Teaching English to Science Students via Theme-Based Model of Content-Based Instruction

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ABSTRACT

This article investigates the effect of application of theme-based model of Content-Based Instruction (CBI) on a group of science students learning English at a preparatory program at the tertiary level in Turkey. In this study, course materials based upon the theme-based model of CBI were applied in order to teach academic English language skills. With a purpose to determine the language needs in the program, questionnaires including structured interview questions were distributed to a number of 97 students of Physics, Chemistry and Biology departments and also 19 students who specifically studied thematic units completed a questionnaire as to the effect of such an application. The majority of students reported that they needed to learn English for academic reasons in order to pursue future courses taught in English. Those students who studied science related thematic units argued that their motivation to learn English increased as they were able to improve their academic language skills through content they received and the activities they were involved in. Data findings may also indicate that if the theme-based model of CBI is applied in the preparatory program widely, it can meet language needs since such a practice involves learners in science English, equipping them with necessary academic language skills.

Key Words: Content-Based Instruction (CBI); Theme-Based Model; Needs Analysis; English for Academic Purposes.

INTRODUCTION

English is the medium of instruction in up to 30% of courses taught in undergraduate programs at the tertiary level in Turkey. A preparatory program in each university is therefore established in order to meet students' language needs which are of both general and academic nature. Students attending English language teaching programs are expected to acquire academic language skills as well as general language skills so that they can take part in their

future courses effectively. However, most language programs may ignore academic English, to a large extent, focusing on general language skills and thereby these students are likely to commence their respective departments, lacking the essential academic language skills.

With a purpose to meet such needs a preparatory English language teaching program was established at Karadeniz Technical University (KTU) in Trabzon, Turkey, where this present study was conducted. A number of studies were held in order to assess the extent to which the preparatory program at KTU achieved such purposes (Arslan, 1989; Çuvalcı, 2001; Arslan, 2001). Concerning the preparatory language program, Arslan (1989) proposed a communicative course design based on the needs of post-graduate students, university subject specialists, and language teachers. In another study, Çuvalcı (2001) performed detailed needs analysis and concluded that students at the same preparatory program wanted to learn technical English related to their own field of study since they needed English for their future studies. Another study by Arslan (2001) also showed that the proficiency level of the students was likely to be found unsatisfactory by subject specialists and students themselves. This was because when these students attended their major courses taught in English, they had too much difficulty in following the courses in English. All these studies indicated an urgent need to meet language needs of academic nature and led us to apply thematic units to this end.

The theme-based model of CBI that has received great interest in both ESL and EFL settings (Gaffield-Vile, 1996; Grabe & Stoller, 1997; Stoller, 2002) would meet such language needs of science students at KTU as well since "in an academic context it is important to take into consideration the types of topics which students will encounter in their general educational curriculum" (Brinton et al., 1989, p. 27). In such a model language classes are organized around a series of selected themes drawn from one content area or from across the curriculum (Crandall, 1993; Dupuy, 2000). Moreover, the theme-based model attempts to integrate the topic into the teaching of all skills including reading, writing, speaking and listening while the topics provide coherence and continuity across skill areas. Brinton et al. (1989) reported that the objectives of the theme-based model in their study included developing university students' academic language skills that would be important for effective study in the university context and also offering them an opportunity to help develop language-processing skills and learning strategies for use after the course since they would continue to study or use English at the university or in their future vocations. Similarly Doğan (2003) argues that adjunct courses designed as part of CBI at Bilkent University, Turkey were also beneficial for students in that such courses prepared the students for the content and language demands of their future university studies. In an example of the theme-based model applied in the Science Faculty, South Africa, the organizing principle for the design of the course was also the acquisition of academic language skills since Parkinson (2000) suggests that the students would need such skills in their future science classes and that such a model would involve the learners in "science content" and offer them "opportunities to acquire important genres in science" (p. 369). In fact Hutchinson and Waters (1987) support the idea that science language varies from general language only in terms of vocabulary and the frequency of particular grammatical structures science students need to be familiar with in advance of their academic studies. A similar study based upon the application of theme-based model would bring out expected outcomes in this particular program at KTU as well.

