

Planning and Evaluation Studies for Science Center Tours: Feza Gürsey Science Center Example

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Abstract: This study is aimed to show that there are some places like this in our country even though the number of them is few; and to provide science educators conscious about this subject; and to present required works and evaluations in the process of a science center tour which can provide sources for teachers. In this context, Feza Gürsey Science Center (FGSC) is taken as an example. In the research, the document analysis method taken from qualitative research patterns was used. In the study, written and visual documents on Feza Gürsey Science Center- needs to be in full first time mentioned (FGSC) were examined and a program of the visit was prepared to ensure that school visits to this center would attain the objectives. The tour should be well planned for student groups to learn museum collection and love it. This planning is carried out in 3 steps as preparations before tour, studies during the tour and evaluation after the tour. The required planning, is elaborated within the scope of FGSC. A model is presented to reduce load from the educators who organize tour to FGSC and give them the opportunity for the best planning. Preparation of some new models about the informal education environments like this model will help the reach for the aims of these places.

Key words: Science center • Informal learning • Science Education • Evaluation

INTRODUCTION

Informal education, which is not planned, programmed and controlled and occurs spontaneously throughout life beginning from the birth of the individual. It results from interaction with the person's surroundings, sometimes being more effective than formal education in the process of changing behavior and helping students gain new behaviors.

The informal education, which is composed of individual's interaction with his environment and is not planned, scheduled and controlled is sometimes more efficient than the formal education in the process of behavior change and gaining new behaviors process [1]. Research has suggested that diversifying and increasing the frequency of activities, that children are interested in, strongly affects the improvement of the abilities they acquired at school [2, 3].

Informal learning environments include many social fields that allow students to have individual relationships with real objects and thus provide them to gain permanent knowledge through a positive attitude, values and points of view. Such environments include some mass media tools like television, radio, newspapers, magazines and internet and sport centers, science centers, science and

technology museums, natural history museums, zoos, botanic parks, forests, libraries, aquariums, open air laboratories, nature centers (caves, lakes, rivers, shores etc.), camps and houses [3]. One of the major issues of informal education environments is science centers.

Towards the end of the 1980s, the number of science centers increased and there are two important reasons for the increased popularity of these centers. First is the increase in complex technological innovations as a result of rapid developments in science and technology and the second reason is providing the opportunity for learning out of school for the increased population [4].

Because science is not static and it steadily changes and develops, the significant duties of science centers which are frequently updated and improved can be listed as;

- Letting people in all ages love and interest in science and technology as its product and especially direct students in their profession decisions,
- Helping visitors to learn with entertainment by organizing various activities, (such as experiments, games, conferences, seminars, summer schools, panel discussions and showing films.)

- Making it possible for the visitors to compare old and new technologies,
- Providing the education of individuals who have the conscious to search by telling scientific and technological progress, creative thought, skills for investigate and problem solving,
- Injecting visitors helping and solidarity by providing social interaction among visitors.
- Providing the skills for understanding the natural phenomena around them and science literacy.
- Helping especially students at the early age to gain self confidence.

As one of the social educational institutions, science centers provide important contributions to teaching science and are complementary factor to formal education in schools, thus they provides an opportunity for transforming the relationship between formal and informal education systems into cooperation. Additionally, the other advantages of these centers are that they provide more motivation and social interaction, arouse more interest and desire and create more opportunity for the students for interacting with the real world objects [5].

The basic objectives of the science courses in primary schools are to acquire and use knowledge (Cognitive objectives), acquire skills (Psychomotor objectives) and moral values, social consciousness and individual responsibility, develop positive attitudes and behaviors (Affective objectives). Science centers can offer assistance in attaining these objectives by including at least one of the areas mentioned above.

In the research, conducted over the last 30 years concerning the relationship between museums and education, it has been suggested that science centers are effective in improving scientific skills, learning about various scientific issues through exploration, increasing achievement in science, developing positive attitudes towards science and arousing interest for science and also these centers facilitate learning process in general sense [5-8]. Additionally, it has been observed that students use oral communication in these centers; thus, improve their social skills [9]. Moreover, it has been found that these centers provide opportunities for teachers to learn from each other, also they can expand and improve their instruction strategies and skills [7].

Science Centers and Education Programs: Because science centers have various exhibitions and activities, the activities related with the education programs should be related with these exhibitions and activities. In addition to this, the prepared education programs should complete

the education at schools. In other words, in order to create efficient education situations, school curriculum and exhibitions in the science centers should be connected with each other. The connecting of the materials in these places with the education in the school provides better understanding of science concepts by students and their better learning of science education by influencing their attitude towards science. It is observed that the cooperation between schools and science centers in this situation is extremely important [5, 10].

