Activity 4 asked students to make either inference or prediction or both when a cut stem is in contact with the soil. On the contrary, Activity 3 only applied knowledge of artificial propagation and grafting concepts and identification of grafting in a given situation.

3 Active Learning Outdoors: Making the most of Summer

Science process was the only cognitive process both in the program book and teachers' pack. On the other hand, comprehension type cognitive process was found only in the teachers' pack. A detailed evaluation of these cognitive processes revealed that "to look at the needs of living things through the changing seasons" and "(encourage children) to explore their own environment" in the program book and "to give some background science to signs of summer" in the teachers' pack stated the same meaning and could be classified as science process. By saying background science, the program meant some science, health and well-being, social studies, religious and moral education, numeracy outcomes related mostly to science process, i.e. “I have observed living things around me over a period of time and am becoming aware of how they depend on each other”, or to comprehension .e. “I have helped to grow plants and can name their basic parts. I can talk about how they grow and what I need to do look after them”, and a few science themes and concepts which can be regarded as knowledge of facts, terminology, concepts, and sequences: “Many plants are at their full growth stage in summer because of extra sunlight”. Therefore the teachers’ pack classified in knowledge, comprehension and science process categories. The result of this analysis was outlined in the Table 7.

TABLE 7 – Cognitive Processes for Active Learning Outdoors.

Cognitive Process	Program Book	Teachers' Pack
knowledge	-	+
comprehension	-	+
science process	+	+

Source: This research.

As said by the program book, the aims to “look at the needs of living things through changing seasons” was regarded as observation, and “explore their own environment” was regarded as collect information and data in science process category. On the other hand, the detailed classification of the program aim in terms of Curriculum for Excellence Early Years Outcomes showed that for Science course, the outcome, “I have observed living things around me over a period of time and am becoming aware of how they depend each other”, was related to observation and interpret data and conclude skills, whereas the other outcome “I have helped to grow plants and can name their basic parts. I can talk about how they grow and what I need to do look after them” was related to identification of knowledge in a new context skill of comprehension and to inference and communication skill of science process. And for Numeracy course the outcome of “I am aware of how routines and events in my world link with times and seasons and have explored ways to record and display these using clocks, calendars and other methods” was related to know and use laboratory materials, measurement, collect information and data, and record data of science process domain and knowledge of sequences of knowledge domain. Also, of science themes and concepts, “Many plants are at their full growth stage in summer because of extra sunlight” was regarded as knowledge of concepts, “Plants have flowers, there are many different shapes and colours of flowers” was regarded as knowledge of terminology, concepts, and classification and as comparison and classification; “Many plants are at their full growth stage in summer because of extra sunlight”.

The evaluation of this program was also done by using affective domain outcomes. And it was found that like Teddy Bears’ Picnic, although no affective domain outcome could be found in the program book, the teachers’ pack contained those. For example: “I can identify my senses and use them to explore the world around me” (Science, Biological Systems: Body systems and cells), which was regarded as sensing, "I am enjoying daily opportunities to participate in different kinds of energetic play, both outdoors and indoors" (Health and well being, physical activity and sport), which was regarded as reacting and valuing, and "Together we enjoy handling, tasting, talking and learning about different foods, discovering ways in which eating and drinking may help us to grow and keep healthy", which was regarded as organising, and "I explore and appreciate the wonder of nature within different environments and have played a part in caring for the environment", which was regarded as developing life style. The result of this analysis was outlined in the Table 8.

TABLE 8 – Affective Domain Outcomes for Active Learning Outdoors.

Attitudes and Values	Program Book	Teachers' Pack
sensing	-	+
reacting	-	+
valuing	-	+
organising	-	+
developing life style	-	+

Source: This research.

3.1 Activities

"Ice Breaker" and "Make a Rainbow" were two introductory activities here. The other activities were called "Bee Finger Printing", "Trust Walk", "Make an Elf or Fairy House", "a Sensory 'Nature Walk' for an Ant", "Tactile Mystery Box", Make a Flower Print Banner", "Digging for Surprises", "Lavender Bags", "Mini Maypole Wand".

