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A Course on 'Conversion of Electrical Energy' Developed With REACT Strategy[1]

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Abstract

The context-based learning approach is an innovative strategy that places real-life contexts at the center of education. An important strategy developed within this approach is the REACT strategy. This study aims to create an activity plan based on the context-based approach, especially following the REACT strategy, for the topic 'Transformation of Electrical Energy' in the 8th grade 'Electric Charges and Electric Energy/Physical Phenomena' unit in the Turkish National Education curriculum. Additionally, students' opinions regarding the implementation were taken. The qualitative research method was adopted in the study. Firstly, the learning objectives related to this topic were determined. Taking into account the learning outcomes of the topic of electrical energy transformations, an activity plan was created that meets the purpose of each stage of the REACT strategy and allows students to learn with real life contexts. Feedback was received from two middle school science teachers and a physics education academician regarding the suitability of the prepared activity plan for the REACT strategy and 8th grade science. The initial plan was refined based on their input addressing issues such as incomplete implementation of collaboration, mismatch between context topics and subject matter, limited student assessment, and suggested time adjustments. The final activity plan was shaped according to these suggestions. The completed lesson plan was piloted and feedback was received from the students. The students gave feedback that the lessons given using the REACT strategy were motivating due to their relevance to daily life, that they were fun, and that they were different from other lessons because they included activities and more group work.

Keywords: *Conversion of electrical energy, lesson plan, REACT*

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Introduction

In the 2018 Education Program of the Turkish Ministry of National Education (MoE), in science education, the goal is to cultivate individuals who can understand and explore the relationship between nature, humans, and the environment by using scientific process skills (MoE, 2018). In this context, it is crucial for individuals to know that there are scientific explanations for the events and phenomena that occur in their daily lives. Many natural events encountered in daily life can be explained with science. However, everyday events are not adequately addressed from a scientific perspective in school science classes. This can lead to individuals to be unable to explain such events scientifically and to make sense of the situation (E. Ültay et al., 2018; N. Ültay et al., 2015). Some science concepts that can be encountered in every aspect of life may either remain completely misunderstood by individuals or lead to conceptual misconceptions due to individuals' existing mental schemata (Dagher & BouJaoude, 1997; Gülçiçek & Yağbasan, 2004; Lawson & Thompson, 1988; Yürük & Çakır, 2000). The failure to establish sufficient connections between everyday phenomena and scientific explanations in science education in Turkey can be seen as a cause of these conceptual misconceptions (Yaman et al., 2004). In order to eliminate these misunderstandings of individuals in daily life, it can be easier to make mental sense of events and facts when they are associated with daily life (Bennett & Lubben, 2006). Among the instructional theories that can provide this connection in teaching and learning, context-based learning theory, also known as life-based or contextual learning theory, stands out (Ayvacı et al., 2016). When it is considered that any knowledge related to life can help individuals better structure their event and schema models, it can be seen that the fundamental teaching philosophy to be adopted in science education is based on context-based applications. The most common models of context-based learning theory are; the REACT (Relating, Experiencing, Applying, Cooperating, Transferring) strategy, the ARCS (Attention, Relevance, Confidence, Satisfactio) model and FEACA (Focusing, Exploring, Analyzing, Conceptual Developing, Applying). (Tatlı & Bilir, 2019; Wieringa et al., 2011).

In Turkey, the REACT strategy has surged in popularity, particularly in context-based lesson plans within the disciplines of physics and chemistry, alongside educational programs crafted around this pedagogical theory. The REACT strategy is structured around sequential steps, each named after the initials of the English descriptors that underpin the model. These steps encompass “Relating”, “Experiencing”, “Applying” “Cooperating” and “Transferring” (Baydere Karslı & Kır, 2021; Crawford & Witte, 1999; Demircioğlu et al., 2012).

REACT Strategy

At the Relating stage of the REACT strategy, it can be organized by considering the topic of the lesson, the readiness of the students, and their experiences, preferably using a story, video, or cartoon. The stronger the chosen association is in this stage, the higher the interest in the lesson and the success in learning will be, making the comprehension of the subject easier (Coştu, 2009). A review of the literature reveals that teachers in the Relating stage have developed learning by taking into account students' existing knowledge and beliefs and then establishing connections are suitable for students' changing concepts (Bransford vd., 2000; Coştu, 2009; E. Ültay & Ültay, 2022).

At the Experiencing stage, environments are prepared where students gain experiences. In these environments, attention is paid to designing courses that will increase students' problem-solving skills. In this stage, students are exposed to activities they have experienced before with their previous knowledge. The teacher should take on a guiding role in this stage. However, the prepared activities may not always align with students' experiences. In other words, students' prior knowledge may be insufficient for the activities. In this case, the teacher should adapt the activities as necessary based on the students' situation. Since the goal is for students to research, problem-solve, and discover, manipulatives, problem situations, or laboratory work may be included in this stage (Crawford, 2001; Utami et al., 2016; Ültay & Çalık, 2011).

At the Applying stage, learning about concepts encountered in daily life is essential. Students make sense of concepts in daily life using their problem-solving skills and their previous experiences gained in the previous stages. In the Relating and Experiencing stages, students should feel that they can understand the topic they are going to learn, and in the Applying stage, they are expected to have a deeper understanding by seeing the contexts they encounter in daily life (Coştu, 2009; Crawford & Witte, 1999; Utami et al., 2016). At this stage, as described by Pintrich and Schunk (1996), tasks that are fascinating but also take into account the students' situations should be given to students, considering their learning thresholds (tasks that are neither too easy nor too difficult according to the students' learning levels) (Coştu, 2009).

At the Cooperating stage, students work in groups to solve problems related to daily life or highly realistic situations through well-structured collaborations. It is essential that each group member actively participates in group work. Since there may be discussions and differences of opinion within the group, teacher guidance is crucial. Problem situations from daily life that may have been included in previous stages may also be included in this stage. Problem-solving exercises often involving realistic situations can be complex and challenging for students working individually. If the teacher does not provide step-by-step guidance and support during this process, students may encounter feelings of failure. However, students working in small groups can easily solve complex problems involving realistic situations with a minimal amount of assistance (Arıkan, 2019; Crawford & Witte, 1999; Ingram, 2003).

At the Transferring stage, students have the opportunity to use the knowledge they have acquired in the previous four stages in new and previously unencountered situations, either within or outside the classroom. To enable students to transfer what they have learned to different contexts or situations, they should encounter a new context or situation that has not been discussed during the instructional process. The goal of this stage is to deepen the learned topics and to make the information learned in the class transferable to daily life or different fields. Students are expected to adapt this knowledge to a new situation. It is preferable to guide students in adapting this knowledge to a new situation through a discussion environment or project tasks (Arıkan, 2019; Coştu, 2009; N. Ültay & Çalık, 2011). Additionally, the ability to relate and transfer new information to different situations is as important as learning new information.

In recent years, an examination of studies conducted in the field of science education based on the context-based approach reveals that the research either focuses on the effects of lesson plans or materials developed using the REACT strategy on student motivation and achievement or gathers student and teacher opinions about these instructional materials (Abele et al., 2024; Erdoğan & Uluçınar Sağır, 2024; Fitri et al., 2023; Kaya, 2022; Putra et al., 2023; Ültay et al., 2024). Given the limited research in the literature on the context-based learning approach in science education and the detailed development process of course materials using the REACT strategy (Kabuklu & Kurnaz, 2019) it is thought that the course materials produced in this study can shed light on new studies. In this study, lesson plans were prepared in accordance with the REACT strategy, taking into account the four objective of the "Conversion of Electrical Energy" subject of the 8th Grade "Electric Charges and Electric Energy/Physical Phenomena " unit of science in the Science Curriculum in Turkey (MoE, 2018). The primary motivation for selecting this unit in the research is the general prejudice students have against science subjects (Boz, 2019) and the observation that students possess low skills in applying the topics covered in the electricity unit to daily life (Cantaş & Kızılcık, 2023).

