The Impact of Inquiry Process on the Cognitive Process Dimensions of Nontraditional Writing

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Abstract

The aim of this study was to evaluate the renewed taxonomy of writing to learn activities in terms of cognitive process dimensions. For this reason, 26 university students, who were at the 3rd year of their education and who studied the class of Education of Natural Sciences Laboratory Applications with the application of inquiry, were selected. These students had one writing to learn activity before and two writing to learn activities after the start of inquiry process. The first writing activity was related to the subject of "nuclear power", and the last writing activities were related to "biofuel" and "power". The sentences on the writing to learn activities were coded according to the cognitive dimensions of revised taxonomy and the resulting findings were evaluated in a comparative way. The results showed that the sentences at a low cognitive level reduced and the ones at the middle and high cognitive level increased on the last writing activities. Moreover, while the students who experienced the inquiry process emphasized the sentences reflecting the application regarding the scientific issues, they used high cognitive level sentences regarding the socio-scientific issues.

Keywords: *Writing to learn; Argumentation; Cognitive Process Dimensions*

1. Introduction

Countries aim to make all of their citizens scientifically literate in order to have a strong future, and are aware of the fact that one of the basic steps for achieving that should be taken in science courses (MEB; 2006, 2013). In this regard, individuals who are in the process of being scientifically literate both affect and may be affected by science. As a result, a process where thoughts affect science and science affects thoughts may emerge. Being important for both individuals and societies in accordance with educational goals, scientific literacy has been defined by different people and organizations in different periods. The National Science Teachers Association described the qualifications of a scientifically literate individual as follows: s/he can use science and technology in the solution of daily life problems, has decision-making skill, discuss and question ideas and actions fluently through evidences, think creatively, reason, and make logical inferences (NRC, 1996). According to Norris and Philips (2003), scientific literacy, in its basic sense, includes reading and writing while its derivative meaning refers to the skill to learn knowledge and education for it, thereby referring to a distinction. Therefore, it is accepted that the basis of the science literacy is reading and writing. However, both in the basic or the real terms, writing and reading is not only forming a passage through writing and reading, but also involves the cognitive processes such as understanding, interpreting, analyzing, and criticizing (Norris and Philips,2003). Even though it is observed that the accepted literacy rate is increasing, it is an important finding that receiving education does not mean acquiring a literate characteristic (Turgut, 2005, 2007). The individuals can also learn without being literate through trial and error, the transfer of spoken words within the individuals or modeling methods (Norris and Philips, 2003). They can do so through verbal (speaking), which involves the elements of the language, or nonverbal communication methods.

2. Theoretical Background

2.1 Writing and Learning

The language, which is one of the most fundamental leanings, is also a part of various information we learn. There are 3

main relations that could be built between the language and the learning (Christie, 1981). First, the language can be used for learning new contents as a limitless and a wide resource. The language which is used every day enables learners to transfer their new experiences, to express their thoughts, and to explain the meanings of the words. Second, learning a language means learning the history, grammar structure, and the aims of the language. Third, learning a language is a way that the learners express their thoughts during the learning process in different ways by using the richness of the language. In enabling all these relations, the individuals' learning and using of their mother tongue is related to the four basic elements of the language (speaking, listening, reading, and writing). Among these four elements; reading and listening are the activities of understanding, and speaking and writing are the activities of explanation. Understanding is interpreting the things transferred through speaking or writing. On the other hand, explanation is the transfer of feelings, thoughts, plans, and experiences through verbal or writing. These four basic elements of the language, which are in relation with one another, are used effectively for retrieving information (Emig 1977).

Writing is superior language ability in delivering the messages that the individuals intend to transfer during communication which is related to reading, thinking, speaking and language education (Demirel, Koç, Topbaş, Odabaşı, Namlu, Yangın, Müftüoğlu 1998). Emig (1977) states that writing is superior to speaking, listening, and reading among the elements of language. It is because writing involves all the other processes. For instance, while writing involves the words used during speaking and listening, it also enables the repetition of reading. Speaking, which is the verbal expression of our thoughts (Demirel et. al., 1998), increases the writing's impact on learning when it is used for retrieving a scientific information and as a first step in activities such as debate (Rivard and Straw, 2000). These different components of the language are interacting with one another with ambiguous boundaries. Emig (1977) brings forward the differences among writing to listen, to speak, to read, and to learn which are the basic elements of communication system, and emphasizes that writing to learn is an untypical and unique learning method.

