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Factors affecting the motivation of Turkish primary students for science learning

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Abstract

In this study, Turkish primary students' (sixth to eighth grade) motivation toward science learning was investigated and factors affecting this determined. The sample for the study consisted of 376 students from 5 different primary schools in İzmir. The data were collected through a Students' Motivation toward Science Learning (SMTSL) questionnaire which was developed by Tuan, Chin & Shieh (2005) and adapted for use in Turkey by Yilmaz & Cavas (2007). It was found that it was a valid and reliable tool for the Turkish students, having 6 sub-scales which were self-efficacy, science learning value, active learning strategies, performance goal, achievement goal, and learning environment stimulation. Also collected was data on students' science attitudes and achievement scores. Results showed that Turkish primary students' science motivation differed significantly in terms of their gender and grade level. Student's motivational level was found to have a considerable impact on their science attitudes and achievement in science.

Key words: *Science Motivation, Science Attitudes, Primary Students*

Introduction

In the last twenty years, science education studies have been conducted to determine not only cognitive abilities, but also affective abilities. These studies have been dominated by constructivist theory in which each learner individually and socially constructs meaning as s/he learns. According to constructivist theory, students do not passively absorb information but rather, meaningful learning involves the active creation and modification of knowledge structures (Palmer, 2005). When students try to learn new science concepts, they use their existing schemas, knowledge, beliefs and interests to make understand and interpret any new information, and this may result in their ideas becoming modified or revised.
In the light of these studies, many governments around the world, including that in Turkey, redesigned and adapted their science curricula according to constructivist theory. The current goal of the new Turkish Science and Technology curriculum is to enhance all students' scientific literacy and to help them to:

• understand science and the nature of science;
• grasp basic science concepts;
• realize the relationships between science, technology, society and environment and the importance of them;

• gain scientific attitudes and values; and
• willingly continue their science studies both at school and out of school.

Therefore, it is very important to focus on the effect of the affective components in science education research (Yilmaz & Cavas, 2007). One of these components is motivation as students' motivation plays a crucial role in science learning, such as the conceptual change process, critical thinking process and scientific process skills (Duit & Treagust, 1998; Lee, 1989; Lee & Brophy, 1996; Pintrich et al., 1993; Strike & Posner, 1983; 1992; West & Pines, 1983; cited in Tuan, Chin & Sheh, 2005).

Motivation in Education

Motivation attempts to give some guidance in understanding an individuals' behavior and the effort applied in different activities. Although many definitions are used in the literature to explain the concept of motivation, this concept is generally defined as the internal state, or condition, that serves to activate, direct and sustain behavior (Brophy, 1998; Glynn & Kleinginna, & Kleinginna, 1981; Koballa, 2006; Palmer, 2005). According to Brophy (1998), motivation to learn is "a student tendency to find academic activities meaningful and worthwhile and to try to derive the intended academic benefits from them" (p. 205-206). From the educational perspective, Palmer (2005) states that motivation can be applied to any process that activates and maintains learning behavior. Recent motivation studies have shifted from being carried out from a behaviorist perspective that emphasizes the influence of environmental factors like rewards and punishment towards a social cognitive view that focuses the importance of students' beliefs about themselves and their learning environment (Palmer, 2005, Weiner, 1990).

Students' motivation in learning science is defined as "students' active engagement in science-related tasks for achieving a better understanding of science" (Lee and Brophy, 1996). Motivation to learn science promotes student construction of their conceptual understanding of science. Motivation is a vital educational variable promoting both new learning and performance of previously learned skills, strategies and behaviors (Barlia, 1999). If students perceive the value of learning tasks, they will actively participate in these tasks to construct a meaningful understanding of a new science concept based on their existing knowledge. Von Glasersfeld (1998) noted that the students' learning goal is also important for construction of their science knowledge, based on learning value and learning strategies (Tuan, Chin & Shieh, 2005).