Methodology

In this study, the initial step was to determine the sequence of operations. The aforementioned steps are illustrated in Figure 1. The aim of this study is to develop a lesson plan based on the REACT strategy, to pilot this plan, and to obtainfeedback from students on this implementation. The study employed a qualitative research methodology.

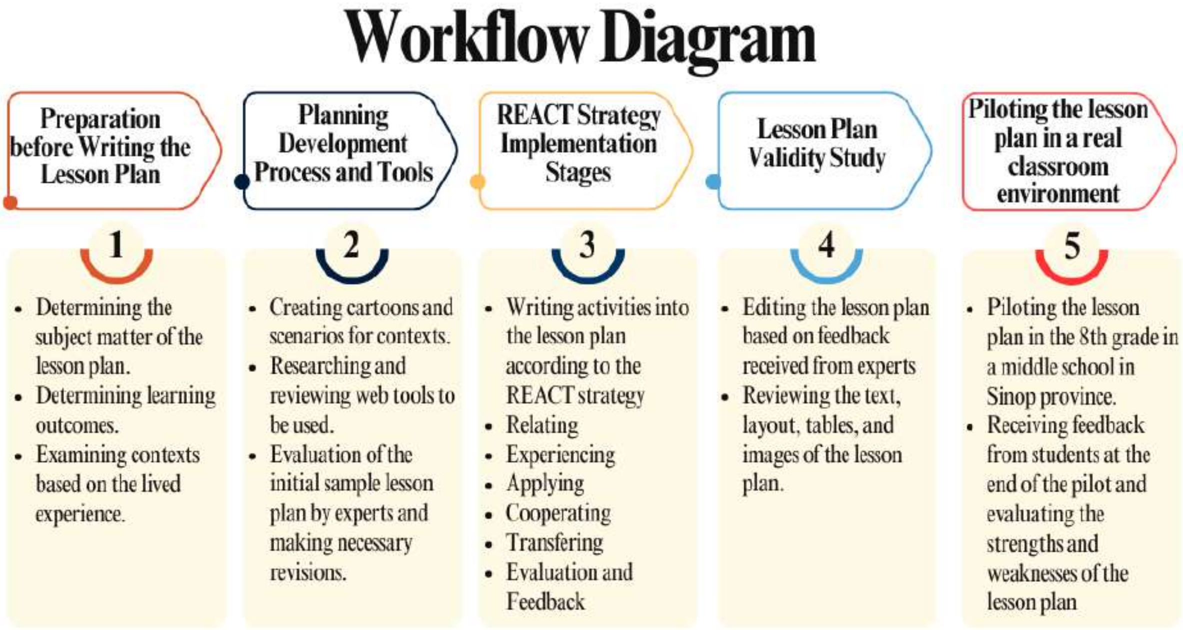

Figure 1 Workflow Diagram

Preparation before Writing the Lesson Plan

The preparation for the development of a lesson plan that can apply the REACT strategy within the context-based learning approach, started by examining the science curriculum of the MoE (2018). The concepts that students have difficulty understanding and the gains that can be achieved through more hands-on activities in the classroom have been examined. In this context, the following four objectives were taken from the "Electric Charges and Electrical Energy/Physical Phenomena" unit in the science curriculum. The reason for selecting the 'Electricity' unit in this study is observed to be the difficulty students encounter in applying their theoretical knowledge of electricity to daily life, despite their strong theoretical understanding of the topic (Vakkasoğlu & Tekerek, 2023). Additionally, contexts that can be utilized in the lesson plan and examples from students' everyday lives were compiled and examined.

Table 1
The Included Learning Outcomes in the Lesson Plan

Code*	Learning outcomes	Instructional Hour
F.8.7.3.1	Provides examples of the transformation of electrical energy into thermal, light, and kinetic energy.	2
F.8.7.3.2	Designs a model based on the conversion of electrical energy into thermal, light, or kinetic energy.	1
F.8.7.3.3	Explains how electrical energy is produced in power plants.	1
F.8.7.3.4	Generates ideas regarding the advantages and disadvantages of power plants.	1

**The codes mentioned here are used to classify the outcomesin the science curriculum in Turkey.*

The recommended duration for the learning outcomes mentioned above in the curriculum is determined as 4 class hours. These durations were used as a guide, and necessary adjustments were made in the lesson plan to determine the target durations for each stage of the REACT strategy.

In crafting the lesson plan, careful consideration was given to incorporating contextual elements from the students' immediate environment. Given that the students attend a state middle school in the Gerze district of Sinop province, during the "relating" stage of the lesson plan, a deliberate effort was made to draw connections with the geographical region where these students reside. It is presumed that 8th-grade students possess foundational knowledge requisite for grasping the intended learning objectives. Nonetheless, in instances where students' preparedness is deemed inadequate, necessary adjustments to the activities can be implemented under the guidance of the teacher.

For the activities in the prepared lesson plan, materials that the teacher can easily access were used. The activity materials are clearly specified in the relevant section of the lesson plan. The teacher, when reviewing the 'Materials' section before the lesson, will be able to make the necessary preparations.

Planning Development Process and Tools

The lesson plan prepared with the context-based learning approach and the REACT strategy follows a certain structure by following some headings to maintain organization. These headings are created as "recommended duration, student learning objectives, materials and equipment, methods and techniques to be applied, warnings, and summary."

During the implementation of the lesson plan, titles for the REACT stages and recommended durations have been specified to facilitate the teacher. To ensure the organization and order of the lesson plan, worksheets to be distributed to students have been added to the end of the plan with the title "Appendix".

For the cartoon activities to be used in the relating stage of the REACT strategy, the web interface of Pixton, one of the web 2.0 tools, was utilized.

In the evaluation stage of the lesson plan, the "Puzzle" crossword puzzle distributed to students was prepared using the Eclipse Crossword application, one of the web 2.0 tools.

The draft version of the lesson plan prepared for this study with the context-based learning approach and the REACT strategy was reviewed by an physics educator academician and two science teachers working in a middle school affiliated with the Ministry of National Education. At the end of the review, teachers stated that the Jigsaw technique in the "cooperating" step of the draft lesson plan was incompletely applied and that the titles of the contexts and the subject were incompatible. They also pointed out that the student assessment was lacking in the evaluation part of the activity, and they recommended the addition of time in the implementation of the strategy stages. Following the review, necessary revisions were made in accordance with the feedback, and the lesson plan was finalized.

REACT Strategy Implementation Stages

Relating Stage:

At the relating stage of the lesson plan, two cartoon activities were created. The first cartoon included a child talking to the mayor about a local problem, and the other one was a dialogue between the child and his mother about using the hair dryer. The prepared cartoon activities aim to capture students' attention by using possible dialogues related to the region's problems. The implementation of this stage is targeted to take 10 minutes. The following instructions were provided in the lesson plan: "Students are given Appendix-1 and Appendix-2 forms, and they are asked to carefully read the speech bubbles in the cartoons and answer the questions under the cartoons. The answers of the students are evaluated."

Experiencing Stage:

At the experiencing stage, students are expected to explore the efficiency of electrical energy by using LED lamps and incandescent filament lamps as indicated in the materials and equipment section of the lesson plan. Additionally, they are asked to think about their responses to the questions in the cartoon activity in the relating stage while using a hairdryer brought to the classroom, and to provide answers related to the energy conversion phenomenon. The implementation of this stage is targeted to take 30 minutes. The following instructions were provided in the lesson plan: In this section, the extension cord in the materials and equipment section is plugged into an outlet. Lamps are connected to socket outlets, and the socket outlets are plugged into a 3-way extension cord. It is observed that both lamps are lit. Students are asked to gently touch the lamps without prolonging the time (In crowded classrooms, incandescent lamps should be turned off occasionally for cooling). In addition, students are asked to examine the brightness of the lamps. Then, the power (watt) of the electrical power on the box is read aloud by two students. Afterward, the following questions are asked, and the answers provided are evaluated:

Which lamp do you think is more efficient?

