ISSN:1306-3111
e-Journal of New World Sciences Academy
2011, Volume: 6, Number: 3, Article Number: 1C0424

EDUCATION SCIENCES
Received: November 2010
Accepted: July 2011
Series : 1C
ISSN : 1308-7274

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THE EFFECTS OF THE CONCEPTUAL CHANGE TEXTS ON CORRECTING THE SIXTH GRADE STUDENTS' MISCONCEPTION ABOUT THE 'ELECTRICITY IN OUR LIFE' SUBJECT

ABSTRACT

In this study, we examine the effects of conceptual change texts, which constitute one of the conceptual change techniques that are used to teach the electricity subject to sixth graders in primary school. We analyze its effects on correcting the misconception and on the success level of the students. The sample set consists of a trial group of 28 people and a control group of 29 people. We used the concept identification tests that we generated to obtain the data of scores of the 57 students that took part in the experiment. Also, we performed the statistical analysis of the collected data by using the SPSS software. We can summarize the results of the analysis of the experiments as follows; 1. The students are considerably more successful on the posterior test both with and without differentiating the trial and control groups ($P<0.001$). 2. The confidence level of the students in general increase from "confident" to "absolutely confident"

Keywords: Science Education, Concept Education, Misconception, Conceptual Change Texts, Conceptual Change Approach

İLKÖĞRETİM ALTINCI SINIF ÖĞRENCİLERİNİN 'YAŞAMIMIZDAKİ ELEKTRİK' KONUSUNDAKİ KAVRAM YANILGILARININ DÜZELTİLMESİNDE KAVRAMSAL DEĞİSİM METİNLERİNİN ETKİSİNİN ARAŞTIRILMASI

ÖZET

Bu araştırmada, ilköğretim 6. sınıf öğrencilerinin elektrik ünitesinin öğretiminde kavramsal değişimi sağlamak için kullanılan uygulamalarından biri olan kavramsal değişim metinlerinin; öğrenci başarısı ve kavram yanılgılarının giderilmesine etkisinin araştırılması amaçlanmıştır. Deney grubu 28 kişi, kontrol grubu ise 29 olmak üzere toplam 57 kişi olarak tespit edilmistir. Araştırmada veri toplama araçları olarak, araştırmacı tarafından geliştirilen kavram tanı testi kullanılmıştır. Bu araçlardan elde edilen verilerin istatistik analizleri için, SPSS paket programı kullanılmıştır. Araştırma verilerinin analiziyle ulaşılan sonuçlar şu şekilde özetlenebilir; 1. Başarı bakımından hem grup ayrımı yapmadan) hem de gruplara göre, öğrenciler ikinci testte başarılarını önemli ($P<0.001$) düzeyde yükseltmişlerdir. 2. Öğrencilerin sorulara verdikleri cevapta eminlik durumları bakımından, genel olarak, önceki teste gore sonraki testte eminlik düzeyleri biraz artsa da "eminim" düzeyinden "kesinlikle eminim" düzeyine geçildiği görülmüstür.

Anahtar Kelimeler: Fen Öğretimi, Kavram Öğretimi, Kavram Yanılgısı, Kavramsal Değişim Metinleri, Kavramsal Değişim Yaklasımı

1. INTRODUCTION (GİRİŞ)

We live in the age of technology, science and communication, in which new scientific discoveries are made every day. In this century rapid developments are observed at a global level, in the areas of communication, knowledge exchange, and technology (Güven, 2001). Advances in the technology emphasize the importance of applied sciences. Development of a country depends on its ability to adapt to this age of information (Akgün, 1998).

In developing countries, science and technology play a crucial role in the development. The development of countries, in which science advances and science education is enhanced, is easier while for other countries it is very difficult. Therefore, countries that are eager for development are working towards improving science education. For this purpose, countries are trying to refine their science education program, and raise the quality of teachers and educational institutions for teachers (Yasar, 1998). The main challenge caused by these changes on education, and science education in particular is that school programs become insufficient or even invalid after some time. Therefore, education systems, school programs, curriculum and also teaching methods require adjustments in accordance with the latest developments (Turgut, 1990).

