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Physics Teachers' Views on Teaching the Concept of Energy

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Abstract

Problem Statement: With the advancement of technology, energy as a concept has become part of the every aspects of life, and it becomes more and more important day by day. Since 2013, the concept of energy has become part of the updated physics education program in Turkey. Teaching the concept of energy is a significant undertaking; most students do not properly comprehend it because it is an abstract concept. In this respect, physics teachers play an important role in teaching this topic, and their views would contribute greatly to the field.

Purpose of the Study: The aim of the research is to determine teachers' views on teaching the concept of energy; on the new physics program, which also includes the teaching of energy; on constructivist learning theory; and on the appropriateness of energy for this theory.

Method: This research is designed as a case study, which is among the qualitative research methods, and there are three physics teachers in the study group. In the research, semi-constructed interview questions were used as a data gathering tool, and a researcher log for observing the participants was kept in order to support the obtained data. Data were analyzed using a descriptive analysis method, and the data were summarized under themes within the frame of the answers given to research questions.

Findings: As a result of the research, we determined that the teaching of energy could not be done in accordance with the constructivist approach due to the teachers' lack of knowledge; however, we also determined that

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the teachers think that energy as a topic is applicable to the constructivist approach.

Conclusion and Recommendations: We determined that when energy is taught, students can become more conscious of the concept of energy and can relate it to daily life. Moreover, our study revealed that if energy is taught by giving examples from daily life, by showing videos and simulations, and if it is supported with experiments in labs and with field trips, students can have a more effective learning experience. Furthermore, if the university entrance exam is made compatible with the curriculum, students can be more successful in learning the concept of energy.

Keywords: Energy, physics education, physics education program, teachers opinions.

Introduction

Related to daily life, energy exists in various forms, such as heat, light, electricity, chemical energy, kinetic energy, petroleum, sound, and nuclear energy, and these energy forms can be transformed from one form to another. With the advent of industrialization and the increase in population, the use of the concept of energy has also increased. In this respect, it is evident that teaching energy, which has a very important place in our lives, has become more and more essential. Defined by some students as being difficult and incomprehensible, energy as a topic is said to be difficult to comprehend because it includes especially abstract concepts (Duit, 1992; Stylianidou, Ormerod, & Ogborn, 2002; Yuenyong & Yuenyong, 2007). From the studies on the teaching of energy, we determined that students have misconceptions about energy as a concept and about conservation of energy, transformation of energy, transmittance of energy, and energy sources (Ellse, 1988; Ogborn, 1990; Solomon, 1982; Toman, Karatas, & Cimer, 2016; Trumper, 1998). Teaching energy as a concept became part of the revised physics education program in 2013 as part of the 9th grade curriculum (Ministry of Education [MEB], 2013). In the curriculum, it is stated that revised programs are important factors in the students learning the concepts, in eliminating misconceptions, and in changing students' negative attitude towards the physics course to a positive one (Peers, Diezmann, & Watters, 2003). Researchers indicate that many physics programs, in which students are expected to discover knowledge and draw connections between this knowledge and other concepts, have been designed in accordance with constructivist learning theory (Bodner, 1986; MEB, 2013; Shiland, 1999). In such programs, the aim is to design lessons in which students are active participants in the education process and in which they discover knowledge and draw parallelisms between what they learn and daily life (Geelan, 1995; Martin, 1997; Zahorik, 1995). Moreover, in such environments where the constructivist approach is employed, different teaching methods that enable students to actively take part in the lesson should be given precedence, and students should be enabled to interact with one another in learning the science (Donaldson, 2004). To this end, teachers who are practitioners of the constructivist learning approach are expected to have proper experience, foundation,