Which lamp would you prefer in your home? Why?

In the continuation of this section, the hairdryer is plugged into an outlet and turned on. Students are asked to examine the working hairdryer to compare with their responses in Appendix-2 Form.

Applying Stage:

At the applying stage, students are encouraged to think multidimensionally by imagining a city where electrical energy is used efficiently, considering the information they have learned in the previous stages. This allows students to apply what they have learned about energy efficiency and energy conversions. The implementation of this stage is targeted to take 20 minutes. The following instructions were provided in the lesson plan: Students are asked to imagine a city where electrical energy is used efficiently, taking into account energy conversions, and to design this city. They are instructed to draw their designs using colored pencils in their notebooks. Students' drawings are examined, and students are asked to indicate energy conversions on their drawings in the form of information boxes.

Cooperating Stage:

At the cooperating stage, students are expected to work collaboratively in groups to explore power plants. They are asked to interact with each other using the Jigsaw technique. The implementation of this stage is targeted to take 60 minutes. The following instructions were provided in the lesson plan: After examining the city designs of the students, they are asked the question, 'Where will the electricity come from in the city you designed?' If students do not answer 'electricity generation plants,' guiding questions like 'Where is electricity generated?' are asked. Then, the Jigsaw technique activity begins. The class is divided into 3 groups. Then, two copies of each power plant listed in Appendix-3 are left on three different tables. Students are divided into groups, and they are asked to distribute the tasks among themselves and determine who will go to which table from their group. Students are assigned to tables and asked to obtain in-depth information about the electricity generation plant on the table. After giving students enough time, each student returns to their group and is asked to explain the electricity generation plant they learned about. Students are asked to talk about the advantages and disadvantages of the electricity generation plants they learned about. Necessary corrections are made by paying attention to any misconceptions that may occur in students.

Transferring Stage:

At the transferring stage, students are expected to use the knowledge they have acquired in previous steps to determine Turkey's energy policies, taking into account parameters such as the economy, efficiency, applicability, and global warming. Students are asked to transfer their knowledge about electrical efficiency, energy conversion, and power plants to daily life, analyze and evaluate each other's energy policies in the activity. The implementation of this stage is targeted to take 40 minutes. The following instructions were provided in the lesson plan: After completing the Jigsaw technique activity related to power plants, students are instructed, 'Considering the data you have obtained so far, write in your notebooks, how Turkey should develop an energy policy for the next 10 years, taking into account parameters such as energy needs of Turkey, global energy sources, and global warming.' The answers provided by the students are evaluated.

Evaluation and Feedback

It is aimed for students to evaluate themselves with self-evaluation forms at the end of the activity and their knowledge at the end of the activity with the riddle study. The self-evaluation forms of the students were examined by the teacher and it was stated in the lesson plan that additional studies could be done in the sections where there was generally incomplete learning. As a result of the riddle study, the activity can be evaluated by students sharing their answers in the classroom environment.

Lesson Plan Validity Study

Three experts, whose demographic characteristics are given in Table 2 below, were interviewed to evaluate the prepared lesson plan in terms of its applicability and suitability to the objectives and REACT strategy.

Table 2
Demographic Charecteristics of Experts

Code	Gender	Title	Highest Education Level	Position	Service Seniority (Years)
1	F	Professor	Mathematics and Science Education	Academician	18
2	M	Expert Teacher	Science Education	Science Teacher	16
3	F	Expert Teacher	Science Education	Science Teacher	14

F: Female M: Male

In the interview with Expert 1, it was pointed out that the cartoon prepared for the relating stage of the draft lesson plan was weak in the meeting the learning objectives, and it was suggested that additional study should be done here. Upon this recommendation, another cartoon was prepared for the relating stage of the lesson plan, based on a different context, which is included in Appendix-2 of the lesson plan. Expert 1 also noted that the (Jigsaw technique in the cooperating stage of the draft lesson plan was incorrectly applied. Following this warning, the Jigsaw technique was reorganized according to the definitions in the studies of Erden (1988) and Donmez and Gundogdu (2018).

In the interview with Expert 2, it was suggested that the recommended time frames during the implementation of the REACT strategy in the draft lesson plan should be reviewed. These time frames were reorganized based on physical conditions, students' readiness levels, and the applicability of the lesson plan in the classroom. Additionally, Expert 2 pointed out that the titles of the context cartoons prepared in the draft lesson plan should be consistent with the content. With this revision, the titles were rearranged accordingly.

In the interview with Expert 3, it was mentioned that the information texts on the 'Energy Plants' information cards in Appendix-3, which would be used in the Jigsaw technique activity, were superficial, and students should be able to achieve in-depth learning in this activity. Therefore, more detailed information cards were added to the 'Power Plants' section by benefiting from the study of Koc et al. (2018). Expert 3 also noted that the draft lesson plan only contained a self-assessment form and that the activity should be evaluated. In line with this opinion, a crossword puzzle was prepared and added to the activity evaluation section at the end of the lesson plan.

Pilot Study of the Lesson Plan in a Real Classroom Environment

The lesson plan, which was finalized according to expert opinions, was piloted by the first researcher in an 8th grade class in a public school in Sinop province. The class in which the pilot study was conducted was determined by the school administration by randomly selecting a class from five different classes.

The pilot implementation was conducted with twenty eighth grade students and their opinions about the implementation were taken after the lessons.

In order to get the opinions of the students, three questions about the implementation were prepared by the researchers. These questions were presented to the students as “OpinionForm”. Opinion Form questions are given in Table 3.

Table 3
OpinionForm Questions

Question No	Question Texts
1	What do you think are the differences between the method applied for the topic 'Electric Energy' and the method applied in previous lessons?
2	Do you think that the method applied in the lesson contributed to a better understanding of the topic 'Electrical Energy'? Explain.
3	Did you associate the activities done during the lesson with your daily life and did you do them with a positive attitude and motivation?
3a	If yes, what did you do differently from other activities?
3b	If the answer is No, what kind of activity do you think would be more motivational for you?

Findings

When interpreting the results of the pilot study, we focused on the results of the puzzle activity in the lesson plan, the self-assessment form and the opinion form.

The results of the “Self-Assessment Form” in the appendix section of the lesson plan are shown in the graph in Figure 2.