The first activity aimed to recognize tree leaf shapes, learn common tree names, and increase describing vocabulary and observational skills and was considered in knowledge (knowledge of facts, terminology, and classifications) and science process (observation, and comparison and classification) categories.

The second activity aimed to learn names of colours, use senses-colours and textures in art, and introduce how rainbows are made-light spectrums and was considered in knowledge (knowledge of facts, terminology, concepts, classifications, and principles and laws) and science process (observation, and comparison and classification) categories.

The third activity aimed to introduce pollination through modelling a bee in the form of painted and a wing stuck finger and was considered in knowledge (knowledge of terminology) and comprehension (translation of knowledge from one form into another) categories.

The fourth activity aimed to use senses and was considered in science process (observation) category.

The fifth activity aimed to use senses. As suggested in the Fairy Rules, it also aimed to use only natural materials, like dry grasses, sticks, pebbles, and pinecones. Consequently, this activity was considered in science process (observation, and comparison and classification) category.

The sixth activity aimed to use senses and measure lengths. As implied in method, choosing a start and finish place and six interesting things along a one metre needs participants to compare and classify among natural ground coverings and things, such as leaves, cones, and grass. Then, this activity was considered in science process (observation, comparison and classification, and measurement) category.

The seventh activity aimed to use sense of touch and imagination, and identify plant parts. Besides, in the method part it is said that "blindfold one of the children in the pair-they then use sense of touch to describe what it feels like" and "they can try to guess what it is". So, this activity was considered in science process (observation, comparison and classification, and inference) category.

The eighth activity aimed to make natural dyes, colour and shape-pattern, so was considered in observation, comparison and classification, and prediction. Also use of stone/wooden mallet suggested know and use of laboratory materials. Both of these skills are of science process.

The ninth activity aimed to explore, and was considered as an observation activity. However use of magnifying glasses, small pots, bug boxes and digger toys implied know and use of laboratory materials. Both of these skills are of science process.

The tenth activity aimed to talk about herbs which smell strongest in summer when the oils are strengthened by the warmth of the sun, to look at common uses/properties of herbs- e.g. lavender is thought to relax you and help you sleep, and sensory activity. As a result, this activity was considered in science process (observation, and comparison and classification) category.

The eleventh activity aimed to think about weather-wind things. Likewise, the method part included to run around outside and see colours flutter in the breeze. Then, the activity was considered as observation skill under science process category. The result of this analysis was outlined in Table 9.

TABLE 9 – Cognitive Processes for Active Learning Outdoors.

Cognitive Process	1	2	3	4	5	6	7	8	9	10	11
knowledge	+	+	+	-	-	-	+	-	-	-	-
comprehension	-	-	+	-	-	-	-	-	-	-	-
science process	+	+	-	+	+	+	+	+	+	+	+

Source: This research.

Note: 1: Ice Breaker, 2: Make a Rainbow, 3: Bee Finger Printing, 4: Trust Walk, 5: Make an Elf or Fairy House, 6: a Sensory 'Nature Walk' for an Ant, 7: Tactile Mystery Box, 8: Make a Flower Print Banner, 9: Digging for Surprises, 10: Lavender Bags, and 11: Mini Maypole Wand.

The evaluation of the activities according to affective domain outcomes revealed that only three of them (Trust Walk, Make an Elf or Fairy House, Lavender Bags, and Mini Maypole Wand) contained those. Firstly, Trust Walk activity aimed to foster trust between children and take responsibility for other people. Thus, this activity was considered in reacting and valuing levels. Secondly, Make an Elf or Fairy House activity had a rule, which was stated as "Be careful not to disturb any of nature's materials that are still living, especially flowers, ferns, mosses, and lichen. Fairies do not like to disturb anything that is growing in nature." Therefore, this activity was classified in valuing level. Thirdly, "Lavender Bags" aimed to "talk about herbs which smell strongest in summer when the oils are strengthened by the warmth of the sun", and "look at common uses/properties of herbs, e.g. lavender is thought to relax you and help you sleep". Hence, this activity was classified in sensing and valuing levels respectively. Lastly, the aim of Mini Maypole Wand activity was to "talk about the maypole tradition on UK history" and "think about weather-wind things". For that reason, this activity was classified in reacting level. The result of this analysis was outlined in Table 10.