Many studies have been conducted on students' motivation to learn and these studies showed that there are many factors related to motivation. Besides intrinsic and extrinsic aspects, factors include self-perceptions of ability, effort, task value, self-efficacy, test anxiety, self-regulated learning, task orientation and learning strategies (Brophy, 1998; Garcia 1995, Garcia & Pintrich, 1995; Nolen & Haladyna, 1989; Pintrich & Schunk, 1996). Tuan, Chin & Sheh, (2005) integrated constructivist learning and motivation theories and found five important factors for motivation in science learning motivation. These were: students' self-efficacy, science learning value (or task values), students' learning strategies, the individual's learning goal, and the learning environment.

In the literature, there have been a number of studies relating individual factors affecting students motivation in science such as home life, parental influence, and peer pressure (Martin, 2002; Singh et al., 2002). These individual factors are a great challenge for teachers since none of these can be easily influenced by the teacher. Other factors which are under the

teacher's control include classroom atmosphere, school environment, teaching style, and relevance of the subject matter (Ames, 1992; Evans, 2004; Swanson, 1995).

Some researchers have conducted case studies to explore eighth-grade and ninth-grade students' motivation in science learning in order to confirm the motivation domains (Tuan & Chin, 1999; 2000; Wu & Tuan, 2000). These studies concluded that students' motivation toward science learning was related to themselves, the teacher's performance and the abstractness and relevance of science content related to their daily lives. Results obtained from students' responses showed that their goals for learning science were both extrinsic (e.g. competition, getting award from teachers) and intrinsic (e.g. satisfying with their own curiosity). These results were coherent with Brophy (1998)'s study on performance goal and achievement goal. Yaman and Dede (2007) investigated Turkish primary school students' motivation towards science with respect to gender, grade level and courses liked by student. They found that there was a significant difference in students' motivation levels toward science learning in terms of these factors Akbas and Kaan (2007) examined high school students motivation and anxiety for Chemistry course and indicated that motivation and anxiety were significant predictors of chemistry achievement.

Science Education in Turkey

The Turkish education system falls under the supervision of the Ministry of National Education (MoNE) and it has strong autonomy, power and responsibility for coordinating state, private, and voluntary organizations; developing policy; planning curriculum; building schools; and providing educational materials. In terms of levels of formal education, Turkish basic education encompasses pre-primary (ages 3 to 5), primary education (ages 6 to 14 and grades 1 to 8) and secondary education (general schools and vocational & technical schools, age 14–17). Primary education is compulsory for all citizens and is provided free of charge in state schools. MoNE has the overall responsibility for preschool, primary, and secondary education. The responsibility of higher education is under the Higher Education Council and higher education includes universities and institutes.

Many national studies and also major international studies, like TIMSS (1993) and PISA (2003; 2006), pointed tot there being a big problem in science education in Turkey. Turkish students' performance in science is very low; when compared to other countries, their performance is below the international average. Such international and national indicators forced the Turkish MoNE to instigate a major curricular change at both elementary and secondary level (Babadogan & Olkun, 2005). In the last decade, the Turkish National Science Curriculum has been revised and renewed twice in line with the constructivist movement in education. With a new and revised science curriculum in 2000, a more student centered approach was implemented. In 2004, the science curriculum was renamed as the Science and Technology Curriculum and revised based on suggestions from all sections of the educational community including science teachers, and administrators (MoNE, 2004). In the new curriculum, more importance was given to scientific & technological literacy and it was emphasized that science and technology literacy does not only consist in knowing scientific principles and theories, but also included acquiring knowledge on the nature of scientific thinking and processes, on scientific values, the general nature of science and technology, and science-technology-society interactions (TUBA, 2005).

Although many improvement attempts have been made in science curriculum, Turkish Science & Technology education still have some problems. The most important problems are:

• intensive curriculum,
• insufficient time allocation for science education, students in a passive position (only listening and writing),
• teachers in active position (writing on the board and teaching in a classical way),
• traditional assessment methods,
• insufficient usage of science laboratories (Esme, 2004; cited in Ozden, 2007).