and knowledge. However, in Turkey, teachers tend to prefer providing theoretical information first, then concentrating on vague points via a Q&A method, and finally resorting to a problem-solving method in order to reiterate the topic (Gecer & Ozel, 2012). In this method, students are passive participants as they are merely the audience. When we examined the literature, we found that the research points to the necessity that teachers include applications and that they teach with improved methods, techniques, and strategies, in addition to providing theoretical concepts. Moreover, students' learning should not be limited to the theoretical knowledge they acquire at school, but it should also allow them to draw connections to daily-life instances. In this process, physics teachers should lead their students in a way that will prevent them from forming misconceptions, especially in relation to such topics as energy, which consists of many complex and abstract concepts (Boyes & Stanisstreet, 1990; Madanoglu, 2015). Another observation is that Turkish teachers have an adaptation problem concerning the revised program and that it takes time for them to get rid of old habits (Crawley & Salyer, 1995). For these reasons, we concluded that revised teaching programs cannot yet be properly applied (Karacaoglu & Acar, 2010).

Therefore, the teaching of energy as a topic will be examined within the scope of the study, and teachers' views on energy, which is a subject taught for the first time within the new physics program, will be examined. We believe that this study will contribute to the literature as it can draw attention to the problems related to the new physics education program and its emphasis on energy. It can also help re-evaluate the needs that exist within the frame of these problems. The study was conducted with three physics teachers working at three different Anatolian high schools, and the research problem – "What are the views of physics teachers on the teaching of energy?" – as well as the subproblems given below were described in detail by using a qualitative case study pattern:

1. What are teachers' views on what takes place before, during, and after the teaching of energy?
2. What are physics teachers' views on the new physics program, which includes the topic of energy?
3. What are teachers' views on constructivist learning theory and its appropriateness for teaching energy?

Method

Research Design

This research was designed as a case study, which is one of the qualitative research methods. Conducted in accordance with the structure of case studies, the researchers investigated study problems without any prejudice and by finding answers to the questions of how and why (Yin, 2009).

Research Sample

After the research problems were taken into consideration, the research was conducted as a descriptive case study because the aim was to describe the case thoroughly with the interviews (Mcmillan, 2004). In the study, a holistic multiple-case pattern was used in order to evaluate the multiple cases in themselves and to make comparisons among them. To this end, three physics teachers working at different Anatolian high schools and teaching the energy topic, which is part of the 9th-grade curriculum, were in the study group of this research. Moreover, in determining samples in the research, a criterion sampling method was used (Yildirim & Simsek, 2013). As the research focuses on a comparison between the teaching of energy in the previous program and the teaching of energy in the current program, physics teachers were selected based on the criterion that they had taught 9th-grade for at least two years.

Research Instrument and Procedure

In the study, semi-constructed interviews, conducted at the beginning and the end of the application, were used as a data gathering tool. In order to support the obtained data, the researcher kept a diary while being present with the teacher in class as an observer. For the data gathering tool, which was designed in accordance with the research problem, three physics, five physics education, and one education sciences experts were consulted. Moreover, in order to test the reliability of the data gathering tool, a pilot study was conducted. Observation was done in the natural environment in which the study was conducted and under the conditions of that particular environment. With the observations in class, more detailed and rich data were collected (Burgess, 1984; Creswell, 2013).

Validity and Reliability

As a result of the analyses, which were conducted by two different experts separately during two different time spans, 85% consensus was achieved. Thus, reliability of the findings was obtained, and in order to support the obtained data, direct quotations were given in the study (Hitchcock & Hughes, 1995; Yin, 2009;).

Data Analysis

Semi-constructed interviews were conducted within the scope of the research and were recorded using a voice recorder. During the interviews, teachers were not swayed one way or another, and they were given the chance to express their views without any limits. Then, these interviews were transferred to electronic files formed for each one of them separately. Data were analyzed using a descriptive analysis method, and the obtained data were summarized under certain themes in accordance with the proper answers given to research questions. Additionally, research diaries were placed according to determined themes (Yin, 2009).