TABLE 10 – Affective Domain Outcomes for Active Learning Outdoors.

Attitudes and Values	1	2	3	4
sensing	-	-	+	-
reacting	+	-	-	+
valuing	+	+	+	-
organising	-	-	-	-
developing life style	-	-	-	-

Source: This research.

Note: 1: Trust Walk, 2: Make an Elf or Fairy House, 3: Lavender Bags, and 4: Mini Maypole Wand.

DISCUSSION

This study content analysed some of the educational programs offered by the Royal Botanical Garden, Edinburgh. Schools' Programme, Teachers' Pack, Worksheets, and observation notes were used as data source. The programs were assessed according to the educational outcomes both in cognitive and in affective domain. The criteria which were developed by Turkish Ministry of National Education were used in data analyses.

The first programme (Teddy Bears' Picnic) included both cognitive and affective domain outcomes however in the simplest form and addressed a few of them, i.e., knowledge of concepts, identification of criteria in a given information, and collect information and data as well as valuing and developing life style. The second programme (World of Plants) included only cognitive domain outcomes but in a range. The sections of this programme also differed in variety, the first Flowers and Pollination for example addressed no more than two cognitive processes, the remaining Fruits and Seeds and Asexual Reproduction sections however sometimes all cognitive processes. The last programme (Active Learning Outdoors) included both cognitive and affective domain outcomes in the compact form and addressed (nearly) all.

When the distribution of outcomes of each programme was considered it was found that as the level of the programme or the level of the participants increases, the variety also increases. That is to say, cognitive and affective domain outcomes of Active Learning Outcomes were more than those of World of Plants, which were richer than those of Teddy Bears' Picnic. This situation is thought to be a result of the content of the programmes, for instance Teddy Bears' Picnic was a day long programme taking place in the garden (classroom applications were excluded from the study) and due to the age level of the participants it was not compact and full of activities. On the other hand, World of Plants took half day and had three parts. In addition, Active Learning Outdoors was a full-day-long activity for nursery and early years staff and consisted of 11 separate parts.

The distribution of educational outcomes of each programme also suggests program design and evaluation in informal learning environments. As stated by Hooper-Greenhill (1999), educational staff of the Royal Botanical Garden might be aware of the necessities of the participant groups and might intentionally design the programs simply so that young children could adapt these unknown environments at their first visit. As the age level gets higher so does the programs. This implies why teachers' program took so long and compact. Hooper-Greenhill (1999) also suggested a continuation of the visits with differing aims in each; first visit is for getting acquaintance, the later is for more conceptual materials. From this perspective, World of Plants can be seen as secondary school students' visit to the Garden for more conceptual understanding of plants.

As the affective domain outcomes are thought, it can be seen that these attitudes and values are related not only to *science* (JOHNSON, 2004) but also to *education* (JOHNSON, 2004), and *sustainable development* (JOHNSON, 2004). The role of botanical gardens on teaching sustainable development is related to understanding of how individual decisions have a significant effect on the environment, diversity, sustainability, and cultural heritage, locally or globally (JOHNSON, 2004). Although both Teddy Bears' Picnic and Active Learning Outdoors included affective domain, unavailability of these outcomes for World of Plants can be regarded as insufficiency. When also considered to ensure continuing student visits to the Garden, these outcomes should be placed in World of Plants programme.

When the content of educational programs are considered, as highlighted in Active Learning Outdoors, many school subjects (science, health and well being, social studies, religious and moral education, numeracy, and physical activity and personal development) are integrated in this continuing professional development programme for nursery and early years teachers. This should be seen as an interconnection between these subject domains and an effort to unite informal and formal learning for botanical gardens (JOHNSON, 2004). Interdisciplinary program assumes that disciplines are rich and relatedness, and there is not always only one answer of real life. It also highlights cognitive, affective, and creative capacities in order to find contrary solutions together in science, mathematics, and language and better and newer ways to communicate ideas.