From another point of view, Emig (1977) evaluates writing as an expression of past, today, and future and as a meeting point of our experiences and thoughts related to these three different times. Moreover, it is like an interactive constructive reading which reflects the special field, strategic knowledge, and aims and interests of the writer (Yore 2000). Writing, with these characteristics, can be used as a means to build arguments, to explicate, to reveal, and to organize and learn the information (Prain 2006). Writing is a process of giving a meaning. That is because students give a meaning to the language that they use daily through writing with their own words. Emig (1977), who states that writing is the basis of learning and it increases the effectiveness of learning, also declares that writing to learn means learning the different processes which is required by writing and that writing is an important model in learning. According to the cognitive process modeling which is developed by Flower and Hayes (1980), writing involves three basic elements, namely planning, converting, and revising (evaluating) among which there is a cognitive interaction. Another model is developed by Bereiter and Scardamalia (1987). According to this model, they recommend using a strategy in which children and inexperienced authors explain their knowledge through writing, and experienced and mature authors transfer the knowledge (Galbraith and Rijlaarsdam, 1999). Students tell the knowledge and transfer it. While doing this, they shape their prior knowledge about the subject regarding their high cognitive awareness through writing strategies (Yore, 2000). Different from these models, the model that Galbraith developed is related to how the information is formed. During writing, many hidden related information arises from the linguistic units of our minds and as a result new information is formed (Galbraith, 1999). Furthermore, Klein (1999a, 1999b) discusses about four hypotheses regarding the impact of writing on learning. These are, namely, natural writing (shaping at the point of utterance), revised writing (forward search), writing through building relations between the elements of the passage (genre hypothesis), and writing through planning (backward search). Natural writing ensures that the writers clarify their thoughts about a passage through fast-thinking and without revising, planning and evaluating. According to the revised writing hypothesis, writers express new ideas by evaluating and interpreting their thoughts. According to genre hypothesis, there is a relation between the whole and the parts of the passage. The writer who uses the processes, in which building relationships within the elements of the passage and within the ideas, using analogy and the thesis are supported, enlightens the thoughts explained on the passage. Lastly, with writing through planning, the writers realize their writings through considering the interaction between the rhetorical goals (such as purpose of writing and the type of the writing, edition, audience) and content goals. What is delimited by the writer with rhetorical area is important in terms of what he will do, in other words, in terms of his plan. Because, the writer takes these delimitations into consideration, uses the content information and makes evaluations. Considering all these models, writing is expressed as a strong learning tool (Keys, 1999).

2.2 Writing to learn in science education

Hand and Prain (1996) suggest a model which will help the teachers with their writing to learn activities in science classes. This model has five components which are, namely, the subject of the writing, the type of the writing, the aim of the writing, the respondent of the writing, and the production method of the writing (Günel, Atilla and Büyükkasap, 2009; Hand and Prain, 2002). The writing methods used at schools involve mostly traditional writing types such as summarizing a book, taking notes from the board, or writing a laboratory report. On the other hand, Prain and Hand (1996) emphasize that the writing using nontraditional writing activities is an important tool which helps learning and that the writers can develop their interpreting processes. The use of nontraditional writing in science classes is an opportunity for the students which shows them what and why they learn (Hand, Prain, Lawrance & Yore, 1999). Moreover, writing to learn activities are helpful for the development of the thoughts, concept changes, communication abilities and studying abilities of individuals (Tynjala, 1998).

It is observed in various studies that the use of writing activities have a positive impact on the learning of the students at the primary school (Mason & Bascolo, 2000; Günel, Uzoğlu & Büyükkasap, 2009), middle school (Hohenshell & Hand, 2006), and university (Günel, Kabataş Memiş& Büyükkasap, 2009) levels. For instance, Mason and Boscolo (2000) show in their study that the test group which made the writing activity understood the targeted concept better than the control group which did not realize any activity, that they had a higher level of awareness about the change in their conceptual structures, and that the writing is a way of learning.

