ISSN 1548-6613 CBSN 382B0036

US-China Education Review

Volume 6, Number 8, August 2009

From Knowledge to Wisdom

David Publishing Company
www.davidpublishing.com

Database of EBSCO, Massachusetts, USA
Chinese Database of CEPS, Airiti Inc. & OCLC
Chinese Scientific Journals Database, VIP Corporation, Chongqing, P.R.C.
Ulrich's Periodicals Directory
ASSIA Database and LLBA Database of ProQuest
Excellent papers in ERIC
Norwegian Social Science Data Service (NSD), Norway
Summon Serials Solutions
Universe Digital Library Sdn Bhd (UDLSB), Malaysia
Google Scholar
J-GATE

The effects of science, technology, society and environment (STSE) education on students' career planning

Nuray Yörük, İnci Morgil, Nilgün Seçken

(Department of Chemistry Education, Hacettepe University, Ankara 06800, Turkey)

Abstract: The leakages in secondary level education brought forward the necessity to restructure the educational system so as to address the social and individual needs and meet the requirements of Turkey; therefore, a "reformation" study became an obligation. The formal education in Turkey starts at the age of 6, when the individual is shaped within the system. Determination of the characteristics of an ideal future citizen of a country should be apprehended at all levels of education and individuals should attain these appreciated characteristics. The reformed science education programs in Turkey aim to guide the individuals to be scientifically and technologically literate. Through enabling an individual, who is in a technological media, to attain the required knowledge, skills and attitudes, the individual should have the "science and technology literacy and creative thinking" skills. Individuals should recognize the technological environment they live in as well as the dimensions and facilities of technology, and should be aware of the fact that they could make use of these opportunities. In the light of this aim, this study involves the teaching of "separating mixtures" to 9th grade students in relation with science, technology, society and environment and the examination of its possible effects on students' achievement as well as their career choices. The Chemistry Achievement Test and the Career Choice Questionnaire were administered as pre- and post-test to serve as data collection tools. The study concluded that chemistry education in relation with science, technology, society and environment would lead students to choosing different fields for their future careers by changing their perspectives towards science. A significant increase in students' chemistry achievement levels was also observed.

Key words: chemistry education through STSE education; career planning; high school students

1. Introduction

As addressed by the second part of the high school by laws, the field determination is made at the end of the 9th grade. The importance of recognizing this choice to be made should be planned and revealed to the student at the beginning of the 9th grade. This choice is the initiation step for a student to shape his/her future. Therefore, s/he should define his/her fields of interest well, understand the occupations that the subjects are linked to and recognize the place of these occupations in life. A student should first explore his/her own characteristics together with the features of the occupation s/he tends to choose and finds out about the common points between the two (Kush & Cochran, 1993). In this case, teaching science subjects through STSE links would enable students to understand that the topics they learn is not independent from the real life and could lead them to learning about

Nuray Yörük, professor, Department of Chemistry Education, Hacettepe University; research field: chemistry education.
İnci Morgil, professor, Department of Chemistry Education, Hacettepe University; research field: chemistry education.
Nilgün Seçken, associate professor, Department of Chemistry Education, Hacettepe University; research field: chemistry education

occupations related to these fields.

1.1 Why is STSE necessary?

The development of a country towards being a community of knowledge depends on the reformations in the field of education. Society exists through individuals and knowledge could be socialized through individuals. The developments in science would affect technology, society and environment in a positive or negative way. Science would develop through the reaction of the requirements stemming from the requirements of the society and technology, which is an application of theoretical knowledge (Yörük, 2008). The effects of this development have also affected the way the science subjects are taught. The most appropriate educational philosophy could be explained through science, technology, society and environment education approach (STSE). This method is student-centered in opposition with the traditional method and active participation of the students is required. This type of study enables students to practice, research, examine and observe. Moreover, this study makes use of students' experiences outside the school related to science and technology and attracts students' interests, improves their attitudes towards the science men, motivates them towards chemistry topics with different contents and empowers their future expectations (Aikenhead, 2005).

1.2 The Scale of Academic Identity Concept

The Scale of Academic Identity Concept (2000) was prepared by Kuzgun in order to guide them in evaluating their interests and skills when choosing a track for a field of education. The Scale of Academic Identity Concept was developed in order to assist the students in conceptualizing their skills and interests in a clearer and more realistic way. The scale assesses four skills and twelve fields of interest.

The four skills are:

(1) Verbal skill: drawing conclusions through words, understanding what is read, and expressing thoughts clearly through words;

(2) Numerical skill: drawing conclusions through numbers, solving problems;

(3) Shape-space skill: recognizing the similarities and differences between the shapes, visualizing how objects and shapes would appear when they are rotated;

(4) Eye-hand coordination: doing things through eye and hand coordination such as cutting or drilling.