The aim of this study was therefore to find out whether or not the theme-based model of CBI would meet English language needs of science students in the preparatory school of KTU. Thus the study sought answers to the research question "Can theme-based model of CBI meet academic language needs of science students in the preparatory school of KTU?" In order to answer this particular question, we had to first identify language needs students

brought to the preparatory program and then to find out students' opinions on the effect of theme-based language instruction.

METHODOLOGY

a) Data Collection and Analysis

In this study questionnaires including structured interview questions were used for data collection purposes and theme based units were applied for instructional purposes. Data were collected from 97 students of Physics, Chemistry and Biology departments and also from 19 science students who received the theme-based units, who were all studying English at the preparatory program during the data collection process. The aim of administering questionnaire to the former group of students in the preparatory program was to collect data about language needs of these students and their expectations from the program. At the outset of the questionnaire, there were general questions to find out information about their major fields of study and also the reasons for which they were learning English. There were also questions as to language skills that would be important when students attended their departments. A number of statements concerning expectations of the students were also included in the questionnaire; namely, 'I want to learn vocabulary relevant to my own field of study', 'I want to read texts, passages related to my own field of study', 'I want to make speech on subjects related to my own field of study', 'I want to write paragraphs and essays on subjects in my own field of study', and 'I want to listen to records and watch CDs about my own field of study.'

Having applied the thematic units, another questionnaire was administered to the latter group of students who had received the thematic units with a purpose to obtain information about what these students thought about the materials used in these units and the possible benefits of such units for language learning. Questionnaire items aimed at finding out students' opinions of language skills they needed and also their views of application of theme-based courses. Questions about the language skills focused on whether reading, listening, and speaking activities in the units were useful to develop their related skills or not. Questions related to motivation of the students were also included in the questionnaire with a specific purpose to find out whether thematic units were relevant to their academic interest and increased their motivation in language learning. With a purpose to validate the quantitative data, the questionnaire included structured interview questions as to what language skills they needed and also what they thought about the application of theme-based units.

Content validity of the questionnaires was ensured through careful review of related literature as to CBI and also by consulting a number of researchers in the field as to survey items before administering the final versions of the questionnaires. A pilot study with a group of 15 students was also conducted in order to avoid weak items in the questionnaires. The pre-questionnaire was conducted with a number of 97 students in order to generalize research results to similar contexts. Post-study questionnaire distributed to 19 students, who all studied thematic units, also validated pre-questionnaire findings, enhancing student needs and expectations from a language program of academic orientation. Data collected were analyzed quantitatively and qualitatively in terms of purposes for learning and the effect of content-based instruction on learning English.

b) Application of Theme-Based Units

Two theme-based units were prepared under the principles of CBI, using authentic materials obtained through library and internet search. These units were completely related to science; namely, 'The Cell' and 'Nuclear Energy'. The application of thematic units lasted

two weeks, and each week, one of the units was finished. A 10-hour-period in a week was allocated for the application of theme-based units. The main goal of applying thematic units was to expose students to academic materials related to science and to find out their attitudes towards such kind of units. These thematic units were chosen because students would encounter similar topics in their courses when they attended their respective departments after the preparatory program. Moreover, they all had background knowledge of these topics since they were all science students and had studied these topics in Turkish prior to admission to university. The major aim of choosing these topics was to trigger students' background information in biology, chemistry and physics. Thematic units included a number of activities fostering students' reading, listening, speaking, and writing skills. With these activities, all four skills were integrated. There were also activities for vocabulary and grammar study and also culminating activities. Graphic organizers, visual aids such as pictures, and transparencies were applied to make students consolidate information they had learnt. Table 1 summarizes the study of unit on cells as an example of theme-based instruction. (See Appendix 1 for sample activities as to the second thematic unit 'Nuclear Energy').