Problem of the Study

Motivation in science learning and positive science attitudes are believed to be vital parts of developing a lifelong interest in science and for developing students' scientific literacy level. Researchers believe that motivation and attitude are fundamental variables for improving students learning and conceptual understanding (Francis & Greer, 1999; George, 2006; Osborne, 2003; Skallingsber, 2003; Tuan, Chin & Shieh, 2005; Wiseman & Hunt, 2001). In the literature, many studies related to motivation have been conducted generally on revealing the characteristics of students' motivation in science classes (Lee, 1997; Lee & Brophy, 1996; Hwong & Tuan, 2001; Wu & Tuan, 2001) and explaining the correlations between science knowledge and motivation (Stephans & McCormack, 1985; Schoon & Boone, 1998; Wenner, 1993 cited in Tuan, Chin & Tsai, 2003). However, few studies have been conducted to investigate the factors affecting student motivation in science learning. In this sense, the main aim of the present study is to examine primary students' motivation in science learning, attitudes toward science and which variables (gender and grade level) affect these selected variables.

Methodology

Sample

The sample for this study was 376 primary students from 6 state schools in Izmir. Among the participants, 182 of them were sixth grade, 125 of them were seventh grade and 69 of them were eight grade. The sample included 188 females and 188 males. The frequencies of the sample can be seen in Table 1.

Table 1. The Population and gender balance of the student Sample

Grade	Gender	Number	%
6	Female	87	23
	Male	95	25
	Total	182	48
7	Female	69	18
	Male	56	15
	Total	125	33
8	Female	32	8
	Male	37	10
	Total	69	18
Total	Female	188	50
	Male	188	50
	Total	376	100

Instruments

In this study, the Students' Motivation toward Science Learning (SMTSL) questionnaire was used as the main instrument. The SMSTL questionnaire was developed by Tuan, Chin & Shieh (2005) to identify science learning motivation of primary students and consisted of 33

items in a five-point Likert-type scale It included 6 scales: self-efficacy (SE) (7 items), science learning value (SLV) (8 items), active learning strategies (ALS) (5 items), performance goal (PG) (4 items), achievement goal (AG) (5 items), and learning environment stimulation (LES) (6 items) scales. The SE scale was related to students' beliefs about their own ability to perform well in science learning tasks; the ALS scale reacted to students' active participation in using a variety of strategies to construct new knowledge based on their previous understanding. The SLV scale was seen as very important in determining students' motivation to learn science since this scale consists of crucial values aspects such as acquiring problem-solving competency, experiencing inquiry activities, stimulating their own thinking and finding the relevance of science in daily life. The scale PG was related to students' competition with other students in the classroom and their desire to get attention from the teacher. The AG scale was about students' satisfaction as they increased their competence and achievement during science learning. The LES scale included learning environment factors affected students' motivation in science learning like curriculum, teachers' teaching and pupil interaction.

The SMTSL was translated into Turkish by Yilmaz & Cavas (2007) and determined to be a valid and reliable tool for Turkish students. In order to confirm the original factor structure of the instrument, a principal component analysis with Equamax rotation was performed. The results of the factor analysis indicated that the factorial structure of SMTSL was the same as that observed by Tuan Chin and Shieh. Two items (items 15 and 21) were deleted from the Turkish instrument because factor loadings were lower than 0.3 so that the final Turkish version consisted of 33 items, in 6 scales. The reliability of the whole instrument and the scales was as shown at Table 2.