2.3 Inquiry in science education

Research-inquiry can be defined as a process of evaluating a problem, examination of the information or the fact which requires critical thinking, observing, drawing a conclusion, inquiring (Zuckerman *et al.* (1998), thinking as a scientist, interpreting the experiments, and learning a study method (Bilgin, 2009) and a science (Hofstein & Lunetta, 2004). Furthermore, the American National Science Education Standards (NRC, 1996; s.23) consider the research-inquiry as central to the education and defines it as the following:

> *"Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanation, and predictions; and communicating the results."*

It is widely accepted by the educators that research-inquiry is very important in reaching a new information. It is suggested that the active learning of students has important consequences in terms of developing their own learning (interpreting), developing their research abilities, and the understanding of the nature of the science (Bilgin, 2009). Students, who are at the research-inquiry-based science classes, become active through dealing with the solution of a real scientific problem which involves thinking of research subjects (Polman & Pea, 2001). Hofstein, Nahum and Shore (2001) report that the research-inquiry type laboratories are the center for learning science. Because, the students deal with interpreting the problem, formulizing the hypothesis, designing the experiments, collecting and analyzing data, and drawing conclusions about a scientific problem or a case during the process. The scientific concepts are learned better when these are combined with the integrating activities which are related to scientific ability and experiments and which enable developing scientific concepts. On pedagogies which support research-inquiry, students become active with scientific process and critical thinking abilities while they seek for answers to their questions (Gibson & Chase, 2002). Moreover, it is observed that the students at the classes which apply research-inquiry have a higher level of academic success (Arslan, 2007; Budak & Köseoğlu, 2007), that research-inquiry has a positive impact on interpreting the relations among science-technology-society-environment (Ortakuz, 2006), and that they have higher levels of problem-solving and self-sufficiency beliefs compared to traditional method (Şensoy, 2009).

The focus of the present study, in the light of this literature, is to identify the impact of experiencing research-inquiry process on the cognitive process dimensions in nontraditional writing activities.

3. Methodology

3.1 Research Model

In this study, the screening model is used. Through descriptive analysis, the characteristics (abilities, choices, behaviors etc.) of individuals, groups or (sometimes) physical environments (such as school) can be revealed (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz & Demirel, 2011). In the current study, the cognitive process dimensions of the writing to learn activities are examined.

3.2 Participants Student-Teacher

The sample of this study consists of 26 teacher candidates who are studying at the 3rd degree of Science Education Department at a middle size university located on the northwest of Turkey during 2012-2013 academic years. All these students are studying at the same class. During the study, the teacher candidates applied research-inquiry method on Science education laboratory practices. The researcher has a 9-year experience and has studied the doctorate degree on the impact of inquiry process on the learning.

3.3 Implementation Process

The study started with an activity which is independent from the science subjects and oriented to get students familiarizes with the research-inquiry process and understand its applications. With this activity, the process was introduced to the students. After this study, the science education laboratory practices were realized based on inquiry. After the students got familiarized with the process, they were given a task of nontraditional writing in different time periods (one writing to learn activity at the beginning of the study and two at the end of the study). The characteristics of these writing activities are; being in a letter format, having a peer as a respondent, limited page number based on the given subject, and completed individually. The writing to learn activity completed by the students at the beginning of the study comprised their preliminary writing. The first writing activity was realized on the subject of "nuclear energy" which was a socio-scientific subject. After the students completed their inquiry processes (at one period) on the subject of electricity, two more writing activities were conducted. One of these writing activities was on the subject of "biofuel" which was a socio-scientific subject, and the other one was about the "power" which was a scientific subject. In each writing activity, all students were given the same opportunity to conduct their writing activities at an equal time period for the same subject, format, and respondent. Each writing activity was collected after completion and afterwards the evaluation process started.

3.4 Coding Process

The evaluation process of the writings was implemented by the professionals of the issue. First, the researchers tried to internalize the revised bloom taxonomy (Ayvacı & Türkdoğan, 2010; Krathwohl, 2002). The size of the taxonomy is illustrated on the Table1. When the table is examined, it is seen that it consists of six dimensions, namely, "remember, understand, apply, analyze, evaluate, and create". The researchers evaluated the letters based on the revised taxonomy. For this evaluation, they analyzed the sentences on the writing activity and coded them according to the stage and sub-stage of cognitive process dimensions on the taxonomy. While doing this, at each step of the process they also received help from another researcher who made studies on revised taxonomy and was a professional on this issue. In order to increase the validity and reliability, the researchers selected four letters from the first letters as a sample, and coded the sentences on these letters individually according to the cognitive process dimension stages. After individual evaluations, sentence codes were compared and discussions were held until reaching a common opinion on the sentences which did not have the same code. Afterwards, the same process renewed for the other letters. Since it is seen that these two evaluations are more effective and more reliable, all letters were first coded by the researchers individually and then were discussed to reach a common opinion comparatively. This evaluation was conducted for all writing activities.