Generally, this kind of affective and cognitive harmony is specific to creative artists, scientists, and thinkers (PERKINS, apud ÖZKÖK, 2005).

Interdisciplinary program always is based on deep themes (principles, theories, generalisations, concepts) underlying a central subject (thematic approach) (MARTINELLO, apud ÖZKÖK, 2005). This idea implies in the titles and content of the educational programs in the Garden; primary school students are engaged in an imaginative bear's picnic, teachers are engaged in a sensory nature walk for an ant. The activities of World of Plants programme secondary school students engage can be considered also as thematic organised around plants. With this programme, science, mathematics, gardening, social studies are thought to be integrated.

CONCLUSION

When cognitive domain is considered, the programs included all processes of knowledge, comprehension and science process though in differing levels. With regard to affective domain outcomes, it was found that although Teddy Bears' Picnic and Active Learning Outdoors programme were sufficient, World of Plants was not sufficient. In order to ensure continuing student visits to the Garden, these outcomes should be placed in World of Plants programme.

With respect to the content of educational programmes, Active Learning Outdoors was found to be an interdisciplinary program. It can be easily understood that any educational program that will be implemented in botanical gardens should have both cognitive and affective characteristics as well as creative characteristics. This research has already evaluated the outcomes for the first two domains. Further research can be suggested to include creative domain. Unfortunately our understanding of educational outcomes is limited with cognitive and affective domain, especially for science curriculum.

World of Plants programme is based on plant science. Seen as unimportant by young people (BALLANTYNE; UZZELL, apud JOHNSON, 2004), this programme may be boring for secondary students. To relate some plants to students' home experience (JOHNSON; TUNNICLIFFE, apud JOHNSON, 2004) can be a strategy (JOHNSON, 2004) that will be used by educational officers in the Garden.

Suggestion

Since nature preservation areas, parks, centres, botanical parks, fossil parks, zoos, etc. have educational staff that assist teachers and instructors in planning teaching, finding appropriate place for excursions, and dealing with basic needs of the groups (WANDERSEE; CLARY, 2006, p.169), the facilities of these institutions should be introduced to all educators and the outcomes of their programs will help the educators to select the suitable program for their class among the alternatives.

As in Turkey, science program development studies have adopted inquiry learning strategy, in which students are responsible for their own learning, participate actively to learning process, and construct knowledge in their minds; in order for students to learn meaningfully and permanently both classroom and out of school environments are suggested to be designed to maximize their inquiry capacities (MoNE, 2013, p.3). By relating the outcomes of science program with the informal activities, teachers can provide teaching/learning activities not only in classroom but also in informal environments (BAKIOĞLU; KARAMUSTAFAOĞLU, 2013). To use both environments would train people on being sensitive toward a more sustainable world (ÖZTÜRK AYNAL, 2013). Moreover teachers and teacher candidates should be educated on the use of these resources and so they can develop more qualified understanding and values (AY et al., 2015; ÖZTÜRK AYNAL, 2013). Science programs should include information about the activities offered by informal learning institutions and the school teachers and administrators of informal institutions should work in cooperation with each other (AY et al., 2015).

As the determination of cognitive outcomes suggested, ensuring science process, which is important in inquiry teaching and learning, is seen as an advantage for informal education, there are also disadvantages reported such as health and safety concerns, shortages of time and resources (RICKINSON et al., 2004, p.51). Therefore these factors too should be considered in developing more effective educational programs for informal environments.

The study should include the learners and teachers in order to triangulate the data and results on the outcomes of educational programs offered by the Royal Botanical Garden, Edinburgh. For this purpose, pre- and post- interviews and questionnaires and observation forms before, during and after the visit should be used to evaluate the outcomes of the programs, which will in turn help to develop the programs accordingly (ÇETIN, 2014).

