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Fizik Dersi Durgun Elektrik Konusunda 5E Öğrenme Yöntemi ve Simülasyonlar İle Bir Dersin Planlanması

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Özet

Bu çalışmanın amacı fizik öğretmenlerinin derslerini 5E öğrenme yöntemi ve simülasyonlar kullanarak hazırlamalarına yardımcı olmaktır. 5E öğrenme yöntemi ilgi çekme, keşfetme, açıklama, derinleştirme ve değerlendirme olmak üzere beş aşamadan oluşmaktadır. 10. Sınıf fizik öğretim programında yer alan durgun elektrik konusu bu yöntem kullanılarak planlanmıştır. Simülasyonlar öğrencilere soyut kavramları kavratabilme potansiyeline ve deneylerdeki başlangıç değerlerini değiştirebilme imkânına sahiptirler. 5E öğrenme yöntemi içerisindeki açıklama ve derinleştirme aşamaları sırasında Colorado Üniversitesi tarafından oluşturulan PHET simülasyonlarından faydalanılmıştır. Bu çalışmanın giriş kısmında sınıflarda teknolojinin kullanımı, bilgisayar simülasyonları ve 5E öğrenme yöntemi tartışılmış, daha sonra uygulama kısmında 5E öğrenme yönteminin durgun elektrik konusunda ne şekilde uygulandığı açıklanmıştır. Sonuç bölümünde öğrenme yöntemi ve simülasyonlar ile ilgili alan-yazındaki araştırmalara yer verilmiş, bu çalışma ile ilgili ortak ve farklı yanları üzerinde durulmuştur. Bunlara ek olarak, öğretmenlere uygulama ile ilgili önerilerde bulunulmuştur.

Anahtar Kelimeler
5E öğrenme yöntemi, bilgisayar simülasyonları, teknoloji kullanımı, fizik eğitimi

Designing a Lesson with 5E Learning Cycle and Simulations for Static Electricity Subject in Physics

Abstract

The aim of this paper is to help physics teachers while preparing their lesson with 5E learning cycle and simulations. 5E learning cycle includes five phases; engagement, exploration, explanation, elaboration and evaluation. A physics lesson designed with these phases was constructed for static electricity subject of 10th grade students. Simulations have potentials to improve students' comprehension of abstract concepts and have opportunities to vary initial values in experiments. Phet simulations which were constructed by Colorado University was used in explanation and elaboration phases of learning cycle. In the introduction part of the paper, the use of technology in classes, computer simulations and the learning cycle are discussed, and then in the implementation part how to apply the learning cycle for static electricity concept was explained. In the conclusion, the other literature examples of learning cycle and simulations were mentioned. In addition to these, some recommendations for physics teachers were made.

Keywords
5E learning cycle, computer simulations, technology use, physics education

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INTRODUCTION

The use of modern teaching strategies and educational technologies are important to increase the quality of education (Reis, 2004). Because of the rapid changes in technology and new approaches in teaching methods, computer based learning activities such as simulations should be adapted in-class environments to increase interactivity (Saka & Akdeniz, 2006). Simulations are especially preferred to perform unrealized (very fast, very slow or expensive) experiments. Simulations give opportunities to students to test and observe their hypothesis by varying initial values in experiments (Şen, 2001). The use of computer simulations in physics education has a special interest because simulation environment support powerful modeling involving physics concepts and processes (Jimoyiannis & Komis, 2001). Simulations improve students' comprehension of abstract physical phenomena (Romero & Martinez, 2012) and have potential to make instruction more interactive (Ramasundarm, Grunwald, Mangeot, Comerford, & Bliss, 2005). In addition to these, simulations allow making and observing experiments, in many cases learners visualize, by their nature, invisible features (Kukkonen, Kärkkäinen, Dillon, & Keinonen, 2014). The use of simulations has a potential to increase the quality of education, at the same time, teaching method can also make a difference on instruction. Yelon (2006) states that ineffective classroom training transformed to technological media is still ineffective training; to produce effective instruction, be sure to design teaching methods well. So the teaching method and the simulations should be integrated well to each other. 5E learning cycle is well-known and easily adopted teaching strategy in physics education literature. Campbell (2000) states that 5E learning cycle supplies constructivism, conceptual change and inquiry learning in a classroom setting. 5E learning cycle is originally proposed by J. Myron Atkins and Robert Karplus in 1962 and then incorporated in the Science Curriculum Improvement Study program (Bybee & Landes, 1990). This original model consisted of three phases: exploration, conceptual invention and application (Hammermand, 2006). The final version of the cycle was developed in the late 1980's as a component of Science for Life and Living curriculum created through the Biological Sciences Curriculum Study (BSCS) group (Bybee & Landes, 1990). This group summarized these five phases as follows in their web-sites as a full report of 2006.

