ISSN 1648-3898

ENHANCING LEARNING THROUGH MULTIPLE INTELLIGENCES IN ELEMENTARY SCIENCE EDUCATION

Esra Ucak, Huseyin Bag, Muhammet Usak

Abstract. *The goal of this research is to investigate whether there is a significant difference between multiple intelligence instruction and traditionally designed science instruction on 7th grade students' understanding of concept with the "The Structure of Material and Its Transformation" unit and attitudes toward science. Two classes, each with 27 students were randomly selected. The experimental group was instructed though MI strategies, whereas the control group was utilized with traditional methods. The measurement instruments utilized were Chemistry Achievement Test and Science Attitude Scale. As a result of this study it was found out that multiple intelligence theory, when compared to the traditional learning method, created positive effects on students' success and attitudes toward science as a school subject.*

Key words: *science education, multiple intelligence theory.*

Esra Ucak, Huseyin Bag, Muhammet Usak
University of Pamukkale, Turkey

Introduction

Learning science is often difficult for students because their theories about how the world works - their schemes for understanding phenomena - conflict with scientific understandings they are to learn (Fellows, 1994). For many years to get rid of difficulties in science teaching and to satisfy the needs of students, new approaches for teaching science have been proposed. There are lots of different learning theories that can be used to help guide a teaching/learning process. One of them is multiple intelligence theory.

In his 1993 publication, Multiple Intelligences: The Theory in Practice, Gardner defines intelligences as "the ability to find and solve problems, or to fashion products, that are valued in one or more cultural or community settings. "MI theory was first proposed by Howard Gardner (1983) in his seminal book, Frames of Mind: Since that time, educators have become interested in the theory as a means to improve teaching and learning in a multiplicity of ways. Schools have been organized around the theory, numerous books and journal articles have been published about the theory and many people have engaged in professional development based on the theory.

Gardner (1983) states that; the students in the classroom are not the same. If we treat everybody as if they are the same, we are only considering one profile of intelligence, the language-logic profile… Students arrive on our doorsteps vastly different from one another (Ellison, 1992).

Mindy L. Kornhaber (2001, p.276), a researcher involved with Project Zero, has identified a number of reasons why teachers and policymakers in North America have responded

positively to Howard Gardner's presentation of multiple intelligences. Among these is that: ... the theory validates educators' everyday experience: students think and learn in many different ways. It also provides educators with a conceptual framework for organizing and reflecting on curriculum assessment and pedagogical practices. In turn, this reflection has led many educators to develop new approaches that might better meet the needs of the range of learners in their classrooms.

Traditionally, school has been directed at verbal-linguistic and logical-mathematical intelligences (Emig, 1997). Students who are weak in neither of these intelligences are usually disadvantaged in school. The learning of science should entail more than the verbal-linguistic and logical-mathematical intelligences; teachers should capitalize on all ways of knowing (or all of the multiple intelligences) in order to make science more meaningful, relevant, and personalized for all students" (Goodnough, 2001, pp.180-194). MI theory challenges traditional theories about intelligence, learning, teaching, cirricula, and assessment (Blythe & Gardner, 1990). Haggarty (1995, p.49) stated, "MI theory offers a richly diversified way of understanding and categorizing human cognitive abilities, and combinations of abilities, heightening our awareness of what makes learning possible for individual students". Beckman (1996) stated, "MIT is a way of thinking, it is an attitude about people, which allows for inclusion and enrichment, for self-esteem building and the development of respect for each individual and the gifts they bring to the classroom.

Reviewing the literature about science education, multiple intelligences and its applications in classrooms revealed that many schools started to integrate the multiple intelligence teaching strategies into their classrooms and even whole curriculum and many researchers have carried out studies to investigate the effect of this strategy on many discipline apart from science. Various studies about MI teaching strategy yielded different results in terms of its usage in classrooms. Therefore there is a need to investigate the effect of MI strategy.

This study was conducted on a limited number of students. This study, it was aimed to examine and observe how the MI based on instructional techniques influence students' learning and attitudes. The findings obtained from this study can not be generalized to other settings.