Findings

As a result of the data gathered through semi-constructed interviews, which were analyzed within the scope of the study via descriptive analysis, detailed data on teachers' views were obtained and are stated as follows:

Before the application, participating physics teachers were asked during the semi-constructed interviews, "What are your general views about the new physics program? What are the positive and negative qualities that you would like to mention in relation specifically to the new 9th-grade physics program?" Two of the participating teachers indicated that the new physics program does not limit teachers during the teaching process; that there is a discrepancy between the course book and the program; that the class hours allocated to physics, especially in 9th grade, are insufficient; and that the learning outcomes in the 9th grade have been simplified. These teachers felt that the objectives should have been made more difficult instead. One of the teachers stated that he/she chooses to disregard this program as no one bothered to ask for the teachers' opinions during the preparation process and that he/she keeps teaching students in the way he/she deems appropriate. All of the teachers expressed that they like the content, context, and applicability of the energy topic, the order of the topics, the applications within the topic, and its relationship to other topics. One teacher indicated that he/she likes it more now that energy as a topic is not taught in a spiral way since that causes distraction. After the application, we determined that the teachers think that students get only theoretical outcomes and have problems with the application of these learning outcomes due to ineffective lab conditions, insufficient class hours, and inappropriate materials in the labs. Moreover, the teachers stated that they like the fact that the topic of energy in the new program is based less on questions with mathematical operations, but rather it can be taught with interpretation-based questions and examples drawn from daily life. With the new approaches, students can comprehend the topic better. The teachers also underlined the fact that students' interest in the topic has increased compared to previous years.

Another question asked the teachers was, "What do you think a constructivist approach denotes? What are your views on constructivist education?" Two of the teachers indicated that they think constructivist education can be realized by drawing parallels between daily life and topics, by lessons based on observation, and by providing students with the ability to make conceptual comments. One teacher noted that he/she does not know anything about the constructivist learning approach and spoke as follows: "I don't know what the constructivist learning approach is. We have not been really taught about these approaches. When I was a student, I learned what the constructivist learning approach is theoretically, but in time I forgot what it is since I haven't applied it." The interview conducted with one of the other teachers is given below (R: Researcher, T: Teacher)

R: What do you think the constructivist approach denotes?

T2: The constructivist approach is a theory that supports the formation of a connection between physics topics and daily life.

R: So, does the constructivist approach mean merely making connections between daily life and the topics?

T2: No, I can say that it also includes observation.

R: How do you think the effect of using constructivist education in physics education is different from that of using it in other disciplines?

T2: There is more prejudice against physics classes compared to all other courses. I believe that constructivist education will eliminate students' conviction that "physics is hard."

R: Do you think constructivist education has been applied to physics courses.

T2: I don't think it has been fully applied.

R: Why do you think this is the case?

T2: Because our university entrance exam system requires an education that is completely different from constructivist education. Students demand that we solve mathematics-based questions related to the topic in class. Likewise, because all students can think about is the university entrance exam, we plan our lessons accordingly.

On this same topic, physics teachers were asked, "Do you think teaching in accordance with constructivist education can be done in the unit about energy?" Before the application, two of the teachers indicated that the unit on energy could be taught in accordance with a constructivist approach, while one teacher said that it cannot be done. Those who said that the unit on energy can be taught in accordance with a constructivist approach expressed that they could draw parallels with and give examples from daily life, and thus the energy types and energy sources can be taught more effectively. The teacher who claimed that the unit on energy cannot be taught in accordance with a constructivist approach argued that laboratories cannot be used during the learning process and that there is a discrepancy between the curriculum and the university entrance exam. Teachers also expressed that there are mathematics-based questions on the university entrance exam even though the program urges the teachers not to delve into mathematical operations while teaching the energy topic. Thus, the teachers revealed that students are not interested in conceptual learning since they would like to focus on the university entrance exam. After the interviews, we determined that although all the teachers think that the energy topic can be approached using constructivist methods, only one indicated that a constructivist approach could be applied properly, and two of them said it could not. The interviews underlined that this problem could be overcome by increasing class hours, by drawing parallels between energy and daily life, by

conducting experiments, by using animations and simulations, and by arranging field trips. Notes about the courses from the researcher's diary are as follows:

The teacher solved a university entrance exam-oriented problem. Moreover, the teacher tried to give examples from daily life while teaching about energy. Videos and simulations were used, but laboratories were not used in this process by any of the teachers.