The twelve fields of interest are:

(1) Science interest: tendency towards learning and studying subjects related to science;

(2) Social studies interest: tendency towards learning and studying subjects related to social studies;

(3) Agricultural interest: tendency towards growing plants or animals;

(4) Mechanical interest: tendency towards working with or fixing tools or machines;

(5) Persuasion interest: tendency towards transmitting one's feelings and interests to others and influencing them;

(6) Commercial interest: tendency towards buying or selling goods and earning money through it;

(7) Business details interest: tendency towards noticing small details of a text and correcting its mistakes;

(8) Literature interest: tendency towards speaking fluently, writing accurately, examining or producing literary works;

(9) Foreign language interest: tendency towards and ability to learn a foreign language;

(10) Art interest: tendency towards producing or examining works of art such as paintings, sculptures, handcrafts etc;

(11) Music interest: tendency towards listening to music, playing musical instruments or composing music;

(12) Social cause interest: tendency towards helping weak and sick people.

In order to determine the above-mentioned interests and abilities, there are 170 question statements and four choices on the answer paper. These are: (A) Never; (B) Sometimes; (C) Often; and (D) Always.

2. Application

While separating mixtures was being taught in relation with science, technology, society and environment, students were administered the chemistry achievement test and career planning questionnaire as pre and posttest. The results were evaluated.

The study, which involved STSE approach, was conducted at Türközü Şehit Nuri Pamir High School during four weeks within the 2007-2008 academic year. Control and treatment groups were formed from the students of 9th Grade and the study involved a total of 4 groups consisting of 2 control and 2 treatment groups. Each group contained 43 students on a voluntary base (Table 1). "Separating mixtures" was taught to the treatment groups through the STSE approach, whereas the control group received the same instruction in a traditional way.

Before the application, the Chemistry Achievement Test (CAT) developed by the author and the Academic Identity Test were administered in order to determine students' fields of interest for career planning. The same tests were also repeated after the application. The data collected were statistically evaluated through the SPSS software.

The study was conducted by the author herself at the school to be studied at. The high school education lasts four years and the time allocated to chemistry is 2 hours a week in 9th grade, 2 hours a week in 10th grade, 3 hours a week in 11th grade and 3 hours a week in 12th grade. The study was applied during four weeks as two hours a week in 9th grade.

Table 1 Data collection tools

Study groups	Pre-test	Application	Post-test
Control group	CAT, academic identity scale	Traditional instruction	Academic identity scale
Treatment group	CAT, academic identity scale	Chemistry instruction related to STSE	Academic identity scale

2.1 Treatment group

The pretests were administered two weeks before the application. Two weeks after the 4-weeks application period when the application was made, posttests were administered (Table 2). The treatment group was taught through STSE using the 5E model within the constructivist learning approach.

2.2 Control group

Teachers of the control group were interviewed in order to find out more about teaching techniques. The way the teachers taught was summarized by the students as follows: teacher starts teaching by giving examples related to the topic and introduces the topic. S/he writes the necessary explanations on the board and dictates the important points to the students. Moreover, students were asked to follow the lesson and note down the important points in their notebooks. There was no guiding towards research and different resources. In the control group the teaching of a lesson is completely the teacher's responsibility and the teacher is quite active in the classroom. As a result of this interview, it could be said that the lessons in the control group were taught in a teacher-centered traditional way. This method does not activate students' previously learnt knowledge but involves only the explanations of the teacher or the course book.

Table 2 Application of four weekly timetable

Time analysis	STSE topics	Content/topic titles	Teaching and learning approaches	Student skills	Concepts
The CAT and academic identity scale were administered 10 days before the application started.					
Week 1	Recycling the metal wastes, security precautions for oil and gas containers	Separating mixtures, separating with magnets, separating through electricity	Small group research, watching movies, questioning based learning, lab practice, data analysis, simulation, concept mapping, creating models	Asking questions, evaluating technology topics, decision making, commitment to the decision.	Mixture, separation techniques, homogeneous mixtures, heterogeneous mixtures
Week 2	Separating salt from sea water, dialysis, obtaining carotene	Separating through density difference (explores the methods that make use of density differences in separating substances from each other), separating through filtering (explains the separation techniques making use of the particle size difference), separating through solubility difference (notices that solubility differences could be used separating substances)	Brainstorming, asking questions, class discussions, questioning based learning, role playing, simulation.	Data analysis, interdisciplinary problem solving, evaluating technology topics, questioning for making decisions,	Solvent, solution, solubility, floatation, defecation, vaporization, crystallizing, dialysis, decantation,
CAT and academic identity scale were administered after the teaching of the subject.					
Week 3	Separating metals from minerals, obtaining medicine and alcoholic drinks from plants through refining, obtaining perfumes	Separating with differences of changing state temperature (difference of boiling temperature), exemplifies separating mixtures by using the boiling point difference (melting temperature difference), exemplifies separation of mixtures by making use of melting point difference	Observing, group work, problem solving, decision making, questioning, questioning based learning	Explanations involving scientific and technological concepts, learning through interacting with the environment	Gas refining, distillation, extraction,
Week 4	Linking science, technology, society and environment	Suggests appropriate separating methods for given mixtures.	All approaches utilized during teaching the subject	All skills attained during the teaching of the subject	All concepts learnt during the teaching of the subject