Methodology of Research

Data Collection Instruments

Two scales, Chemistry Achievement Test and Science Attitude Scale were used to collect data and to measure the differences in the students' knowledge levels before and after the study depending on the methods used.

In order to collect the quantitative data which construct the investigation, the portfolios, which were held by EGs during their study, were used.

Chemistry Achievement Test

Chemistry Achievement Test (CACT), used in this study, was developed by researcher to assess students' chemistry achievement. The aim of this test was to measure the fore-knowledge of students about "The Structure of Material and Its Transformation" and to see their achievements after the end of study. In the test, some questions were taken from the entrance examinations of various kinds of schools in Turkey. Through the table, the targets to be achieved in students' learning at the end of this study were determined, and for each target a question was prepared.

The draft test consisted of 34 multiple-choice questions related to the unit "The Structure of Material and Its Transformation". Each question had one correct answer and three distracters. The reason for preferring multiple-choice items is that it is easy and quick to apply and it enables the researcher to score objectively.

Before the study, draft form of test was applied to 88 7th grade students and factor analyses of them were calculated. As a result, 25 questions were selected as CACT. Related to 25 questions,

new subject content table upon which the targets to be achieved at the end of the study, was prepared.

The Cronbach j-reliability was found as 0.81 for CACT. In the CACT, possible achievement scores could range from 0 to 25, with higher scores indicating greater achievement. The total time for students to complete was approximately 35 minutes.

A sample question used in this study:

A student, who wants to show how a mixture can be separated into its components by physical methods, mixes salt, sugar, naphthalene and iron-dust with enough amount of water. He applies the process numbered as I and II to the mixture sequentially.

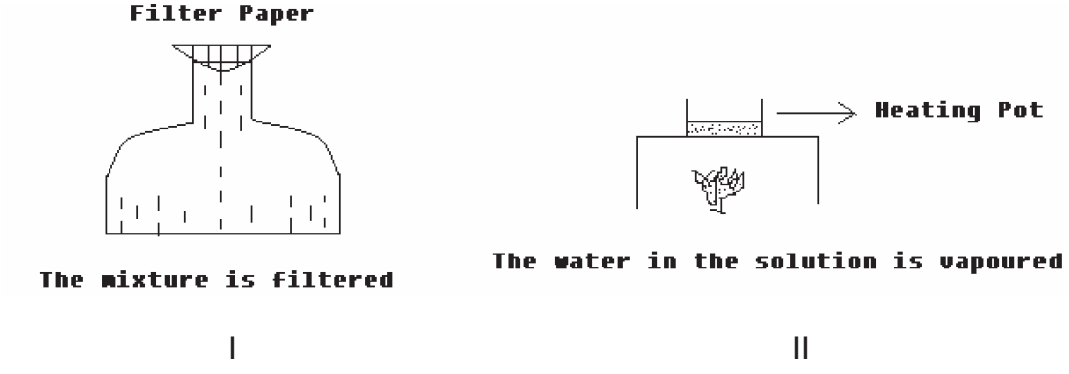

Figure 1. (I) Separation process, (II) Heating process.

According to the applied processes described above, which materials will remain on the filter paper and in heating pot at the end of the processes I and II, respectively?

	Filtering	**Heating**
A)	Salt, Sugar	Naphtalene, Iron-dust
B)	Naphtalene, Sugar	Salt, Iron-dust
C)	Naphtalene, Iron-dust	Sugar, Salt
D)	Iron-dust	Naphtalene, Sugar, Salt

Science Attitude Scale

Science Attitude Scale (SAS) was used as a tool for measuring. This is likert scaling that was developed by Geban and Ertepinar (1994) to measure students' attitudes toward science as a school subject. This scale consisted of 15 items in a 5 point likert scaling (fully agree, agree, undecided, disagree, fully disagree). From the SAS, students can get minimum of 15 and maximum of 75 points. The reliability of the SAS was founded as 0.83 by Geban *et al.*

Method of instruction in the experimental and control groups

This treatment was conducted over four weeks on September in the 2005-2006 first term at Kinikli Basma Boyama Primary School, 7th grade students of two classes were enrolled in the

study. This experimental research design was taken from Campbell and Stanley's (1963) pre and post-test control group model. Students were divided into two groups; control (CG) and experiment (EG) group. The previous year's science lesson marks of groups were compared and the two groups whose marks were close to each other were chosen. Firstly, Chemistry Achievement Test and Science Attitude Scale were performed as pre-tests. In the next step, the chemistry lessons of the primary school 7 year students were taught to the control group (CG) by using the traditional method and to the experiment group (EG) by using the Multiple Intelligences Theory.