Table 1. The Structure of the Cognitive Process Dimension of Revised Taxonomy

1.0 Remember – Remembering the related information from the long-term memory
1.1 Recognizing
1.2 Recalling
2.0 Understand – Inference from the educational messages which involve verbal, written, and graphical communication
2.1 Interpreting
2.2 Exemplifying
2.3 Classifying
2.4 Summarizing
2.5 Inferring
2.6 Comparing
2.7 Explaining
3.0 Apply – The use and application of a method on a given situation
3.1 Executing
3.2 Implementing
4.0 Analyze – Analyzing the material into its components and identifying how the elements are related to one another and to the general structure and the object of the material
4.1 Differentiating
4.2 Organizing
4.3 Attributing
5.0 Evaluate - Making a decision based on the criteria and the standards
5.1 Checking
5.2 Critiquing
6.0 Create – Combining the elements in order to form an original product or a consistent whole
6.1 Generating
6.2 Planning
6.3 Producing

4. Findings

In this section will present the results driven by coding the letter data of the current study according to the cognitive process dimensions and the examples from the students' writings on the appropriate parts by emphasizing the general characteristics highlighted on the writings. As it was also stated on the methodology section, the students made their writings in three different time periods and on three different subjects. The first writing activity was about "nuclear energy", the second writing activity was about "biofuel", and the third writing activity was about "power". These writing to learn activities were intended to enable students to express themselves easily and teach the information they have about the subject to the respondent. These writing to learn activities were limited to maximum 2 pages. This page limitation was not changed even when the writing activity was conducted on different subjects. In this context, each word and sentence that students used for writing to learn in the limited page conditions were examined and the average value of word and sentence numbers that were used for each letter was depicted on Table 2.

Table 2. The average values of word and sentence numbers used in writing activities.

Writing Activities	The average number of words used	The average number of sentences used
1st writing (nuclear energy)	356	24
2nd writing (biofuel)	231	15
3rd writing (power)	176	15

According to Table2, the average number of words that the students used in the first writing is 356, in the last writing which is about "biofuel" it is 231, and in the writing which is about "power" it is 176. The similar result can be observed on the average number of sentences. While the average number of sentences used in the first writing is 24, in the second and last writings the average numbers of sentences are 15. The few words and sentences used by the students, show that at the end of the process students express themselves by using fewer words and sentences. This aspect is discussed by and captured attention of the researchers also in the evaluation phase of the writings. Moreover, the researchers suggest that the students support their own sentences with references and they give examples and make analogies regarding daily life. It can be seen below the examples of the students' sentences which reflect the abovementioned situation.

> *"....Dr. Figen Ar states in her article published on 4-5 September 2007 on the Karadeniz Energy Forum that the best product for biofuel production is sugar beet..."*
> *"...When we wear a flat shoe while walking on the ice, it will be harder to stand since the friction between the iced surface and the shoe is low... "*
> *"...but when an action is applied a reaction occurs in a negative way. Thus, if we consider this, when you love me, shouldn't I give a reaction in a negative and equal way?... "*
> *"...Do you remember? When we were children, we were going out for skiing with a part of a wood and a soap in our*

hands when it was snowy. If the wood did not ski then we were putting soap on it unknowingly. How could we know that the soap decreases the friction?"

The revised taxonomy consists of six dimensions, namely, "remember, apply, analyze, evaluate, and create". These sentences on the writings are coded by identifying the cognitive process dimensions based on this classification and total number of sentences on writing activities for each dimension is depicted on Table3.

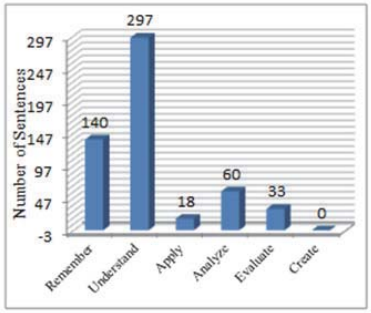
Table 3. Analysis of sentences based on cognitive process dimensions.

