2006-1240: INCORPORATING PEER ASSISTED LEARNING INTO A BIOMEDICAL ENGINEERING INSTRUMENTATION AND MEASUREMENT LABORATORY

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Incorporating Peer Assisted Learning into a Biomedical Engineering Instrumentation and Measurement Laboratory

Abstract

The Biomedical Engineering (BME) 315 Instrumentation and Measurement Laboratory class was created to expose BME students to biological instrumentation and measurement laboratory modules. This is a time intensive laboratory class where both the instructor and teaching assistant are required in the laboratory at all times. Often times, having one teaching assistant is insufficient to interact with the more than 30 students (in multiple sections). In order to enhance the student experience, we introduced the principle of Peer Assisted Learning (PAL) into our laboratory class. The main objective of the PAL system is to provide a student-to-student support system. We invited six senior students who had completed the class to act as "BME mentors". The BME mentors' main responsibility was to interact with the students. They did not "teach" the subject and they were not to provide the students with "quick answers" but provide guidance. The mentors also played a key role in assisting the instructor in evaluating the effectiveness of the lab module. They enhanced the interactions with the students and promoted an effective cooperative and collaborative laboratory learning environment.

Introduction

Biomedical Engineering (BME) is a diverse area of study for which a student needs to be familiar with various engineering principles as well as biology and medicine. To deliver the knowledge and skills necessary, the BME 315 Instrumentation and Measurement Laboratory class was developed. Traditionally, an instrumentation laboratory class focuses on transducers and electrical instruments, similar to an Electrical Engineering Laboratory class. While this traditional instrumentation class is important for all engineers, BME students need to be exposed to biological-based measurements. According to the Accreditation Board for Engineering and Technology (ABET), a bioengineering laboratory experience must include an emphasis on solving "the problems at the interface of engineering and biology"[1]. The main focus of this laboratory class was to introduce and apply basic engineering principles and tools to biological systems.

This class is the first time that our students are exposed to various engineering concepts and their hands-on application to biological systems. In this class, the students performed six experimental modules each of which involved at least three hours of laboratory time. The students wrote technical papers and gave a 20- minute oral presentation after each module. Hence, this is a time intensive laboratory class where both the instructor and teaching assistant are required in the laboratory at all times. It is inadequate to have one teaching assistant to interact with the more than 30 students.

Another challenge with graduate students as teaching assistants at our institute is that they often have a limited background in the many areas of BME. Most BME departments in the US have focused BME specializations meaning that, depending on the particulars of their undergraduate program, some graduate students themselves do not have the appropriate background to be effective teaching assistants for this laboratory class. For example, a person might have a strong electrical engineering background but a limited biological background or vice versa. Even though the instructor makes every effort to recruit the best teaching assistant, it is difficult to find a graduate student that can interact and assist all students effectively in all experimental modules performed in BME 315. In order to enhance the student-mentor interaction, we introduced the principle of Peer Assisted Learning (PAL) into our laboratory class.

Peer Assisted Learning (PAL)

PAL is a well established educational tool in many different levels of schools and universities. It was first introduced in 1973 at the University of Missouri- Kansas City[2]. Since then, the technique has been adopted by over 350 different departments at the university level[3]. The basic principle of PAL is to develop a student-to-student support system in which "Student Leaders" will help their peers improve their understanding of the subject matter. Student leaders often lead group discussion sessions, offer advice on the subject matter and share their own experiences. Based on this principle, we have implemented PAL into our laboratory class.

BME Mentor Recruitment

The student leaders or "BME Mentors" were recruited at the end of the spring semester of their junior year. They completed the BME 315 in the fall semester of their junior year. The process of selecting BME Mentors was based on an application, academic performance, their ability to attend the laboratory class time as well as weekly group meeting with the instructor and their desire to be a leader. The instructor evaluated applications and gave priority to students meeting the above criteria. We invited six seniors to be BME Mentors last year.

BME Mentor Responsibilities

The BME Mentors' main responsibility is to interact with the students. They do not "teach" the subject and they are not to provide the students with "quick answers" but rather guidance. Based on their previous experience in BME 315, they are to encourage students to try different methods, troubleshoot the equipment and share ideas. Each Mentor spends at least three hours in the laboratory with the students. We had three BME Mentors, a teaching assistant (same for both sections) and instructor present at each of two laboratory sections. The Mentors helped the graduate teaching assistant set up the experimental modules as well as clearing of the setups. Since we had six experimental modules, each BME Mentor was responsible for one module. He/she organized and led the module.