In the CG, the teacher directed strategy represented that the traditional approach was used in the course. The student was instructed only with traditionally designed science text. Mostly of time, the teacher presented the topic and the students listened their teacher and answered the questions asked by teacher. At the same time they carried out laboratory work in their text-book.

In the EG, the activities were prepared in light of Multiple Intelligence theory. Different types of activities were taken for different types of intelligences of students by taking the lesson plan samples prepared for the MI instruction.

At the end of the study, Chemistry Achievement Test and Science Attitude Scale were performed as post-tests.

Participants

This study was performed among students of 54 primary schools students. The distribution of the students according to their groups was presented in Table 1.

Table 1. Distribution of participants according to their groups.

	Age	Female	Male	Total
EG	12-13	16	11	27
CG	12-14	12	15	27

Data Analysis

The data collected in this study were analyzed by using SPPS/PC version 11.5 statistical program, two different t-tests were performed: Paired Samples t-test was conducted to determine whether there was a significant difference between pre-test and post-test results in each group, in group analysis, as the result of the methods used in the study. Independent Samples t-test was performed to identify whether knowledge levels of all students in CGs and EGs and to find out whether a significant changes arise between groups as results of the method used. Significance level was decided by taking p values into consideration $p>0.05$, meant there was not a meaningful difference, $p<0.05$ meant there was a meaningful difference.

Results of Research

The results of the analysis of pre-test applications of chemistry achievement test and science attitude scale performed to find out the students' achievement to subject The Structure of Material and Its Transformation , before they were taught in this study, in the integrated science lesson, and to compare the students pre and post performances and to find out whether there was a significant difference in students' success and attitude related to methods used, in groups and between groups were presented in Table 2 and Table 3 .

The data which were collected from portfolio files are presented in Table 4 and Table 5.

A. Results of Qualitative Analysis

Chemistry Achievement pre and post test results taken from CG and EG were analyzed separately. Differences in students' knowledge levels between pre and post-test results in CG and EG were presented in Table 2.

Table 2. Pre and Post Test Results of CACT.

Group		N	$\bar{X}$	SD	t	p
CG	Pre-test	27	7.48	2.39	-6.06	0.000
	Post-test	27	12.37	4.29		
EG	Pre-test	27	8.11	1.86	-7.70	0.000
	Post-test	27	15.33	4.64		

As it can be seen from Table 2, there were statistically significant differences between pre and post-test results in CGs and EGs for CACT. When we looked at means values in all CGs and EGs, it was seen from the table that differences between pre and post test mean values of EGs were higher than those of CGs. In other words, achievement levels of students in EGs who received the topic through the multiple intelligence theory used in EGs were higher than the students that were taught the topics though traditional method used in CGs.

Science attitude pre and post scale results taken from CG and EG were analyzed separately. Differences in students' attitude to science between pre and post-test results in CG and EG were presented in Table 3.

Table 3. Pre and Post Test Results of SAT.

Group		N	$\bar{X}$	SD	t	p
CG	Pre-test	27	3.80	0.56	0.59	0.55
	Post-test	27	3.72	0.57		
EG	Pre-test	27	3.87	0.50	1.53	0.13
	Post-test	27	4.11	0.49		

As it is understood from the table, there weren't statistically significant differences between pre and post test results of CGs and EGs for SAT. When we looked at means values of EGs and CGs while the science attitudes of CGs, whom the traditional method was used, declined after the experimental process; the science attitudes of EGs, whom the lessons depending upon MI theory were used, increased after the experimental process. There was difference among the means of CGs and EGs, but this difference was not meaningful statistically.

B. Results of Quantitative Analysis

In order to collect the quantitative data which constructed the investigation, the portfolios, which reflected classroom activities and held by EGs during their study, were used.