Writing Activity	Cognitive Process Dimensions																	
	Remember		Understand							Apply		Analyze			Evaluate		Create		
	11	12	21	22	23	24	25	26	27	31	32	41	42	43	51	52	61	62	63
1st writing	22	118	24	27	17	10	54	26	139	11	7	24	9	27	20	13	0	0	0
2nd writing	20	51	19	14	13	1	16	4	76	8	5	17	2	31	35	18	0	9	5
3rd writing	15	36	3	24	2	4	39	4	45	31	9	41	4	35	25	15	0	0	1

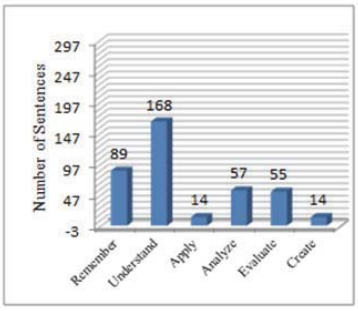
11: recognizing, 12: recalling, 21: interpreting, 22 : Exemplifying, 23: Classifying, 24: Summarizing, 25: Inferring, 26:Comparing, 27: Explaining, 31: Executing, 32: Implementing, 41: Differentiating, 42: Organizing, 43: Attributing, 51:Checking, 52: Critiquing, 61: Generating, 62: Planning, 63: Producing

According to Table3, it can be seen that from the sub dimensions of "remember" dimension (recognizing (11), and recalling (12)), while "recognizing" sub dimension does not show much difference in the coded sentences between the first and the last writings, the number of sentences used at the "recalling" sub dimension show 50% decrease. When the dimension of "Understand" is analyzed, it can be seen that there is a decrease in the number of sentences on the writing to learn about socio-scientific subjects on sub dimensions which are "interpreting (21), exemplifying (22), classifying (23), summarizing (24), inferring (25), comparing (26), and explaining (27)". It is observed that especially the sentences at the dimensions of "summarizing" and "comparing" decrease more than the other dimensions. When the first and the third writing activities are compared, while "exemplifying" dimension increases, the other dimensions decrease. Furthermore, when the "Apply" dimension is analyzed, while similar number values are observed at the first and the second writings which are about socio-scientific subjects, at the third writing activity an increase is observed on the "executing (31)" and "implementing (32)" sub dimensions. A similar result is seen on the "Analyze" dimension. From the expressions used in the third writing activity, it is observed that the expressions which belong to "differentiating (41)" and "attributing (43)" sub dimensions increased more. Moreover, at the fifth dimension, which is "evaluate", we can state that the number of sentences which express "controlling (51)" increase at the last two writings. It is seen that the numbers of sentences which reflect "Critiquing (52)" sub dimension are similar in all three writings. Lastly, when the number of sentences which belong to "Create" dimension is analyzed, the sentences which reflect these expressions are seen only at the second and the third writings. In the writing to learn activities, "generating (61)" sub dimension does not exist, "planning (62)" sub dimension exist only in the second writing, and "producing (63)" sub dimensions exist on a very little amount at the second and the third writings.

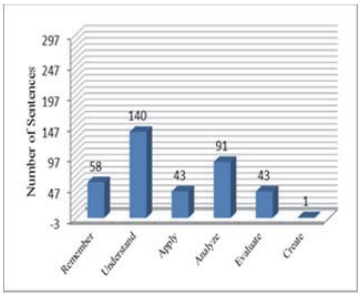
The graphs which show the total amount of sentences regarding the dimensions "remember, understand, apply, analyze, evaluate, and create" which are observed on the writings are illustrated separately for each writing (Graph 1 for the first writing, Graph 2 for the second writing, and the Graph 3 for the third writing).



Graph 1. Writing activity about "Nuclear Power".

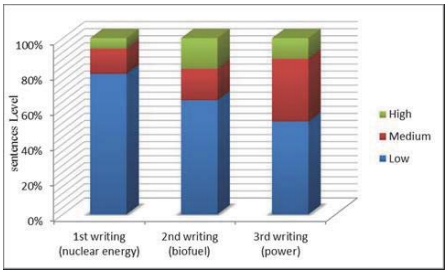


Graph 2. Writing activity about "Biofuel".