Applied sciences usually induce understanding issues in students because of its topics and concepts, and also because they require active thinking and understanding (Ayas and Costu 2001). The causes of failure among students in applied science classes are due to these difficulties and the fact that topics are shown in an abstract manner (Super et al, 2001).

Studies in recent years show that in many areas of applied sciences, students face difficulties understanding the concepts. As a consequence, research for alternative views of students about science concepts is gaining increasing importance for science education (Bell 1981, Driver 1981, Bloom 1990).

We come across science in our daily lives in different ways in many areas, and our experiences give us ideas about related scientific concepts. Unfortunately, these ideas are usually without scientific foundation. These false ideas, so-called misconceptions, prevent meaningful and permanent learning.

In general, misconception is explained as information formed as a result of personal experiences, which is proven to be inconsistent with the scientific facts. It disrupts the process of learning and teaching the scientifically proven concepts. Miconception is also defined as the misguided usage of scientific concepts that are correlated due to insufficient resources or incorrect process of thinking. (Baserand Çataloğlu, 2005).

The traditional teaching methods applied in science education are insufficient in creating the conceptual change in students. These methods prompt students to memorize information, and prevent students from learning subjects that require definition, explanation and prediction because of the existing misconceptions of students.

For these reasons, research methods developed for eliminating misconceptions holds an important place in science education (Sonmez et al, 2001). In recent years, there have been numereous national and international misconception related studies about science education and physics (Capa 2000; Sungur 2000; Asci et al., 2001). One reason why there are so many studies is that ways for revealing and correcting the misconceptions of students are essential for effective learning.

Acquiring the scientific background, which is required in all areas of life, is directly related to the adequacy of teaching scientific concepts. Therefore, being acquainted with the preliminary knowledge of students before formal science courses and monitoring the conceptual changes are vital.

- Some of the sources causing misconceptions are listed as follows:
  - Word based (language related) errors.
  - Analogy and metaphor caused errors.
  - Symbol related errors.
  - Errors arising from preliminary information.
  - Errors due to bias.
  - Errors originating from non-scientific beliefs.
  - Errors arising from concepts.

Many educators have used teacher-student and student-student interaction for elimination of misconceptions among students and for encouraging the learning of concepts in a meaningful way in order to provide conceptual learning. Such methods are more effective for classes with smaller number of students (Chambers and Andre 1997; Eryılmaz 2002). The larger number of students in the class, the more difficult it becomes to implement this method. Therefore, using the conceptual change texts, which attain conceptual learning and contain information to eliminate the misconceptions, is considered to be more proper for large classes (Chambers and Andre, 1997).

Conceptual change texts present opposing claims that aims to correct students' misconceptions of scientific concepts. Conceptual change texts constitute some of the persuasive arguments against the students' misconceptions (Hynd, 2001). According to Hynd and Alverman (1986b), conceptual change texts should clearly identify the contradictions between the misconceptions and the scientifically accurate information (Pinarbasi and Canpolat, 2002). Conceptual change texts aim for correcting existing misconceptions in students. These texts are prepared in a way that will make the students see that their existing concepts are insufficient in explaining som events. Conceptual change texts contain various explanations and examples that help students understand and implement the targeted concepts. Also applying conceptual change texts in classes with small number of students help the teacher as a method for conceptual change and enrich teaching (Chambers and Andre, 1997).

Two types of conceptual change texts can be prepared. In the first type of conceptual change texts, first students are told about the misconceptions. Then, evidence is presented that will prove these misconceptions to be incorrect. However, since such tests are very difficult to find, teachers usually prepare the texts themselves. The second type conceptual change texts, the subject is explained to the students directly. Tests of this type are commonly found in textbooks, but their effect on eliminating misconceptions is stated to be of less influence. In this test, subjects are offered only to students in a direct way, but the misconceptions and the evidence against these misconceptions are not mentioned (Guzzetti et al. 1992). In order to prepare a conceptual change text about any subject, one first needs to find the common misconceptions in students new arguments against these misconceptions should be found. In scientific studies, it has been observed that students who read these texts replace their misconceptions with the scientific concepts. These conceptual change texts intend to change old and false ideas with the new scientific concepts. In this way, conceptual change texts lead to a drastic reorganization in the person's knowledge structure. In the preparation of these texts,

first a question is asked to activate a related misconception in students. Then, the common misconceptions about that topic are listed, along with the explanations about why they are wrong. In this way, students question their misconceptions and realize the insufficenct of their knowledge. Afterwards, new information about the topic is described and examples are given (Hynd 2001; Pinarbasi and Canpolat 2002).

