GUIDED INQUIRY-BASED PHYSICS LABS FOR FUTURE ENGINEERS

YUKI KANEKO
Sabancı University, Türkiye
E-mail: yuki@sabanciuniv.edu

Traditional introductory physics labs, in which students follow step-by-step experimental procedures, fill out the data tables provided and follow the analysis procedures, often fail to engage them in high order scientific thinking while performing experiments [1]. These labs are intended to enhance the conceptual understanding level of physics topics, yet the effectiveness of such labs is unclear [2]. What then, is the role of labs in an introductory physics course for engineering students? How can labs engage them in deeper thinking and discussions for better learning?

In our uniquely-designed basic physics course for engineering students, we implemented a lab component in Fall 2025. When designing the labs, we employed a guided inquiry-based approach, in which students are provided scaffolding in designing their own investigations. The inquiry-based approach not only allows students to observe the actual physical phenomena but also challenge students to wonder and think, and help equip them with the skills for scientific investigations. We find that the "guided" aspects are necessary for our students, most of whom are novice to real scientific investigations. The students kept lab logbook during each lab, reflecting real scientific laboratory practices.

In this talk, I will share the overall design and a few examples of our labs, including prelab worksheets, lab instructions with engineering application scenarios, and individual "think and explain" questions. The preliminary results of post-semester lab survey show that the students gained confidence in their ability to design, conduct, and analyze physics experiments, while also benefiting from the labs in terms of learning the concepts. The current status and remaining challenges will also be discussed.

[1] M.S. Smith, M.M. Stein, C. Walsh, N.G. Holmes (2020). Direct Measurement of the Impact of Teaching Experimentation in Physics Labs. Phys. Rev. X 10, 011029. https://doi.org/10.1103/PhysRevX.10.011029

[2] C. Wieman, N.G. Holmes (2015). Measuring the impact of an instructional laboratory on the learning of introductory physics. American Journal of Physics, 83, 972–978. https://doi.org/10.1119/1.4931717