Graph 3. Writing activity about "Power"

When the first graph is analyzed which shows the first writing, it is observed that the numbers of students' sentences are gathered more densely on the stages of "remember" and "understand". When the second graph is examined for the second writing activity, besides the increased density of sentences on the "remember" and "understand" stages, a significant increase in the number of sentences which reflect "analyze" and "evaluate" stages is observed. Furthermore, when the third graph is analyzed, the numbers of sentences which reflect "apply", "analyze", and "evaluate" sub dimensions increase significantly compared to the first writing. The cognitive process dimensions can be grouped as; low cognitive level for "remember" and "understand" sub dimensions, middle cognitive level for "apply" and "analyze" sub dimensions, and high cognitive level for "evaluate" and "create" sub dimensions. The percentage (%) comparisons of the number of sentences which reflect these three levels are illustrated on Graph 4.



Graph 4. The percentage comparisons of the levels of cognitive process dimensions (low – medium - high)

When we analyze the Graph 4, we see that there are differences in all three levels of cognitive process dimensions – low, middle, high – between the first and the last writings. The number of sentences at low cognitive level decreases and the one at middle and high cognitive level increases on a percentage basis on the last two writings compared to the first writing activity which is about "nuclear energy". The decreasing rate of the number of sentences at low level is higher on the "power" subject and lower at the "biofuel" subject. The examples of sentences which reflect the low cognitive level regarding both writing subjects are given below:

The example sentences which reflect low cognitive level on the writings about "biofuel":

"Biofuel refers to liquid fuel which is produced from the bio mass and used as an energy source in transportation industry." (11)
"The biofuel is produced from the remains of the organisms which were living recently" (12)
"When considered from this point of view, it is really a nice happening" (21)
"When we examine the agricultural products which are grown widely in order to produce biofuel around the world, sugar beet in Brazil, corn and soybean in the US, and safflower in Turkey..." (22)
"Bio mass is classified into three main parts. These are namely solid biomass, liquid biomass, and gas biomass (biogas)" (23)
"For this reason, the burn of bio fuel does not cause the increase of carbon dioxide amount in the atmosphere" (25)
"Bio benzene and bio diesel, which are known as bio fuels, have important roles in these studies. These two products are used as fuels, but they are different in terms of producing methods, chemical characteristics, and the way they are used." (26)
"This fuel is not like the fuels that we use today such as petroleum or natural gas since this gas can be renewed." (27)
The example sentences which reflect low cognitive level on the writings about "power":
"Power is an action we use on an object" (1.1)
"You can give floating ships as an example of buoyant force" (22)
"In short, the power is the thing that results in an action on a still substance, stops the substance on action and changes its shape and direction" (24)
"This is because the asperity of the rug is more" (25)
"A heavier object gets down to the ground faster than the lighter object" (26)
"The reason is to avoid the car from slipping by increasing the friction power" (27)
"For example, while crumpling a paper is a change I make, watching a toy car moving on a rough ground and stopping after some time is the stopping effect of friction force " (31)

Analyzing the increasing rate of the number of sentences which reflect the middle cognitive level, the highest increase is observed on the "power" which is a scientific subject, and at the high cognitive level the highest increase is observed on the "biofuel" which is a socio-scientific subject. Similarly, the example student sentences are given below:

The example sentences which reflect middle-high cognitive level on the writings about "bio fuel"

"At the same time, besides these benefits, there is also economic side of this subject" (41)
"Due to energy types used unconsciously, the carbon dioxide rate in the atmosphere is increasing everyday" (43)
"Think how much the exhaust gas of the cars pollutes the atmosphere. With this system, the exhaust gases won't pollute as much as before and this is an important development for the nature and the living creatures." (51)
"Although this is a nice situation, this might cause a decrease in the yearly amount of wheat and corn in Turkey and therefore an increase in the prices of grains, increase in the rate of hunger and maybe only rich people will be able to eat" (52)
"Biofuels which is at the bottleneck today should be independent from outside, be reconstructed taking the future risks into consideration, created new opportunities for agriculture, and integrated with the world which is competing at the carbon dioxide." (62)
"Considering that biogas can be converted into natural gas, Turkey should prepare soon its biogas principles and infrastructure for serious investments" (63)
The example sentences which reflect middle-high cognitive level on the writings about "power"
"For example, while crumpling a paper is a change I make, watching a toy car moving on a rough ground and stopping after some time is the stopping effect of friction force " (31)
"If the density of the object is higher than the density of the water, the object won't stand long and will sink" (41)
"However, with the impact of the friction force on a rough surface, the object will move harder" (43)
"Can you think what would happen if it didn't have a moving impact" (52)
"However, if it is an airless environment, a paper and an elephant will fall on the ground at the same time" (63)