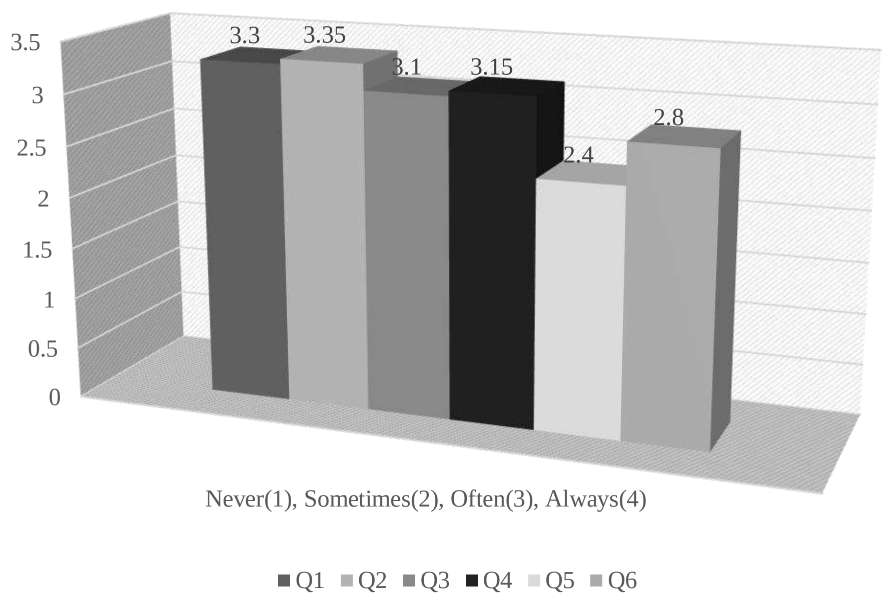

Figure 2 Self-Assessment Form Class Averages

According to Figure 2, the average response to the statement “I can understand the conversions of electrical energy into other forms of energy.” of the Self-Assessment Form included in the lesson plan was 3.3. The mean of the responses to the statement “I understand the concept of efficiency in electrical energy.” was 3.35; the mean of the responses to the statement “I can provide examples of electric vehicles with high energy efficiency from daily life.” was 3.1; the mean of the responses to the statement “I can determine the selection criteria for home appliances with high energy efficiency.” was

3.15; the mean of the responses to the statement "I can list different types of electricity generation power plants" was 2.4; the mean of the responses to the statement "I can list the advantages and disadvantages of electricity generation power plants." was 2.8.

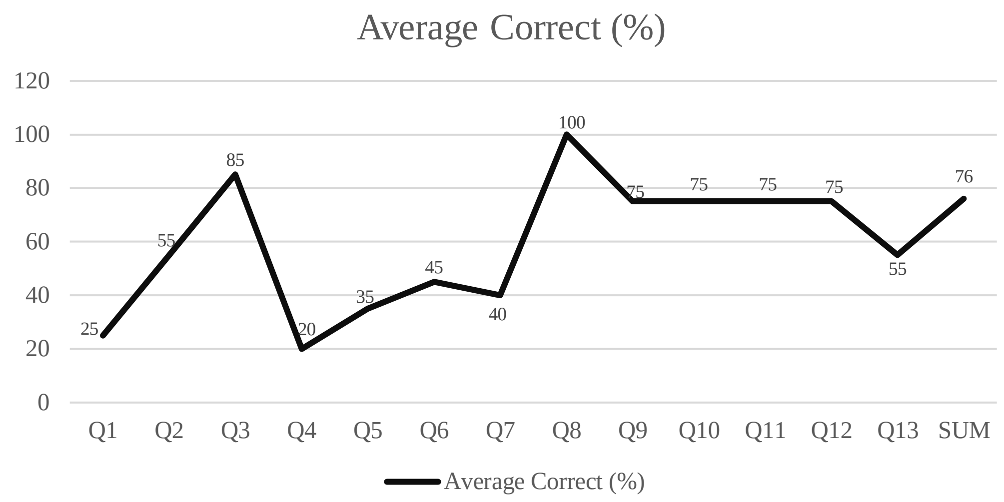

Figure 3 Puzzle Activity Response Averages

When the graph in Figure 3 is analyzed, it is seen that the response averages of question 1 with the answer "Airpollution" and question 4 with the answer "TermalPowerPlant" in the "Puzzle" activity were quite low. In addition, all students gave the correct answer to question 8, "WindPowerPlant". In addition, the average responses to questions 5, 6 and 7 about thermal power plants and hydroelectric power plants were found to be less than fifty percent. The average activity score of the whole class was at a level that can be considered successful.

Table 4
Opinion Form Response Codes

Themes	Codes	n
Course Method Differences	High number of activities	5
	Experimental study	2
	Group work	3
	Fun and memorable	6
	Low memorization and expression	2
Contribution to Lesson Understanding	Better understanding because it is fun	7
	Better understanding through experimentation	1
	More visuality	1
Relation of Lesson Activities to Daily Life and Motivation	Motivation	14
	No Motivation	6
Differences from Other Courses	Group work	8
	Experimental study	1
	Individual study	1
	More fun	3

After the lesson plan was implemented, the responses to the Opinion Form presented to the students were grouped and coded by the researchers. These codes are given in Table 4 together with the determined themes. When the responses to the Opinion Form were examined, it was found that 14 students reported that the course conducted according to the REACT strategy increased motivation in terms of establishing a relationship with daily life, 8 students reported that there was more group work, 7 students reported that it facilitated understanding and was fun, 6 students reported that there were memorable activities, and 5 students reported that there were more activities than in other courses.

The answers given by some students to the question “What do you think are the differences between the method applied for the topic 'Electric Energy' and the method applied in previous lessons?” in the Opinion Form are as follows:

> S5: “In normal lessons, only the subject is explained, but with this method, I both understood the subject and had fun.”

> S9: “I think this method is better. Because there are no such demonstrative activities in the other lessons, it would be nice to show and introduce in the lesson.”

> S20: “I think electrical energy is a fun lesson that we can understand better than other lessons. Because I started to grasp the power plants. If it was a normal lesson, I would not have understood so well.”

> S18: “In this lesson, we measured the temperature of the lamps and had a slightly fuller lesson than the other lesson.”

> S13: “It was more descriptive and helped us understand more by experimenting and helped us understand more. The difference with other lessons is that we do it in groups and try things out.”

The answers given by some students to the question “Do you think that the method applied in the lesson contributed to a better understanding of the topic 'Electrical Energy'? Explain.” in the Opinion Form are as follows:

> S6: “Yes, I think so, but some of my friends read from the paper without studying the switchboards and didn't listen to what was said. So I was a bit upset, but the method our teacher used was very fun and good.”

> S5: “Yes, I do, because I understood the lesson better by doing different activities and I had a lot of fun doing them.”

> S10: “I think it worked. Because in this activity, first we looked at which lamp was hot and then we did an activity about the hair dryer, which was good. Only the activity where I learned the topic and explained it was a bit bad because my friends and I were in the boys' group, which was a bit bad.”

> S12: “I think it is because I think that forming groups and doing studies affects our understanding in a good way.”

> S19: “It was a very good contribution, with the help of our friends, we did activities by talking and understanding, we did not understand when the school and the bell rang and we liked it. We didn't understand how the time passed.”

> S9: “I think it worked. Because in this activity, we first looked at which lamp was hot and then we did an activity about the hair dryer, which was good. Only the activity in which I learnt the subject and explained it was a bit bad because my friends and I were in the boys' group, which was a bit bad.”

> S13: “Because we worked in an active and explanatory way, we divided into groups and told each other the topics together, but some of the people in some groups did not memorise and did not listen to our explanations properly. But we still understood it well and it was useful for us.”

The answers given by some students to the question “Did you associate the activities done during the lesson with your daily life and did you do them with a positive attitude and motivation?” in the Opinion Form are as follows:

S10: "We did something like this instead of just solving questions, normally we always experience the same thing, the subject work is always like this and it is boring, but here we saw it by trying it, we did group work and we were well informed."

S15: "We became a group and went to the desks, worked there and then came to our groups and told our friends what we had learned."

S20: "I understood the power plants, although not very well. If I come across a topic or question about such power plants elsewhere, I can remember this activity and probably solve that question easily. And I grasped it better than other activities."

S19: "Drawing together, having fun, discussing, helping our friends who don't understand by doing it this way with our teacher and those who understand."

S16: "I had a lot of fun chatting with my friends."

Discussion, Conclusion, and Recommendations

The aim of this study was to outline the process of preparing a lesson plan using the context-based learning approach with the REACT strategy and to obtain student opinions regarding the implementation . The study focuses on how teachers can make the necessary preparations and adapt their lesson plans to effectively fulfill their role in the context-based learning approach. Additionally, this study will open the door to new research on the positive effects of lesson materials prepared with the REACT strategy on student motivation and achievement. This, in turn, will help us better understand the potential of the context-based learning approach. In this study, the process of preparing a lesson plan according to the target approach by a teacher from start to finish is discussed. Thus, the prepared lesson plan aims to serve as a guiding material.