2.3 Data analysis

Data collected through the questionnaire were analyzed using the SPSS 12.0 software. The questionnaire involving students' career planning before and after the application was evaluated (Table 3).

Table 3 Analysis of working group

Gender	1. Female	40
	2. Male	46
STSE related chemistry education receiving status	1. Students that received the STSE education	43
	2. Students that did not receive the education	43

The study concluded that the students' achievement levels increased in chemistry after the application. The chemistry achievement levels of students, who received STSE related education, were observed to display a statistically significant increase after the application; however this statistically significant finding was not obtained from the control group. The difference between the chemistry achievement levels of the control and treatment groups were found to be favoring the treatment group. At the same time, science, technology, society and environment relativities were observed to be more stabilized, which lead to a more meaningful learning. After this application, students were noticed to be more willing to participate in social responsibility studies.

Apart from that, differences were observed in students' interests and choices regarding their future careers before and after the study. These observations were explained on the tables and graphs.

Students' skills and interests were determined through a pretest and the following chart was drawn (Table 4).

Table 4 (a) Working groups' skill classification as a result of pretest

Number of students		Female	Male	Skills			
				Verbal	Numerical	Shape-space	Eye-hand coordination
Treatment group	43	19	24	24	26	31	10
Control group	43	21	22	22	24	32	6
total	86	40	46	46	50	63	16

Table 4 (b) Working groups' interest field classification as a result of pretest

	Science	Social studies	Persuasion	Foreign language	Commercial	Agricultural	Mechanical	Business details	Literature	Art	Music	Social cause	total
Treatment	15	18	13	4	14	7	10	10	11	7	8	10	
Control	18	22	22	11	16	6	11	8	14	9	10	12	

Students' skills and interests were determined through the posttest and the displayed on the following chart and graph (Table 5 & Figures 1, 2).

Table 5 (a) Working groups' skill classification as a result of posttest

Number of students		Female	Male	Skills			
				Verbal	Numerical	Shape-space	Eye-hand coordination
Treatment group	43	19	24	20	28	32	11
Control group	43	21	22	22	24	32	6
total	86	40	46	42	52	64	17

Table 5 (b) Working groups' interest field classification as a result of posttest

	Science	Social studies	Persuasion	Foreign language	Commercial	Agricultural	Mechanical	Business details	Literature	Art	Music	Social cause
Treatment	24	12	10	4	14	10	13	11	9	5	8	8
control	16	24	22	11	16	6	10	10	12	9	10	11

As the study concluded, teaching chemistry, and establishing different links with other subjects would enable them to explore the fields of their interest as well as themselves. Looking at the findings, there was not much change observed regarding the students' skills, whereas significant changes were observed in the fields of their interests. Figure 1 displays that after the STSE related study was applied, changes were observed in students' fields of interest as the academic identity scale was administered again. Students were determined to have tendencies towards science and technology-related fields. This interest of theirs was also found to be affecting their career planning. For the control group, not much difference was observed in students' pre and posttest results

regarding their skills or fields of interest. As Figure 2 displays, teaching chemistry through traditional methods could not make students explore different fields of interest. Since students were involved in topics theoretically, they did not have the chance to learn about practice. The subjects they learnt, therefore, did not affect their academic thoughts. Students of the treatment group experienced differences in their academic thoughts as they noticed their interests in different fields. Among the treatment group, 15 out of 43 students were found to have tendencies towards science before the STSE education, whereas after the application of the study, 24 students displayed an interest in science. In the control group, 18 students displayed interest in the science field and this number decreased down to 16 after the application of the traditional chemistry teaching. Moreover, increases in students' interests in agricultural studies, mechanics, commercials and business details were observed within the treatment group as a result of the academic identity scale. The control group did not display a significant change in their results, however, decrease in the science field interest was observed as well as smooth changes of 1 or 2 students in the fields of social studies, literature and business details.