Portfolios can be divided into three groups: Portfolios which have the aim of studying, reflecting and evaluating. In this investigation, portfolios which have the aim of studying, were used.

Studying: The studying portfolio, which is also named as teacher-student portfolio, provides the teacher and student a chance to measure and evaluate the process together. The two choose

the examples of growth and development in the learning process. From this point of view, it can include not only the finished, but also the keeping on studying examples. Parents can also contribute to this process. The studying portfolio, which is a developing treasure of students' ideas and studies, can be used with the aim of formative evaluation. In fact, this type of portfolios can be thought as process-focused portfolios (Bahar, 2001; MEB, 2004).

During this investigation, portfolios which have the aim of studying, that students explore their studies, were used. In this way, it was provided for parents to follow students' studies. Therefore, the parents, who have an important role in the educational system, were included into the investigation.

In this investigation, the teacher, by sending letters to parents through portfolios reached to parents' thoughts about the studies in the classroom.

The following Table 4 shows some parents' thoughts about the students' files:

Table 4. Some parents' thoughts about the students' files.

Parents	The Most Favourites	The Activities They Like in TheFiles
1. Parent	To learn by seeing the experiments, to write stories by imagination, to orient the stories with pictures	To keep file and the attention of teacher
2. Parent	Word haunting and working sheet	To like the studies
3. Parent	Song, story and puzzle	To like the file and to thank the teacher
4. Parent	Studies and activities	To have different activities and the success of teacher
5. Parent	Poem and story	To like the file and the properness of activities for learning and keeping in mind.
6. Parent	To learn by experiencing and seeing with experiments	To compose the file

The following Table 5 shows some students' view about their files:

Table 5. Some students' favorite studies and their thoughts about the lesson in the development files.

Students	The favorite studies	The things they like in the lesson
1. Student	"The Horoscopes of Materials"	L./ to take pleasure, to keep file, participation A./ story and picture
2. Student	"The Tragedy of Water" story	L./ to take pleasure, to keep in mind, satisfaction A./ fairly tales, poems, theatrical performance
3. Student	My song, poem, story	L./ to take pleasure, to compare other lessons A./ song, puzzle, story and experiment
4. Student	___	L./ to take pleasure, to compare other lessons A./ puzzle, picking up things from nature, train game in computer
5. Student	"Solid, liquid, gas granules" picture	L./ to like, to work harder, to compare other lessons, to enjoy A./ puzzle, experiment, pictures, making search, picking up things from nature
6. Student	___	L./ not to get bored, to compare other lessons, to like A./ imagination, train game in computer, experiment, puzzle

Discussion and Implication

As a result of the obtained results from the study; it is seen that the instruction methods which depend upon the Multiple Intelligence Theory has made positive contributions for the students' attitudes towards the science lesson and their success about "The Structure of Material and Its Transformation" unit. The thoughts of experiment group about the studies in the lesson and the class activities they made support the statistical findings. It has been observed that the experiment group students, during the lesson, participate actively in practices like writing poem and story, composing song, drawing schema which summarizes what they understand, using work sheets, solving riddles, playing games among group. Besides, the students stated that they take pleasure from the lesson and they don't get bored in the science lesson. By the letters, sent to the parents through the portfolio files, the thoughts of parents about the studies in the lesson have been reached. Most parents indicated that in terms of learning and keeping in mind, they liked the activities in the files and they are pleased to follow their children through file.

Following the thoughts of students and parents, it is seen that the instruction, depending upon the multiple intelligence theory, gets positive feedbacks about its usage in science lesson.

The findings obtained from this study, resembles other studies which evaluate the instruction methods depending upon MIT for the student success and attitudes. MIT has increased the success, conceptual understanding and scientific attitudes of the primary school students about concepts, when compared with traditional methods. (Kaya, 2001) Some other studies support our results. For example, Özdemir (2006) investigated whether there was a significant difference between multiple intelligence instruction (MII) and traditionally designed science instruction (TDSI) on fourth grade student's understanding of concepts associated with the "Diversity of living things" unit. The experimental group was instructed through MII while the control group employed traditional methods. At the end of the study, experimental group produced significantly greater achievement in the understanding of diversity of living things concept.