Table 1. *Application of thematic units: The cell*

1.Warm-up:	At the very beginning of the unit, students examined some cell pictures. Having done this, in a chart they wrote about what they knew about cells and also what they wanted to learn about cells.
2.Pre-reading:	Students got into groups and discussed what else they wanted to learn about the cell. In pairs they filled in the chart and with the rest of the class they discussed what they wanted to learn about the cell.
3.Reading for gist:	Students read a text about the cell, looking at the headings and matching them to paragraph numbers.
4.Detailed Reading:	Students read the text again and demonstrated their understanding by using a chart.
5.Post-reading:	After these activities, students read the passage in the unit, and then studied unknown vocabulary. Then, the students analyzed the text using graphic organizers, and answered some comprehension questions, which was followed by vocabulary study.
6.Vocabulary building:	Students were asked to make use of newly learnt vocabulary about cells in their own sentences.
7. Grammar teaching:	Having completed the reading and vocabulary activities, the students studied the key grammatical patterns, using the content in the units.
8.Writing:	Having finished grammar exercises, students were asked to write about a given figure (cell division) and compare their writing with the original one in the unit. As a prewriting activity students first examined a diagram that described cell division. Students compared their writing with those of their friends and then read the original text, from which the diagram was taken and compared their description of the process with that of the text.
9.Speaking:	Students read the extra information about cell division and then talked about the stages of it.
10.Reading, Listening and Speaking:	Students got into two groups as A and B. Group A read Text A and group B read Text B. While reading the texts, they made a note of the main ideas and then talked about the text to their friends.
11. Post reading:	Each student paired with a student from the other group and told them about what they had read. They listened to friends from the other group and took notes.
12.Culminating Activity:	Students got into seven groups of two or three. They prepared a presentation on the importance of cells and expanded their presentation in order to present the roles of tissues, organs and seven types of organ systems in human body.

FINDINGS

Analysis of the questions concerning identification of students' basic aims, language skills and language activities in learning English indicates that students mostly needed to learn English for future academic studies and for job purposes. The majority of students reported that they wanted to be successful in the courses taught in English, to find a good job after graduation, to pursue future studies, and to use course materials in their majors as shown in Table 2. Only a small group of students learnt English since it was compulsory to attend the preparatory program or they wanted to go abroad for work purposes.

Table 2. *Students' purposes for learning English*

Purposes for learning English	Frequency
to be successful in the courses taught in English	25.8%
to find a good job in the future	22.7%
for future studies	21.6%
because attending the language program is compulsory	15.5%
to make use of materials in their field of study	10.3%
to go abroad and work.	4.1%

Understanding lectures presented in English, writing assignments and projects related to their field of study, and understanding the detailed information in texts as presented in Table 3 emerged as the most prominent sub-language skills, which are also of academic orientation, while acquiring ability to communicate with people speaking English outside the classroom can fall into either general or academic English.

Table 3. *Most frequently needed language skills*

Language skills	Language sub-skills	Frequency
Listening	understanding lectures presented in English	51.5 %
Speaking	communicating with people speaking English outside the classroom	37.1 %
Reading	understanding the detailed information in texts	30.9 %
Writing	writing assignments and projects related to the field of study	30.9 %

In addition, identification of students' ideas on whether they would like to study academic English may also show that they mostly needed activities as to academic language as in Table 4; namely, learning technical terms and vocabulary, reading academic texts or articles relevant to their own field of study, listening to records and watching CDs about their field, writing paragraphs and essays on subjects in their field of study, and making speech on subjects related to their field of study.

Table 4. *Activities required for academic language*

Activity Types	Frequency
being taught and presented technical terms and vocabulary	93.8%
reading academic texts or articles relevant to their field of study	85.5%
listening to records and watching CDs about their field of study	84.6%
writing paragraphs and essays on subjects in their field of study	68.1%
making speech on subjects related to their field of study	60.0%

All these findings indicated an urgent need to meet such academic needs, thereby designing language courses based upon science language and academic language skills. Analysis of data findings as to the application of thematic units shows that students increased

their level of motivation highly while learning English through thematic units, as is displayed in Table 5.

