ENSURING CONTINUITY AND ENHANCEMENT OF LABORATORY EXPERIENCE FOR UNDERGRADUATE STUDENTS

Manohar R. Kulkarni S. Sudarsan Teo Kia Moh
Associate Professor Graduate Assistant Undergraduate Senior
Department of Mechanical Engineering and Energy Processes
Southern Illinois University, Carbondale, Illinois, USA
(618)-453-3221
kulkarni@siu.edu

1.0 ABSTRACT

In Fall of 1997 the author was assigned to teach a laboratory course entitled, "Thermal Measurements Laboratory". This was his first time teaching the course. In prior two years the course had been taught by three different instructors and among those three instructors only one was still on the faculty. To make the matters worse the laboratory had to be relocated and over the years it had become a 'holding-place' with sharing of some equipment with another department within the college. While a new course assignment is not a cause for alarm for a lecture course, it was problematic for this laboratory course especially under this particular set of circumstances. With the support from department chair, the author carried out a number of activities to ensure the continuity of laboratory experience. Further, steps were taken to enhance this experience via updating of the equipment and revision of the manuals. New experiments were designed and introduced. Students, both a graduate and an undergraduate, were utilized in different capacity. Details of these activities are reported in this paper with a particular emphasis on continuity.

2.0 THE COURSE

As mentioned before, in Fall of 1997 the author was assigned to teach a laboratory course entitled, ME-401: "Thermal Measurements Laboratory". This is one of our required laboratory course. It is a one credit hour course that all Mechanical Engineering students have to take. The course is a study of basic measurements used in thermal sciences. It covers calibration techniques for temperature and pressure sensors, thermal measurements under transient and steady-state conditions. The applications include conduction, convection and radiation experiments. Emphasis is also placed on uncertainty analysis, handling and reduction of data. There is only one pre-requisite viz. Heat Transfer Fundamentals.

The Fall 1997 was author's first time teaching the course. Additionally, in prior two years the course had been taught by three different instructors and among those three instructors only one was still on the faculty. To make the matters worse the laboratory had to be relocated just before the semester began, there was some sharing of equipment with another department within the college and over the years the laboratory had become a 'holding-place'! While a new course assignment is not a cause for alarm for a lecture course, it was problematic for this laboratory course especially under this particular set of circumstances.

During relocation some of the experimental setups got damaged or broken. We also came across a lot of unidentified or unidentifiable pieces of equipment and electronics. There was neither the centralized cataloging nor the collection and organization of various instruction/operating manuals. The existing laboratory manuals were written in 1987, before the days of computers, and that they were in English system (not SI) of units! It is needless to state that the teaching of this course during Fall 1997 was not the optimum. However, the author and his graduate assistant tried to minimize the hardship to the students.

Then during the Spring 1998 semester with the support from department, the author carried out a number of activities to ensure the continuity of laboratory experience. It should be noted that this laboratory course was not offered during the Spring semester and that the author initiated and volunteered to carry out theses activities on an overload. This activity was in addition to his full teaching load for the Spring-98 semester which was: ME-402 (3 credit hours) and ME-502 (3 credit hours). The ME-402 was a new course for the author and he also participated in a team-

taught course, "Friction Science & Applications".

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3.0 UPDATING

The author made a request for a 1/4 time graduate assistant during the Spring semester for updating and modernizing the ME-401 (Thermal Measurements Laboratory) lab. Since the laboratory course was not being offered during the Spring semester this request was rather unusual. But after some discussion the department chair expressed his support for this. He also gave us a commodities/equipment budget of $2,000 and a computer.

The lab had been moved to a new room which was larger and better suited for the course. During the move some equipment had gotten damaged. The first thing that we did was to make a complete inventory of all the pieces of equipment. Then we planned our Spring semester. The major activities planned were:

1) To update the handouts/manuals for the various experiments. Most of these were written by an emeritus faculty in 1987. The handouts and illustrations were to be modified to make them current with the present practice of **SI units** and the use of computers for data acquisition, analyses & reporting.

2) To carry out the necessary repairs to bring existing experiments in good working order.

3) Last Fall the author had managed to introduce a new experiment on Transient Heat Conduction. But the experiment needed to be brought to the professional level in terms of the set-up.

4) Time permitting, to design and develop one or two new experiments.

Most of these tasks were accomplished with help of the dedicated 1/4 time graduate assistant. However one undergraduate student was also utilized for designing and building a new experiment. This particular student needed one *design* hour in addition to his usual course load. When he approached the author about a one hour ME-492: "Special Research Investigation" project the author had him develop, design and get built in the machine shop a new experiment on Fin Heat Transfer. He did a very good job and picked up a good experience along with the needed one design hour.

At the end of the semester he wrote and we quote, "The hardware of the fin experiment has been made. I have just finished setting up the experiment and it will be run for the first time tomorrow morning. I will pick up the steady state data and calculate the corresponding results by afternoon. On Friday, I will submit the calculations and results to you. Due to time limit, only one , at most two, experiment(s) will be conducted. In the experiment, copper rod with known
thermal conductivity will be used as a standard to find out the k value of the aluminum. Thank you for this design project. I learnt a lot about designing especially after the first Fin rod broke due to high stress!"

4.0 CONTINUITY OF EXPERIENCE

Since the author experienced the impact of discontinuity he bought a video camera and video taped all the experiments and also documented the various laboratory pieces of equipment, their usage and care. Each experiment was put on a separate video tape. The taped experiment also came with the lecture and demonstration from the author. These tapes should be very helpful to the next person who may teach this course. They should also be helpful to train the new graduate assistants about the workings of the laboratory course. Additionally if a student were to miss a lecture he or she can now view the tape before coming to the lab to do the actual experiments. Efforts are underway to put these video tapes on a CD and also on the web!

5.0 CONCLUSIONS

In many universities, a one credit hour laboratory course is typically not given the full attention as compared to a three credit hour course. Many times the course assignment is "rotated" among various faculty to lighten up their teaching load. This is not desired from the point of consistency and continuity of a laboratory experience. The equipment and all the probes etc. need to be well

maintained and documented. The author would advise against the frequent rotation of the assignment to teach a laboratory. The effort required to properly deliver a one hour laboratory course should be recognized at the same level as that of a three credit hour lecture course. For this recognition the faculty should be encouraged to design a new experiment every semester when the course is taught. Over the years this will lead to a comprehensive collection of a variety of experiments in good working order with the proper documentation.

Use of video taping may prove to be beneficial. However, the pitfall of replacing a faculty-in-charge by the video tapes should be avoided! The laboratory should not be conducted just with the video tapes and a graduate assistant. It should be realized that the graduate assistant will be graduating and the continuity of lab experience will be placed in jeopardy every time he or she graduates.