Another question asked the physics teachers who participated in this study was, "What was the process of teaching energy like in your classes in previous years?" All the teachers expressed that the process of teaching the energy topic has improved by making use of lecturing, question-and-answer techniques, and a problem-solving approach (Table 1).

Table 1.

Approaches, Methods, and Strategies Employed by Teachers

Teachers' Answers	**Number of Teachers (f)**	**Percentage of Teachers (%)**
Lecturing method	3	100
Question and Answer Technique	2	66,66
Problem-solving method	2	66,66
Demonstration technique	2	66,66
Discussion method	1	33,33

We determined that the reason why teachers prefer especially the methods, techniques, and strategies stated in the table is that they do not want to break their habitual teaching style. The researcher put the following expressions into her diary:

Teachers usually teach using the lecturing method. Moreover, they enable students to participate in class discussion by posing questions and responding to answers. Then, they prefer solving problems on the board so as to reiterate the topic.

When the teachers were asked, "Is there a difference between the learning process in the unit on energy and the learning process in other units, and if the answer is yes, what are these differences?" they stated that there is no difference in the learning processes, and one teacher expressed that "The only new thing about the energy topic in the new physics teaching program is the exclusion of heat and temperature." After the application, two teachers indicated that the teaching process with energy was more effective compared to the teaching process in other units, and one said it was not. Those who indicated that the teaching process with energy was effective stated that their teaching was suitable for the students' level, that they raised students' awareness about energy, and that they were now able to relate energy with daily life. Moreover, teachers also indicated that outcomes on energy sources and energy conservation could be added in order for students to gain more awareness. In addition to these insights, we learned that the teacher who indicated that the

teaching process with the energy topic is not effective thought so because the teachers are not able to take students on field trips or to museums due to insufficient class hours.

Another question asked of the participating physics teachers is, "What are the points in the energy unit that students have found difficult to comprehend conceptually in previous years?" All the teachers expressed that in previous years students found it difficult to comprehend the concepts of labor and energy transformations and problems in which kinetic and potential energy transformations are found together. Moreover, they said that in previous years they made use of smart boards, chalk, pencils, and books when teaching energy and that this was also true for other topics. That is why they said, "I do not do anything special when teaching the energy topic." We determined from teachers' sentences such as "I enable my students to visualize things" that teachers aim to help students concretize concepts. After the application, teachers indicated that they made use of simulations, class tools, photocopied booklets, and projects in teaching energy and that these things were effective in increasing students' motivation.

The physics teachers were asked, "How did you determine the methods, techniques, and strategies that you used?" One of the teachers said that he/she determined them by taking into consideration how he/she could teach the energy topic better, and one teacher said that he/she focused on a visual-aid-based teaching method that required fewer sentences. Another teacher said that he/she took personal notes while referring to secondary sources and that he/she determined the appropriate method, technique, or strategy based on these notes. However, in addition to these methods, techniques, and strategies, teachers indicated that they could teach more effectively by using a demonstration method, a simulation, individual study, a problem solving method in which interpretation-based questions are asked, or a simulation-based demonstration technique.