Table 5. *Students' views of theme-based instruction*

	Frequency
Thematic units were interesting and motivating.	94.7%
Thematic units would be useful for future studies in departments.	89.5%
Thematic units triggered background knowledge.	89.5%
Learning English through both course books and thematic units was useful.	84.2%

The most prominent finding was related to the increased level of student motivation which was probably due to thematic units they were introduced to. The majority of students reported that they found the application of those thematic units interesting and motivating because content was related to their own field of study. S1 highlighted this fact, stating "since the units were different from the units we had been studying since the beginning of the semester, I think these units were much more effective in terms of motivation". Similarly, S2 stated that s/he noticed how much pleasure s/he got when s/he commented on the things s/he had been learning since primary school. One of the most attractive statements belonged to S3, who stated that "I really felt I am at a university for the first time", which was probably due to the academic nature of the thematic units. Most of students reported that they were able to learn both basic and academic English through both course books they had been studying and thematic units as a new application. These students expressed their views positively as the activities in thematic units helped them analyze the sentences grammatically, improve their vocabulary, and write about what they understood and remembered. They also commented that they still remembered what they had talked about in the courses.

Another important contribution of such a study was that thematic units triggered students' background knowledge. Some students commented that they were able to understand the subjects better than the ones in the course books because they had knowledge about them in advance and also they could understand what the text was about although they did not know all the words in English. Some students also expressed positive views in that they were able to understand the texts related to physics, chemistry, and biology better than the texts in the course book. The students also stated that they did not have any difficulty in studying those thematic units although they were anxious at the beginning of thematic units, and they believed they had the chance to review their background knowledge in science. Related to this view S4 stated that "I was worried about taking classes in English, but I felt relaxed when I understood the topic studied in a single unit". S5 also said that "I do not know what my friends think, but I am trying to benefit from these units especially information in them". When asked about whether such units would be useful for their future studies in their departments, most of them responded "Yes." Some of these students highlighted that they would be familiar with the vocabulary and structures of the texts they would be dealing with when they attended the courses in their majors as these units helped them learn the English equivalents of the terms relevant to biology, chemistry and physics and remember what they had learned in science courses in Turkish. Another student reported that "since the subjects of the units are related to my department, I think they will be useful next year and in the following years" (S6).

It was quite obvious that such an application was likely to meet students' academic language needs to a great extent. A look at related data in Table 6 also shows that students had positive views as to the effect of thematic units on learning various language components.

Table 6. *Students' views on the contribution of thematic units to the development of language skills*

Type of Language Skill	Frequency
Writing activities in thematic units were useful to develop writing skills.	79%
Reading activities in thematic units were useful to develop reading skills.	78.9%
Listening and speaking activities in thematic units were useful to develop listening and speaking skills.	73.7%
Learning grammar was easier with background knowledge about the subject matter in thematic units.	73.7%
Thematic units improved our vocabulary to meet our needs in departments.	57.9%
Culminating activities were effective for us to produce language for different purposes such as preparing for a debate or preparing presentations.	57.9%

Data findings as to the identification of students' ideas about the activities in thematic units also showed that reading, writing, speaking, and listening activities were all useful for the majority of students. These students reported that such activities helped them analyze sentences grammatically, improve their vocabulary, and write about what they studied and remembered. Since these learners had some background knowledge about the subjects studied in the units, the majority of students also reported positive views about the effect of thematic units on learning English grammar as well. For the students culminating activities were also very useful for a number of academic purposes such as preparing for a debate or presenting a project work. More than half of students also agreed that such kind of units could improve their vocabulary to meet their needs when they attended their departments; for example, student 7 stated "I still remember some of the vocabulary. Some of the vocabulary will be in my memory, so I will not have so much difficulty".