In a study by Chambers and Andre (1997); they analyze the effects of gender, experience and interest in electric concepts, and the effect of teaching with conceptual change texts in direct current concepts. They show that conceptual change texts improve the conceptual understanding in students more thant traditional texts.

Yalvaç (1998), examined the effectiveness of the conceptual change texts in 6th grade students' understanding of electric current subject. In the first study, students' misconceptions about electrical issues in the existing literature are presented. During the implementation four conceptual change texts were used. In conclusion, the group of conceptual change texts was found to be more successful compared to traditional teaching methods used. According to the results of recent testing, even after one month the students learned the information, they still remembered it. Therefore, the study suggests that students' misconceptions should be considered and eventually eliminated. Moreover, it suggests that additional conceptual change texts in other subjects should be prepared.

Alvermann and Hague (1989), analyzed the impact of the type of the text and preliminary information of the students in learning the concept of motion. They found that conceptual change texts are more effective than traditional texts on students' success. Additionally, they found that the preliminary information the students have is critical while learning new concepts.

In a study by Wang and Andre (1991), about the effect of conceptual change texts in teaching electrical circuits, it is shown that students understand the electrical circuit subjects better when conceptual change texts are used.

Guzzetti, Williams, Skeels and Wu(1997), found that traditional texts encourage misconceptions, and that students insist on misconceptions unless they are presented conceptual change texts.

Sungur, Tekkaya and GEBA (2001), came to the conclusion that conceptual change texts supported by concept maps are more effective on students when learning new concepts. They also mention that both control and trial group students continued to have some of the misconceptions even after the teaching.

Gülçiçek, N., (2004), in his thesis "Conceptual Change Text students Magnetism subject to understand and Physics Attitude Effect", states that he did not observe a significant difference between the understanding of students who learnt the magnetism subject by using conceptual change texts and traditional texts.

Şeker (2006), examined the effects of conceptual change texts supported with examples on students understanding of atom-molecule-ion-matter subjects and their approach towards applied science courses. In this study, conceptual change texts are found to be more successful in learning concepts, however they are found not be as effective on students' approach to the course.

2. RESEARCH SIGNIFICANCE (ÇALIŞMANIN ÖNEMİ)

In this study, we aimed to understand how the 6th grade students of Konya Province, Central Elementary School perceive the fundamental concepts in the electricity subject, which constitutes a

big part in the curriculum of the Science and Technology course. Also we aim to identify the misconceptions and explore the effects of conceptual change texts on the success of students and elimination of misconceptions.

Conceptual change texts are accepted as one of the most powerful methods for effective teaching of concepts(Guzzetti et al. 1992; Chiu and Lin, 2005).

In summary this work tries to answer the question:'Are conceptual change texts effective on students' understanding of the electricity subject?".

3. PROBLEM SENTENCE (PROBLEM CÜMLESİ)

Are conceptual change texts effective on students understanding of the electricity subject?

4. METHOD (YÖNTEM)

4.1. Design of Study (Araştırmanın Tasarımı)

Experimental and control group design was used in this study. Patterns of this kind are called "Semi-Experimental Design (or Quasi-Experimental Design)". The study is based on one of the most commonly used and scientifically highly valuedexperimental method, the 'pre-test, post-test control group design model'.

4.2. Working Group of the Research (Araştırmanın Çalışma Grubu)

The work group of this research is the academic year 2009-2010 6th grade students of the Joint Primary School in Konya province, which is affiliated with the Konya Provincial National Education Directorate, and the Ministry of Education. We selected a total of 57 people, of which 28 constitute the trial group while 29 constitute the control group. Selection is made by randomly assigning the groups.

4.3. Data Collection Tools (Veri Toplama Araçları)

The data for this study was obtained from the 'Conceptual Change Text' that covers the contents of the subject "Electricy in Our Life" which is a part of the 6th grade Science and Technology course, and the measurement tools of 'Concept Recognition Test' .