Besides offering educational programs to students and teachers, informal institutions should design programs for adults in order to achieve lifelong learning. Since informal environments may serve adults with self-directed learning, their education staff should develop activities for adults that will create awareness (TÜRKMEN, 2015). Moreover technology should be integrated into the programs in order to make activities more scientific, multidisciplinary, integrated, and specific (local) (WANDERSEE; CLARY, 2006). Smart mobile devices (SMDs) should be used to provide contextualised, personalized and unrestricted learning (SHRAIM; CROMPTON, 2015) in informal education.

ENDNOTES

[1] There is a couple of more terminology for the informal education: Out-of-school, free-choice, and non-formal. Out-of-school learning is used as a contrary to in-school or formal learning and as can be guessed, it means informal learning. The second term, free-choice,

refers to the previous one, but Falk (2001) suggested using free-choice instead of informal when describing the learning which is free-choice, inconsequential, self-paced, and voluntary. Free-choice learning is also constructed socially between individual and her/his socio-cultural and physical environment. On the other hand, the term "nonformal" refers to the learning taking place in youth science community programs, which is exampled by Carlson and Maxa (1997) as 4-H programs, scouts, boys and girls clubs.

[2] Free-choice refers to what is learned is prescribed by the learner rather than the educator (BITGOOD, apud MEREDITH et al., 1997).

[3] Science for All Americans is the 1989 publication of Project 2061, which was developed by the United States government to identify what was most important for the next generation to know and be able to do in science, mathematics, and technology and what would make them science literate. This document defines science literacy and shows affective learning and teaching strategies (PROJECT 2061, 2010).

ACKNOWLEDGEMENTS

I would like to express my special thanks to the education officers of the Royal Botanical Garden, especially Ms. Susie Kelpie, Ms. Cath Evans for giving me the chance to meet them and participate in their activities, the volunteers who took part during the activities, and the teachers and students who participated to the educational programs. I am also indebt to Mr. Orhan Ekemen for his assistance in my transportation and other helps he has given me during my stay in London. I would like to also thank to Prof. Justin Dillon, and Dr. Jennifer DeWitt of Kings' College London for their support throughout my study in the UK. I am also grateful to my university, Niğde University for giving me permission for post-doctorate and to the Higher Education Council of Turkey for supporting my research. Finally, I would like to show my gratitude to my parents and family for their moral and financial support. Without these valuable contributions, I could not establish this study.

REFERENCES

ANDERSON, K.; ARCHER, L.; MOKLER, S.; PANTALONE, R. *London Science Museum Launch Pad Extension Project*. Unpublished BSc Report. Worcester Polytechnic Institute, 2007.

AY, Y., Anagün, Ş. S.; DEMIR, Z. M. Sınıf öğretmeni adaylarının fen öğretiminde okul dışı öğrenme hakkındaki görüşleri [Pre-service primary school teachers' opinions about out-of-school learning in science teaching]. *Turkish Studies International Periodical of the Languages*, Literature and History of Turkish or Turkic, v.10, n.159, p.103-118, 2015.

BAKIOĞLU, B.; KARAMUSTAFAOĞLU, O. Okul dışı ortamlarda fen eğiitmi: Diyaliz merkezine bir teknik gezi. In: THE INTERNATIONAL EJER CONGRESS, 24-26 April 2014. *Abstract of Papers*. Istanbul University Congress Center. Ankara: Anı Yayıncılık, 2014.

BAYKAN, Z. Ö. 2005 ve 2006 *İlköğretim Programlarının "Müze Eğitimi" Açısından Değerlendirilmesi* [Evaluation of Museum Education of Primary Education Programs Developed in 2005 and 2006]. Unpublished master's thesis, Ankara: Ankara University, 2007.

BEVAN, B.; SEMPER, R. J. *Mapping Informal Science Institutions onto the Science Education Landscape*. The Center for Informal Learning and Schools. A Partnership of the Exploratorium, King's College London and Universıty of California Santa Cruz, January 2006. Disponível em: <http://cils.exploratorium.edu/resource_shared/downloads/4229/Mapping%20Informal%20Science%20Instituions%20onto%20the%20Science%20Eductaion%20Landscape.pdf>. Acessado em: 26 Aug. 2010.

