
Design and Development of Take-home Laboratory Kits for Enhanced Food Science and Engineering Education

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Laboratory-based courses are a vital part of food engineering and related curriculum because they help students connect theories to applications and build both practical skills and conceptual knowledge. Studies show that laboratory activities enhance students' conceptual understanding and improve cognitive growth. However, many students struggle to gain access to laboratory facilities and physical experiments for a variety of reasons, including shrinking financial resources and scarcity of expensive laboratory equipment at many universities. Further, during the COVID-19 pandemic, many institutions were forced to switch to virtual classes and halt in-person laboratory activities. The development of remote laboratories offers a promising solution to support engineering education and provide equal access to all, including students taking online degree programs and students with physical disabilities that prevent them from accessing laboratory buildings. Remote laboratories employ low-cost, take-home kits that replicate laboratory equipment using inexpensive scale models. We designed and developed low-cost yet user-friendly take-home laboratory kits for measuring a variety of performance functionalities of food packaging materials, such as water vapor transmission rates of polymeric films and puncture resistance of certain thermoplastics and paper-based packaging materials. The take-home kits included in-house fabricated components and commercially available low cost sensors. We developed a set of instructions to guide users (students) to perform experiments, collect, and analyze experimental data. The laboratory handouts also included pre- and post-lab quizzes and questionnaire to assess the effectiveness of take-home kits on student learning. A separate set of instructions were developed for the instructors to implement the remote laboratory and to collect formative and summative assessment data. We are in the process of collecting experimental data to examine the effectiveness of the take-home laboratory kits in food processing and engineering courses from the participating institutions. Findings will be presented at the conference.