Education programs, which include various working group activities and provide more opportunity for the students to use more sensory organs, offer great benefits for the students, in terms of acquiring knowledge and experience. Therefore, education programs should be created taking into consideration the interests and needs of the students and without neglecting the entertainment factor. In addition, proper instruction strategies and activities should not be neglected [5, 11].

A further issue, which should be paid attention to, when preparing the education programs, is the age and expectations of the visitors. It is useful/ necessary/ important to organize educational activities, which are appropriate for the ages and expectations of the visitors, attract the students' interest, appeal to all their senses, make them curious and achieve this at the level of their understanding.

In a museum education program, the following 3 basic factors, are complementary and form the whole program [12];

Objectives (Aims): Which describe the qualities that can be acquired by the individual through education.

Teaching and Learning Activities (Educational activities): In order to ensure that the individual attains the objective, specific teaching techniques should be used and the educational activities should be conducted according to a plan. Attaining the objectives, which have been determined concerning museums, is possible only if the individual learns, in other words, if the individual has gained appropriate education experiences. The individual can only acquire this kind of appropriate education experience by interacting with people and the factors other than people, which are included in an environment which is arranged to ensure that individuals gain such experiences.

Evaluation: These procedures are applied on the completion of each educational activity in order to

discover whether the pre-determined objectives have been attained. Evaluation is necessary for individuals to recognize the items/ elements, which they had not been able to learn or they have/had difficulty in learning and to investigate the reasons of this and therefore, ensure that the education proves is more effective.

As it is understood, science centers are no more places that people visit for only 10 or 15 minutes, they organize some activities in accordance with some goals as it is in the formal education institutions and how much these activities are efficient on reaching predetermined goals. But it is observed that because typical school tours to science centers are generally organized in a short time and for the aim entertainment and there is no tour plan and efficient evolution after it, the desired goals can not be reached.

In his study, Bozdoğan (2007) stated that the visits to the science and technology museums are mostly made through schools. However, most of the teachers, who work in the schools and participated in the study, did prepare a program for the visit [13].

Purpose of Study: With this study, it is aimed to show that there are some places like this in our country even though the number of them is few; and to provide science educators conscious about this subject; and to present required works and evaluations in the process of a science center tour which can provide sources for teachers. In this context, Feza Gürsey Science Center (FGSC) is taken as an example.

METHOD

Research Model: In the research, the document analysis method taken from qualitative research patterns was used. This method includes the analysis of written and visual (film, video, photograph, etc.) resources, which contain information about the focus of the research [14]. In the study, written and visual documents on Feza Gürsey Science Center- needs to be in full first time mentioned (FGSC) were examined and a program of the visit was prepared to ensure that school visits to this center would attain the objectives.

Learning Environment: The name of the center is firstly planned as Ankara Science Center. But later, it is changed as Feza Gürsey Science Center in order to keep the name of foremost physicist in the world and in Turkey, Feza Gürsey, who died in 1992 and has world wide fame. Feza Gürsey Science Center which is the first and only science center in Turkey is opened on 23rd April 1993

with the assistance of Ankara Major City Municipality. Feza Gürsey Science Center has the goals to introduce basics of science, let people understand it and help students to understand and practice what they learned in their science lessons. Because of this, all units are designed to let visitors do experiments individually and observe.

RESULTS

Tours and Tour Programs to Science Centers: Teachers generally think that museum tours are tours in which students see very interesting things and enjoy. But the most important thing to be considered is preventing students to tour without aim. Researches about the long and repeated museum tours showed that these tours provide students to learn and understand deeply. In addition to this, it is observed that students gain information and social benefits from relating the school curriculum with the activities in museum and doing activities like museum activities in the school [10].

The tour should be well planned for student groups to learn museum collection and love it. This planning is carried out in 3 steps as preparations before tour, studies during the tour and evaluation after the tour [15-20].

The required planning, is elaborated within the scope of FGSC and explained in Tables 1, 2 and 3.

* The teacher should attend the visitors' center in advance and should obtain the necessary information about the science center exhibits from museum officers. The teacher can prepare an information paper by using both this experience and additional resources obtained from the web site of FGSC (<http://www.bilimmerkezi.com>).

