Board 341: Mobile Learning in STEM: A Case Study in an Undergraduate Engineering Course

Dr. Krishna Pakala, Boise State University

Krishna Pakala, Ph.D, is an Assistant Professor in the Department of Mechanical and Biomedical Engineering at Boise State University (Boise, Idaho) where he has been since 2012. He was the Faculty in Residence for the Engineering and Innovation Living Learning Community (2014-2021). He served as the Director for the Industrial Assessment Center at Boise State University. He served as the inaugural Faculty Associate for Mobile Learning and as the Faculty Associate for Accessibility and Universal Design for Learning. He has a Ph.D. in Mechanical Engineering from the University of Wyoming (Laramie, Wyoming). He is a member of the American Society for Engineering Education (ASEE). He is the recipient of David S. Taylor Service to Students Award and Golden Apple Award from Boise State University. He is also the recipient of ASEE Pacific Northwest Section (PNW) Outstanding Teaching Award, ASEE Mechanical Engineering division's Outstanding New Educator Award and several course design awards. He serves as the campus representative (ASEE) for Boise State University and as the Chair for the ASEE PNW Section. His academic research interests include innovative teaching and learning strategies, use of emerging technologies, and mobile teaching and learning strategies.

Maeve Bakic, Boise State University
Dr. Diana Bairaktarova, Virginia Tech

Dr. Diana Bairaktarova is an Assistant Professor in the Department of Engineering Education at Virginia Tech. Through real-world engineering applications, Dr. Bairaktarovaâ€™s experiential learning research spans from engineering to psychology to learning

Dr. Devshikha Bose, Boise State University

Devshikha Bose, Ph.D., is a Senior Educational Development Specialist at Boise State University, Idaho. Her academic research interests include just-in-time learning, online learning, flipped classrooms, hybrid learning, video-based learning objects, social media,

Mobile learning in STEM - A case study in an undergraduate engineering course

In order for educational outcomes to improve and expand in the modern era, a student-centered educational system is needed. Technology enabled pedagogy has helped immensely during the pandemic times when a rapid transition to remote learning was essential. This poster describes the preliminary findings from a quasi-experimental mixed methods study on implementing mobile devices (iPad and Pencil) and a technology-enhanced curriculum in a foundational undergraduate engineering class. The technology-enabled curriculum was fully integrated in a thermal-fluids course to deliver content and to facilitate student engagement with the content, instructor, and fellow students. This approach leveraged the social-constructivist learning theory: a connected community of learners with classroom peers and co-construction of knowledge where the instructor's role is that of a subject matter expert who facilitates learning. To examine the impact of mobile devices on student learning in this two-year study (year one fall 2021 - spring 2022), the following research questions were addressed, hypothesizing improvements in the areas of engagement, enhancement of learning outcomes, and extension of learning to real-life engineering scenarios: (1) Does mobile device use facilitate engagement in thermal-fluid science course content? (Engagement), (2) Does mobile device use increase learning of identified difficult concepts in thermal-fluid science courses as indicated by increased achievement scores? (Enhancement) and (3) What are student perceptions of using mobile devices for solving real-life problems? This poster will provide an overview of the research plan and describe year 1 results and some preliminary research efforts based on year 2. This work is supported by the NSF: Research Initiation in Engineering Formation (RIEF) (Award#2106345).

Major Project Goals

To address the three primary research questions, achieve the project goal, and gain competency in social science research, the PI Dr. Krishna Pakala, a faculty in a traditional engineering discipline in a midwest university is working with the PI and mentor, Dr. Diana Bairaktarova a faculty and a researcher in engineering education, to complete the following objectives: collaborate on research study methods, implement study 1, analyze and report on study 1, revise and implement replication of study 1, synthesize and disseminate the outcomes and recommendations for study 1 (fall 2021 - spring 2022) and the replication of study 1 (fall 2022 - spring 2023).

Research Instruments

In order to answer the research questions of the study associated with this project, in both fall 2021 and spring 2022 data was collected using 5 instruments to complete Study 1 of the project (IRB#126-SB21-104). The instruments were the following: pre and post semester thermodynamics

concept inventories, post semester survey, classroom observations, post semester student interviews, post semester student project evaluations.

Significant Results

Below we report preliminary results gathered through each of the data collection instruments for study 1 in the first year of the project. Year 2 results (fall 2022 and spring 2023) will be included in this poster as well, after analysis in the upcoming months:

1. Pre and post semester Thermodynamics concept inventories: The students who utilized iPads in the spring 2022 section (n=42) overall saw a larger increase in performance compared to students in the fall 2021 section (n=28). A higher gain-mean score for their Pre vs. Post Concept Inventory was seen, as well as higher percentages on the Midterm Exam and overall final grade.

2. Post semester survey: In spring 2022, when students used mobile devices for learning. Most students (n=38) reported that the ipads were a huge help for their learning. Specifically, in saving them time and enabling them to interact with notes, more than possible through paper and pen.

3. Classroom observation: Classroom observers noted that in spring 2022 (n=42), when students had access to mobile devices, they were able to engage more effectively with learning. The technology allowed them the ability to communicate complex problem solving strategies and apply them in real time. Mobile devices enhanced learning, more than was possible through pen and paper, and facilitated extension of learning, meeting the criteria of the Triple E Framework.

4. Post semester student interviews: Student feedback especially in spring 2022 (n=10), when students had access to mobile devices, indicated that their access helped increase engagement with peers and course content, course concept understanding, and real life problem solving.

5. Post semester student project evaluations: In spring 2022 (n=42) when students used mobile devices, three evaluators assessed each presentation group on: professionalism, visual aids, presentation content, extension of learning using technology, and ability to answer questions. The evaluators agreed or strongly agreed that in 83% of the presentations, technology use created opportunities for students to learn outside of their typical school day, thus extending learning beyond the classroom. 78% of the presentations showed that technology created a bridge between students' school learning and their everyday life experiences, thus enhancing learning by connecting learning goals with real life experiences. Technology was used in 76% of the presentations, in a way that allowed students to build authentic, life soft / professional skills.

Impacts

The findings from this research have the potential to be transformative in that it will be one of the first to offer full integration of mobile devices in the teaching and learning of thermal-fluid science in engineering. In doing so, this research study will determine whether mobile devices, as compared to traditional paper-based tools, can facilitate and increase student engagement in the thermal-fluid science course and enhance the learning of difficult engineering concepts.