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Science center and attitude

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The project team gathered data with the assistance of Recreational and Cultural Organization of Mashhad Municipality, Organization of Mashhad Municipality and Science and Astronomy Science Center of Mashhad Municipality, Khorasan Razavi, Islamic Republic of Iran. This paper discusses the effect of science center on attitude of students who visit it. Previous research identified key variables that are fundamental to free-choice science learning. The samples consist of 1002 students of grades 9, 10 and 11 studying in high schools. Before and after the students visited the science center, they filled a questionnaire about their attitude toward science. Results showed that visiting the science center improved the students' attitude towards science. Based on the criterion of attitude growth and gender difference, male's attitude was improved more than female's. Moreover, there were significant differences between students in grade 11, 10 and 9. In addition, Univariate analysis of variance (ANOVA) indicated that the grade and gender difference had significant effect on criterion of attitude growth.

Key words: Attitude toward science, gender difference, science center.

INTRODUCTION

Science centers offer visitors exciting opportunities to explore scientific ideas and ways of thinking through fun, interaction and hands-on science exhibits. A myriad of studies now clearly document the range of learning that museums afford (Falk, 1999; Leinhard et al., 2002; Rennie and McClafferty, 1996). Most science center professionals agree that these attractions nurture curiosity, improve motivation and attitudes toward science, engage the visitors through participation and social interaction and generate excitement and enthusiasm, all of which are conducive for, if not necessary, science learning and understanding (Anderson and Cook Roe, 1993a, Dierking, 1994). Therefore, most learning takes place in the context of meaningful activity and social interaction. Many people visit science centers in family groups. As they talk together, families are observed moving from identifying and describing to interpreting and applying their science center experiences as evidence that learning is taking place (Anderson and Cook Roe, 1993b, Ramey-Gassert et al., 1994).

The science center is beneficial in the following ways:

1. Science centers work directly with students through school outreach programs and field trips (Falk, 2002).

2. Students in hands-on or activity-based science programs have been shown to exhibit increases in creativity, positive attitudes toward science, perception, logic development, communication skills and reading readiness. Not only that, science center experiences are enjoyable, leading to measurable increases in motivation among students who visit (Falk, 1999).

3. A review of research on field trips concluded that the opportunities given to students to visit the museum can support their learning process within formal education

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environments and in other facets of their lives (Friedman, 1995).

4. Studies in many countries have identified out-of-school exposure to science, including visits to science centers, as a significant factor in career choice (Falk, 1999; Persson, 2000).

5. Young people engaged in enrichment and employment programs in science centers gain self-confidence and work skills as well as interest in science.

6. Learning is "constructed over time as the individual moves through his socio-cultural and physical world; over time, meaning is built up, layer upon layer," and visits to science centers and museums become part of our store of long-term memories (Rennie and Williams, 2000).

About Science Center of "Science and Astronomy[1]"

Science Center of "Science and Astronomy" is located in Koohsangi Park of Mashhad, Khorasan Razavi, Islamic Republic of Iran. This science center contains 11 exhibitions, as follows:

Astronomy exhibition: this includes many telescopes, planetarium and astronomy illustrations. This makes the visitors to observe the stars and learn about the universe through the explanation of experts.

Physics exhibition: this includes many physics equipment like laser gun, sound mirrors, pixel simulation, hand electronic generator and thunder and lightning simulation case; this makes visitors to know more about electromagnetic waves, radio waves, Monitor, LCD LED, power network, ozone layer and the thunder and lightning phenomena.

Math exhibition: with this**,** visitors learn about attractive theorem, for example, game theory and play together. Illusion and computer vision are other subjects that are so funny for all to see.

Flight and engineering exhibition: this includes civil engineering, Macaroni Bridge, Flight attains, aerodynamic and the virtues of hybrid and many other fields that everyone can enjoy.

