TEACHING ELECTRICITY WITH A ROLE PLAY

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Abstract. This paper provides an example of an innovative science activity applied in a science methods course for future elementary teachers at a small university in northeastern Turkey. The aim of the activity is to help prospective elementary teachers understand science concepts in a simple way and see an innovative teaching example.

Keywords: electricity; role play; drama; demonstrations and analogies; school science; elementary; middle and high school science

Introduction

Many science educators see teachers' professional development as the most critical variable in science education reform (Moore, 1997; Wheeler, 1998; Moreno, 1999). The National Research Council (NRC, 1996) standards call for "substantial change in how science is taught". Teacher education programs should educate teachers to reason soundly and scientifically about their teaching as well as to perform skillfully (Fenstermacher & Soltis, 1986). Better-prepared teachers are more effective in developing higher-order thinking skills in their students and meeting the needs of diverse students through different learning approaches (Begle, 1979; Fenstermacher & Soltis, 1986). Conceptual teaching of problem solving and thinking skills, life relevancy, and life experiences are recommended by science educators (Rutherford & Ahlgren, 1990). Problem solving and thinking skills that revolve around life experience may be better taught through student-centered classrooms that emphasize process-oriented learning (Cachapuz & Paixao, 2002). Furthermore, in constructivist learning theory, every learner constructs knowledge individually. Students do not accumulate all the knowledge that is presented to them as it is. In this learning an individual's prior knowledge, individual capabilities, and learning environments are very important (Ausubel, 2000; Driver & Bell, 1986). A new knowledge has to be connected with an individual's prior knowledge so that it can have some meaning to the individual. Thus, students' prior knowledge has a great role both in accumulating and in putting in context the new knowledge that they are learning (Ausubel, 2000; Naylor & Keogh, 1999). Instructional strategies that "allow the integration of a variety of approaches such as hands-on activities,

visualization, writing, demonstrations, role play, and guided inquiry are important in bridging the gap between concrete and abstract understanding of scientific concepts" among students (Cherif et al., 1997).

Because they took very few science courses in high school, students in the science methods course were unfamiliar with the concept of electricity; this is something that needs to be pursued as we train prospective elementary teachers. When asked whether they have ever heard the term electricity almost all the students said that they did, but did not know how it is produced. All the 53 students in the science methods class were junior students in the sixth semester of their study of elementary teaching in 2014 in a small university in northeast of Turkey.

This paper is the result of an innovative introductory science activity (a role play) planned, designed and implemented by the instructor in a science methods class for elementary teachers with an aim to achieve the above mentioned science teacher education goals. The main objective was to teach prospective elementary teachers concepts in a simple but novel way. Electricity has many applications in science and is included in the National Science Education Standards (NRC, 1996). Additionally, 'teaching for understanding', as Wiggins & McTighe (1998) advocated, 'has to be every teacher's purpose in teaching'. Scientific conclusions have to be artfully interpreted by teachers and applied to particular educational situations (Dewey, 1963). In particular, students should be able to "interpret physical phenomena from a phenomenological or macroscopic, point of view and from a microscopic perspective, and to relate one to the other" (Borges & Gilbert, 1999). Based on this philosophical stance, the instructor incorporated a role-play analogy for easy understanding by the student teachers. Analogies "are used because they have the power to evoke rich, almost instantaneous, mental pictures that serve to challenge the hearer to transfer knowledge from a familiar to unfamiliar domain" (Harrison & Treagust, 1993). Moreover, this analogy could help future elementary teachers understand what the term "teaching for understanding" means by experiencing an example of teaching for understanding implemented by their instructors. A number of researchers have noted that analogies can be seen as a 'two-edged sword' in that they help students to understand difficult scientific concepts, but if not used properly they can engender alternative conceptions (Harrison & Treagust, 1993). There are also limitations to using this instructional method. Models, visual aids, role-plays are all great strategies for teaching complex science concepts, but they can never really replicate all essential components of the concept. The instructor was aware of this possibility. Finally, the focus of this activity was both to teach the concept of electricity in order for the pre-service elementary teachers to understand the concept and to show the pre-service elementary teachers how to teach the concept of electricity so the elementary school children will understand the concept.