5. Discussion and Conclusion

The discussion of the results will be examined in the light of two different reasons. First, the evaluation of cognitive analysis of the writings that students at the 3rd year of their studies realized before and after the inquiry process, and second the evaluation of the differences in the writings written on the scientific and socio-scientific subjects are provided.

When we analyze the findings, the evaluation of the first and the last writings reveals that the students express themselves using fewer words and sentences at the last writings. The last writings which students realized at the end of the inquiry process and where they used more simple and sharp expressions indicate that the process helped them increase in the students' ability to reach and transfer the information. Because the students at this inquiry process also

learn how the science is developed (Hofstein, Nahum & Shore, 2001;Bilgin, 2009). The students who go through an inquiry process reflect this in their writings. This is the most noteworthy finding of the process of the writings' evaluation. The students experience and express the inquiry process while they explain the subject of the tasks they have. The most significant characteristics of the last writing activities are; explaining with examples, making experiments, making analysis, associating and critiquing. The students become selective in explaining the subject in their written arguments by using the sentences that directly serve for the target.

Furthermore, each written sentence is examined in terms of renewed bloom taxonomy cognitive process stages reflection levels. When we analyze the results of this evaluation, we can suggest that there is a difference (in %) in the cognitive levels between the first and the last writings. This difference can be seen clearly in Graph 4. While the number of sentences which reflect the low cognitive level decrease in percentage, sentences which reflect the middle and the high cognitive levels increase in percentage significantly. Writing is a learning method used in the education environment (Keys, 1999; Günel, 2009). Writing is important in developing the conceptual understanding which is a potential for the improvement of high cognitive thinking (Wallace, 2007). The deficiencies in conceptual structures can be better recognized in writing. In this process, the thoughts are discovered. Wallace suggests that this high cognitive awareness can evoke the cognitive strategies such as research for a new information or literature review. Therefore, high cognition is a form of learning through writing (Wallace, 2007). Moreover, the more students use writing strategies and review what they write, the more benefits they get from the class (Kief, Rijlaarsdam and Bergh, 2006). The study results also indicate this situation. The main purpose of the writing to learn activities is to provide information to the respondent about the written subject. For this reason, the students should generate a written argument. This argument process is realized in two different subjects. The students who wrote the inquiry process used more explanations regarding the application and analysis stages about the subjects that they can conduct applications. At Table 2 it is observed that there are more expressions at the "executing" (31) sub dimension when the sentences at the "Apply" stage for each writing are analyzed, and at the "Analyze" stage there are more sentences at "differentiating" (41) and "attributing" (41) sub dimensions. It is also observed that there are expressions at the high cognitive level (evaluate and create stages) more in the writings related to socio-scientific subjects than in other writings. Graph 4 indicates that the percentage rate of sentences reflecting low cognitive level decreases in the last writings compared to the first writings. When the increase rates are compared, the results show that the increase in middle level is more in the "power" which is a scientific subject, while the increase in high level is more in the "biofuel" which is a socio-scientific subject. The main reason of this situation can be the impact of the process experience. Because the students try to build strong arguments in order to convince the respondents with the evidences they acquired. The same situation occurred in Apply process is also observed in writing activity. The main reason of the students' focus on the application and analysis in order to convince the respondent on the writings with "power" subject can be attributed to the belief that the provability can be ensured by the application and association. The support and strength of information depends on its congruity with other thoughts. The argumentation in socio-scientific subjects results in the appearance of high cognitive processes. While the experience of inquiry process improves the high cognitive process during the writing to learn process, it should also be kept in mind that there can be subject-based differences.

Furthermore, in order for the writing to learn to be effective, the teachers are required to establish an appropriate learning environment and to encourage the students for writing to learn activities. Taking into consideration that the writing is a complex activity which requires an effort (Warnock 1983; Kieft *et al.* 2006), the teachers should make an effort to involve students into writing to learn activities.

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