In this study, the following steps are performed to develope the 'Conceptual Change Text':

First, we examined how these subjects are explained in the 6th Grade Elementary school textbooks of Ministry of Education. In order to determine the content of topics that have been written in this field of Science and Technology, publications of private publishers and foreign textbooks have been investigated. Moreover, in determining the content, science and technology teachers' views have been taken into consideration. After the examination of issues related to the content is complete, we reviewed the literature for the misconceptions about the electric subject. Additionally, we conducted a concept test on a group of 7th grade students. As a result of these analyses we identified misconceptions about the brightness of the bulbs when the switch is on or off, and the direction of the electric current and the electrons. After the identification of misconceptions like these, for the purpose of eliminating them, we searched for the concepts to use when designing the conceptual change texts. We decided to design conceptual change texts based on mainly conductivity-insulator and bulb brightness.

We also examined the important aspects when designing and editing Conceptual Change Texts (CCT). For this purpose, the relevant literature is reviewed in detail.

While editing the content of CCT, we exploited the above-mentioned books, literature review and thetest results on 7th grade students.

As a result of this work, the drafts of conceptual change texts are assembled before the pilot study.

As noted above, these draftsare examined with the specialized faculty of Gazi Faculty of Education. Some modifications were done on the drafts based on their reccomendations. In particaular, the missing scientific information is included and new studies in this area are added to the texts and the CCTs are finalized before the pilot study.

In this study, we conducted a three-stage 'Conceptual Diagnostic Test' with multiple-choice questions to the students in order to identify the possible misconceptions about the subject of electricity. We prepared the questions in the test according to the criterias refered in the literature, and also based on the topics in which misconceptions are common in students. Therefore, we have analyzed the related studies in literature and determined these common misconceptions to prepare the diagnostic test. Conceptual diagnostic test is designed to have three stages and multiple-choice questions as in literature this design is believed to be the best measure for misconceptions (Eryılmaz,2002). In the first stage of the diagnostic test, there areordinary performance measuring questions. In the second stage, the questions ask about the reasonsof the answers of first stage questions. Finally in the third stage, the questions ask the students how sure they are about the questions in the first two stages. We also added a blank option for the first two stages in case there are students who have answers other than the given options. We determine that there is a misconception about a question if students give the wrong answers in the first two stages and select "I'm absolutely sure" in the last stage.

The conceptual diagnostic test we prepared was conducted on 80 7th grade students of the Joint Primary School in Konya province as a pilot study for validity and reliability purposes. We used statistical software tools to analyze the obtained data and also consulted four faculty members who are experts in their fields and four 6th grade teachers. After the data was inspected, the errors were corrected and questions that reduced the reliability of the test were removed in accordance with the expert opinions. As a result, the conceptual diagnostic test consisting of 25 multiple-choice questions, which explain the logic of student replies, is finalized. While we were preparing the questions in the test, we were carefulto stay in the scope if the electric chapter. We endeavored to prepare the questions in a manner that will serve the purposes of Science and Technology curriculum. The students were given enough time (two hours) to answer all the questions of the conceptual diagnostic test.

4.4. Application Steps of The Research (Çalışmanın Uygulama Basamakları)

The conceptual change texts used in this study are prepared according to the 'Conceptual Change Approach' by Posner et al. (Posner, Strike, Hewson, & Gertzog, 1982). Posner et al. describe this approach as reorganization and it is derived from the opinions of Piaget and Thomas Kuhn. According to this approach, for the

realizaton of conceptual change these four conditions must be fulfilled(Chambers, & Andre,1997; Posner, Strike,, Hewson,, & Gertzog, 1982):

- Dissatisfaction: Students should understand the shortcomings of existing concepts,
- Intelligibility: Students should find new concepts understandable,
- Plausibility: Students should find the new concept logical,
- Fruitfulness: Students should be able to use new concepts in other areas.

While designing the CCTs we ensured that these conditions were fullfilled.

In this study we formed two groups, namely, the trial and control group. The classes were randomly labeled as trial and group. We prepared class notes in accordance with the purposes and gains of 'Electricity in Our Lives' chapter.