** While preparing the student question form, the teacher can make use of the information paper about the museum which (s)he prepared. The purpose of the question form should be to determine the level of prior knowledge amongst the students about the visit location. Some examples of possible questions are given below.

- Who was Feza Gürsey?
- When was Feza Gürsey Science Center opened?
- What is the name of the generator which was used in the electrical experiment? What kind of electricity does this generate?
- Do you think shadows can be photographed?
- What is the name of the experiment set in which the transformation of mechanical energy to electrical energy was demonstrated?
- What are the features of the model of the human body.

Table 1: Work to be completed before the visit

| Phases | Preparations | Preparations for FGSC |
|--|--|--|
| Educational Preparation | <ul style="list-style-type: none"> •The teacher should visit the museum beforehand, obtain information from museum staff about the materials in the museum and determine the student's needs before the museum visit. •The teacher and the staff, who will guide the students should be in communication and determine the activities to be conducted either by the teacher or the museum staff. •The visit should be organized in conformity with the content of the course program, within this scope a plan about the museum in general or the points to be focused on should be prepared. That is, the teacher should correlate the materials in the museum with the subjects introduced in the course. •The purpose of the visit, the basic concepts and skills, to be used, should be determined. •The teacher should inform the students about why they are going to the museum, the kind of activities they will do there, which subjects of the course are related with this visit and how they should behave in the museum, in order to alleviate any concerns about the visit, to arouse their interest and realize appropriate learning. <p>Brochures or leaflets should obtained from the museum, or simple information sheets can be prepared so that the students can understand. The brochures, leaflets or simple information sheets should include information which arouses the interest of the students and gives various questions for evaluation.</p> | <p>Address: İrfan Baştuğ Caddesi No: 142 Altınpark 06140 Ankara. Communication: +90 (312) 317 99 19 E-mail: info@bilimmerkezi.com Web: http://www.bilimmerkezi.com</p> <p>There is appointment system in FGSC. You can make an appointment with the science center for any day of the week through phone call, e-mail or web site. The science center is open between 09:00 - 18:00. Groups coming via a school can visit the museum for a duration of 90 minutes. Entry to the museum is provided free of charge by Ankara Metropolitan Municipality for the students from Ankara city. Adults and students from the surrounding provinces pay a fee.</p> <p>The leaflet* prepared concerning FGSC should be distributed to the students and it should be ensured that the students have information about the science center before the visit.</p> <p>Before the visit, the question form ** prepared for students should be distributed and it should be ensured that they answer the questions properly.</p> |
| Bureaucratic Procedures and Transportation | <ul style="list-style-type: none"> •The teacher should take the necessary legal permission from the parents of the students, school administration and authorities of the local administration and also should inform all parties about the visit. •The teacher should determine the route, duration, vehicles, time of departure, number of students, price and structure of the visit beforehand. <p>The museum, to be visited, should also be informed about the number of students, the date and time of the visit and an appointment should be made.</p> | <p>The visit plan concerning the visit to science center should be prepared; the necessary permissions should be provided and the catering, transportation and accommodation needs of students should be met.</p> |
| Catering and Accommodation | <ul style="list-style-type: none"> •If the museum is out of the city and arrival-return lasts more than one day, the necessary reservations for catering and accommodation should be made. | |

Table 2: During- visit activities

| Phases | Activities | in FGSC |
|----------------------|---|--|
| Educational Elements | <ul style="list-style-type: none"> •A sufficient number of guides should be provided by taking into consideration the need for guidance. The guides should inform the students? about the exhibitions and activities during the visit and should help while the students are undertaking activities. However, they should not help with the answers to the questions that the students are required to find. The students should find the answers of their questions by exploring. •The guide should help the students acquire practical skills by ensuring that the students participate actively by touching and trying; they should teach the students the features, structure, working principles of the exhibitions or activities and how these can be used in daily life. By asking limited number of open-ended questions, the guide should ask the students to make observation, discuss and make inferences about the realities, which are based on the exhibits in the museum. Within this scope, by taking into consideration that the students' motivation can decline, various activities (search find, collection hunting, etc.), games can be organized; puzzles and crosswords can be prepared. •The attitudes and orientation of the teachers and museum officers are particularly important in the improvement of student attitudes towards science, thus, they should approach students in a friendly manner and allocate some time during the visit for the students to walk freely within the scope of their interests. The creativity and interaction processes of the students, who are left unaccompanied to tour the exhibitions and participate in the activities, should be monitored. <p>Within the scope of the visit program, the teachers should be careful about not to place too much responsibility on the students during the visit. Since this may negatively affect their attitudes towards the exhibitions and activities, teachers should try to create opportunities for students to have fun and engage in social interaction during the visit.</p> | <p>In FGSC, there are 7 personnel and 10-20 guides. The guides in the science center work either as part-time or full time guides and they are physics, chemistry, biology, science, astronomy, mathematics, computer and geology graduates or university students who are still studying.</p> <p>Prior to the science center visit, an electric or nitrogen show is presented. After the show, which lasts approximately 20 minutes, the students are divided into groups of 10 and continue their visit to other areas in the science center accompanied by guides.</p> <p>The last 15 minutes of the visit is allocated for free walking in accordance with the interests and needs of the students.</p> <p>During this process the teachers, in cooperation with the guides, should observe and orient the students. Within this period, conception mistakes of the students should be determined. Moreover, the observation-question form*, should be distributed to the students and should be completed by the students during their visit, should enable the students to fill them properly.</p> |