Table 2. Cronbach alpha coefficients of the SMTSL and scales

Variable	Number of Item	Cronbach Alpha
Self-efficacy (SE)	7	0.71
Science learning value (SLV)	5	0.74
Active learning strategies (ALS)	7	0.85
Performance goal (PG)	3	0.54
Achievement goal (AG)	5	0.77
Learning environment stimulation (LES)	6	0.77
SMTSL	33	0.87

As it can be seen from Table 2, The Cronbach alpha reliability coefficient for the whole instrument was 0.87 ranging from 0.54 to 0.85 for the scales.

Another instrument used in this study was the "Science Attitude Scale (SAS)" developed by Geban, Ertepınar, Yılmaz, Atlan & Şahpaz (1994). This scale aimed to investigate primary students' attitudes toward science. SAS included 15 items for which the reliability was found to be 0.83. Also students' science achievement mean scores were obtained from their schools.

Results

In this study, descriptive statistic analysis, t-test, ANOVA and Pearson correlation were used to analyze data. A descriptive analysis indicated that primary students have a high motivation to learn science (X=3.90; SD=0.51) and positive attitudes toward science (X=3.89; SD=0.69). In order to find out whether there was a significant difference between female and

male mean scores of the selected variables, independent t-tests were carried out. The results are shown in Table 3.

Table 3. Comparison of the Female and Males Mean Scores on the 6 scales for Science Motivation, SMTSL as a whole, Science Attitudes and Science Achievement.

Variables	**Groups**	**N**	**M**	**sd**	**p**
SE	Females	188	3.34	0.77	.255
	Males	188	3.25	0.73	
SLV	Females	188	4.07	0.63	.007*
	Males	188	3.86	0.80	
ALS	Females	188	4.19	0.72	.126
	Males	188	4.02	0.79	
PG	Females	188	3.04	1.02	.537
	Males	188	2.98	0.98	
AG	Females	188	4.04	0.71	.014*
	Males	188	3.85	0.78	
LES	Females	188	4.45	0.92	.069
	Males	188	4.27	0.99	
SMTSL	Females	188	3.97	0.49	.006*
	Males	188	3.83	0.51	
Science Attitudes	Females	188	3.91	0.67	.181
	Males	188	3.89	0.71	
Science Achievement	Females	188	3.71	1.08	.777
	Males	188	3.55	1.22	

(*p<.05)

Table 3 indicates that, in almost all variables, female students had higher mean scores than their male counterparts. However these differences were not statistically significant for all scales. There were significant differences in Science Learning Value scores for females (M=4.07, SD=0.63) and males [M=3.86, SD=0.80; t(374)=2.71, p=.007] and in Achievement Goal scores for females (M=4.04, SD=0.71) and males [M=3.85, SD=0.78; t(374)=2.47, p=.014]. Also significantly differences were found in total Science Motivation scores of students, in favor of females. These results showed that girls were more motivated to learn science than boys. Female students also obtained higher mean scores on the science attitude scale.

Table 4 indicated that students have high level of motivation in science learning. Their mean scores obtained from SLV, ALS, AG and LES scales decreased as their grade level increased. Among the scales of the SMTSL, 8th graders only had higher mean scores from Self Efficacy and Performance Goal compared to students in other grades. Their attitudes toward science and achievement in science showed a fluctuating change regarding grade level.

In order to find out whether there are significant differences in the students' mean scores for science motivation, attitude and achievement regarding grade level, ANOVA was utilized to analyze data. The results were as shown in Table 5.

Table 4. Descriptive Statistics of Students' Motivation(in the 6 scales and overall), Attitudes and Achievement in Science with respect to Grade Level

