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A Study on Primary School Students' Understandings of Energy Concepts

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Abstract
The aim of this study was to investigate how understand secondary school students relationship between energy, sources of energy, form of energy and how change these conceptions in time at science and technology programmed. For this aim, a questionnaire composed of four open ended question was applied to 60 students. The data obtained from students responses, we identified that students have some problem to constructing the conceptions in your mind related to energy, sources of energy, form of energy and transfer of energy.
This study carried out secondary school students from six to eight classes with 60 students that ages ranged from 11 to 14. Data obtained from students' responses to the questionnaire showed that secondary school students didn't understand correctly related to energy concepts.
The survey results showed that the students have some problems related to meaning of energy concept, energy transformation and different form of energy.

1. Introduction
A huge part of the studies related to the physics education going on for the last twenty years have focused on the term "energy" [1-4]. It has been mentioned that students have problems on understanding the definition of energy. Especially the students who are under secondary school education have troubles on understanding the terms such as preservation and circulation of energy and energy sources [5,6]. Similarly, it has also been mentioned that students have neglected the term energy, can not fully understand the difference between heat and temperature, have no idea on the difference between work and energy and comprehend all these terms as energy [6].

1.1 The concept of Energy
One of the basic and critical concepts of science lesson is the "energy" unit. Comparing with the other concepts, Energy is an abstract term which necessitate high level of thinking [7,8]. As a science lesson subject, energy is inserted into the programme from 4th grade and so on. Within the context, "electricity is a kind of energy" is the starting point in the education programme of 4th grade. In 5th grade, energy is correlated with sun, heat and burning energy. In 8th grade, production, transportation and distribution of electricity energy take place in objectives of the unit.
Although there are various kinds of energy studies in literature, there is limited study and source in our country [9-16]. Especially, we have encountered terms related to energy such as energy source, energy form and transferring of energy in interdisciplinary contexts. Revealing the relation between these terms and energy would make a better framework of energy concept and make the relationship between other terms clear. This is crucial for a term taking place in education programme and an important element for interdisciplinary studies. Besides, getting information on understanding of the terms such as energy and related to the energy could be helpful for the education specialist on determining education methods and techniques leading misunderstandings on the terms. The purpose of the study is researching the understanding level of energy by secondary school students.

2.Method

In the study, document analysis has been implemented as a quantitative method , analyzed all the answers given by the students one by one in order to find out all students opinions on subject.

2.1. Subjects of the study

This study carried out secondary school students from six to eight classes with 60 students that ages ranged from 11 to 14 at 2010-2011 semesters.

2.2. Data collection tool

In this study, a questionnaire was used include four questions [17]. The first question in the survey is related to the concept of energy. We asked to students first comes to your mind when you hear the word energy. Students' responses to this question are strength, power, motion, light, electricity, sun. The second question in the survey, When Wind Energy, Solar Energy, Geothermal Energy is added to the left side of word energy concepts, how change your idea related to energy concept? Students the answers to these questions would be yes and no. In the third question, we asked to students Can you draw a picture of the concept of energy that occurs in your mind?. In general, the answers to questions students draw a picture of the sun and the walking man. The last question in the survey, as seen when the switch is closed in a simple electric circuit, what kind of energy transformation occurs 1, 2, 3, and 4 section of circuits? In general, students believe that energy is converted into heat and movement.

2.3 Data Analyze

In analyzing process of data, context analysis method has been used students' answers have all been transferred to computer data base. Students' answers have been categorized in one of the categories or sub-categories determined by one of the researchers according to the common answers and ideas produced by the students in this study. Then, frequencies and percentages have been calculated. Charts and tables have been formed for each category. Obtained data, separated on sub and main topic, have been backed with direct quotes of students .These quotes are characterized in italic in the paper. Findings have been explained, associated and commented by the researchers. Total property in tables are more than students' numbers as students one by one have defined more than one property.

3. Findings

3.1. Energy Concept

Students' answers to the question "what is the first thing that come to your mind when you hear the term Energy?" have been given below.

According to the answers, 30% of 6th and 7th grade students and 15% of 8th grade students replied as electricity. 25% of 6th and 7th grade students and 10% of the 8th grade students replied as Sun. 8th grade students all answered the question but the percentages of replies such as power, force, sun, electricity, light, movement are close to each other. According to the data, especially students in 8th grade have no exact definition on energy.

3.2 Kinds of energy

"when you add another word at the left side of energy term such as (..... energy), wind energy, solar energy, geothermal energy, are there any chances that clear in your mind?" explain why? 16,2 % of the students answered it with yes while 7,2% of them answered with no.

Answers given by the students are given below.