Attitude

It has been a common topic in various research studies whether affective characteristics play roles in determining students‟ fields of interest as well as their preferences, social activities, achievements or failures. There are proven effects of affective characteristics related to the school subjects on the learning at school (Bloom, 1979). Students‟ attitudes towards school subjects are directly or indirectly related to various issues, one of which is motivation as an affective characteristic.

Attitudes are one of the major determiners of human behavior. Attitudes of individuals strongly affect their love, hatred and behaviors (Morgan, 1991). Therefore, it is a requirement for many fields to assess the attitudes and find out the degrees of attitudes towards an item or situation (Erkus, 2003). Attitude is a phenomenon that is attained through learning, which guides the behaviors of an individual and causes subjectivity. Having positive attitudes towards a school subject would involve behaviors such as willingness to participate in a lesson, satisfaction by responding to questions, accepting one‟s own value and allowing one‟s value to be recognized (Ozcelik, 1998).

Attitude is a psychological structure perceived to be a critical and important commentator of individuals‟ behaviors in terms of their cognitive, affective and behavioral aspect (Fisbein and Ajzen, 1975).

Attitude and science center

Within the personal impact category, most studies are concerned with science learning in science centers. Some studies look at the effect of science centers in changing attitudes towards science and leading to the enjoyment of visitors. A very few are concerned with the impact of science centers on career choice and on the professional development of teachers.

Piscitelli and Anderson (2001) write, „In the 1980s, museum and visitor research studies were regarded as being in their infancy (Feher 1990). The intervening years have seen considerable growth and development in this field of research, although it can be regarded as having been in a formative stage throughout the past two decades. By the middle of the 1990s, there was wide spread acceptance among researchers of the cognitive, affective and social aspects of the learning experiences of visitors in museums and similar institutions (Raphling and Serrell 1993). Rennie and McClafferty (1996), Rennie (1994a) and Falk and Dierking (1992) had drawn attention to the physical, social and personal contexts in which learning occurs. Some studies have linked the highly stimulating, novel and interactive physical and social environments of museums to ineffective learning outcomes by visiting school students (Kubota and Olstad, 1991; Anderson and Lucas, 1997). Other studies of the 1990s period have demonstrated that students enjoy visits to museums tremendously and that increased interest, attitude and enjoyment of post-visit activities constitute extremely valuable learning outcomes (Anderson, 1999; Ayers and Melear, 1998; Ramey-Gassert et al., 1994), if they that persist over time (Anderson, 1999; Rennie, 1994a; Wolins et al., 1992).

Gender difference

It is clear that there is an emotional debate regarding a

[1] "Science and Astronomy" science center is under Recreational and Cultural Organization of Mashhad Municipality. This science center, "which is the most comprehensive one; in Islamic Republic of Iran", embraces more than 2000 students every month.

Table 1. Descriptive of attitude toward science according to grade and gender.

Gender	Grade	N	Before visiting		After visiting	
			Mean	SD	Mean	SD
Male	9	167	27.41	7.48	37.66	3.68
	10	167	30.77	8.3	39.79	4.36
	11	167	24.63	6.92	36.38	3.50
Female	9	167	31.57	7.24	40.41	3.83
	10	167	29.88	7.43	38.24	3.95
	11	167	32.20	6.58	40.31	3.49

gender gap in math and science (Glazer, 2005). This debate is further inflamed by questions regarding “innate differences” between males and females, and theories that claimed that women were biologically incapable of reason (Glazer, 2005). However, despite the passions and political correctness encountered by former Harvard President, Larry Summers (Summers suggested that the gender gap in math and science might be due to “issues of intrinsic aptitude”), these are important questions that must be addressed by the academic community if we are to provide quality education.

Research purpose

The main aim of the present study is to investigate the effect of science center on the attitude of grades 9, 10 and 11 students. Thus, the main question addressed here is, „Can science center affect the attitude of students?‟ In an attempt to answer this question, the following objectives are sought:

- The first objective of the study is to discover in which grade science center has more effect on students‟ attitude.
- The second objective of the study is to find if science center has more effect on male‟s attitude or female‟s.
- The third objective of the study is to determine which group of gender has more criterion of attitude growth after visiting science center.
- The last objective of this study is to find out interaction effect of grade and gender difference on criterion of attitude growth of students.