Discussion and Conclusion

Discussion

Throughout the course of the study, when the teachers compared the energy topic in the old 9th-grade program with that in the new program, they felt that there were no huge differences between the programs. In previous years, energy was taught through mathematics-based questions, and in the revised program, it is accomplished through questions that are based on interpretations and examples from daily life (Benzer, Bayrak, Eren, & Gurdal, 2014). We determined that the teachers mostly emphasized the discrepancy between the course book and the program, especially that the book has many examples that include mathematical operations. The new program does not dwell on mathematical operations. The results show similarities to Bayrak and Bezen's (2013) study. Moreover, the fact that there is no limitation for teachers in teaching energy was listed as a negative quality in the study. In a study by Yigit (2013), it was suggested that having no limitations within

the teaching-learning processes provides teachers a certain comfort; however, instruction that takes place without commitment to one approach could create differences and thus problems. The study also revealed that teachers think that class hours should be increased, that transition between learning levels could be difficult for students as learning outcomes are very much simplified at the 9th-grade level, and teachers' views should have been taken into consideration during the preparation process of the program (Mercan, 2013). The teachers felt that programs designed by taking their views and suggestions into consideration would be more effective since they would be considering class hours, teaching environment, and student performance levels (Karacaoglu & Acar, 2010). The teachers then determined that insufficient class hours was a problem in the previous program and still is in the new program (Kutluca & Aydin, 2010). Yigit (2004) states that insufficient class hours is one of the most significant reasons that teachers are unable to use a constructivist learning approach in their instruction. Our study underlined that if teachers could run their classes according to a constructivist learning approach, students might rid themselves of the belief that "physics is hard." According to Hancer (2006), prejudices can be eliminated because in a constructivist learning approach the focus is on the students and their knowledge construction, and this approach gives students the opportunity to construct new knowledge. Another insight obtained from our study came from the teacher who indicated that he/she has no knowledge of what a constructivist approach is (Gomleksiz 2007). Accordingly, teachers think that such lack of knowledge can be overcome through in-service training. Yapici and Leblebiciler (2007 determined that in-service trainings on the constructivist learning method are insufficient. Thus, we believe that such in-service trainings should be supported with theoretical information and effective examples for application.

The literature supports the results of this study. It shows that including examples from daily life, using video and simulations, doing experiments in labs, increasing the use of materials and the Internet, organizing field trips, and redesigning the university entrance exam so that it becomes compatible with the program would make more effective instruction possible (Brna & Burton, 1997). This is because energy as a concept is a magnitude that can be felt as sound, light, heat when moving, heating, and getting enlightened. Additionally, there are various types of energy, such as mechanical, electric, and nuclear energy. However, the study revealed that teachers are not able to achieve meaningful instruction because there is a discrepancy between the university entrance exam and the program. The physics teachers' views on this discrepancy show similarities with the results of various other studies (Kutluca & Aydin, 2010). The results of other studies also show the necessity for making the university entrance exam compatible with the program (Nartgun et al., 2011; Tuysuz & Aydin, 2009). Next, we determined that teachers are limited in the methods, techniques, strategies, and materials they use when teaching energy. In the study, the teachers expressed the desire to enrich the teaching process by using different methods, techniques, strategies, and materials (Madanoglu, 2015). Clearly, teachers should be open to continuous growth and improvement and use appropriate and different approaches so that the teaching process becomes richer and learning increases (Liarakou, Gavrilakis, & Flouri, 2009).

Conclusion

In our study, we reached the conclusions that teachers are not limited during the teaching process in the new program; there are discrepancies between the course book and the program; the class hours are insufficient, especially in the 9th grade; objectives for the 9th grade have been simplified when they should have been made more difficult; teachers have not been consulted during the preparation process of the program; and generally teachers teach by following what they already know. We determined that these are all reasons why teachers do not use a constructivist learning approach. When we asked the teachers why they keep employing the same methods, techniques, and strategies even though they desire to teach energy better through visual-aid based instruction, we found that teachers prefer not breaking their old habits of teaching and want to prepare students for the university entrance exam. On the other hand, teachers realize that a constructivist learning approach is suitable for teaching energy because, through this approach, energy can be related to daily life, experiments can be conducted, simulations/animations can be used, and field trips can be organized. However, we found that even though the teachers see the advantages of this approach, they are unsuccessful at teaching energy within the frame of the new program. Therefore, the study shows through the teachers' responses that students are hindered in their conceptual comprehension of energy and are not able to improve in their learning (Krueger, 1990; Papadouris, Constantinou, & Kyratsi, 2008).From the study, we learned that teachers make use of smart boards, chalk, pencils, class tools, photocopied booklets, projects, and books. However, we also learned that this equipment and these materials, though used to concretize the concepts, do not change the teachers' traditional approaches. In light of this study, we therefore suggest that teachers increase their use of materials that appeal to all five senses and consider the individual differences of the students (Kurnaz & Arslan, 2014).