Variable	Grade Level	N	M	sd
SE	6. grade	182	3.24	.81
	7. grade	125	3.14	.63
	8. grade	69	3.70	.64
SLV	6. grade	182	4.11	.77
	7. grade	125	3.86	.70
	8. grade	69	3.79	.77
ALS	6. grade	182	4.18	.79
	7. grade	125	4.06	.69
	8. grade	69	3.99	.78
PG	6. grade	182	2.93	1.03
	7. grade	125	2.92	.99
	8. grade	69	3.39	.84
AG	6. grade	182	4.02	.79
	7. grade	125	3.88	.68
	8. grade	69	3.85	.76
LES	6. grade	182	4.60	.98
	7. grade	125	4.24	.84
	8. grade	69	3.97	.94
SMTSL	6. grade	182	3.98	.52
	7. grade	125	3.80	.45
	8. grade	69	3.88	.54
Science Attitude	6. grade	182	4.03	.708
	7. grade	125	3.70	.707
	8. grade	69	3.89	.519
Science Achievement	6. grade	182	3.62	1.22
	7. grade	125	3.42	1.11
	8. grade	69	4.03	.95

Table 5 indicates that grade level significantly affected students' motivation in science, attitudes toward science and science achievement. Except for achievement and active learning strategies scales, there was a change in scale values of SMTSL for students' grade level. Post-hoc comparisons using the Turkey HSD test indicated that the mean scores of Self Efficacy, Performance Goal and Science Achievement for 8th grade students were significantly different from 6th and 7th grade students. Sixth grade students' mean scores for Science Learning Value and Learning Environment Stimulation were significantly different from those of 7th and 8th graders.

In order to investigate the effect of motivation levels on science attitude and achievement, students' mean scores for science learning motivation were categorized as high motivation (N= 57), moderate motivation (N=256) and low motivation (N= 63). High motivation level included means scores between 4.41 and 5.00; moderate motivation level included means scores from 4.40 to 3.39 and finally low motivation level included mean scores below 3.38. Students' motivation levels labeled regarding Table 6 showed the comparison of students' science attitude and achievement scores using ANOVA regarding motivational levels.

Table 5. Comparison of Students' Motivation, Attitudes and Achievement in Science with respect to Grade Level

Variable	Source	Sum of Squares	df	Mean Square	F	p	Differences
SE	Between Groups	15.081	2	7.541	14.388	.000*	**8-6**
	Within Groups	195.480	373	.524			**8-7**
	Total	210.561	375				
SLV	Between Groups	7.153	2	3.576	6.394	.002*	**6-7**
	Within Groups	208.642	373	.559			**6-8**
	Total	215.795	375				
ALS	Between Groups	1.978	2	.989	1.709	.182	-
	Within Groups	215.855	373	.579			
	Total	217.833	375				
PG	Between Groups	12.451	2	6.226	6.389	.002*	**8-6**
	Within Groups	363.491	373	.975			**8-7**
	Total	375.942	375				
AG	Between Groups	2.072	2	1.036	1.852	.158	-
	Within Groups	208.687	373	.559			
	Total	210.759	375				
LES	Between Groups	23.119	2	11.559	13.373	.000*	**6-7**
	Within Groups	322.415	373	.864			**6-8**
	Total	345.534	375				
SMTSL	Between Groups	2.250	2	8.16			**6-7**
	Within Groups	94.199	373	1.29	6.29	.002*	
	Total	96.45	375				
Science Attitude	Between Groups	7.467	2	3.734	8.127	.000*	**6-7**
	Within Groups	171.355	373	.459			
	Total	178.822	375				
Science Achievement	Between Groups	16.325	2	8.163	6.297	.002*	**8-6**
	Within Groups	483.547	373	1.296			**8-7**
	Total	499.872	375				

(*p<.05)

Table 6. Descriptive Statistics of Students' Attitude and Achievement in Science Regarding Motivational Level

Variable	Motivation Level	N	M	sd
Science Attitudes	Low Motivation	63	3.34	.89
	Moderate Motivation	256	3.92	.56
	High Motivation	57	4.40	.50
Science Achievement	Low Motivation	376	3.22	.69
	Moderate Motivation	256	3.62	1.04
	High Motivation	57	4.12	1.14

Table 6 showed that students' motivational level affected their attitudes towards science and science achievement. As motivation level increased from low to high, students mean scores of science attitude and achievement also increased. For both variables, students who were labeled as at a high motivation level had higher scores than other groups of students.