Explaining the instructional procedure

The instructor started the lesson by writing the title *'Teaching Electricity with a Role Play'* on the board. This was to attract students' attention. Then he asked what is electricity? There were several answers from the students such as it is energy, it is a light, and it is produced inside the turbines. The instructor then asked how electricity is produced inside the turbines. There were no answers. Then he asked have you ever seen a dynamo? Some students said yes. The instructor said have you ever seen inside the dynamo? A male student said there is a magnet and copper wires. The instructor then showed an open dynamo with a magnet on the side and copper coil in the middle attached to a wheel. The instructor then showed a much simpler version of the dynamo (Fig. 1) made with tin copper cables and a nickel magnet in the middle attached to a wooden stick and rotated by hand by the instructor.

The copper wires were attached to a LED lamp. The instructor rotated the magnet and the LED lamp lighted up. Some students said wow in amazement. Most of them where seeing how electricity is produced for the first time. Some students wanted to rotate the magnet and the instructor let them do it. Then the instructor asked the class how do you think the LED light is lighting up? Some students said the magnet is doing something to the wires. Some said copper wires are taking some electrons from the magnet. The instructor said well you are getting closer; lets try to explain what is going on by making the invisible particles visible. The instructor then stated that in this lesson they will make a role-play and asked who wants to play? Most students held their hands up and the instructor selected 20 students and asked them to come forward and act as copper wire. He asked them to line up in the aisle from the front desk to the last and asked one of them to come closer to the electric light switch. The instructor then asked three students to come forward and stay close to each other in front of the class and act as magnet. In the meanwhile, all students were laughing, because students who were acting in the role-play were touching and playing with each other. Then the instructor asked another 6 students to go around the three students in front of the class and act as copper wires. The instructor then asked all the remaining students to come forward and connect the wires around the magnet with the copper wires that reach the light switch. The instructor then asked all

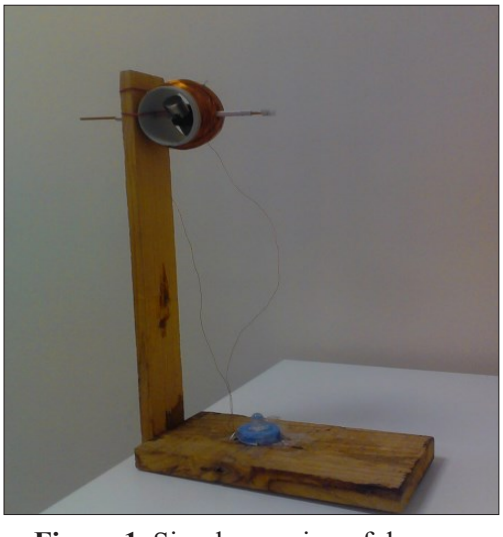

Figure 1. Simpler version of dynamo

the students who are copper wires to hold their right hands up. Some students got confused but eventually all the students held their right hands up except the three students in the middle representing the magnet. Then the instructor asked the students representing the magnet to turn around in a circle like the magnet rotating in Fig. 1. The three students representing the magnet happened to be girls and students representing the copper wires around them happened to be boys. So the instructor asked the three magnet girls to make eye contact with the copper boys around them while turning around. The instructor said that the eye contact represented the magnetic field around the girls, which affected the right hands while changing positions. The right hands represented the last electrons of the copper atoms around the copper wire and when the boys saw the eyes of the girls in the magnet their right hands started moving and hitting each other till they reached the light switch in the back of the room and the last students turned on the lights and that is how electricity transfers and reaches our homes the instructor explained (Fig. 2.).