CARLSON, S.; MAXA, S. *Science Guidelines for Nonformal Education*, 1997. Disponível em < http://www1.cyfernet.org/prog/schl/science/4h590.html>. Acessado em: 29 Aug. 2010.

ÇETIN, G. Field trip to Kazdagi National Park: Views of prospective biology teachers. *Educational Research and Reviews*, v.9, n.19, p.823-833, 2014.

FALK, J. H. Free-choice science learning: Framing the discussion. In *Free-Choice Science Education*. How We Learn Science Outside of School. Edited by John H. Falk. New York: Teachers' College Press, 2001.

FRANCZYK, J., M.; BURCH, A. Science, Learning, Museums and Young People. In: *Learning to Live Museums, Young People and Education*. Edited by Kate Bellamy and Carey Oppenheim. Institute for Public Policy Research and National Museum Directors' Conference 2009, 2009. Disponível em <http://www.nationalmuseums.org.uk/media/documents/publications/learning_to_live.pdf>. Acessado em: 2 Sep. 2010.

HOOPER-GREENHILL, E. *Müze ve Galeri Eğitimi* [Museum and Gallery Education]. Translated by Meltem Özge Evren and Emine Gül Kapçı. Edited by Bekir Onur. Ankara Üniversitesi Çocuk Kültürü Araştırma ve Uygulama Merkezi Yayınları, No. 4, Ankara, 1999. Disponível em: <http://kitaplar.ankara.edu.tr/dosyalar/pdf/374.pdf>. Acessado em: 2 Sep. 2010.

JOHNSON, S. Learning science in a botanic garden. In *Learning Science Outside The Classroom*. BRAUND, Martin; REIS, Michael (Ed.). London: RoutledgeFalmer, 2004.

MEREDITH, J. E.; FORTNER, R. W.; MULLINS, G. W. Model of affective learning for nonformal science education facilities. *Journal of Research in Science Teaching*, v.34, n.8, p.805–818, 1997.

MINISTRY OF NATIONAL EDUCATION. *Eğitimi Araştırma ve Geliştirme Dairesinin Durum Tesbiti Faaliyetleri ve Fen Bilgisi Durum Tesbiti Sonuçları* [The Assessment Activities of Educational Research and Development Directorate and Results of Science Assessment]. Ankara: Eğitimi Araştırma ve Geliştirme Dairesi [Educational Research and Development Directorate], 1995.

MINISTRY OF NATIONAL EDUCATION. *İlköğretim Fen ve Teknoloji Dersi Öğretim Programı ve Kılavuzu: 6-7-8. Sınıflar Taslak Basım* [Elementary Science and Technology Course Teaching Program and Guide: 6th, 7th, and 8th Grades Draft Publication]. Ankara: T.C. Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı [Republic of Turkey Ministry of National Education Board of Education], 2005. Disponível em: <http://ttkb.