Table 3: Post visit activities

| Phases | Activities | Evaluation after Visit to FGSC |
|------------|--|--|
| Evaluation | <ul style="list-style-type: none"> •After the museum visit, an end-test can be administered to assess the students' knowledge about the technical terms and proper names concerning the objects and exhibitions in the museum, the working principles and their place in everyday life. •A discussion can be held in order to correct student's misunderstandings, wrong concept in the class. Within the activities conducted in the museum, during the period allocated for discussion the critical thinking skills of the students can be improved. •Students can be asked to write essays and draw pictures including description and interpretation of the exhibitions and activities in the museum. •The photos taken in the museum can be displayed in the school notice boards and the students can watch various films and slides and prepare projects. •The families of the students should be informed about the activities connected to the visit therefore, facilitating the families involvement in encouraging the students participate and helping in increasing the student's interest in science. <p>By reviewing the visit,, opinions can be elicited in order to develop more and improved activities through the next academic year.</p> | <p>After the visit to FGSC, the achievement test* can be administered. This test was prepared in order to determine the academic achievement of the students within the scope of the exhibitions in the science center. In addition, the following activities can be given; the matching test**, which helps student's reinforce the names of the exhibitions in the science center; drawing and essay writing*** for describing and interpreting the exhibitions; and after the visit, detailed brainstorming**** in the class environment about the subjects which were determined within the scope of science center visit. This evaluation process can be extended to include project work***** on the knowledge and skills, they acquired during and after the visit.</p> |

* Sample questions about the observation-question form which should be filled in by the students during the visit are given below.

- Look at your surroundings when you enter the museum. What are the things that you find interesting?
- In the model of the human body (located in the entrance of the science museum), which parts were made larger than the normal ratio? Why?
- The demonstration of the working principles of the Van der Graaf Generator produced approximately 500,000 watts of "potential" energy. Did this hurt your friend who took part in the demonstration? Why?
- What are the uses of liquid nitrogen in daily life?
- What kinds of effects does liquid nitrogen have on living cells?
- What is the name of the exhibit in which air-heat relationship was explained?
- Imagine that you are in a car in which you were irritated by someone smoking. When you opened the car window slightly, you saw that the smoke was quickly drawn through the opening.. What is the reason for this? (Answer this question with reference to the "Bernoulli blower" demonstration, where items were suspended in the air-stream).
- Explain the working principles of whispering bowl?
- Describe the movement of metal balls which represent the stars and planets in the black hole model? Why do they move in this way?
- Did you see the lungs of a smoker and a non-smoker? Explain the difference that you observed between the two.

- How is the shadow photographed? In your daily life, when we switch off the light in our rooms, electric lights do not lose their brightness for a while. Can this be related with this activity? Explain how.
- Write the three demonstrations you liked most in the science center.
- Describe any problems you experienced or ways in which the science center could be improved. Write down the three most important things that a science center should have.