One week before the lecture for this chapter started, we gave information to the students in the trial group about this study that will use 'Conceptual Change Texts'.

The research was conducted by the author in both trial and control groups.

In order to determine if there is any difference between the trial and control groups, we conducted the 'Electricity Conceptual Diagnostic Test' of 25 questions as a pre-test in the second semester of 2009-2010 Academic Year.

Questions to identify misconceptions were prepared after identifying misconceptions, and conceptual change texts were prepared.

In the second semester of the 2009-2010 academic year, we taught the 'Electric in Our Lives' chapter to 6th grade students of both trial and control groups. In the trial group of 28 students, we used conceptual change texts to teach the target concepts while in the control group of 29 students we used the constructivist teaching method.

After the target material is covered in class, in the second semester of 2009-2010 academic school year, the 'Electric Concept Diagnostic Test' (ECDT) is administered to both trial and control groups as the post-test. During "Life in our power" in relation to the unit, prepared by researchers consisting of 25 questions, "Electric Concept Recognition Test (ECR)" as a final test was administered to experimental and control groups.

In this research, in the application of both pre-test and post-test, the students were not under any influence and they choose the correct answer independently. Since the students were free from outside intervention, the relationships they created did not turn into a link that is incorrect or that lacks information.

Experimental analysis of the data obtained at the end of the study was done in SPSS. The effects of Conceptual Change Texts on 6th grade students' academic success on the subject of electricty were evaluated.

Many studies (Guzzetti al. 1992; Bilgin and Geban 2001) state that conceptual change texts play an important role in eliminating the misconception of students. However, especially students with inadequate reading skills, conceptual change texts alone are not sufficient. Therefore, along with using conceptual change texts, having discussions in the class is a more effective way in understanding concepts (Guzzetti et al. 1992; Hynd et al. 1994; Eryılmaz 2002). For this reason, after the conceptual change texts

were distributed to the students, and after they read them we had discussions in the class.

After the lectures, we obtained the opinions of the students about the Conceptual Change Texts.

Teaching was supported by the same experiments in both groups, (e.g., conductivity and insulation of the wires, the brightness of light bulbs, etc.) During the research, we allowed the students to do experiments related to the target concept and discuss the results.

The electricity subject was taught to the 6th grade students according to the Science and Technology course curriculum in a regular way, in the lecture time.

4.5. Analysis of the Data (Verilerin Analizi)

Following the administration of the tests, the results were saved to the EXCEL program. The resulting data was transferred to SPSS statistical program and all the statistical analyses was done using the SPSS package program.

Before the multiple-choice test comparison, we find the correct answer number for each student for both tests. Then, without differentiation between the trial and control group, we compared the results of the pre-test and post-test. This comparison was done by usng "Paired - Samples t test".

The comparison of pre-test and post-test in the control and trial group and in gender groups was done by using the 'Independent - Samples t-Test'.

5. FINDINGS AND DISCUSSIONS (BULGULAR VE TARTIŞMA)

We aimed to identify the misconceptions about the electricity subject in 6th grade students and evaluate the effectiveness of conceptual change texts on correcting these misconceptions. For this purpose we administered the 'Electricity Conceptual Diagnostic Test' as a pre-test to both trial and control group students before the electricity subject was taught. After the subject was taught, we administered the test again as a pot-test.

After that we analyzed the test results for all 57 students.

In both the pre-test and post-test, we compare the success on the multiple-choice tests of trial and control groups as well as the gender groups. For the last stage of the test, which investigates how sure the students are about their answers, we first find the average of answers to all 25 questions. Then we compare the averages among pre-test and post-test, and also trial-control and gender groups.

- **Comparison of Success Level of Trial and Control Groups**

The test results of the trial group who learnt from conceptual change texts and the control group who learnt from classical texts are shown in Table 1.

When we examine Table 1, we see that the difference between the trial and control groups is insignificant on the pre-test ($P > 0.05$). On the other hand, the difference on the post-test is significant ($P < 0.01$). This results show that the teaching method on the trial group was effective. The difference between the gender groups is insignificant in both cases ($P > 0.05$).