In another study, titled "Multiple Intelligence Styles in Relation to Improved Academic Performance in Kuwaiti Middle School Reading" and carried out with middle-school Kuwaite children, Al-Balhan (2006) reported that the students whose multiple intelligence was applied to learning, performed better overall for the academic year than the students in the control group who studied traditional teaching methodology. Similarly, (Greenhawk, 1997 ve Hoerr,1997) in the school-wide applications which were made in two different primary schools in America, the conclusion that the lessons, carried on through activities that are chosen according to intelligence fields, increased the academic successes of students has been attained. In the extent of SUMIT Project, Mindy Kornhaber and his friends, in 41 schools in America, has been making the lessons depending upon multiple intelligence theory for 3 years and the 78% of schools get positive results from Standard tests (Gardner 2003).

Besides, in this study, the thoughts of families, that constitute an important part of education, has been taken. When the students take pleasure and get satisfied with the study they made, the families get happy. According to families, this method not only increases the academic success of the student, but also increases their love for school. Champell (1997) states that in the primary school whose instruction is arranged with activities that include the 8 fields of theory, the applications provide the satisfaction of student, teacher and parents. Hoerr (2004), states that Multiple Intelligence Theory affects the instruction styles undoubtedly, but looking at the Multiple Intelligence Theory only in terms of instruction and pedagogy means ignoring its great contributions in New City School. He indicates that following the Multiple Intelligence Theory changes the instruction process, the assessments, the studies of colleagues and the communication of students with their parents.

Recommendations

In order to get rid of the perception that the science lesson is an abstract and difficult lesson to be understood for students, instead of straight explanation methods, the methods which get positive feedbacks should be used. From these results, we recommend further studies be conducted using Multiple Intelligences in other subject areas. Studies should also be conducted in different cultures amongst students attending private and government institutions as well as different residential areas. Studies should address the view of the parents.

References

Al-Balhan, E. M. (2006). "Multiple Intelligence Styles in Relation to Improved Academic Performance in Kuwaiti Middle School Reading". *Digest of Middle East Studies*, Vol. 15, Issue 1. p.18-34.

Anderson, R. (1988). "Why talk about different ways to grade? The shift from traditional assessment to alternative assessment" *New Directions for Teaching and Learning*, 74, 5-16.

Bahar, M. (2001). "Çoktan seçmeli testlere elestirel bir yaklasim ve alternatif metotlar". *Kuram ve Uygulamada Egitim Bilimleri*, 1(1), 23-18.

Beckman, M (1996). "Multiple Ways of Knowing: Howard Gardner's of Theory of Multiple Intelligences Extend and Enhance Student Learning. Available" on-line: file:\Earlychildhood.com-The Professional Resource For Teachers and Parents (10.05.2006).

Blythe, T. & Gardner, H. (1990). "A school for all intelligences". *Educational Leadership*, 47, 33-37.

Campbell, D. T., Stanley J. C. (1963). *Experimental and Quasi-Experimental Designs For Research*. Chicago: Rand McNally & Company.

Champell, L. (1997). "How Teachers Interpret MI Theory". *Educational Leadership,* 55(1) S.8-13.

Ellison, L. (1992). "Using Multiple Intelligences To Set Goals". *Educational Leadership,* 50 (2): 69-70.

Emig, V.B. (1997). "A Multiple Intelligences Inventory". *Educational Leadership,* 55 (1): 47-50.

Fellow, N. J (1994). A Window into Thinking: Using Student Writing to Understand Conceptual Change in Science Learning. *Journal of Research in Science Teaching*, 31(9), pp.985-1001

Gardner, H (1983). *Frames of mind: The theory of multiple intelligences*. New York: Basic Books.

Gardner, H. (1993). *Multiple Intelligences: The Theory in Practice*. New York: Basic Books.

Gardner, H. (2003). "Multiple Intelligences after Twenty Years". Available on the Internet: http://www.pz.harvard.edu/ PIs/HG_MI_after_20_years.pdf (12.07.2006)

Greenhawk, J. (1997). "Multiple Intelligences Meet Standards". *Educational Leadership,* 55(1) S.62-64.