" Yes, there is, because they are totally different energy types. (6th grade student)

" Yes, there is, because words that we use in the left side of the term determine the energy types. (7th grade student)

No, there isn't. Because, they are all the same energy types. (8th grade student)

When we add another word at the left side of the term, many of the students mind have been lightened with "renewable energy" . The percentages are as 25% in 6th and 7th grade, 10% in 8th grade. However, the explanations made by the students for defining renewable energy differ from each other. Students' opinions are as follows.

" the definitions of wind energy differs from solar energy, ın other words they haven't got the same definition. (6th grade student)

" heat energy can be converted into a different energy, each is different . (7th grade student)

In addition, 7,2% of the students answered the question with no and they mentioned that there would not be any changes in their minds when another Word would be added at the left part of the term. Some of the opinions are as follows:

"all can be called as energy." (6th grade student)

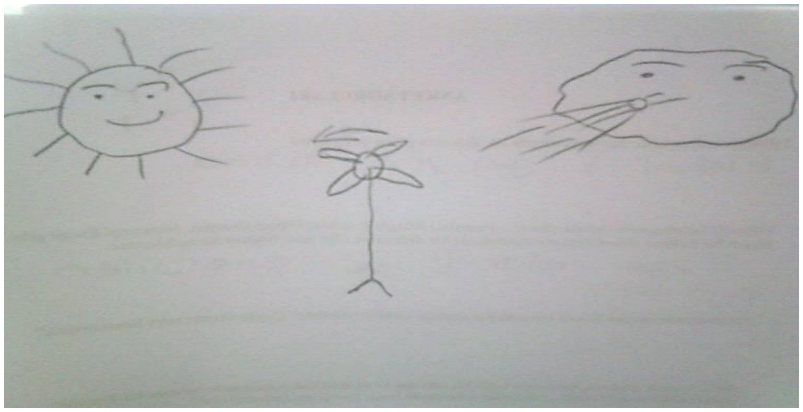
"all are energy" (7th grade student)

"all are in the same concept" (8th grade)

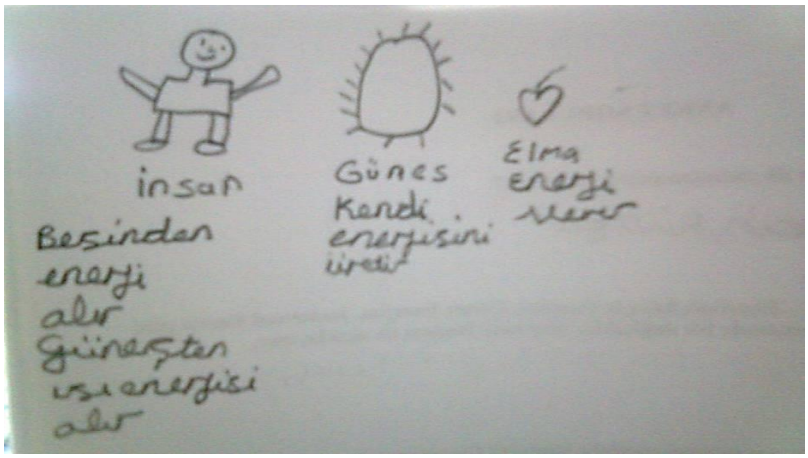
3.3. Picture of Energy

Students' answers to the question "Can you draw a picture of energy concept that occurs in your mind? Or if not, do you have any idea what it looks like?" are as follows.

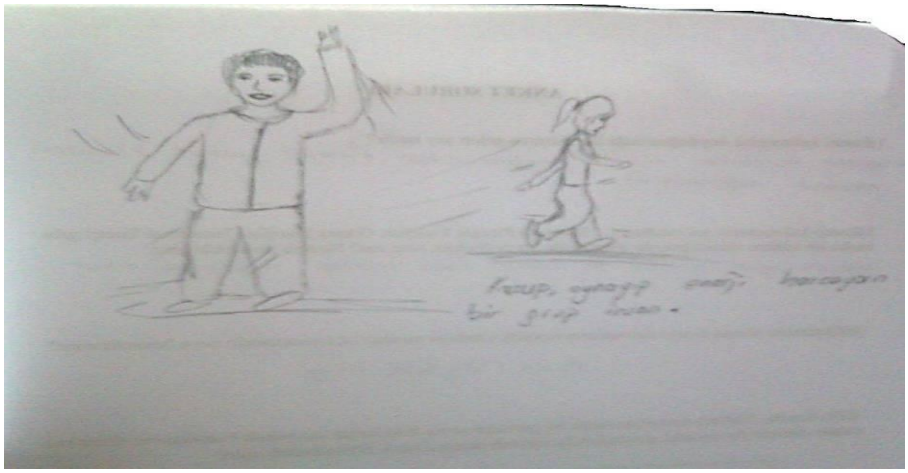
75% of 6th grade, 65%of 7th grade and 60% of 8th grade students have drawn the picture. Others have chosen to mention what it looked like. 25% of students who have drawn the picture have drawn sun, house and cloud. (picture 1 and 2) the percentage has dropped slightly in 8th grade and the number of the students who drew electricity circuit, have raised. 5% of 6th grade students mentioned that energy concept looked like movement and electricity, electricity, light and movement in 7th grade student and electricity has been more used among 8th grade students. Pictures drawn by students as a reply for the question are as follows:



Picture 1: students' designs examples (a drawing of 6th grade student: a drawing of sun and wind)



Picture2: students' designs examples (a drawing of 6th grade student: a drawing of sun, food and heat)



Picture3: students' designs examples (a drawing of 6th grade student: a drawing of movement)
Students who could not draw a picture but mentioned what it looked like especially used the sources such as movement and electricity. There are also students who used heat as an example.

4.4. Energy Transitions

Related to the energy cycle, *" which energy transitions can occur in 1st,2nd and 3rd parts of a simple electricity circuit when key is closed and current flows?* has been asked to the students . That simple electricity circuit is formed by four main parts. In the 1st part, a battery has been used, in the 2nd part there is a light bulb, in the 3rd part a propeller motor and in the 4th part, a bowl of water containing resistance has been used. Students' answers are as follows to the questions about the materials in all parts.

1st Part

Answers to the question *" Which energy transitions can occur in the 1st part of a simple electricity circuit when key is closed and current flows?* are as follows

When the current flows in the 1st part in the circuit, chemical energy turns into electrical energy. Students have answered it in different ways according to their education levels. 40% of 8th grade students have given correct answers to the transition. This percentage has dropped in 20% in 7th grade and 15% in 6th grade students' replies. Lastly, more than half of the students haven't given correct answer to the question.

In the 2nd part of the circuit, electrical energy turns into light energy. Most of the students answered the question,(35,7% of 6th grade, 30%of 7th grade,35% of 8th grade) have told that electrical energy turned into light energy. 50% of 8th grade students have mentioned that it turns into electrical energy directly.

3rd part

Answers to the question *" Which energy transitions can occur in the 3rd part of a simple electricity circuit when key is closed and current flows?*are as follows:

When the current flows through the circuit , electricity energy turns into movement energy with starting the engine. More than half of the students analysed this in a correct way, hovewer there are a number of student who could not give an answer. Also, there are students who have thought the question in a different perspective and mentioned that the propeller has started with the wind energy.

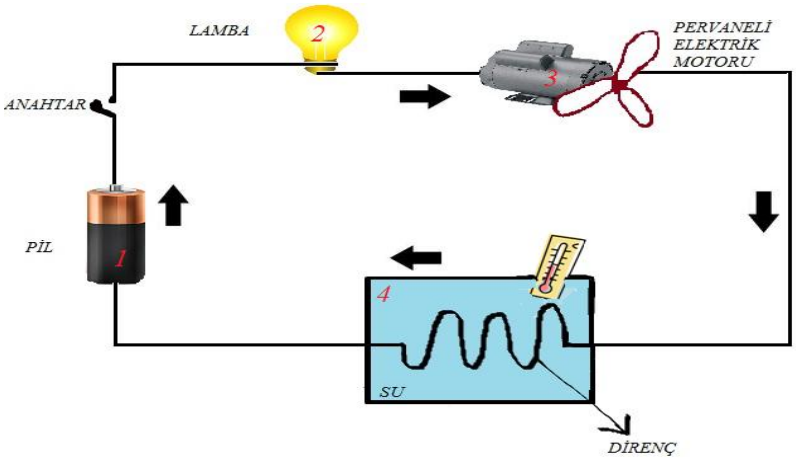
4rd part

Answers to the question *" Which energy transitions can occur in the 4th part of a simple electricity circuit when key is closed and current flows?* are as follows:

Electricity energy turns into heat energy in the 4th part of the electricity circuit. Generally, this part is the most widely known by the students. 55% of 8th grade, 50%of 7th grade and 30% of 6th grade students answered the question correctly.

4. Conclusion

Research outcomes have shown that students do not know the term energy fully and complete the term in alternative concepts in their minds. So, we ca say that in secondary level education, there are mistakes and missing information while teaching the "energy" concept.



Yürümezoğlu ve arkadaşları [17].

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