- Engage: this phase aims to promote curiosity and make connections between past and present knowledge of the students. Discrepant events can be used to supply curiosity.
- Explore: Conceptual change is facilitated. Students may complete lab activities, explore questions and possibilities, design and conduct preliminary investigations.
- Explain: Students' understanding of engage and explore phases is important and this phase provides opportunity to demonstrate their conceptual understanding, processes and skills. This phase also provides opportunities for teacher to directly introduce a concept and make explanations. • Elaborate: Through new experiences, teachers challenge and extend students' conceptual understanding and skills. Students use their understanding for new additional activities.
- Evaluate: Students assess their understanding and teachers evaluate students progress toward achieving the educational objectives. 5E learning cycle format is a widely used inquiry based format for science instruction and it provides a structured way to implement inquiry in the classroom (Talley, & Cherry, 2009)

In physics many subjects can be thought by using learning cycle. For example, buoyant force (Nelson & Nelson, 2015), inclined projectile motion (Ergin, 2008), force and motion (Campbell, 2000), state of matter and solubility (Ceylan & Geban, 2009). No study was found in the literature about static electricity, simulations and 5E learning cycle. The aim of this paper is to present how a physics teacher can use 5E learning cycle with simulations for static electricity lesson.

Implementation

Static electricity is a 10^{th} grade physics subject in physics curriculum in Turkey. The related objectives are listed as: Students should be able to:

- Explain the properties of electric charges
- Explain charging with electricity and compare charging of different types of materials
- Compare the charge distribution and the movement of electric charges
- Explain the interaction among charged materials

To obtain these objectives, a physics teacher can do the following activities as described below:

Engagement

A short-term video can be used to get students' attention. This video is about static electricity accident passing on an oil-station and available in web https://www.youtube.com/watch?v=bECP76c_lCw. In the video, a woman is coming to oil-station to get petrol for his car. She gets off her car and puts pumps to the car's tank. Then she turns back to car for a minute and leaves the car to get off the pump from thank. At this moment, tank and pump start to fire as in figure 1. At the end, woman starts to run while pump is firing.

Figure 1: Accident in Oil-Station Video

After watching the video, teacher can ask students some questions to explain the event;

- What happened in the video?
- Why fire started and what may cause the fire?

In the first question, students should explain their observations. They should say while the woman leaving from the car, she rubbed her hands to her sweater. For the second question, students should think static electricity and should say the fire started because of the electrification by friction.

Exploration

Teacher distributes balloons to the students who are sitting near to the wall. Teacher wants them to rub the balloons to their hair and then touch rubbing part of the balloon to the wall. Students observe that balloons are staying on the wall as in Figure 2. If students can't succeed, then teacher may use another video. This experiment is also shown in another youtube address: https://www.youtube.com/watch?v=aU5_psBT610 .

Figure 2: Staying Balloons on the Wall

After the activity is finished, teacher asks students: why do the balloons stay on the wall? Students explain with trying to static electricity, and some answers should be;

- "After rubbing, balloon got positive charges and the wall has negative charges, so they attracted each other".
- "After rubbing, balloon got negative charges and the wall has positive charges, so they attracted each other".

At this phase, students may think the charging wrongly as stated above. To explain why balloon stays on the wall, next phase of the lesson started.