The Mentors also attended the oral presentations and facilitated discussion of the data. After each experimental module, two groups were selected to share their results. The student group presented a 20-min Power point presentation followed by discussion and questions. Both instructor and the Mentors led the discussion of the data and implication of the results.

Another responsibility of the BME Mentor was to assist the instructor with the assessment of the laboratory modules. Implemented this year, each laboratory module has three assessment tools: pre- and post-experiment tests, hand written feedback forms and a quantitative survey. The pre- and post-experiment tests are designed to assess if the students understand the key concepts. The pre-test is given before the laboratory module to gauge their basic understanding of the subject. The same test is given at the end of the laboratory module (post-test) to measure their hopefully increased level of understanding. We also have a feedback form that each student fills out throughout the laboratory module. The feedback form encouraged the students to provide their comments and suggestions at each major step of the process (e.g. objectives clearly defined, usefulness of the pre-lab questions). The final assessment was a survey designed by the instructor and the Mentors. Ten to fifteen questions were asked and the answers were in the form of rankings (1=poor to 5=excellent). The Mentors analyzed the feedback forms and surveys to determine the effectiveness of the experimental modules.

Finally, each Mentor was to re-evaluate the experimental module based on the feedback and surveys collected from the students. Mentors repeated the experimental modules and proposed any necessary changes to the modules.

Effectiveness of BME Mentors

Student-to-student learning has begun to play an important role in higher education. It promotes an active learning environment where students are comfortable asking questions and participating. The BME Mentors provided that role in the BME 315 Instrumentation and Measurement Laboratory. Their presence in the laboratory and at oral presentations promoted open communication. Initially the students were concerned when the Mentors did not provide them with the "quick answers". The students learned that the purpose of the Mentors was to guide them through the experimental modules and initiate discussions of the experiments. Mentors were specifically instructed not to give out quick answers. It took several weeks for the students to accept and get used to this idea. However, by the end of the semester, the Mentors were the main personnel overseeing the laboratory instead of the instructor and the teaching assistant.

Mentors were also most effective in the oral presentations. In the previous year, when there were no mentors in the laboratory, the initiation of discussion was always done by the instructor. However, with the BME Mentors, the instructor was able to observe more as they were the first to initiate the questions and discussion. Following the example of the Mentors, the students began to ask questions and discuss what the experimental results meant without major facilitation from the instructor. The Mentors asked some tough questions and by the end of the semester, the students enjoyed the questions from the Mentors.

Mentors were responsible for assisting the teaching assistant with the set up and maintenance of the experimental modules. This eliminated the teaching assistant spending numerous hours maintaining the equipment and setups, allowing the teaching assistant to focus on the office hours and answering pre-laboratory questions. Overall, it allowed the teaching assistant to do a better more focused job.

Finally, the Mentors were effective in collecting comments and feedback from the students. The Mentors handed out a feedback form at the beginning of each particular module. The form asked the students to provide any comments on the background information provided, the pre-laboratory exercise, the experimental procedure, the data analysis and to note any errors in the manual. The forms were then collected and summarized by the Mentors. The instructors did not see or received the forms until the semester was completed. This format allowed the students to give honest and valuable comments. These comments were far more valuable towards improvement of the course than the evaluation the students complete at the semester. Since they filled out the forms as they were working on the pre-laboratory work and the experiments, the students provided greater detail in comments and suggestions to modify the modules. The Mentors utilized these comments and modified the current laboratory manual. The current plan is to re-test the modified modules in the summer before offering the class again in the fall semester.

A future improvement for incorporating the BME Mentors into a laboratory class would be to provide a short-training course prior to the semester. The instructor and the Mentors met every week to discuss their role and improve the strategy to encourage student initiated discussions. However, it would be beneficial if a short workshop were given for the Mentors to better understand their roles and responsibilities.

Conclusion

A PAL system has numerous advantages for the instructor, teaching assistant, mentors and the students in BME laboratory class. The students benefit from having peers that they can ask questions without the worry of asking silly questions and can learn from the mentors how they attacked and addressed the problems. The mentors are able to develop personal skills such as leadership and facilitation. Such skills will be value in future post-graduate work. For the instructor and teaching assistant, this system provides another means for the students to ask questions and share ideas and problems many of which may not have been expressed due to the general student-professor comfort levels. The PAL system is a good educational method to incorporate into a laboratory setting and greatly facilitated the learning process.

Bibliography

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