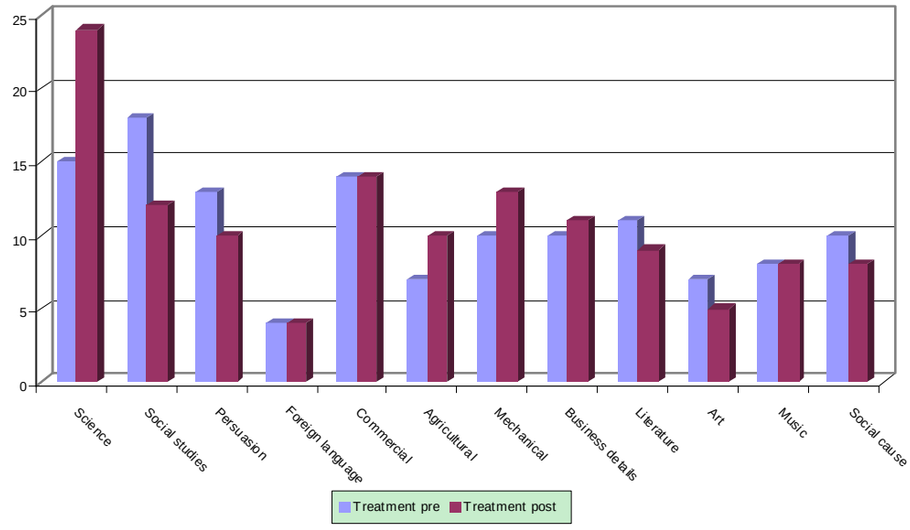

Figure 1 The academic identity concept scale results for the treatment group (pre- & post-test)

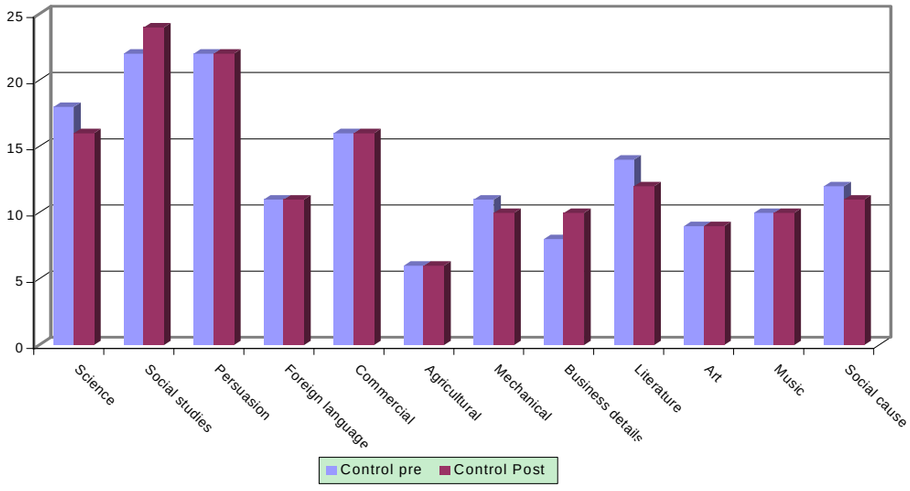

Figure 2 The academic identity concept scale results for the control group (pre- & post-test)

3. Suggestions

(1) The aims of the topics of a teaching process should be emphasized and linked to the real life. Students should attain the skills to use the learnt knowledge in real life.

(2) Students should be encouraged for researching and such bases for the students to explore their fields of interest should be prepared.

(3) Teaching materials that refer to more sensual organs should be prepared for students.

(4) Science teachers should target to bring up individuals, who are aware of what they know, are sure of what they know and have self confidence. Therefore, it would be appropriate to teach the contents of the curriculum together with their links to the real life.

(5) Students' abilities to use their skills and knowledge in possible problems they may face should be improved rather than how much they learnt the contents of a topic is focused on.

(6) While teaching science topics, it would be appropriate to inform students about related occupations and career planning in order to get acknowledged about the topic and determine their own choices.

(7) The topic of "separating mixtures", which is taught through STSE, should be applied to other topics in chemistry in order the students to recognize their different skills and fields of interest that could also lead to an increase in their achievement levels.

At the conclusion of this study, we further wish to qualify and characterize science lessons in such a way to motivate students' fields of interests and skills as well as to prepare them for their future careers.

References:

Akenhead, G. S. (2005). Research into STS science education. *Educacion Quimicia*, (16), 384-397.

Kush, K. & Cochran, L. (1993). Enhancing a sense of agency through career planning. *Journal of Counseling Psychology*, (40), 434-439.

Kuzgun, Y. (2000). *Career consultancy theories and practices*. Ankara, Nobel Publication Distribution.

Ministry of Education. (2005.8.12). *Secondary schools association examination regulations*.

(Edited by Max and Maggie)