In the context-based learning approach, it is essential for the student to be active, with the teacher taking on the role of a guide. The teacher's role as a guide can sometimes be facilitative, sometimes observational, and sometimes instructional (Davidson, 1990, cited in Crawford and Witte,1999). The role that the teacher will assume in the lesson plan produced for this study directly affects the impact of the lesson plan on learning. Before implementing this lesson plan, the teacher should make the necessary preparations and be able to adapt hands-on activities to the readiness of their students and the context in which they live. The teacher should be able to make adjustments to the activity texts in accordance with scientific realities. When the teacher makes the necessary adjustments and preparations, there are studies indicating that lesson materials prepared with the REACT strategy positively affect learning motivation and student achievement (Barker & Millar, 2000; Baydere Karslı & Kır, 2021; Bennett & Lubben, 2006; Bilgin & Yiğit, 2017, 2019; Demircioğlu et al., 2012). The teacher plays an important role in transferring the knowledge that students are trying to learn from short-term memory to long-term memory (Stallings, 1982). This lesson plan prepared with the REACT strategy, with its features such as students actively engaging in learning, having activities that create effective learning environments, and the teacher acting as a guide, may facilitate students in storing the information they have learned in their long-term memory.

With advancing technology, web 2.0 tools that can be integrated into this lesson plan, augmented reality applications, and virtual reality applications may be considered effective in attracting students' attention, ensuring permanent learning, and increasing academic achievement in the lesson. The "Puzzle" activity prepared with the web 2.0 tool for this study provided both feedback on the lesson plan and an opportunity for students to test their learning objectives. According to the results of the puzzle activity, it was understood that the topic of "Power Plants" should be focused more.

According to the feedback received from the students to whom the lesson plan was piloted, it was concluded that the lessons with the REACT strategy supported fun and permanent learning, and the collaborative activities were very effective in the learning process of the students. These results are consistent with the findings of Ültay et al. (2024), Abele et al. (2024); Erdoğan and Uluçınar Sagir (2024), Fitri et al. (2023), Kaya (2022), Putra et al. (2023). Students' feedback is expected to guide the lesson plans to be prepared according to the REACT strategy.

In addition, students complained that not all students worked equally in group work during the collaboration phase. In lesson plans to be designed according to the REACT strategy, it was understood that attention should be paid especially to the development of the “Cooperating” stage. In order for students to work in cooperation, the organization should be done well. Tasks should be created in which each student can work actively.

It has been observed that particularly pre-service teachers struggle to write contexts related to daily life in the introduction sections when preparing lesson plans (Vakkasoğlu & Tekerek, 2023). This study is expected to serve as a guide for teachers and pre-service teachers in preparing lesson plans. By implementing this lesson plan in a classroom using the REACT strategy, studies can be conducted on the impact of this plan on students' achievements in science courses, their learning motivations, and more. Once the effectiveness of the produced lesson plan is established through a study, lesson plan preparation can also be carried out for other subjects and topics.

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SCIENCE LESSON PLAN (REACT)

PART I

Course title:	Science class	
Class:	8th grade	
Unit No-Name:	Unit 7: Electric Charges and Electric Energy	
Subject:	Conversion of Electrical Energy	
Recommended Lesson Time:	4 Lesson Hours	

PART II

Student Achievements/Goals and Behaviors:	F.8.7.3.1. Provides examples of applications where electrical energy is converted into heat, light, and kinetic energy. F.8.7.3.2. Designs a model based on the conversion of electrical energy into heat, light, or kinetic energy. F.8.7.3.3. Explains how electrical energy is generated in power plants. F.8.7.3.4. Generates ideas about the advantages and disadvantages of power plants.
Unit Concepts and Symbols:	The conversion of electrical energy into heat and light energy, the conversion of electrical energy into kinetic energy, and the conversion of kinetic energy into electrical energy, power plants, and the conscious and efficient use of electrical energy.
Methods and Techniques to be Applied:	Context-Based Learning Application (REACT Strategy)
Tools and Equipment to be Used:	• 220V Incandescent Bulb (100Watt) • 220V LED Bulb (9Watt) • 2 Plug sockets • 3-way extension cord • Hair dryer
Descriptions:	Sample Lesson Plan for Context-Based Learning Application
Activities and Warnings:	• *The suggested durations in the REACT stage headings are for guidance purposes. They can be adjusted based on class size and environmental conditions.* • *In the Relating stage, students are asked to review and evaluate their responses after the Experiencing stage.* • *During the Cooperating stage, the "Separation and Merger" technique is used, and group design can be adapted based on class size.*
Summary:	**Relating: (10 minutes)** Students are given Forms Appendix 1 and Appendix 2, and they are asked to carefully read the speech bubbles in the cartoons and answer the questions below the cartoons. Student answers are evaluated. **Experiencing: (30 minutes)** In this section, the extension cord from the equipment section is plugged into an outlet. Light bulbs are attached to the socket outlets, and the socket outlets are connected to a 3-way extension cord. It is observed that both light bulbs are lit. Students are then asked to gently touch the light bulbs without prolonging the contact (in crowded classrooms, the incandescent bulb should be occasionally

	turned off to cool down as students' touch durations may extend). Additionally, students are asked to examine the brightness of the bulbs. Later, the students are given the boxes of the light bulbs and are asked to read aloud the electrical power (wattage) on the boxes. Then, the following questions are asked, and the responses are evaluated: • In your opinion, which bulb is more efficient? • Which type of bulb would you prefer to use at home? Why? **Applying: (20 minutes)** Students are asked to imagine a city design where electrical energy will be used efficiently, considering energy transformations. They are instructed to draw their designs using colored pencils in their notebooks. The drawings by students are examined. Students are also asked to indicate energy transformations on the drawings in the form of information boxes. **Cooperating: (60 minutes)** After examining the city designs created by students, they are asked, "So, where will the electricity come from for the city you designed?" If students do not answer "power plants," guiding questions like "Where is electricity generated?" are asked. Then, students move on to the separation and merger activity. The class is divided into 3 groups for this activity. Next, 2 power plant cards from Appendix 3 are placed on each of the 3 different tables. Students within each group are instructed to divide tasks among themselves and designate who will go to which table from their group. Those students designated to the tables are asked to gather in-depth information about the power plants on the table. After giving students sufficient time, each student returns to their group and presents the power plant they learned about. Students are then asked to discuss the advantages and disadvantages of the power plants within their groups. Conceptual misunderstandings are corrected as necessary. **Transferring: (40 minutes)** After completing the separation and merger activity related to power plants, students are asked to write in their notebooks for at least, taking into account the data obtained so far: "Considering the data obtained so far, think about Turkey's energy needs for the next 10 years, global energy resources, and parameters such as global warming. Write about what kind of energy policy should be developed for Turkey." Student responses are evaluated.

PART III

Assessment and Evaluation:	• The self-assessment form titled 'What I Learned' in Appendix 4 is distributed to students for process evaluation. • The 'Puzzle' form in Appendix 5 is distributed to students. Students are asked to carefully answer the questions in the puzzle. The answers provided by the students are evaluated. The answer key for the 'Puzzle' form can be found in Appendix 6.