* Examples are given below of the questions used to determine students' post-visit academic understanding of the exhibitions in the science center:

- Why does the metal rod held with bare hands which was rubbed with wool cloth not attract small pieces of paper?
 - a) The fact that it was not charged with electricity by rubbing
 - b) The fact that an electric charge was not maintained
 - c) The fact that it did not interact with the wool cloth
 - d) The fact that the paper and metal rod have the same charge (polarity)
- Which of the following statements accurately describes the association between heating the air in a balloon and the ascent or descent of the balloon?
 - a) The density of heated air within the balloon is lower than the density of the surrounding air
 - b) The density of heated air is higher than the density of the surrounding air
 - c) The density of heated air is equal to the density of the surrounding air
 - d) Heating leads to a reduction in the volume of the balloon

- Which of the following are the structures that swallow objects in space in an irreversible manner?
a) Black hole
b) Supernova
c) White dwarf
d) Black dwarf
- Which of the following is one of the ways cigarettes harm our body?
I. It causes the blood to coagulate faster
II. It damages the vocal chords
III. It causes heart attacks and atherosclerosis (hardening of the arteries)
IV. It causes lung cancer
a) I-II b) III -IV c) I-II-IV d) all
- It was observed that when the window was opened, the smoke of the cigarette in the car quickly went out of the window. What are the factors that cause this to happen?
I. The fact that the pressure outside is lower than the pressure inside the car, due to the speed of the car
II. The fact that the pressure outside is higher than the pressure inside the car due to the speed of the car
III. The fact that fluids or gases flow from low pressure to high temperature
IV. The fact that fluids or gases flow from low temperature to high temperature
a) I-III b) II-IV c) I-IV d) II-III
- Which of the below is true about the properties of sound?
a) Weak sound vibrations which can hardly be heard can be amplified (made louder) by collecting them using a cone shaped funnel.
b) Sound vibrations are transmitted best in gases.
c) Sound waves in an empty room are absorbed faster than in a filled room
d) Sound waves spread in one direction, not in all directions
- With which of the below can the single-celled animals be seen better?
I. Magnifier
II. Microscope
III. Telescope
a) Only-I b) Only-II c) I-II d) II-III

** The photographs of the exhibitions or experiment sets in the visitor center can be used to prepare matching questions which will help the students to acquire the names of the exhibits. For this, the teacher can use photographs taken before the visit or the ones on the web site of FGSC.

*** The following questions can be used to prepare drawing and composition studies to assist the students to recognize and interpret the exhibitions in the science center.

- Draw the exhibition or activity which you liked the most in science center.
- What is the name of the object you have drawn?
- Describe what this object does and its' main features.
- Write a composition about the visit to Feza Gürsey Science Center within the framework of the following items.
- Your preparations before the visit, the journey and the visit to the science center
- The object that you liked the most in the science center and the reason for this. Any problems you encountered in the science center
- The science museum of your dreams (the objects and activities which you want to see)

**** Evaluation of the FGSC visit can be held in the class, using brainstorming techniques. The evaluation framework could include the following subjects

- Evaluate your preparations before the visit, the journey to the location and the science center itself.
- Evaluate the most popular exhibits or activities in the science center
- Evaluate the least popular exhibits or activities in the science center.
- Identify the concepts and events which were learned for the first time during the visit to the science center.
- Evaluate the associations and linkages between the activities in the science center and the subjects studied in science and technology lessons.
- Describe the ways in which the objects in the science center are utilized within different technological fields and the benefits they offer to humanity.
- Evaluate any problems encountered in the science center and suggest solutions.
- Conduct a brainstorming session on the exhibitions and activities that the students want to see in science museum.

***** The following projects may form the basis for long-term follow-up studies to reinforce the skills and information gained by the students during their visit.

- Establishing a small science museum at school by bringing unused, old materials to the school.

- Making models of the objects selected from the science center and exhibiting them. Asking the students to draw plans and then make models of, their “dream” science museum.

CONCLUSION AND DISCUSSION

Teachers have a significant responsibility in tours to science centers in all steps. In order to reach the goals of the tours, teachers must plan the tour process in details.

It was observed that pre- acknowledgement of students before the tour to science centers made exhibitions in the science centers more interesting; the achievement of students increased and because of this it is helpful for students to be pre- acknowledged for qualified learning [3, 21]. In addition to this, it is emphasized to organize some activities after the tour in order to build students knowledge from the tour. It was said that activities after a well planned tour not only help students to progress and strengthen the scientific concepts but also let new concepts to come into being and gained by students in the informal education centers museum tour process [22].

When literature is examined, it is understood that teachers don't have a clear view on how to use informal education environments; they think tours are only for fun; they have difficulties in doing preparations before tour; and they don't struggle to relate curriculum of school and materials and activities in the museum [23-26]. It is explained that this is because they can not relate their tour plans with the curriculum, teachers have different individual and professional information and skills; and visitors have different interests and experiences [24].

By considering these problems, a model is presented to reduce load from the educators who organize tour to FGBM and give them the opportunity for the best planning. Preparation of some new models about the informal education environments like this model will help the reach for the aims of these places.

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