DISCUSSION

The theme-based model of CBI may be a key to everybody's satisfaction while there remains ineffective use of academic English in the Turkish context (Sert, 2008). When the required language skills reported by the students were analyzed, it was seen that these language skills were mostly academic in nature. Therefore in thematic units we developed, the content was chosen according to students' interest and academic goals with a purpose to trigger their background knowledge (Stoller, 2002; Alptekin et al., 2007). In these thematic units, activities were also developed in order to help students understand the content of the course through a number of integrated skills activities (Stoller, 2002). In our study similar to that of Gianelli (1997) those students who studied theme-based units would no longer forget what they were studying because they became quite familiar with the content of the units. In addition Song (2006) attributes such an academic success of students to the application of content-based ESL program. Similar to Song' study (2006) students in our study were also likely to achieve better academic results in their major studies due to theme-based instruction they received. In our study content-specific materials were used in the courses in the same way as Raphan and Moser (1994) used in their theme-based courses. Many of the students in our study argued that such science related texts helped them learn grammar and vocabulary better than other texts in general course books designed to teach general English. So these students enjoyed learning English through content about which they had already had some knowledge since the content students were familiar with helped them understand the main point of the texts although they did not know all the words in texts. In this way, learning language was easier for them as Alptekin et al. (2007, p.11) argue that "CBI enables the learners to relate the systemic features of English to what they have already internalized as schematic knowledge of the given topic in Turkish".

The common idea that emerged as a result of the study is that science students needed to receive language instruction based upon more academic content. As the content in a thematic

unit was revisited for many different purposes, students' language skills were likely to be improved as well. Theme-based units provided the students with better opportunities to improve their language skills and to be successful in their future studies (Kasper, 1997; Song, 2006). Reading, writing, speaking, and listening skills based upon academic content were therefore incorporated into the present curriculum as in Parkinson's study (2000). Those students involved in theme-based instruction in Parkinson's study (2000) and also in our study made gains in speaking, listening, and reading skills and also increased their self-confidence and motivation to study the target language (Dupuy, 2000). Gaffield-Vile (1996) is also of the opinion that content-based courses are motivating since students know that they are learning English through authentic materials meeting their academic interests and needs.

Students were highly active in preparing for the activities individually and collaboratively as well. A number of activities that would enhance students' language skills and prepare them for academic settings in a theme-based classroom included revisiting the content for different purposes such as reading, writing and speaking about it, synthesizing information using graphic organizers, and preparing project works. That's why theme-based model of CBI was likely to offer solutions to possible problems students would face in their major studies (Brinton et al., 1989; Song, 2006).

Research results obtained through the questionnaire administered to the students after the implementation of two theme-based units were very important because those findings highly support the wider application of the theme-based model of CBI in the preparatory school of KTU. The theme-based model of CBI with its broad perspectives and advantages for the students (Brinton et al., 1989; Raphan & Moser, 1994; Kasper, 1995; 1997; Kirschner & Wexler, 2002; Parkinson, 2000; Stoller, 2002; Tsai & Shang, 2010) might therefore offer an alternative in the program.

CONCLUSION

Theme-based model of CBI proves to produce effective and successful outcomes in terms of learners' academic language learning achievements. Thematic units studied for a short time increase students' motivation and help them improve academic language skills. If the theme-based model is implemented in the whole preparatory program and science related thematic units are studied for longer periods, students can be more successful in their further major courses upon the completion of the program. Theme-based model of CBI can therefore be implemented in the overall preparatory program at KTU since it can prepare students for their future studies in their departments, helping them develop language processing skills and learning strategies through materials relevant to language needs.

This study may also indicate the need for an extensive application of the theme-based model of CBI in similar contexts nationwide and internationally. Thus this study may set a successful example of how academic language skills can be attained in English preparatory programs not only at KTU but also elsewhere.

The study may also suggest that English language instructors need to learn how to teach English to science students to achieve better outcomes from English language teaching programs of academic nature. Those language instructors unaware of academic content and the means of teaching academic English are likely to face major problems in teaching English in academic contexts, thus requiring prospective and practicing teachers of English to receive training in English for Specific or Academic Purposes.