meb.gov.tr/ogretmen/modules.php?name=Downloads&d_op=getit&lid=883>. Acessado em: 2 Sep. 2010.
MINISTRY OF NATIONAL EDUCATION. *Ilköğretim Kurumları (Ilkokullar ve Ortaokullar) Fen Bilimleri Dersi (3, 4, 5, 6, 7 ve 8. Sınıflar)* [Elementary Education Institutions (Primary and Secondary Schools) Science Course Teaching Program (3rd, 4th, 5th, 6th, 7th, and 8th Grades]. Ankara: T.C. Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı [Republic of Turkey Ministry of National Education Board of Education], 2013.
NIELSEN, N. Project 2061: Science literacy in museums. *ASTC Newsletter, n.*25, January/February, 1997. Disponível em: <http://www.project2061.org/publications/articles/nielsen/nielsen1.htm>. Acessado em: 23 Aug. 2010.
ÖZKÖK, A. Disiplinlerarası yaklaşıma dayalı yaratıcı problem çözme öğretim programının yaratıcı problem çözme becerisine etkisi [Effects of interdisciplinary creative problem solving teaching program on creative problem solving skills]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, n.28, p.159-167, 2005. Disponível em: <http://www.efdergi.hacettepe.edu.tr/200528ALEV%20%C3%96ZK%C3%96K.pdf>. Acessado em: 2 Sep. 2010.
PROJECT 2061. *Science for All Americans:* Education for a changing future, 2010. Disponível em: <http://www.project2061.org/publications/sfaa/default.htm>. Acessado em: 23 Ago. 2010.
RAMEY-GASSERT, L. Learning science beyond the classroom. *The Elementary School Journal*, v.97, n.4, p.433-450, 1997. Disponível em: <http://www.jstor.org/stable/1002356>. Acessado em: 15 Ago. 2010.
RICKINSON, M.; DILLON, J.; TEAMY, K.; MORRIS, M.; YOUNG CHOI, M.; SANDERS, D.; BENEFIELD, P. *A Review of Research on Outdoor Learning*. National Foundation of Educational Research and King's College London. Field Studies Council, 2004.
ROYAL BOTANICAL GARDEN EDINBURGH. Schools' Education Programme. 2009/10. Primary | Secondary | CPD | Outreach. 2009.
ROYAL BOTANICAL GARDEN EDINBURGH. Schools' Education Programme. Primary, Secondary, Continuing Professional Development, Outreach. 2010-11 Academic Session, 2010. Disponível em: <http://www.rbge.org.uk/assets/files/Education/Schools/RBGE%20Schools%20Programme%2010-11.pdf>. Acessado em: 2 Sep. 2010.
SHRAIM, K.; CROMPTON, H. Perceptions of pedagogical affordance of smart mobile technology. In: İSMAIL Şahin, S.; AHMET KIRAY, Selahattin Alan (Eds.). INTERNATIONAL CONFERENCE ON EDUCATION IN MATHEMATICS, SCIENCE & TECHNOLOGY (ICEMST), Antalya, April 23-26 2015. *Proceedings…*. p.207-214. 2015.
TÜRKMEN, H. (2015). Yetişkinlerinin informal öğrenme ortamlarına ziyaret gündemleri: Sasalı Doğal Yaşam Parkı örneği [Visiting agenda of adults for informal learning environment: the case of Sasalı Wildlife Park]. *Journal of European Education*, v.5, n.1, p.15-23.

WANDERSEE, J. H.; CLARY, R. M. Fieldwork: New directions and exemplars in informal science education. In: *Handbook of College Science Teaching*. National Science Teachers Association, 2006.
WATERS, M. Creating a Learning Adventure. In *Learning to Live Museums, Young People and Education*. Edited by Kate Bellamy and Carey Oppenheim. Institute for Public Policy Research and National Museum Directors' Conference 2009. Disponível em: <http://www.nationalmuseums.org.uk/media/documents/publications/learning_to_live.pdf>. Acessado em: 2 Sep. 2010.

APPENDICES

1. Cognitive Processes (Knowledge, Comprehension, Solving Problem)

Level	Explanation	Knowledge and Skill
Knowledge	The knowledge of fact, term, concept, principle and law, classification and sequencing, and technique and procedure, which student learned by heart and will recall when face with them.	Knowledge of facts
		Knowledge of terminology
		Knowledge of concepts
		Knowledge of classifications
		Knowledge of sequences
		Knowledge of techniques and procedures
		Knowledge of principles and laws
		Knowledge of theories
Comprehension	The skills to explain in their own words, make summary, give a new and original example (exemplify), predict, translate into a different form of knowledge related to science concepts, principles, laws, etc.	Identification of knowledge in a new context
		Explanation
		Summarization
		Giving example
		Identification of criteria in a given information
		Relation
		Comment
		Translation of knowledge from one form into another
		Prediction
Solving Problem	The skills to bring knowledge, laws, and formulas together in order to solve the problem, use units correctly, make transition, and show the answer in required form are in this category.	Finding required principle for solution
		Bringing knowledge, law, and principle together
		Using formula and algorithms
		Using units correctly and making transition
		Show the answer in required form

Note: Translated from "Taxonomy of Educational Objectives" (MoNE, 1995).