Table 1. The success level among trial-control and gender groups (number of correct answers in 25 questions
(Tablo 1. Deney ve cinsiyet gruplarına göre öğrencilerin çoktan seçmeli iki testteki başarı durumları (25 soruda doğru cevap sayısı)

	n	$\overline{X}$	$S_{\overline{X}}$
Pre-test			
Trial group	28	11,64	0,647
Control group	29	10,04	0,488
P =0,051			
Male	31	10,84	0,622
Female	26	10,81	0,535
P =0,971			
Post-test			
Trial group	28	20,82	0,549
Control group	29	17,72	0,847
P =0,004			
Male	31	19,03	0,803
Female	26	19,50	0,728
P =0,673			

- **Comparison of Pre-test Post-test Success Levels**

The results obtained from the pre-test and post-test are given in Table 2. The comparison is made between the students among the same group and alsoin different groups. When we analyze the results in Table 2, we see that the success level increased significantly (P < 0.01) in the post-test in general (without differentiating between the groups) and also among the groups. Students in the control group had approximately 8 more correct answers in the post-test, while that number is at least 9 and more in the trial group.

(Table 2. The success level of students on the multiple-choice pre-test and post-test in overall and by different groups(number of correct answers in 25 questions)
Tablo 2. Genel olarak ve farklı gruplara göre öğrencilerin çoktan seçmeli iki testteki (ön test ve son test) başarı durumları (25 soruda doğru cevap sayısı) *

	n	$\overline{X}$	$S_{\overline{X}}$
Overall	57		
Pre-test		10,83	0,414
Post-test		19,25	0,545
P =0,000			
Trial group	28		
Pre-test		11,64	0,647
Post-test		20,82	0,549
P =0,000			
Control group	29		
Pre-test		10,04	0,488
Post-test		17,72	0,847
P =0,000			

*: According to the results in Table 1, there is no significant difference between genderand thus gender comparison is omitted in this table.

(*: Tablo 1 sonucuna göre başarı bakımından cinsiyet farkı önemsiz bulunduğundan bu tabloda cinsiyete göre bir karşılaştırma yapılmamıştır)

- **Comparison of Confidence Levels about the Answers of the Trial and the Control Groups**

The results of the confidence levels of students about their answers to the first two stages of the test are shown in Table 3 (1 = Absolutely sure, 2= Sure, 3 = Not sure, 4=Absolutely not sure).

We obtained the statistical results on the numbers, rounded the results and presented the corresponding text.

When we examine Table 3, we see that the difference between the trial and control groups is significant (P < 0.05) in the pre-test since the trial group students answered 'Absolutely sure' while the control group students answered 'Sure'. In the post-test, the confidence level of the control group increased and the difference became insignificant (P>0.05).There is no important difference between the gender groups in both tests (P > 0.05). However, we see that the confidence level of both genders increased from 'Sure' to 'Absolutely sure'. Since there is no improvement in the confidence level of the trial group, we can say that the procedure on the trial group was not effective on the confidence levels.

Tablo 3. Deney ve cinsiyet gruplarına göre öğrencilerin çoktan seçmeli iki testte sorulara verdikleri cevapta eminlik durumları (Kesinlikle eminim =1, Eminim = 2, Emin değilim = 3, Kesinlikle emin değilim = 4)

(Table 3. The confidence level of students about the answers on the first two stages of the test according to trial-control and gender (1 = Absolutely sure, 2= Sure, 3 = Not sure, 4=Absolutely not sure)

	n	$\overline{X}$	$S_{\overline{X}}$	Rounded*	Result
Pre-test					
Trial group	28	1,3	0,10	*1*	*Absolutely sure*
Control group	29	1,7	0,10	*2*	*Sure*
P =0,013					
Male	31	1,5	0,09	*2*	*Sure*
Female	26	1,5	0,13	*2*	*Sure*
P =0,942					
Son test					
Trial group	28	1,3	0,08	*1*	*Abolsutely sure*
Control group	29	1,5	0,11	*2*	*Sure*
P =0,109					
Male	31	1,4	0,09	*1*	*Abolsutely sure*
Female	26	1,4	0,12	*1*	*Abolsutely sure*
P =0,861					

