

Physics 'Office Hours' educational learning platform

Background

Science and engineering education faces important challenges in terms of meeting US workforce needs. The US Bureau of Labor Statistics projects that total employment in science and engineering will increase at 18.7% between 2010 and 2020. Yet, ACT college entrance exam scores show that only 36% of high school graduates are ready for college-level science course work.

New digital teaching tools have been developed to address this challenge. In fact, digital STEM classrooms are disrupting the \$16 billion educational publishing industry. Global digital educational publishing is projected to grow at a CAGR of more than 12% between 2016-2020, while the global education apps market will grow at a CAGR of nearly 35% between 2015-2019.

Existing apps for students in STEM fields, including Physics, tend to either offer a rigid tutorial format, or to offer algebraic solutions without explaining why a problem needs to be solved a certain way. There is a growing unmet need for a research-based, educational mentoring platform that stimulates learning by addressing student questions in the moment, and help users start *any* homework problem through a discipline-specific way of reasoning.

Technology

A physics education researcher at the University of Wisconsin-Green Bay has designed a novel and interactive app-based study aid platform for students in STEM disciplines. The platform's interface is built around education research into how students conceptualize problems they do not understand. It is a novel tool to help students see *why* they are struggling with a particular problem, and what might help them solve it, rather than solving the problem for them.

The team's first working prototype, the Physics Office Hours app, has been designed for use in introductory-level college physics. The app is designed to mimic a scenario students might face during 'office hours' with a professor: Rather than offering an answer, the instructor guides the students through problems via a series of questions.

While students learning physics tend to focus on using math to find solutions, most learning actually takes place while students work to conceptualize the problem itself. Education research has shown that stages of conceptualization include identifying core principles, drawing representations of problems, and selecting which formulas to apply. Only after completing these steps can a problem be solved mathematically. Students who neglect the earlier stages may find themselves frustrated or unable to start the problem at all. The Physics Office Hours app aims to correct this by meeting students where they are.

The app offers students three entry-ways into the most common responses students have when struggling with a given problem set: "I can't get started", "Something is missing", and "Wrong answer". The interface's decision tree helps students identify what physics principle to apply, the type of diagram they need, and the equation they need. Additional guidance under each of these three categories is available in the app itself. If students need more help, the app connects them with an interactive website showing a problem with the same physics principle and similar surface features.

A user-friendly online interface allows app content to be easily updated and changed over time and as more problem sets become available. In addition, the app architecture can easily be adapted to problem sets in other STEM disciplines and therefore serves as a platform technology.

Research and Development Status

A working prototype of the app and web editor has been designed for use in college-level physics. Trial use by undergraduate physics students is underway to validate the app's utility and to obtain valuable end-user feedback.

WiSys is actively seeking a commercial partner who is interested in licensing and distributing the existing app focused on Physics, expanding the platform beyond Android applications as well as further development of additional apps directed towards other STEM disciplines. Physics Office Hours is fully functional, and content and graphic design can easily be adapted to meet the needs and requirements of the end user and/or partner.

Key Technical Features

T150035 offers a fully functional app, web-based app editor as well as resource website for use in college-level physics. The app and editor can be adapted to any discipline with set approaches to problem solving. Key performance features include:

- Beta version has been developed in an Android app that can be easily updated in a user-friendly web interface (e.g. editor);
- App and editor have been developed with ability to be expanded beyond Physics to additional academic disciplines;
- An already-developed website offers backend, supplementary support for users who need additional research;
- Comprehensive user guide available (with illustrations) showing app administrators how to use the app editor and update content’;
- Current version contains over 150 problems directed towards Physics;
- App provides student support for any problem in kinematics, dynamics, rotational dynamics, energy, momentum, DC circuits, and special relativity units;
- Does not require coordination with any particular text or problem set, and offers an innovative and useful tool that complements widely used tutorial- and feedback-based physics education products such as Webassign and Mastering Physics.

Commercial Applications

- Research-based educational platform technology with utility across all STEM disciplines and any field with set approaches to problem solving such as:
 - Chemistry
 - Biology
 - Engineering
 - Mathematics

Intellectual Property

WiSys holds copyright and trademark protection around the Physics Office Hours app and platform. Access to beta version is available for evaluation by interested parties. For more information on partnering opportunities, please contact Jennifer Cook at jennifer@wisys.org or by phone at 608-316-4131.