Recommendations

According to the results of the study, we feel that defining and evaluating the teaching of energy as a topic would be helpful to the field. Using a case study pattern, we determined three teachers' views on the teaching of energy, on the new physics program in which energy is a topic, on the constructivist learning theory, and on the appropriateness of this theory in teaching the energy topic . We believe that studies done with different analysis methods would achieve more detailed results. Moreover, when the insufficient class hours are taken into consideration, program designers should find that reformulating objectives by consulting teachers would contribute to the field. Lastly, we suggest that studies focus on simulation, animation, field trips, and other activities that would make it possible for teachers to relate the topic to daily life. Researchers should also emphasize laboratory activities that would help students improve their scientific process skills and help them construct concepts and acquire problem-solving skills.

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Fizik Öğretmenlerinin Enerji Konusunun Öğretimine Yönelik Görüşleri

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Özet

Problem Durumu: Günlük hayatla bağlantılı olan enerji kavramı, ısı, ışık, elektrik, kimyasal, kinetik, potansiyel, petrol, ses ve nükleer enerji şeklinde bulunabilmektedir ve bu enerji formları birbirlerine dönüştürülebilmektedir. Son yıllarda nüfusun ve sanayileşmenin hızla artması ile birlikte bireylerin günlük hayatta sürekli dile getirdikleri enerji kavramının kullanımı da artmıştır. Bu ifadelerden yola çıkıldığında yaşamımızda çok önemli bir yere sahip olan "Enerji" konusunun öğretiminin gün geçtikçe önem kazandığı görülmektedir. Genellikle öğrenciler tarafından zor ve anlaşılmaz olarak tanımlanan enerji konusunun, özellikle soyut kavramlar içermesinden kaynaklı tam olarak anlamlandırılamadığı belirtilmektedir. Enerji konusu üzerine yapılan çalışmalarda öğrencilerin enerji kavramına, korunumuna, dönüşümüne, iletimine ve kaynaklarına yönelik kavram yanılgılarına sahip oldukları belirlenmiştir. Öğrencilerin zihinlerinde yapılandırmakta zorluk çektikleri enerji kavramının öğretimi ortaöğretimde, fizik öğretim programı içerisinde karşımıza çıkmaktadır. Öğrencilere öğretim boyunca kazandırılması amaçlanan belirli tutum, değer, beceri ve bilgi öğretim programı aracılığıyla gerçekleştirilebilmektedir. Ayrıca öğretim programlarının günümüzün koşullarına uygun olarak sürekli güncellenmesi gerektiği düşünülmektedir. Bu kapsamda ülkemizde de fizik öğretim programı 2013