PART IV

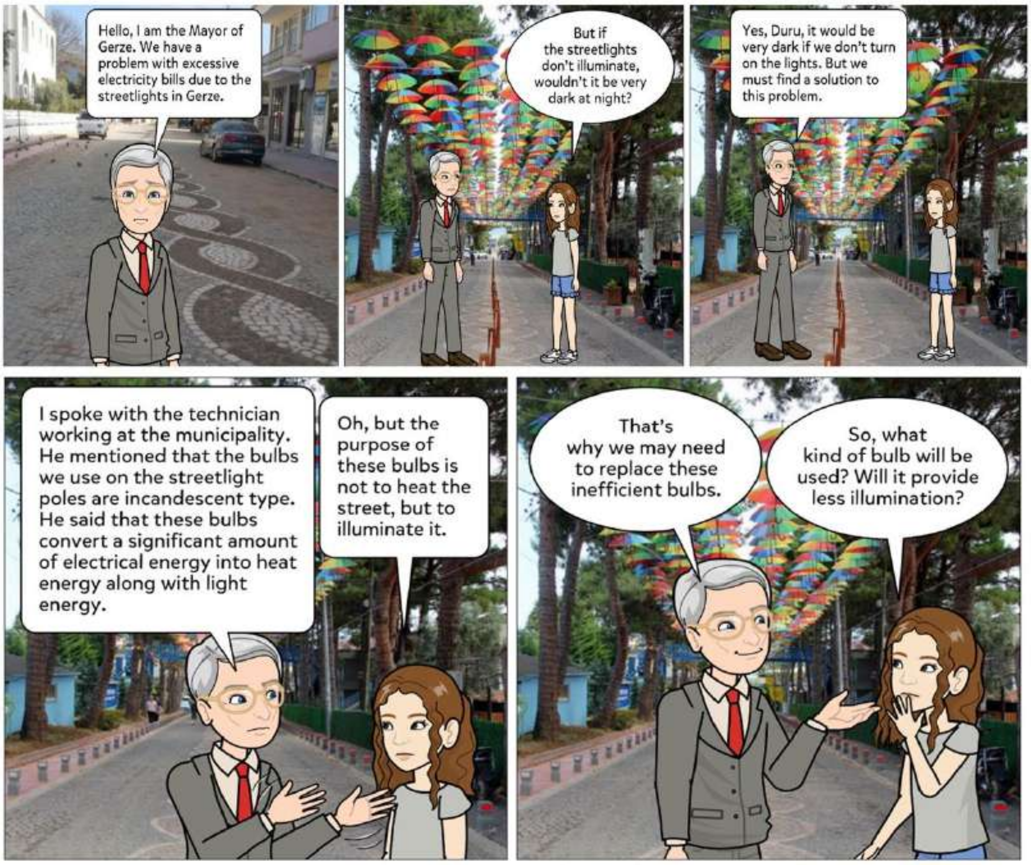
Relationship with Other Lessons:	Visual Arts

PART V

Additional Notes on the Implementation of the Plan:	This is a lesson plan prepared using the REACT Strategy.

Appendix-1

Luminous Efficacy



According to the conversations in the cartoon above, please answer the following questions.

1) What is the reason for the high electricity bills at the municipality?

....
....
....
....
....

2) With what type of bulb mentioned by the Mayor can the municipality solve the mentioned problem? Please answer in the blank with the reason.

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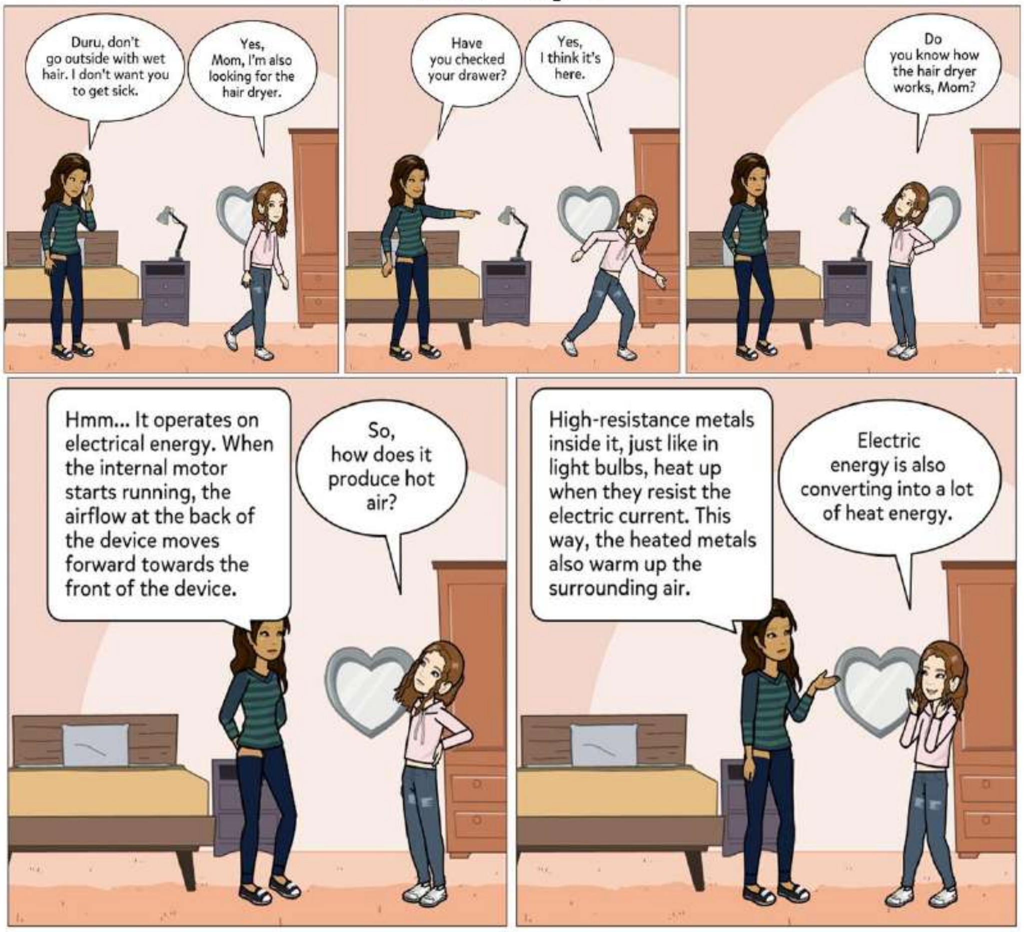
Appendix-2

Hair Dryer



Based on the conversations in the cartoon above, please answer the following questions.

1) In the hair dryer, into which form(s) of energy does electrical energy convert?

....
....
....
....

2) List other devices that operate with energy transformations similar to those in a hair dryer.

....
....
....
....

Appendix-3.1

Wind Turbine Power Plant

Canakkale Wind Turbines
https://www.enerjisauretim.com.tr/_assets/images/gallery/canakkale_2.jpg

A wind generator power station is a type of power plant that generates electricity using wind energy. As of today, electricity generated from wind is classified as a high-cost category, and it is mainly used in remote areas such as farms, independent radio stations, lighthouses, etc. Wind is only suitable for large wind generator power stations beyond a certain speed. The energy obtained is approximately proportional to the cube of the wind speed. At speeds lower than 6 meters per second, which is less than 21.6 km/h, wind energy often proves insufficient. For specific needs, the technique of generating electricity with small wind generators, regulated by accumulators, provides relatively satisfactory results. However, a viable solution for effectively regulating machines exceeding 10 kW in production capacity has not yet been found.