METHOD

Participants

The samples consist of 1002 students of Grade 9, 10 and 11 studying in high schools. Before students visited the science center, they filled the questionnaire about their attitude toward science and they filled the new questionnaire after their visited the centre.

The scale of attitudes towards science (ATS)

In order to determine school attitude toward science, "The scale of attitudes towards science" developed by Saeed Daneshamooz in Ferdowsi University of Mashhad was used. The 5-point Likert-type scale consisted of 10 statements. The reliability coefficient of the scale was calculated as 0.91. The repetition test consistency was found to be 0.91. For measuring criterion of attitude growth, the difference between the second and first score was gathered.

RESULT

According to their grade levels and gender diffrence, the average scores of students obtained from the Scale of Attitude Towards Science and their standard deviations were calculated befor and after visiting the sceince center. The results are displayed in Table 1.

Paired sample t-test showed that there was a significant diffrence between Student‟s ATS befor and after visiting science center ($P < .01$). Paired sample t-test showed that there was a significant difference between female and male ATS. Also, according to gender and grade there was a significant diffrence between Student‟s ATS befor and after visiting science center. The results are displayed in Table 2.

One way ANOVA indicated that grade significantly has effect on criterion of attitude growth for male but there was no significant difference for female. The results are displayed in Table 3.

Univariate analysis of variance (ANOVA) indicated that grade and gender difference had significant effect on criterion of attitude growth. In addition, there was a significant intersection effect of grade and gender difference. Table 4 shows univariate analysis of variance (ANOVA) results obtained for each main and intersection effect of grade and gender difference.

Figure 1 interprets thegrade, gender difference and criterion of attitude growth of the sample. Female students had no significant difference in terms of criterion of attitude growth. Male students in grade 11 had significant

Table 2. P-values of gender difference, grade and attitude toward science before and after visiting science center.

Gender	Grade	P-values based on grade			P-values based on gender			P-values total		
		Mean	SD	P-Value	Mean	SD	P-Value	Mean	SD	P-Value
Male	9	10.28	5.53	P < .01						
	10	9.09	5.67	P < .01						
	11	12.25	5.00	P < .01	10.42	5.56	P < .01			
Female	9	9.14	5.74	P < .01						
	10	8.29	6.17	P < .01						
	11	8.17	5.36	P < .01	8.44	5.73	P < .01	9.61	5.71	P < .01

Table 3. Effect of science center on criterion of attitude growth based on grade separated by gender difference.

Gender difference	F	P-value
Male	13.14	P<.001
Female	0.846	P=.43

Table 4. P-values of grade and gender difference on attitude toward science.

Factors	F	P-Value	R squared
Grade	5.53		
Gender difference	26.51	P<.001	0.058
Grade * gender difference	7.56		

difference in terms of criterion of attitude growth compared to grades 9 and 10.

DISCUSSION

Many researchers report that positive beliefs, attitudes and feelings will lead to increased achievement in formal learning (Grootenboer, 2003a; Wilkins and Ma,2003; Hassi and Laursen, 2009). Attitudes towards science appears to be very important in relation to differences in achievement as well as in participation in school courses. According to historical background, attitude can improve achievement and that achievement, in turn, can improve attitude (Fardin et al., 2011; Meelissen and Luyten,2008). Negative attitudes and emotions, together, are often connected with students‟ preventive beliefs and perceptions in formal learning situations (DeBellis and Goldin, 2006; Malmivuori, 2001; McLeod, 1992). According to the results of this study, students‟ attitude toward sience can be improved by learning their lessons in real life, for example visiting science center and understanding their lessons in real experience.