yılında güncellenmiştir ve 2013-2014 öğretim yılından itibaren dokuzuncu sınıflardan başlanılacak şekilde uygulaması gerçekleştirilmektedir. Güncellenen fizik öğretim programında, öğrencilerin eğitim sürecinde aktif olacağı, bilgiyi keşfedeceği ve öğrendiklerini yaşam ile bağdaştırabileceği bir öğretim amaçlanmıştır. Bu süreçte öğrencilerin yönlendirilmesi, gözlemlenmesi, aralarında iletişimin sağlanması ve bilimsel gerçeklere ters düşen yanlış bilgiler olarak tanımlanan kavram yanılgılarının önlenmesi açısından öğretmenlere önemli görevler düşmektedir. Ancak ülkemizdeki öğretmenlerin konunun öğretiminde ilk başta teorik bilgi vermeyi, daha sonra soru cevap tekniği ile anlaşılamayan yerler üzerinde durmayı ve en sonda konuyu pekiştirmek açısından problem çözme yöntemini tercih ettikleri görülmektedir. Tercih edilen bu öğretim yöntemlerinden kaynaklı öğrenciler derste pasif bir rol almaktadırlar. Öğrenciler derslerde daha aktif duruma gelebilmeleri için öğretmenlerin, öğrenci merkezli öğretim yöntem, teknik ve stratejileri kullanmaları gerekmektedir. Enerji konusunun da kompleks ve soyut birçok kavram içermesinden kaynaklı öğrenim sürecinde öğrencilerin konuyu anlamlandırmalarında sorunlar yaşadıkları bilinmektedir. Bu nedenle araştırmada ele alınan yeni fizik öğretim programındaki enerji konusunun öğretiminin, öğretmenler tarafından nasıl gerçekleştirilmesi gerektiği ve nasıl gerçekleştirdiklerine yönelik düşüncelerinin araştırılmasının alana katkısı olacağına inanılmaktadır.

Araştırmanın Amacı: Araştırmanın amacı enerji konusunun öğretimine, enerji konusunun öğretiminin içerisinde yer aldığı yeni fizik öğretim programına, yapılandırmacı öğrenme kuramına ve enerji konusunun bu kurama uygunluğuna ilişkin öğretmen görüşlerinin belirlenmesidir.

Araştırmanın Yöntemi: Araştırma nitel araştırma yöntemleri arasında yer alan durum çalışması şekilde ele alınmıştır. Araştırma problemleri göz önüne alındığında öğretmenlerle gerçekleştirilen görüşmeler ile durumun ayrıntılı bir şekilde betimlenmesi hedeflendiğinden, araştırma betimsel durum çalışması olarak desenlenmiştir. Aynı zamanda araştırmada birden fazla durumun kendi başına değerlendirilmesi ve aralarında karşılaştırmaların yapılabilmesi amaçlandığından bütüncül çoklu durum deseninden yararlanılmıştır. Bu kapsamda araştırmanın çalışma grubunda üç farklı Anadolu Lisesi'nde dokuzuncu sınıf fizik öğretim programı içerisinde yer alan enerji konusunun öğretimini gerçekleştiren üç fizik öğretmeni yer almaktadır. Araştırmada örneklem belirlenirken amaçlı örnekleme yöntemleri arasında yer alan ölçüt örnekleme yönteminden yararlanılmıştır. Araştırmada, önceki programda yer alan enerji konusunun öğretimi ile yeni fizik öğretim programında yer alan enerji konusunun öğretimi arasında karşılaştırmalar yapılacağından, fizik öğretmenlerinin Anadolu liselerinde en az iki yıl süre ile dokuzuncu sınıfların öğretimini gerçekleştirmiş olmaları ölçüt olarak belirlenmiştir. Araştırmada veri toplama aracı olarak, yarı yapılandırılmış görüşmelerden yararlanılmıştır. Elde edilen verileri desteklemek amaçlı da süreç içerisinde öğretmenlerle sınıf ortamında belirli bir süre bulunularak katılımcı gözleme dayalı araştırmacı günlüğü tutulmuştur. Veri toplama aracı araştırmacı tarafından geliştirilmiştir ve araştırmanın problemini kapsayacak bir şekilde olup olmadığına yönelik uzman görüşleri alınmıştır. Ayrıca veri toplama aracının geçerliliğini test edebilmek amacıyla bir fizik öğretmeni ile pilot çalışma yapılmıştır. Araştırma kapsamında gerçekleştirilen yarı yapılandırılmış görüşmeler, ses kayıt cihazı ile