In Turkey's Wind Turbines (2018 data)

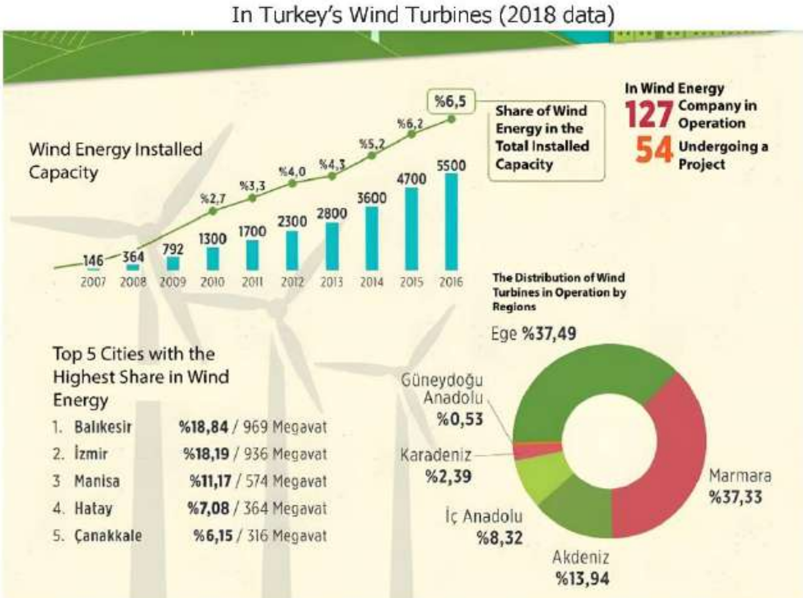


Image Source: https://ekolojist.net/turkiyede-ruzgar-enerjisi/

Appendix-3.2

Geothermal Power Plant

Denizli Kızıldere 3 Jeotermal Enerji Santrali
(https://www.enerjiatlasi.com/jeotermal/kizildere-3-jes.html)

A geothermal power plant is a type of power plant that generates electricity by harnessing the heat energy present in underground sources. Geothermal power plants directly tap into thermal energy from underground sources. The Earth's core is, in practical terms, an inexhaustible source of energy. However, harnessing this energy is challenging. This energy is most prominently evident in volcanic eruptions, but all attempts to use it have been unsuccessful. Conversely, in regions with dormant volcanoes, the residual heat in rocks can be utilized. This heat emerges in low-flow hot underground waters.

The Larderello facilities in Tuscany, Italy, are the only ones of their kind globally and utilize underground steam with temperatures of up to 200°C. Turbo-generators producing several hundred thousand kilowatts directly take in the natural steam without the need for a heat exchanger. Chemical processes are applied to the condensed water resulting from the steam to obtain boric acid. The underground source is considered a geothermal one. The heat and temperature originate from the Earth's crust.

In Turkey, there are a total of 32 operational geothermal energy power plants. The provinces where these plants are located and the number of plants are as follows: Aydın (20), Denizli (5), Manisa (5), Çanakkale (2). Additionally, there are ongoing efforts to establish 4 geothermal power plants in Aydın, 2 in Manisa, and 1 in Denizli.

Appendix-3.3

Solar Generator Power Plant

Antalya/Dosemealti
https://www.solar.ist/antalyanin-2nci-etap-3-megavatlik-gunes-enerjisi-santrali-kurulumu-tamamlandi/

Solar energy is the heat energy produced by the fusion process in the core of the sun, resulting from the fusion process of hydrogen gas in the sun turning into helium. The intensity of solar energy outside the Earth's atmosphere is approximately constant and is about 1370 W/m2, but it varies between 0-1100 W/m2 on the Earth's surface. Even a small portion of this energy reaching the Earth far exceeds humanity's current energy consumption. Efforts to harness solar energy have gained momentum, especially since the 1970s. Solar energy systems have made technological advancements and cost reductions, establishing solar energy as an environmentally clean energy source.

The total installed capacity of solar energy power plants in Turkey is 7,325 MW. In 2019, solar energy power plants generated 9,620,335,000 kilowatt-hours of electricity.

Solar energy power plants primarily operate with two different structures: photovoltaic systems and thermal systems. In photovoltaic systems, solar radiation is converted into energy through panels, and the obtained energy is made suitable for use with an inverter device. In thermal systems, solar rays are directed to a specific point through special mirrors, and a liquid such as oil or water at that point is heated. This heated liquid is then converted into kinetic energy through steam pressure, similar to thermal systems

Solar Power Plants Status	
Number of Registered Power Plants	667
Installed Capacity of Solar Power Plant	7325 MWe-7116 MWe
Capacity Ratio	% 7,51
Annual Electricity Production	~11056 GWh
Production-to-Consumption Ratio	% 3,69
License Status	36 631

https://xn--uurk-0wa4ia18a.com/gunes-enerji-santralleri/

Appendix-3.4

Hydroelectric Power Plant

Arkun Dam / Hydroelectric Power Plant

https://www.enerjisauretim.com.tr/enerji-uretimi/hidroelektrik-santrallerimiz/arkun-baraji-ve-hes

A hydroelectric power plant is a type of power plant that generates electricity by harnessing the kinetic energy of moving water falling from a high point. In a hydroelectric power plant, a turbine is operated by the kinetic energy of the falling water mass. The demand for electrical energy is highest during the winter months. During this period, hydroelectric energy production decreases to its lowest level because water is drawn from rivers. Due to the high energy demand and low production during this period, the energy generated during the summer season becomes crucial. On the other hand, the value of this energy is lower at night compared to daytime, and it is lower on weAppendixends compared to weAppendixdays. The value of a hydroelectric facility is determined not only by the quantity of energy produced but also by the quality of this energy, which is its distribution over time. The choice of the location for a hydroelectric power plant is determined by nature and can sometimes be far from population centers. As a result, there is a significant cost burden due to energy transmission, making it generally more expensive in terms of cost price compared to thermal power plants. However, hydroelectric power plants do not consume fuel, and their operation and maintenance costs are very low compared to thermal power plants. If a hydroelectric facility covers its initial setup costs with its operational economy, it is considered to have favorable conditions.

In Turkey, there are approximately 685 hydroelectric power plants located in various provinces such as Kars, Erzurum, Muğla, Adıyaman, Sivas, Mersin, Denizli, Osmaniye, Artvin, Adana, Giresun, Diyarbakır, Trabzon, Kahramanmaraş, Hakkari, Eskişehir, Bayburt, Antalya, Isparta, Bilecik, Erzincan, Zonguldak, Bursa, Şırnak...

Appendix-3.5

Thermal Power Plant

Zonguldak Eren Thermal Power Plant

http://www.zonguldak.gov.tr/enerji

A thermal power plant is a power plant that operates with steam power as its main driving mechanism. Heated water is converted into steam, which is then used to turn a steam turbine that drives an electricity generator. The steam passing through the turbine is condensed back into water using a method called the Rankine cycle. The major difference in the designs of thermal power plants lies in the type of fuel they use. Since these facilities utilize heat energy to produce electrical energy, they are sometimes referred to as energy conversion plants. Some thermal power plants are also used for purposes other than electricity generation, such as industrial and heating purposes, as well as desalination of seawater. Intensive efforts are being made to reduce the outputs of fossil-fueled thermal power plants, which account for a significant portion of human-produced CO_2 emissions.

Coal-fired thermal power plants, which are found in almost all regions and provinces including Zonguldak, Kahramanmaras, Manisa, Bursa, Adana, Hatay, Canakkale, Muğla, Sırnak, Kutahya, Bolu, Zonguldak, Izmir, Ankara, Sivas, Denizli, and Nigde, operate in the form of steam turbine thermal power plants.

Appendix-3.6

Nuclear Power Plant

Mersin/Akkuyu Nuclear Power Plant

https://akkuyu.com/tr/how-it-works

A nuclear power plant is a facility that uses one or more nuclear reactors to produce electricity by utilizing radioactive materials as fuel. Due to the use of radioactive materials, it incorporates different and more stringent safety measures and technologies compared to other power plants. In the core of the reactor, the thermal energy produced is transferred to water, causing the water to undergo a phase change and turn into high-pressure steam. This generated steam is then supplied to a steam turbine connected to an electric generator. As the steam passes over the turbine blades on the turbine shaft, it utilizes the thermal energy it acquired earlier to rotate the turbine shaft. This mechanical rotation results in the generation of electricity in the alternators.