Post-hoc comparisons using the Turkey HSD were conducted to illustrate whether there were meaningful differences between groups to investigate meaningful differences between groups. There were as shown in table 7.

Table 7. Comparison of Students' Attitudes and Achievement in Science related to their Motivational Level

Variable	Source	Sum of Squares	df	Mean Square	F	p
Science Attitude	Between Groups	34.556	2	17.278	44.673	.000*
	Within Groups	144.266	373	.387		
	Total	178.822	375			
Science Achievement	Between Groups	24.359	2	12.179	9.554	.000*
	Within Groups	475.514	373	1.275		
	Total	499.872	375			

(*p<.05)

According to the Table 7, there were statistically significant differences at the p<.05 level in science attitude and achievement scores for the three motivation groups. In order to find out the actual differences in mean scores between the groups, the effect size was calculated using eta squared. This value for science attitude and science achievement was 0.19 and 0.05 respectively. Cohen (1988) classifies 0.01 as a small effect, 0.06 as a medium effect and 0.14 as a large effect. Regarding this classification, the actual difference in mean scores of science attitudes among the groups was quite large. Post-hoc comparisons using the Turkey HSD test indicated that the mean scores of high motivation level students were significantly different from those of the other motivation levels for both science attitudes and achievement. According to these results, students' science attitudes and achievement were changing meaningfully with the motivation levels of students.

Discussion

Students' motivation, attitudes and interest are important elements for science education because these affective elements are highly correlated with students' success in science learning. Results showed that primary students, in general, have high motivation in science learning, positive attitudes toward science with more positive attitudes relating to higher achievement scores in science. While there were gender differences in selected variables, although not statistically significant different in all variables, the results suggest that females are more motivated in learning science than males. Female students also obtained higher mean scores on the science attitude scale.

Results showed that students' motivation declines gradually as their grade level increase. This result is consistent with other studies conducted by Hidi and Harackiewicz, 2000; and Singh et al., 2002. According to them, on entering the middle and high school years, the learning emphasis in science shifts from a focus on participation to a focus on performance. Such a transition is difficult for many students. When adolescents perceive that they do not possess the skills needed to meet such challenges, they are less likely to even attempt the tasks (Csikszentmihalyi, 1990). Furthermore, after students enter high school, they typically view science as dull and tedious (Lunetta, 1998). Other grade level results indicate that 8th graders only illustrate high mean scores for Self Efficacy and Performance Goal compared to students in other grades. This suggested that students who were in the last year of primary school believed that they had capabilities to achieve learning tasks whether these were easy or difficult and they wished to achieve highly independently of external indicators of success

such as getting high marks. For the other four scales, sixth graders had high mean scores comparable to students in other grades.

Student motivation levels also influence their attitude toward science and their achievement in science. Thus students who have high motivation to learn science are more successful in science learning and their attitudes toward science are more positive than other students. Hasan (1985) found that students' perception of his/her science ability have the most important impact on attitudes toward science. Oliver and Simpson (1988) studied the effects of science motivation on academic achievement and concluded that motivation predicts academic success. Patrick et al (2007) suggested that motivation has very strong influence on students' achievement in science.

Researchers also presume that motivation is a function of student expectation for success in addition to the inherent value that students assign to learning (Wigfield & Eccles, 1992). Specifically, student motivation is a tool used by researchers to clarify the degree to which pupils show effort and interest in their pursuits, regardless of whether these tasks are desired by the teacher (Brophy, 2004). Relevance of science is also crucial to motivate students in learning any subject. Researchers suggested that relevance need to be considered from students' point of view (Holbrook & Rannikmae, 2010; Rannikmae, Teppo, & Holbrook, 2010). In order to understand students' motivation in science learning, further qualitative research should be conducted for assessing the interaction of different environmental and social factors.

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