Tools to improve at home lab experiences for STEM student

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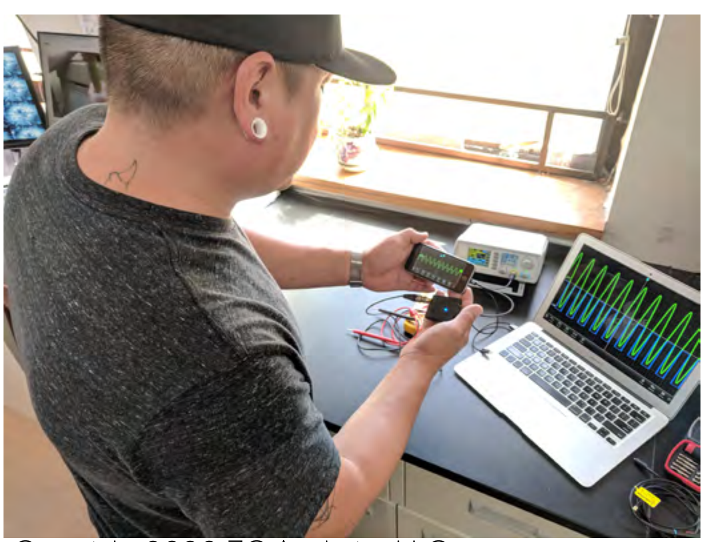
The global pandemic caused by the SARS-COV-2 novel corona virus has caused many learning institutions to abruptly change the delivery of courses from in-person to online. COVID-19, the disease caused by person-to-person spread of the novel coronavirus (SARS-COV-2; Harapan, 2020) has forced campuses to enact social distancing policies that have significantly changed the student experience. Changing to remote learning requires creating new ways to deliver content through online meeting platforms. Performing lab courses that require access to specialized equipment and resources typically found in laboratory classrooms has been particularly challenging for many STEM educators.. This challenge to move to virtual classrooms is amplified in laboratory courses requiring research performed with specialized equipment (Gage, 2019).

One of many strategies that has been used successfully in STEM disciplines to implement a remote lab course is to post videos of instructors doing the experiments, so that the students can see the methodology firsthand, and experience virtually the experiment being performed. Often the raw data produced during these experiment is then shared with the class to analyze from home. While this approach provides procedural and content knowledge, it has a negative effect on the self-efficacy of the students. Self-efficacy is an individual's belief in his or her capacity to execute procedures and practices necessary to produce successful experiments in the future. In an example from Neuroscience, DeBoer et al. 2017 demonstrated a positive change in self-efficacy was shown when students watched experiments online (control group) versus the group actively participating in the laboratories from home using the SpikerBox, a low-cost amplifier for collecting and recording biological signals. (Marzullo and Gage, 2012).

Our distance learning solutions should provide equal opportunity and exposure to cutting- edge technology to all students, underrepresented, low- income and minority included. Curricula development should be built to empower, inspire and prepare students for independent scientific inquiry in any given set of conditions. Often overlooked is the well-researched fact that active learning of STEM is especially beneficial for underrepresented students (Cervantes et al., 2015; Haak et al., 2011; Kanter & Konstantopoulos, 2010).



Many small footprint, platform agnostic, testing devices lend themselves to the remote learning environments.
Prior to the COVID 19 outbreak, distance learning in higher education, often in the form of widely accessible Massive Open Online Courses (MOOCs) have transcended the economic concerns barring underrepresented and/or low-income students from enrolling in prestigious university programs. Global annual growth of distance learning was projected at over 10% between 2018 and 2023 (Wotto, 2020). Approximately a third of all university students in the United States are enrolled in at least one online course even as early as 2012 (Koedinger et al. 2015; Keebler & Huffman, 2020).

Many believe 2020is a turning point for increased demand for distance learning. The COVID crisis will subsite however the option for students to have a high quality STEM lab experience in a remote setting will not disappear. Well founded research shows that online learning yields significantly better results when paired with hands-on activities (DeBoer et al., 2017; Koedinger et al., 2015).

At home labs for Engagement and Accessibility

The biggest challenges when moving to remote labs can be summarized in the major themes of engagement, and accessibility. Equity comes in the form of providing equal access to educational equipment/tools. Using platform agnostic devices that build upon PCs and mobile devices that students already own. Many, many STEM hardware/ software kits are available for less than $400. The Oscium iMSO software app runs on PC, Mac, iOS and Android operating systems. Most students will have a compatible device or will be able to borrow one for the at home lab portions of the course. Many campuses have developed an equipment loan program through their campus Library. Campus Wi-Fi can be used by the students to download necessary software while they pick up their kits.

Student protocols should made printable to be more accessible for home use or situations without internet. Engagement involves creating a remote learning experience that is not exhausting, one-dimensional and thus not boring to students. Finally, accessibility implies taking into consideration students' special needs and different attitudes toward technology. Care should be taken to ensure that all students have the minimal required technology to carry out their labs at home.

To address any technical or practical concerns students may have during the setup process, we suggest approaching the first at home lab session as a support call. This session should help ensure that all students can connect kits, record signals, and perform analyses on their data. Troubleshooting with individual students can be done drop in sessions as necessary. Additionally, instructors should consider holding drop in sessions at different times to provide flexible engagement to students in different time zones to address any additional technical issues.

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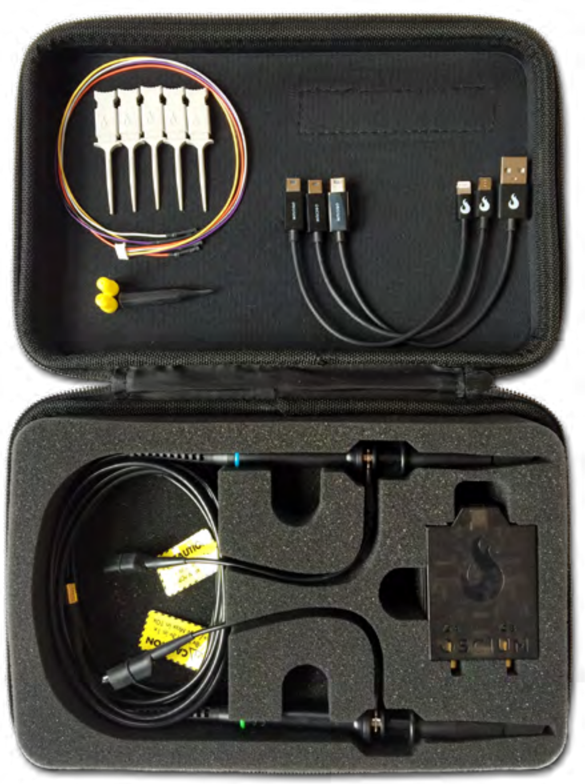

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