kayda alınmıştır. Daha sonra öğretmenlerle yapılan görüşmeler, elektronik ortamda her birine ayrı ayrı oluşturulan dosyalara aktarılmıştır. Ayrıca gözleme dayalı olarak araştırma süreci içerisinde sürekli tutulan araştırma günlükleri ile de, araştırmacının düşünceleri, gözlemleri, yorumları, açıklamaları ve tepkileri elde edilmiştir. Betimsel analiz yöntemi ile verilerin çözümlenmesi sağlanarakta, elde edilen veriler araştırma sorularına uygun verilen yanıtlar çerçevesinde temalar altında özetlenmiştir.

Araştırmanın Bulguları: Uygulama öncesinde öğretmenlerin yeni fizik öğretim programının öğretiminde öğretmenlere kısıtlamaların getirilmediğini, kitap ile öğretim programı arasında uyumsuzluk olduğunu, 9. sınıf kazanımların basitleştirildiğini, kavramsallaştırıldığını, eski ve yeni programdaki enerji konuları arasında çok büyük değişikliklerin olmadığını düşündükleri ortaya çıkmıştır. Öğretmenlerin ayrıca laboratuvarların ders saati yetersizliği sorunundan kaynaklı kullanılamadığından enerji konusunun yapılandırmacı yaklaşıma uygun hazırlanmadığını, enerji konusunun ve diğer konuların önceki yıllardaki öğrenme süreci arasında fark olmadığını ve genel olarak konuların öğrenme sürecinde anlatma yönteminden, soru-cevap tekniğinden ve problem çözme yönteminden yararlanıldığını ve enerji konusu ile diğer konularda kullandıkları ders araç-gereç ve materyaller arasında farklılık olmadığını düşündükleri belirlenmiştir. Uygulama sonrası öğretmenlerle gerçekleştirilen yarı yapılandırılmış görüşmeler sonucunda ise, enerji konusunun öğretiminde zaman yetersizliğinden dolayı laboratuvarların kullanılamamasından ve öğretmenlerin bilgilerinin eksik olmasından kaynaklı enerji konusunun öğretiminin yapılandırmacı yaklaşıma uygun olarak yapılamadığı ancak enerji konusunun yapılandırmacı yaklaşıma uygulanabilir olduğu ve öğretim sırasında öğretmen, öğrenci ve ortam açısından sorunlarla karşılaşıldığı belirlenmiştir.

Araştırmanın Sonuçları ve Önerileri: Enerji konusunun öğrenimi ile öğrencilerin enerji konusunda bilinçlenerek günlük hayatla konuyu bağdaştırabildikleri tespit edilmiştir. Aynı zamanda enerji konusunun öğretiminde günlük hayattan örneklere, video gösterimlerine ve simülasyonlara yer verilmesi, laboratuvarlarda deney yaptırılması, geziler düzenlenmesi ve üniversiteye giriş sınavının öğretim programına uygun hale getirilmesi ile öğrencilere daha etkili öğrenim sağlanabileceği ortaya çıkmıştır. Bunların yanı sıra araştırmada tespit edilen ders saati yetersizliği sorunu düşünüldüğünde, öğretim programı içerisinde yer alan kazanımların öğretmen görüşleri ile tekrar düzenlemesinin alana katkı sağlayacağına inanılmaktadır. Son olarak, enerji konusu içerisinde öğrencilerin kavramları yapılandırmalarına, problem çözme becerisi kazanmalarına, işbirliği içinde çalışmalarına, bilimsel süreç becerilerinin gelişmesini yardımcı olacak etkinliklere yer verilmesi gerektiği önerilebilir.

Anahtar Sözcükler: Enerji, fizik eğitimi, fizik öğretim programı, öğretmen görüşleri.