Goodnough, K (2001). Multiple Intelligences Theory: a Framework Personalizing Science Curricula. *School Science & Mathematics*, Vol. 101 Issue 4, p. 180, 14p, 3 charts.

Haggarty, B.A. (1995). *Nurturing Multiple Intelligences: A Guide to Multiple Intelligences Theory and Teaching*. New York: Addison Wesley.

Hoerr, T. R. (1997). Frog ballets and musical fractions. *Educational Leadership*, 55 (1): 43-46.

Hoerr, T. (2004). "How MI Informs Teaching at New City School". *Teachers College Record*, 106 (1): 40-48.

Kaya, O. N. (2002) Ilkögretim 7.Sinif Ögrencilerinin Atom ve Atomik Yapi Konusundaki Basarilarina, Ögrendikleri Bilgilerin Kaliciligina, Tutum ve Algilamalarina Çoklu Zeka Kuraminin Etkisi., Yüksek Lisans Tezi, Gazi Üniversitesi Egitim Bilimleri Enstitüsü, Ankara.

Kornhaber, M. L. (2001) "Howard Gardner' in J. A. Palmer (ed.) Fifty Modern Thinkers on Education. From Piaget to the present, London: Routledge". http://www.infed.org/thinkers/gardner.htm (17.03.2006).

Milli Egitim Bakanligi, Talim Terbiye Kurulu Baskanligi (2004). Ilkögretim Fen ve Teknoloji Dersi (4-8. Siniflar) Ögretim Programi. Milli Egitim Basimevi: Ankara.

Özdemir, P., Güneysu, S., Tekkaya, C (2006). "Enhancing Learning Through Multiple Intelligence". *Journal of Biological Education*, Volume 40, Number 2 p.74-78.

ISSN 1648–3898 ENHANCING LEARNING THROUGH MULTIPLE INTELLIGENCES IN ELEMENTARY SCIENCE EDUCATION
(P. 61–69)

Резюме

ИДЕИ МНОГОСТОРОННИХ СВЯЗЕЙ В УСОВЕРШЕНСТВОВАНИИ ЕСТЕСТВЕННОНАУЧНОГО ОБРАЗОВАНИЯ В ОСНОВНОЙ ШКОЛЕ

Эсра Уцак, Гусеийн Баг, Мугаммет Усак

Целью данного исследования являлось выяснение возможных различий в усвоении понятия «Структура вещества и её превращения», а также выработки отношений учеников 7 класса основной школы к естественным наукам, если вместо традиционной методики применить методику, многосторонних связей. Были выбраны два класса, в каждом из которых обучалось по 27 учеников. Экспериментальный класс учился по методике, основанной на методологии многосторонних связей, в то время как контрольный класс следовал традиционным учебным методам. Средствами измерения являлись «Тест достижений по химии» и «Шкала отношений к науке». В результате настоящего исследования установлено, что, следуя методологии идей многосторонних связей и сравнивая их традиционными методами, установлены положительные эффекты, как в учебных достижениях учеников, так и в отношениях к естесвенным наукам и их изучению в рамках соответсвующих школьных учебных предметов.

Ключевые слова: естественнонаучное образование, идея многосторонних связей.

Received 07 August 2006; accepted 20 September 2006

Esra Ucak
Research Assistant at the University of Pamukkale in Turkey,
Pamukkale University, Faculty of Education,
Department of Science Education, 20020 – Denizli.
Phone: +90 258 2125555
E-mail: eucak@pamukkale.edu.tr

Huseyin Bag
Dr., Associate Professor at the University of the Pamukkale in Turkey,
Pamukkale University, Faculty of Education,
Department of Science Education, 20020 – Denizli.
Phone: +90 258 2125555
E-mail: hbag@pamukkale.edu.tr

Muhammet Usak
Dr., Research Assistance at the University of the Pamukkale, Turkey,
Pamukkale University, Faculty of Education,
Department of Science Education, 20020 – Denizli.
Phone: +90 258 2125555
E-mail: musak@pamukkale.edu.tr