Explanation

In this phase, free simulation published by Colorado university PHET team was used to explain what happens when the ballons are staying on the wall. The name of this simulation is "Balloons and Static Electricity" with internet address: https://phet.colorado.edu/tr/simulation/legacy/balloons-and-static-electricity . This simulation, shown in Figure 3, demonstrate the charges in the balloon and when the balloon is rub to the wool sweater, the distribution of charges on the sweater changes and the balloon get negative charges. Then the user release the charged balloon near to the wall and it moves towards the wall and finally it clings.

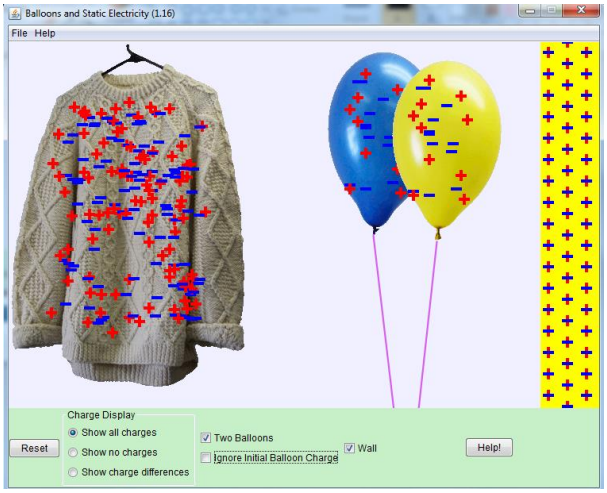

Figure 3: Balloons and Static Electricity Simulation

At this stage students observe the charge distribution on the wall and the sweater. Also teacher may change the number of balloons and show what happens when the wall is getting near to each other.

Elaboration

In this phase, another simulation again from PHET simulations was used. The name of this simulation is "John Travoltage". In this simulation, Phet team uses John Travolta's picture as in Figure 4. He rubs his foot to the carpet and then moves his finger towards doorknob. At this moment, electrons that pill up on the body starts to move from body to doorknob. Also at the same time there is sound effect in the simulation.

Figure 4: John Travoltage Simulation

After students share their observation from the simulation, this phase show the daily life example of static electricity.

Evaluation

At the last phase of the lesson, students answer the following questions:

- How many types of charges are there in the nature? What are the properties of them?
- In which season can accidents occur because of friction?
- Explain the charging of sweater and the balloons? Why are they different?
- Explain the behavior of the objects, when one is negative and the other is neutral?
- Which types of charges can move during electrification by friction?

After getting the answers from the students, teacher finishes the lesson.

CONCLUSION

This paper gives some activity examples for physics teachers to design their static electricity lesson. In the engagement part, an interesting video, accident in oil station" was used to start the lesson to attract attention of students. Yalçın and Bayrakçeken (2010) states that the aim in engagement phase of learning cycle is to promote students ask questions and videos, stories and experiments can be used. In the study of Cheng, Yang, Chang and Kuo (2016), scientific videos are used in learning cycle as stated in this paper. In the exploration phase, it was needed to explore the distribution of electric charges. Students observe that balloons can stay on the wall. In exploration phase, teachers facilitates learning and provide materials to the students (Kaynar, Tekkaya & Çakıroğlu, (2009). Similar to this paper, Aktaş (2013) states that in his study simple experiments was performed with students and new knowledge is noticed by using questioning techniques. In explanation phase, students try to reach new knowledge by using data obtained and participation of students is important (Açışlı & Turgut, 2012). In this paper, students explained both the observation in exploration phase and "ballons and static electricity" simulation. In the simulation, students can observe charge distribution both wall and the balloons. In elaboration phase, the aim is to apply new knowledge and skills to new situations (Aktaş, 2013). Teacher provides feedback and support new materials to class (Cheng, Yang, Chang & Kuo, 2016), At this stage new simulation "John Travoltage" was used in the paper. Students observe and explain a daily life event. In evaluation phase, students need to evaluate their own learning. Questioning technique was applied at this phase. Five questions that are related to objectives of Turkish physics curriculum were asked to students. Answers show the how much students access the new knowledge. As a conclusion, while applying learning cycle for static electricity subject, teachers can use simulations and 5E learning cycle together as stated in this paper. They can also add difeerent simulations from internet to their lesson. However the effect of teaching methods should not be forgotten, while adapting technology to classroom environments, so teachers carefully design their lessons.

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