There are currently no nuclear power plants in Turkey. However, there is an ongoing construction of a nuclear power plant in Mersin, and nuclear power plants have been planned for Sinop and Kırklareli provinces, with construction expected to start at a later date.

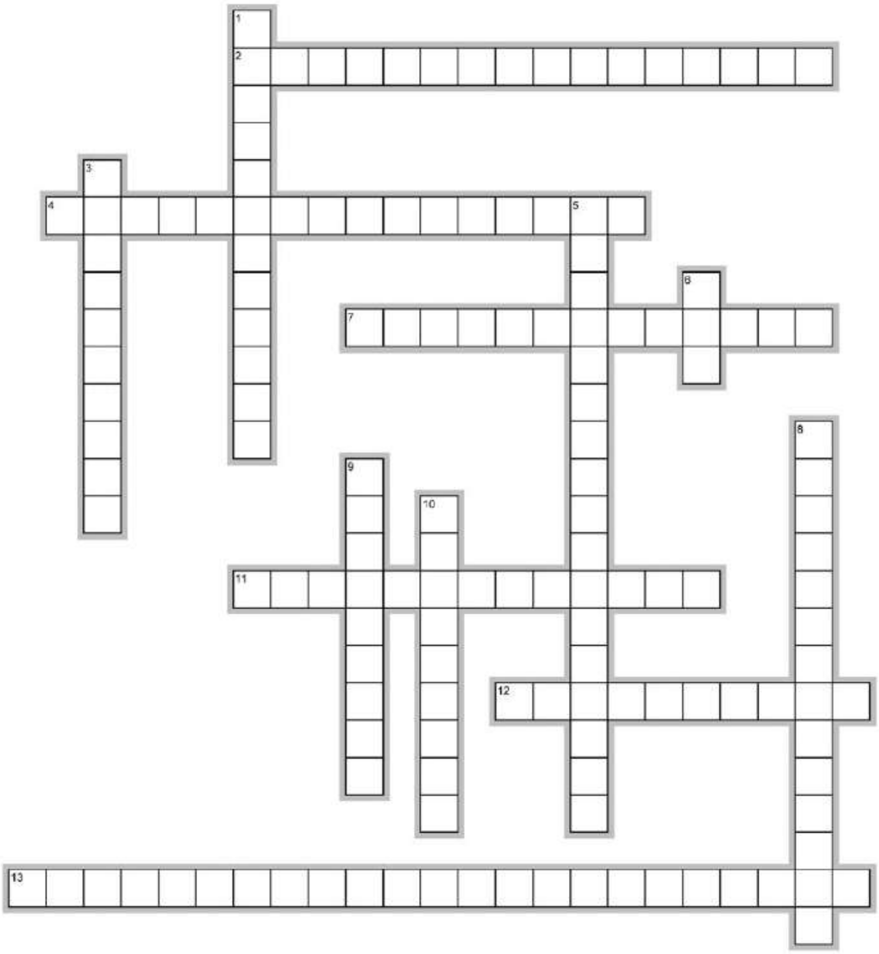
Appendix-4

What I Learned?

Self-Assessment Form	(1)Never	(2)Sometimes	(3)Often	(4)Always
I can understand the conversions of electrical energy into other forms of energy.				
I understand the concept of efficiency in electrical energy.				
I can provide examples of electric vehicles with high energy efficiency from daily life.				
I can determine the selection criteria for home appliances with high energy efficiency.				
I can list different types of electricity generation power plants.				
I can list the advantages and disadvantages of electricity generation power plants.				

Appendix-5

Puzzle



Across

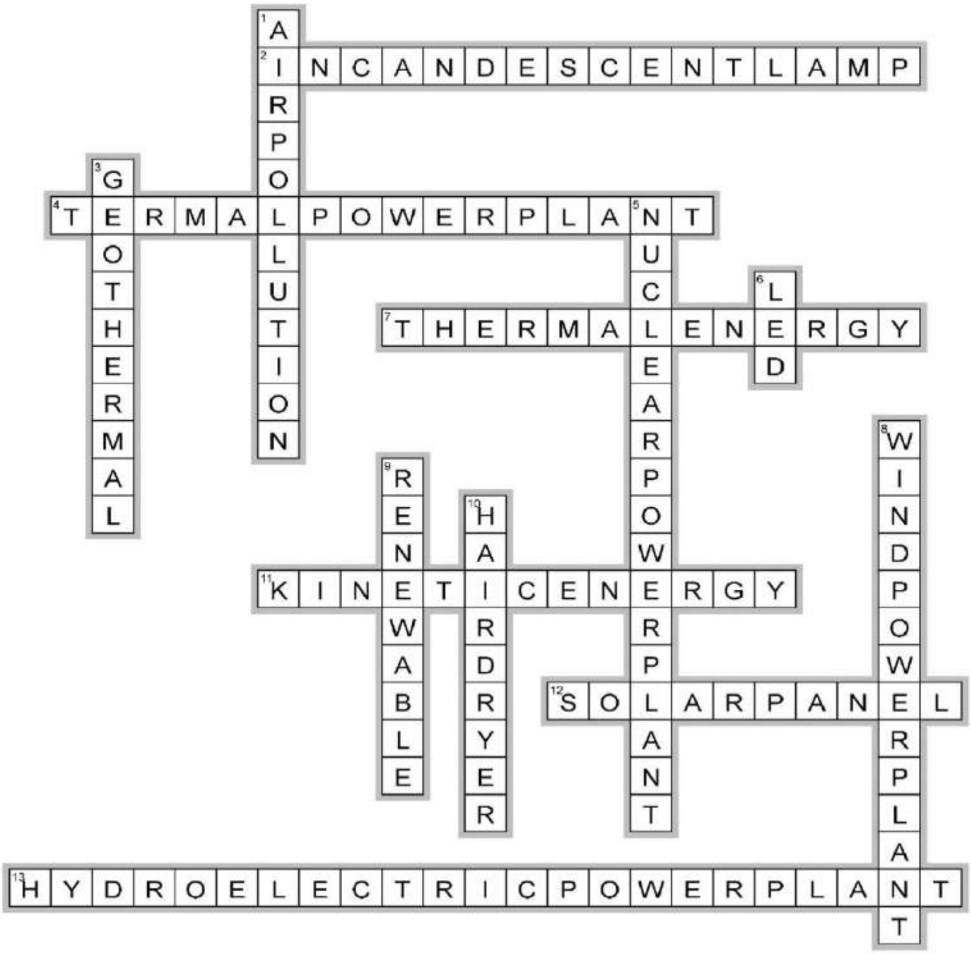
2. It is a device that converts electrical energy into both heat and light energy.
4. The electrical energy plant where water is heated by burning fossil fuels.
7. An energy type that electrical energy can be converted into.
11. Electric energy can be converted into a type of energy.
12. It is the device that converts light energy into electrical energy.
13. A power plant that operates using the kinetic energy of water.

Down

1. The environmental damage caused by thermal power plants.
3. The place where hot underground water vapor is converted into electrical energy.
5. The place where high energy in the atomic nucleus is converted into electrical energy.
6. High-efficiency, low-energy-consuming type of lamp.
8. A power plant that harnesses air movement resulting from changes in air pressure to generate electrical energy.
9. Power Plants with Periodic Maintenance for Long-Term Use
10. A device that converts electrical energy into both heat and kinetic energy.

Appendix-6

Puzzle (Answers)



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Ethical Declaration and Committee Approval

This study complied with the principles of scientific research and publication ethics. Since this study aimed to develop a lesson plan, ethics committee approval was not required.

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Proportion of the Authors' Contribution

All researchers contributed equally to this study.