2. Cognitive Processes (Science Process Skills)

Observation	Gather information by using sense organs and instruments that extend the senses, and the various instruments used in medical diagnosis (Minnesota Mathematics and Science Teaching Project, apud CARIN et al., 2005, p.38).
Comparison and Classification	Organise information, i.e., sort objects according to their properties. There are two kinds of classification, binary and multistage. Binary classification is organization of objects into two groups on the base of common characteristics. On the other hand, multistage classification is organization of objects over and over again (CARIN et al., 2005, p.41-42).
Inference	Interpret observations based on prior knowledge and experiences
Prediction	Forecast a possible outcome based on knowledge of patterns in data. The difference between inference and prediction is backward looking feature of inference (what happened), whereas forward looking feature of prediction (what will happen) (CARIN et al., 2005, p.44).
Estimate	Suggest approximate values for the quantities such as mass, length, time, temperature, and unit related to objects and events.
Define variables	Determine one or many variables in a given event or relation. Identify the independent, dependent and control variables.
Hypothesise	Form hypotheses, which are the statements of possible relationships between the independent and dependent variables that might be identified through investigation
Plan Experiment	Suggesting an experiment in order to test the hypothesis.
Know and Use Laboratory Materials	Select and use materials safely and effectively
Set up experiment	build experimental set up in order to test hypothesis by using materials
control and change variables	Keep the variables constant other than those related to hypothesis. By changing independent variable determine its effect on dependent variable
Define Operationally	Describe variables exactly with a measurement criterion.
Measurement	Know measurement devices i.e. ruler, thermometer, balance, and chronometer. Determine quantities by using appropriate measures. Represent quantities with their units.
Collect Information and Data	Gather information from various sources via observation and experiment, and using books, maps or information and communication technologies. Collect qualitative or quantitative data in order to test hypothesis
Record data	Record data gathered from observation and measurement in the form of writing, picture, table, and figure (TTKB, 2005).
Analyse Data and Formulate Models	Present data gathered from experiment and observation in the forms of frequency distribution, histogram, table, physical models, etc. Apply the rules of drawing graphics.
Interpret data and conclude	Interpret data analysed and model formed. Reach trend and relationships from results.
Communication	Present and share the results of observation and investigation by using oral, written, and visual materials

Note: Translated from Table-2.2 Science Process Skills Outcomes for 6th, 7th, and 8th Grade Levels (MoNE, 2005).

3. Attitudes and Values

Level	Explanation	Attitudes and Values
Sense	give and continue attention	Listen carefully, observe events/activities in neighbour, is eager to learn and understand, be open-minded, and do not have prejudice.
React	respond and get satisfied with it	Be interested and curious about herself and her environment, develop ideas individually, perform task willingly and voluntarily, be interested in careers and hobbies related to science, try to perform her responsibilities.
Value	give importance and value behaviours, event, and objects	Always have a willingness to try outs (internal motivation), rely on democratic procedures, rely on logic, science and technology, appreciate developments and people that helped the prosperity of humanity, try to live clean and healthy and/or appreciate those who live like this, respect to herself and environment (do not make noise, give harm, and be fair and honest).
Organise	develop a consistent value system	Act after considering the results of events (be careful, fussy, accept the responsibilities of her behaviours), accept the importance of systematic planning in solving problems, know herself and rely on herself (be self-confident, know her weak and strong aspects), cooperate, perform her own responsibilities.
Develop life style	develop life style after controlling behaviours for long time with value system	Always question herself and environment, continue healthy life habits, recognize that everything is for serving love, peace, and happiness, be self-disciplined (auto-controlled, perform everything on time, evaluate herself, be sincere and consistent), take safety precautions for herself and environment.

Note: Translated from Table-2.3, Attitude and Value Objectives for Grades 6, 7, and 8 (MoNE, 2005).