WORKSHOP

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Designing Pedagogically Sound Laboratories

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OVERVIEW OF THE WORKSHOP

Over the last decade remote laboratories have emerged as valuable educational resources, providing the potential for improved educational outcomes, student flexibility, richer laboratory experiences, and cross-institutional resource sharing. Recent work has seen the successful establishment of a national laboratory sharing initiative. While there has been increasing attention given to the pedagogy that underpins the use of remote labs, the focus on the design of the lessons that take advantage of remote laboratories has been much more limited. Especially, the shared laboratories have been limited by a lack of a mechanism for systematically guiding students through laboratory lesson guides (sometimes also known as lesson plans) that aim to structure their learning.

In an effort to move towards this, we have been exploring approaches for developing pedagogically-sound student lab guide through creating lesson templates that capture best practice in laboratory-based learning. The hypothesis is that a sound lesson guide design will fill the existing gap in laboratory pedagogy, and mediate the student laboratory experience with the laboratory rigs from cradle to grave (Lowe et.al., 2012). In this quest to explore what makes a good laboratory lesson guide and what is good practice, we have elicited key factors that might contribute to best practice in laboratory lessons from pedagogical literature, exemplar lesson guides (from a variety of laboratories), subject matter experts (SMEs) and end-users (students).

We collected and carried a preliminary review of the exemplar lesson guides in-house. We also carried out a detailed literature search. In eliciting expert inputs, we followed a hybrid approach, combining open holistic evaluation that gave the expert freedom to generate their own criteria followed by more structured evaluation where provide criteria that we elicited from the literature. Subsequently, we also interviewed the experts to understand and elicit contextual factors that might influence the laboratory design, as well as the interdependencies between laboratory design factors. Inputs from end-users (students) were elicited via a focus group based evaluation containing both structured elicitation and an idealized design exercise, as well as through crowd-sourcing from a large number of interested students. Based on these factors, we developed proof of concept laboratory lesson guides suitable for remote laboratories. We have integrated such lesson guides with a Learning Management System (LMS) (in this case Blackboard) and remote laboratory rigs to provide for automated linkages between stages of the lesson guide and the physical laboratory session. We have also developed generic guidelines for designing effective laboratories, be they are remote labs or physical labs.

This workshop will focus on sharing the outcomes of this previous work on laboratory lesson guides, and using it to explore how student laboratory practices can be enhanced. Participants will be engaged in a dialogue around laboratory activity best practice, and will be shown how using design heuristics can be used to improve practice in the context of a set of adaptive lesson plans for remote laboratories.

ACTIVITIES

The workshop will consist of the following activities:

- The participants will be introduced to the context, the background as well as the design factors/ elements for the generic labs and the context in which the factors might be applicable (or not applicable). The participants will have an opportunity to explore and revise these factors and evaluate their relevance.

- Then, the participants will be introduced to the laboratory lesson design guidelines. The participants will have an opportunity to reshape the guidelines.
- Finally, the participants will have hands-on introduction to a sample of remote laboratory lessons (will involve demonstration and guided participation through remote laboratory software and lessons) that were designed to exhibit some of the design elements or guidelines. The participants will have an opportunity to discuss the application of such principles in remote laboratory context in their own labs or related labs.
- Workshop will end with organizers summarising the findings at the end.

TARGET AUDIENCE

The workshop is suitable for all researchers and practitioners interested in the fields of engineering or science education. There is no prior knowledge required to participate in these workshops.

OUTCOMES

The workshop will have two outcomes, aimed at two parties to the workshop:

- For the participants, it is an opportunity to learn about, gain first-hand experience, as well as contribute to, pedagogically sound remote labs as well as general guidelines for developing laboratory lessons.
- For the workshop facilitators, it gives the necessary feedback about the laboratory lessons as well as laboratory guides developed.
- For the general readers, it kicks starts the discussion of issues pertaining to remote laboratories as well as designing laboratory lesson guides.

REFERENCES

Lowe D., Bharathy G., Stumpers B., Yeung H. (2012). *Laboratory Lesson Plans: Opportunities Created by Remote Laboratories*. REV2012 - Remote Engineering & Virtual Instrumentation. University of Deusto, Bilbao, Spain July 4 - July 6, 2012.

KEYWORDS

Pedagogically-sound Laboratory Lessons; Remote Laboratories; Laboratory Lesson Design.

PRESENTERS BACKGROUNDS

Professor David Lowe is the Associate Dean (Education) in the Faculty of Engineering and IT at University of Sydney. Formerly, he was the director of the Centre for Real-Time Information Networks at the University of Technology, Sydney, where he currently holds a visiting professorship. He is the CEO of The Labshare Institute – a not-for-profit company that is focused on promoting the national sharing of teaching laboratory infrastructure using remote laboratory technologies. He is also the President of the Global Online Laboratory Consortium. He has active research interests in the areas of remote laboratories, distributed systems, and real-time control. He is also one of the Principal Investigators for the ALTC/OLT project on laboratory lesson plans that led to this workshop proposal.

Gnana Bharathy is a project manager for the above ALTC project, and has experience centered on modelling and simulation of social, environmental and socio-technical systems for enhancing the decision making capacity of the individuals (educational games), organizations (e.g. Banks), and policy makers (e.g. US Govt agencies, DARPA, NZ Govt organizations). Gnana pursues both qualitative and quantitative research.

Ben Stumpers is a research assistant on the ALTC project. He has a bachelors degree in mechatronics engineering from Curtin University, and has strong interests in engineering education.

Steve Murray is a senior lecturer in the Faculty of Engineering and IT at the University of Technology, Sydney. Steve's professional background includes industrial computer systems development in Australia and the UK. As well as developing and delivering a great number of undergraduate and postgraduate coursework subjects, and completing a term as Program Head of the Computer Systems Engineering and Software Engineering programs, he has authored and co-authored several papers and a book chapter on topics related to remotely accessible laboratories. He was the team leader of a group which was honoured with a UTS Teaching Award in 2005 for work in this area, and received a 2006 Carrick Citation for work on remote laboratories. He is also one of the Principal Investigator for the ALTC project that enabled the investigation pertaining to the project.