RECENT DISSERTATIONS

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Effects of the use of the surface charge theory-based approach to understanding of direct current circuits in university studies

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Abstract

The aim of this study is to investigate how an instructional approach based on the use of the surface charge theory affects students' understanding of direct current circuits in the first year of university studies. In order to reach the aim, a new course was implemented and studied. The subject group consists of two groups; five case study students and the whole cohort (N=32) including the case study students.

The main instructional ideas of the course are based on the existence of the surface charges. They can be understood as a mechanism that causes adequate electric fields inside wires and components and consequently electron current. The surface charge based micro-level models are needed, if the connection between the domains of electrostatics and DC circuits is meant to be created. The approach explains the operation of DC circuits by using fundamental conservation principles of charges and energy.

The progress of students' understanding was studied by using both qualitative and quantitative research methods. Although the five case study students selected played a major role in this study, the whole cohort was examined as well.

The results show that the implemented course has caused a very positive response to students' learning if the occurrence of alternative conceptions and misleading reasoning models are examined. In terms of conceptual understanding the learning result was average. On the other hand, it was not disappointing even if the expectations were very high. The highest level of understanding, the theoretical one, was reached by only one third of our students. The result was predictable because at this level a student has to master almost perfectly the domain.

Based on the results of this research, the surface charge based approach can be recommended if the aim of teaching is to show and understand how complicated these so-called simple DC circuits actually are, or if a more profound explanation of the concepts of potential and potential difference is meant to be offered.

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