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HANDS-ON ACTIVITY ABOUT WIRELESS ELECTRICITY TO PHYSICS UNDERGRADUATE STUDENTS

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Abstract

This paper presents a physical experiment, involving wireless electricity, in a workshop for students entering in an undergraduate course in Physics as a way to stimulate interaction between students, seeking to achieve meaningful learning through an example that can be generalized during the course.

Keywords: Undergraduate Course; Physics; Wireless Electricity; Hands-On Experiment.

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1. Introduction

The undergraduate course in Physics at the State University of Maringá (UEM), presents a high failure rate between the students during the course, as demonstrated by OGAWA (2011), causing a high dropout rate. To avoid dropouts and motivate new graduates with all the framework that the UEM Physics course has to offer, the *Tutorial Education Program in Physics* (TEP-Physics), together with the members of the *Academic Physics Center "Isaac Newton"* (CAFIN), created the "Physics Students' Beginners Week": a whole week focused on immersion and adaptation of students' beginners within the academic world.

During the week, a series of lectures and seminars on the course are held and many possibilities are presented within the undergraduate Program, in addition to various inclusion and integration activities between beginners and old's students. In order to create a greater interest in the beginners, for the "3rd. Physics' Beginners Week", it was decided to carry out a practical workshop in which the students made a small circuit and could elaborate some concepts and ideas of Physics that, *a priori*, will only be studied later in the course.

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The concept of the "Wireless Electricity" workshop was the creation and understanding of a circuit that, through alternating magnetic fields, induces electric current in a wire at a distance (NUSSENZWEIG, 2015) due to the Faraday induction effect. After the development of the workshop and the end of the week, we prepared a questionnaire to assess what the students thought of the proposed activities and how they felt after the reception.

2. Materials and Methods

Initially, a methodological script was developed to be applied to students, using slide's show and materials that would allow a better idea of the physical phenomenon that occurs during electromagnetic induction (TIPLER; MOSCA, 2015). After all the previous preparation, the students who had signed up for the workshop, formed some groups to be able to share the materials and also stimulate the interaction between the beginners. Then, each group of students received two 1.10 meter wires each, a NPN BD139 transistor, a 1.5-volt white LED, a 9-volt battery and a battery connector. So, each group started the assembly of their project, according to the circuit shown in the figura 1.

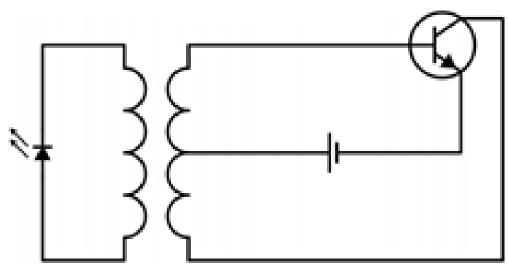

Image 1: Wireless electricity circuit

Each group assembled the first coil by wrapping one of the wires in four centimeters radius' circumferences and connecting this coil to the LED. Then, the second coil was mounted [Figure 2], in the same dimensions as the first one, with the difference that it had a small cut in its cover right in the center of the wire. This incision would allow to connect the positive part of the battery connector to the middle of the coil.

Figure 2: Details of the experimental apparatus

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Finally, one of the extremities of the coil was connected to the base of the transistor, while the other end was connected to the collector and the emitter of the transistor was connected to the negative part of the battery connector. During the assembly, TEP's students helped groups with difficulties in assembly and reduced their doubts about theories.

3. Results and Discussions

After the conclusion of the workshop and the "III Beginners' Physics Students Week", evaluation forms were delivered to the students, requesting an opinion and evaluation on all activities that occurred during the event. The students could evaluate the activities with grades from 0 to 10, with 0 being *poor* and 10 *excellent*, and, at the end, leaving comments on activities that occurred. It is possible to see in the figure [3] the evaluation's results submitted by the students regarding the workshop.

Through the analysis of the graph in figure 3, it is possible to observe that most of the participants (89.5%) rated the workshop as excellent, in addition to leaving positive comments and requests for more workshops on other subjects during the school year. One of the workshop's summary comments was: "You could do more experiments with beginners' students such as those presented in a Science Museum and the wireless electricity workshop." [Anonymous student].

This demonstrates how important and functional the application and use of workshops' Hands-on are to stimulate and develop an even greater interest in Physics and Science, in general, and that there is a positive way in fixing the students and their permanence in the undergraduate course.

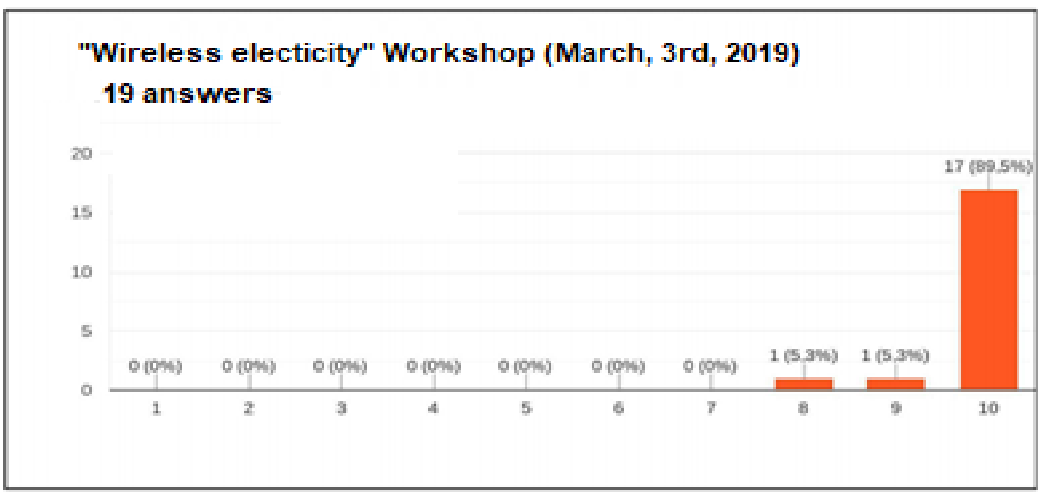

Figure 3: Answers from students who participated in the "Wireless Electricity" Workshop.

4. Conclusions and Recommendations

With the realization of this workshop, it was possible to stimulate a lot of the participation and a team collaboration of the beginners' students, in addition to building a more advanced knowledge that is only developed in the final half of the Physics course for the beginners, motivating them and demonstrating how much they can learn if they persist in Physics' graduation course.

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It was observed a great interest from new graduates in more practical activities (hands-on workshops). This is important because it motivates the TEP´s group to prepare and organize more hands-on (experimental) activities. These activities can allow a more dynamic exchange of knowledge with the students involving TEP's students to work with the research for the application of the physics' experiments enabling a field of knowledge that was once restricted to the academic environment but that can be turned to the entire external community.

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