However, in order to draw better conclusions as to the effect of such a study on learners' language skills, a more comprehensive study is required: the study of thematic units can be extended to longer periods and applied to other participants in similar contexts.

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Appendix 1

Thematic Unit on "Nuclear Energy": Sample Activities

1.   Warm up:
        Look at the picture below. What do you think it is?

2.   Reading:
Reading: Read the following text and match the paragraphs to the headings below the text.

How nuclear energy works and what it's used for

1.   When uranium atoms are split, the heat produced is called nuclear energy. This energy is converted to electricity by a nuclear power plant.
…
7.   The steam makes electricity by spinning the turbine that drives an electric generator. Inside the generator, coils of wire and magnetic fields interact—and electricity is created. The electricity can then be carried to your home, so you can do your homework on your computer, watch television, play video games, have a snack from your refrigerator, and make toast.

⇨ **Read the text again and demonstrate your understanding using the following chart.**

⇨ **Read the text again and mark the following statements True or False.**

____ **1.** It is fusion that makes the production of nuclear energy possible.
…
____ **7.** Neutrons should be slowed down for fission to be efficient.

3. Vocabulary building:

Fill in the blanks with the following words:
converts, magnetic field, produced, generator, protons and neutrons, uranium, nuclear energy, Matter, neutrons, spins, splitting, generate

1. _____ is made up of billions of tiny particles called atoms.
…
12. Nuclear energy is a way to _____ heat using the fission process of atoms.

⇨ **Choose three of the words in bold in the text and make sentences.**
1.
....
2.
....
3.
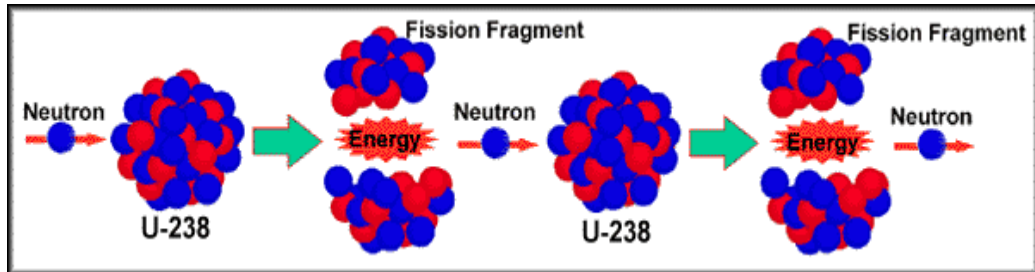..

4.   *Writing*

Look at the diagram below: Write the fission process and what can it be used for?
Then, first compare your writing with your friends' and then with the original one.

Source: http://library.thinkquest.org/3471/nuclear_energy.html

Original text:
Nuclear Fission: In nuclear fission, the nuclei of atoms are split, causing energy to be released. The atomic bomb and nuclear reactors work by fission. The element uranium is the main fuel used to undergo nuclear fission to produce energy since it has many favorable properties. Uranium nuclei can be easily split by shooting neutrons at them. Also, once a uranium nucleus is split, multiple neutrons are released which are used to split other uranium nuclei. This phenomenon is known as a chain reaction.
Source: http://library.thinkquest.org/3471/nuclear_energy.html

5. *Grammar:*
The Passive Voice
Passive constructions are derived from active constructions. Follow the examples:

6. *Post-reading:*

Get into two groups as A and B. Group A reads Text A and group B reads Text B. While reading, make a note of the main ideas to talk about the text to your friend.

7. *Speaking:*
Pair with a friend from the other group and tell them about what you have read. Listen to your friend from the other group and then prepare a T graph listing the pros and cons of nuclear energy together.

Discuss with the class some of the pros and cons of Nuclear Energy in relation to what you have read and listened to.

Tell the class if there are any changes to your views about the issues surrounding Nuclear Energy.

8. *Culminating Activity:*
Get into groups and prepare to support your ideas about nuclear energy in a classroom debate.

Do the debate in class and get feedback.