This study showed that students who visited science center significantly have their attitiude toward science improved. This finding supports this fact that experiencing the science programs have helped the students to have increases in creativity, positive attitudes toward science and communication skills. Also, science center experiences are enjoyable, leading to measurable increases in motivation and attitude toward sceince (Falk, 1999, 2002).

Although increase in the attitude toward science was indicated in the result for both male and female, but males had more than females. So, science center experience can provide support to students in their learning process within formal education environments and in other facets of their lives; especially for the boys. By improving their attitude toward the science, students will be motivated to learn more and understand better (Falk, 1999; Friedman, 1995; Persson, 2000).

In addition, in all grades, students‟ criterion of attitude growth increased, but this criterion increased more for the males than the females. It may be because of two reasons, career and skills. Studies in many countries have identified out-of-school exposure to science, including visits to science centers, as a significant factor in career choice and boys think about suitable career more than girls do. Young people engaged in enrichment and employment programs in science centers gain self-confidence and work skills as well as interest in science (Morey and Associates, 2001; Persson, 2000).

Results indicated that gender difference and grade have significant effect on criterion of attitude growth. Learning is constructed over time as the individual moves through his socio-cultural and physical world; over time, meaning is built up, layer upon layer, and visits to science centers and museums become part of our store of long-term memories. So, science centers work directly with students through school outreach programs and field trips (Sheppard, 2000).

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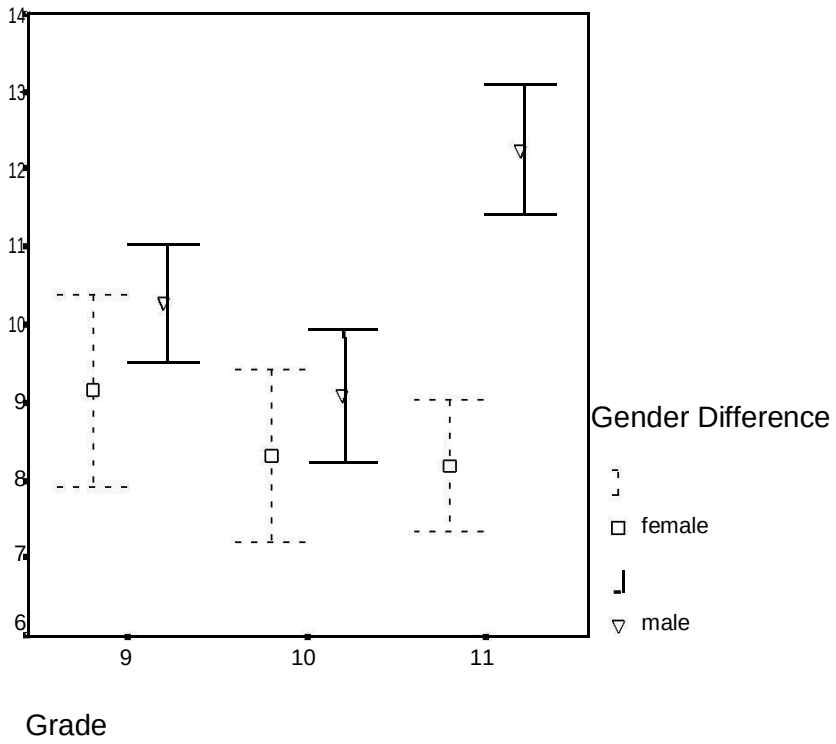

Figure 1. Grade, gender difference and criterion of attitude growth.

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Appendix: Questionnaire about student‟s attitude toward science.

1.	More scientists are urgently needed
2.	Scientific discoveries do more harm than good
3.	Science is very important for a country‟s development
4.	Money spent on science is worth spending
5.	Science will help to make the world a better place in the future
6.	Science is relevant to everyday life
7.	Science and technology are making our lives healthier, easier and more comfortable.
8.	Scientific and technological research cannot play an important role in protecting the environment and repairing it.
9.	With science development, automation will create more jobs than it will eliminate.
10.	The benefits of science are greater than any harmful effects it may have.