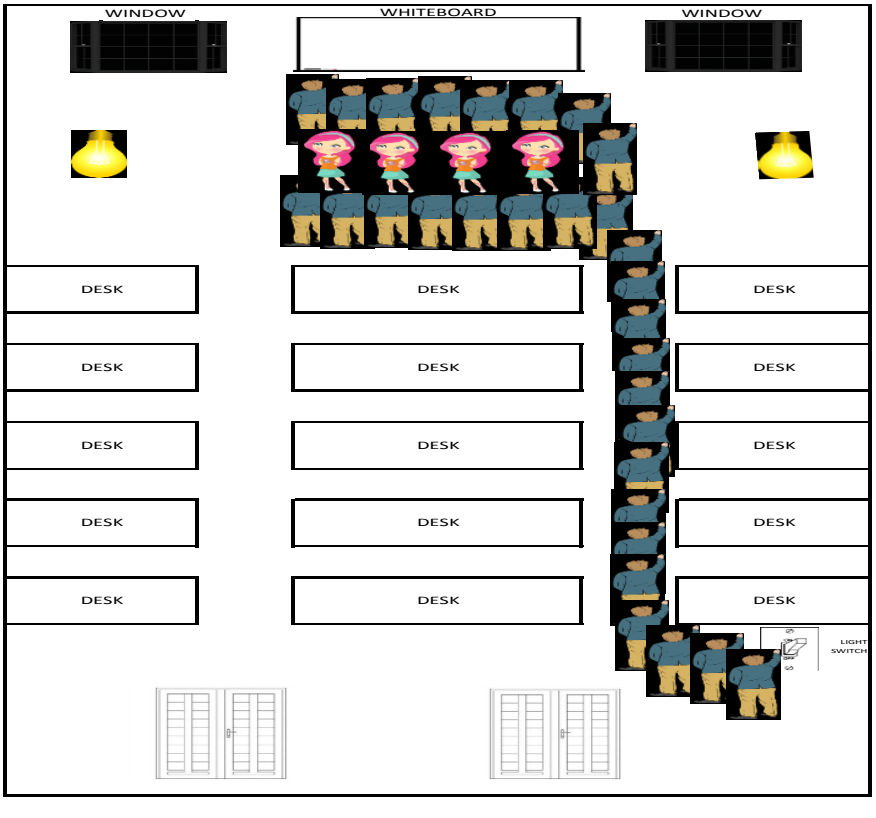

Figure 2. Electricity transfer role-play

All the students were laughing and said that they wanted to do the role-play again. Later, the instructor familiarized student teachers with the electricity concept as it was described in the textbook. Thus, there was a gradual shift from known to unknown as recommended by Lawson (1999). Students first saw how electricity is produced from the simple dynamo and the LED lamp then they become familiar with what is going on inside the copper wires and the magnet and how the LED lamp lights up. The objective of using an alternate explanation with simple terms and play was to use language and play known to student teachers that will explain the meaning of the taught concept and to give them an example of teaching with role-play so that they can use it in their future classrooms.

Evaluation

No formal evaluations, such as tests or open-ended exam questions, were conducted with participants. However, informal interviews with a few students were conducted and most of them said "for the first time I understood how electricity works" and they were "surprised to see role play incorporated in a science class." Moreover, how much the prospective elementary teachers understood the electricity concept was not formally evaluated, because the main objective of the activity was to show future elementary teachers an innovative teaching example, so that they can incorporate it in their future classrooms.

Conclusion

The instructor described the mechanisms underlined in electricity by arousing the curiosity of the students (by giving an attractive title), by sustaining their interest throughout the topic (by relating to real life activity and by using a simple turbine model), and by using simple language (appropriate to their level of understanding) (Karakas, 2008a; 2008b; 2010; 2012). The way of explaining the electricity used in this article could also be used in junior high and elementary schools and maybe even in science teacher education and high school science classes. Many science educators recommend connecting hard to understand science concepts to real life experiences. Teaching in ways described in this article supports the National Research Council's call for "substantial change in how science is taught" and also contributes to teachers' professional development practices (NRC, 1996). Teaching in ways described in this article could help science educators educate future science teachers to reason soundly about their teaching as well as to perform skillfully (Fenstermacher & Soltis, 1986). It also supports Cachapuz & Paixao's (2002) call for student-centered classrooms that emphasizes process-oriented learning, thinking skills that revolve around life experience, and presents pre-service teachers with teaching strategies that challenge their thinking and encourage them to ask questions. Teaching in ways described here gives an example of the Holmes Group's

(1986) call for vigorous modeling of student-centered and process-oriented instruction where teachers actually learn science content. Furthermore, I think every teacher should implement activities similar to the one presented in this paper in his or her own way.

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