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Context Based Problems for Electricity Topics in Introductory Physics Courses

Tuesday 14 December 2021 11:00 (1h 30m)

Abstract. Electromagnetism topics—might seem as irrelevant for some disciplines at the first sight—can easily be related to students'home disciplines and everyday-lives by integrating relevant contexts to the topics or problems. Therefore, we would like to provide examples that integrate contexts relevant to everyday lives/future careers of students from various bachelor programs. We have been working on 18 problems in six electricity topics in various contexts. In this roundtable, we would like to work on them for further reach and practice possibilities to be able to share them with the instructors teaching introductory physics courses to non-physics majors.

1 Introduction

Many students taking a (mandatory) introductory physics course do not see the relevance of such a course. This might result in a lack of motivation for these courses. Integrating contexts from students'lives (everyday, daily/real lives) and/or their future careers—including courses in their home disciplines—might be a way to highlight the relevance of physics. Thus, some recent physics education research have been focusing on building relevance in introductory physics by collaborating with researchers from other STEM fields such as biology to design "Introductory Physics for Life Sciences"in many universities [1-5]. A noteworthy example is the University of Maryland—leading the NEXUS project and the reforms in these courses [4]. However, studies that aim to build relevance of physics for other non-physics majors are limited [6]. Thus, there is still need for concrete examples of how instructors can integrate contexts to the introductory physics courses of other non-physics majors.

Electromagnetism topics in the introductory physics courses—particularly perceived as irrelevant for many disciplines at the first sight—can easily be related to students'home disciplines and everyday-lives by integrating relevant contexts to the topics/problems. This might be a way to help students to see the usefulness of the course for their future careers and everyday lives, to stimulate their interest in the topic, and hence motivate them to learn physics. Therefore, our aim is to provide examples that integrate contexts relevant to students' everyday lives and future careers to the physics problems of various bachelor programs. In this roundtable, we would like to work on these problems and develop them further to share them with the instructors teaching introductory physics courses to non-physics majors.

We started this study by searching for contexts in the E&M course of the pharmacy bachelor program and then decided to include everyday-life contexts as we believe these are different means of building relevance, thus we believe a combination of them will enhance relevance of physics better when carefully chosen and formulated for the target group. In a preparatory phase, we conducted focus group interviews with ten instructors teaching in the pharmacy bachelor program, to determine potentially relevant pharmacy topics. Afterwards, several professors gave feedback on the problems in iterative rounds.

2 Context Based Problems Developed

We have developed 18 problems in six electricity topics. The list of the topics and the distribution of the problems to each topic are presented at the following table. Nine of the problems might be specifically relevant for pharmacy and life science majors, while the remaining nine items might be useful for the physics courses of the other groups. We would like to share these exercises with the participants of the roundtable and work on them for further research and practice possibilities.

List of problems in various contexts

Topics Contexts

1. Coulomb's law DNA strands Drug docking Pollination

Dust particles on solar panels

2. Electric field Electrophoresis X-ray (drug quality & luggage scanner)* E-reader

1. Gauss's law Membrane of a nerve cell Photocopy machine
2. Electric potential Mass spectrometry in various sciences* Thundercloud Computer Memory Chip
3. Capacitors Electroporation Red blood cell
4. DC circuits Iontophoresis Voltage divider

5. 2 different versions of the problems Acknowledgements The DiFuSeEM project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 843951. We would like to thank to the members of the KU Leuven Faculty of Science and Pharmacy Faculty for their feedback on the various versions of the problems. References [1] E.F. Redish, C. Bauer, K.L. Carleton, T.J. Cooke, M. Cooper, C.H. Crouch, B.W. Dreyfus, B.D. Geller, J. Giannini, J.S. Gouvea, M.W. Klymkowsky, W. Losert, K. Moore, J. Presson, V. Sawtelle, K. V. Thompson, C. Turpen, and R.K.P. Zia, Am. J. Phys. 82, 368 (2014). [2] C.H. Crouch and K. Heller, Am. J. Phys. 82, 378 (2014). [3] A. Nair and V. Sawtelle, Phys. Rev. Phys. Educ. Res. 15, 20121 (2019). [4] D.C. Meredith and E.F. Redish, Phys. Today 66, 38 (2013). [5] D.P. Smith, L.E. McNeil, D.T. Guynn, A.D. Churukian, D.L. Deardorff, and C.S. Wallace, Am. J. Phys. 86, 862 (2018). [6] I. Descamps, T. Moore, and B. Pollard, Phys. Rev. Phys. Educ. Res. 16, 20118 (2020).

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