*: the average is rounded to the next integer
(*: ortalamanın yuvarlanarak tam sayı haline getirilmesi)

- **Comparison of Confidence level between Pre-test and Post-test**

The results that show the condifence level of sutdents in the pre-test and post-test are shown in Table 4. Avvording to these results, there is a slight increase on the confidence level in the post-test (from 'Sure' to 'Absolutely Sure'), however the increase is not significant statistically (P> 0.05).We do not see an important change in the trial group as well, since the students were 'Absolutely Sure' in both tests. In the control group, the confidence level increased slightly, which does not have statistical signifacance (P>0.05).

Table 4. The confidence level of students in overall and by different groups in the multiple-choice pre-test and post-test (Tablo 4. Genel olarak ve farklı gruplara göre öğrencilerin çoktan seçmeli iki testteki (önceki ve sonraki test) sorulara verdikleri cevapta eminlik durumları

	n	$\overline{X}$	$S_{\overline{X}}$	Rounded	Result
Overall	57				
Pre-test		1,5	0,08	*2*	*Sure*
Post-test		1,4	0,07	*1*	*Absolutely sure*
P =0,118					
Trial Group	28				
Pre- test		1,3	0,10	*1*	*Absolutely sure*
Post-test		1,3	0,08	*1*	*Absolutely sure*
P =0,602					
Control Group	29				
Pre- test		1,7	0,10	*2*	*Sure*
Post-test		1,5	0,11	*2*	*Sure*
P =0,083					

5. CONCLISION AND RE COMMENDATIONS (SONUÇLAR VE ÖNERİLER)

In terms of success in the pre-test between trial and control groups, there is aninsignificant difference (P> 0.05), while in the post-test, the difference between the two groups is important (P <0.01). These results show that the procedure was effective on the trial group. The differences between the gender groups are not important in both tests
(P >0.05).

In terms of success among all students and in both groups, we see that there is an important increase (P<0.001). Students in the control group had approximately 8 more correct answers in the post-test, while that number is at least 9 and more in the trial group.

According to the confidence level of students' answersto questions, the difference between the trial and control group was significant on the pre-test (P<0.05). Trial group students stated that they are 'Absolutely Sure' while the control group students said they are 'Sure'. In the post-test, the confindence level of the control group increased and the difference became insignificant (P>0.05). There is no difference between the gender groups in both tests (P>0.05). In both gender groups the students increased their confidence levels.

Since there is no change on the confidence levels of the trial group, we can say that the application of conceptual change texts are not that effective on confidence levels.

The control and trial groups are assigned randomly. Some of the success in both groups can be attributed to individual students.

As a result of this study we see that using conceptual textshelps eliminating most of the misconceptions in students in theScience and Technology course. Additionally, we see that the constructivist approach, in which students participate actively in the lecture, is effective in providing meaningful learning.

The trial group students who were taught the conceptual change texts had more tendencies to change their misconceptions to correct information than the control group students.

The conceptual change texts aim to eliminate the misconceptions and teach the correct concepts better. The information that is given in conceptual change texts draw attention to the conflicts between the students' current information and the scientific facts, which could be shown as the main reason that trial group was more

successful in the electricity conceptual diagnostic test. The students became aware of the non-scientific information they had and tried to learn the correct versions. Hence, the misconceptions were mostly eliminated.

All teachers should try to do progress and not be satisfied with the existing methods and they should try to learn new teaching approaches and improve them. Teachers should be aware of academic research and they should be persuaded that when new techniqies are used, the education is enhanced.

Different teaching methods should be used in order to eliminate the misconceptions. We should analyze how effective those metnods are and develop new data collection tools to do that.

Students should be willing to change their misconceptions. If students are uninterested in changing their opinions, then their misconceptions will resist change and they will acquire new misconceptions. Students and teachers should see learning as a process of change from misconceptions to scientific conceptions.

In future works, a measuring tool to determine the students' attitudes towards conceptual change texts can be developed and used.

In this study we investigated the effects of conceptual change texts on students understanding of the electricical concepts. In future research, this effect can be studied by using conceptual change texts with various teaching strategies such as concept maps, analogies, simulations.

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