FINAL REPORT

LITRE: Interactive Modules for Undergraduate Laboratory Preparation

Kara Peters, Eric Klang, Chau Tran

Overview

For this LITRE project, interactive modules were prepared by a graduate student for two of the laboratory sessions in MAE 405: Continuous Vibration Analysis and Analog Control (Integral and Derivative Operations). These interactive laboratory sessions are to be completed by the students after attending the lecture but prior to attending the in-class laboratory session. The goal of these interactive sessions is to increase the student learning in MAE 405 by motivating the particular laboratory session through applications, placing it in context within associated course and engaging the students through active participation prior to the hands-on laboratory work. Each module was composed of a PowerPoint series of slides emphasizing figures rather equations to demonstrate an example for which the material learned in the particular laboratory session could be applied in practice. Additionally, interactive Maple and MATLAB based files were included to allow the students to see the effects of varying certain parameters in the example. For example, one of the modules demonstrated the vibration of sail for a sailboat and a circular drum. The student could then change the aspect ratio of the sail or mode number to visually see how the vibration changed. Each laboratory module also contained an online quiz for which the student needed to complete the questions correctly prior to attending the in-class laboratory session. Finally, each laboratory module was prepared so as to be easily transferable to other undergraduate laboratory courses.

Two important changes were made to the original proposal for the development and assessment of these interactive laboratory modules. The first is that since the original LITRE proposal was written, new instructional methods were separately implemented in MAE 405, independent of the LITRE project, such that the weekly laboratory lecture attended by students from all sections has been replaced by a video lecture. This video lecture is to be downloaded by each student and viewed prior to the laboratory session. Also, these video lectures were created in the WebVista system, whereas the laboratory modules were created using the WebAssign system. This requirement to use two separate systems created some frustration amongst the students as will be explained later in this report.

The second important change was that after both modules were created, it was determined that the simulations of the Analog Control module required the students to run MATLAB files, for which many of the students had not previously had experience. Therefore, it was decided to not assess the Analog Control module, but instead to limit the assessment plan to the Continuous Vibration Analysis module so as to better evaluate the future potential for the modules. Modifications to the Analog Control module will be made in the future to make it more accessible to the students.

Assessment Plan

Two sections of MAE 403 (fifteen students per section) where chosen for assessment in the Spring 2007 semester. These two sections were taught by different TAs to provide varying data sets. For each section to be assessed, a second section taught by the same TA but without the interactive modules were used as a control group. For assessment of the student work, each TA graded both sections combined (both the experimental and control groups) of the other TA's classes so that the placement of a particular student in the experimental or control group was blind to the grader. Assessment data was collected through the completion of the on-line quiz, the graded lab reports, a TA questionnaire and a student questionnaire (for the experimental groups).

The specific learning outcomes to be assessed for the Continuous Vibration Analysis module were:

1. Student must be able to write the boundary conditions for a continuous cantilever beam.
2. Student must be able to generate the first four mode shapes for the cantilever beam using a simulation software such as MAPLE.
3. Students must be able to extract the corresponding nodal points for each of the mode shapes from the simulations.
4. Students must be able to qualitatively predict the mode shapes and natural frequencies for the continuous beam subjected to other boundary conditions.

The first three were to be collected from the on-line quiz data, while the fourth was to be collected from the graded lab reports.

Assessment Results

One hundred percent of the students in the experimental groups completed the on-line quiz successfully (multiple completions to pass the quiz were allowed), indicating that the first three learning outcomes were achieved by the members of the sections using the laboratory modules. These outcomes could not be assessed for the control groups.

More emphasis was placed on the fourth learning outcome, as this could be evaluated for both the experimental and control groups. For this outcome, data was collected based on the Analysis and Discussion portions of the written laboratory reports, for which a score was given on a scale of 1-10 with 10 being the highest score. The specific results were:

	TA	
	1	**2**
Control Section	9.28	8.7
Experimental Section	9.88	9.5
% Change	+ 6.5	+ 9.2

Both sections therefore demonstrated an increase in the success of this learning outcome.

On the other hand, the student response to the questionnaire was mixed. Many of the students had difficulties negotiating WebAssign which created frustration. The most common comment was that the time requirements to prepare for the lab, complete the lab and then write the lab-report were more than should be necessary for a one-credit hour course. There also appeared to be some confusion amongst the students as to whether the WebAssign interactive laboratory module was designed to replace the laboratory video lecture, which was not its intention.

Some example student comments were:

> *Yes, lab module sparked some interest. I didn't like the maple files but WebAssign worked easily.*
>
> *I like the extra material given to help answer the questions.*
>
> *The actual lab is the only important part. The laboratory module should be extra material that students can take if they don't understand concepts….. students should be expected to learn on their own….. If students don't understand it should be up to them to supplement their studying.*
>
> *I feel I would learn better if I could peruse lab information at my own pace.*
>
> *I did not like that I had to make calculations for the quiz.*

The response from the TA questionnaire confirmed those from the student questionnaire. Generally, they reported that the logistics of running the WebAssign module created frustration and extra time for the students and did not show a noticeable difference in student learning between the experimental and control groups. One TA did mention that there was a significant difference in attitude towards the class in general between the two sessions from the beginning of the semester, making it difficult to compare them. Furthermore, one of the TAs commented, "most of them commented that they answered the WebAssign by trial and error without going over the extra material and still were able to get a full grade." This would appear to negate the assessment of the first three learning outcomes.

Conclusions

As implemented, the interactive laboratory modules have the potential to increase student learning, however the logistics were frustrating for students. There was not an apparent change in the interaction between the students and TAs during the laboratory hands-on laboratory session. Some of the student frustration could be eliminated by introducing the particular on-line system to be used at the beginning of the semester and integrating the interactive modules in the video lectures for the laboratory sessions. In a separate survey, not part of this LITRE project, the students appeared to have adapted to the WebVista lectures well and indicated that they preferred these to the original in-class weekly lectures. Better coordination between these two activities would decrease the time required for each student to cover the same material.