Students Gain Practical Experience through the Laboratory Internship Program

Randy K. Buchanan[1] and Brett J. Chessher[2]

Abstract

Students majoring in Electronics and Computer Engineering Technology at the University of Southern Mississippi participated in a pilot Laboratory Internship Program. Students were solicited to register in a laboratory internship course, and were subsequently placed with a particular lab course based upon courses previously completed, prior experience, and related interest. The lab interns were responsible for functions related to specific labs, including testing, setup, development, and student assistance. According to data collected before the program, all interns indicated they would expect to benefit educationally from the program by gaining a better understanding of the laboratory equipment and measurement procedures. Data collected at the end of the program indicated that the interns did, in fact, benefit from their participation. Results indicated that the interns benefited not only educationally, but also personally. Participants in the program expressed a high level of satisfaction with the benefits to their overall educational experience and professional career preparation. Benefits to the university included the ability to develop new laboratory experiments and upgrades to existing experiments, and being able to create a more productive learning environment for the students.

Background

An Engineering Technology professor or instructor carries an average course load of 9-12 hours each semester, including lectures and laboratories. In Electronics Engineering Technology (EET) at USM, 16 of the 19 courses have corresponding laboratory sections. A laboratory section usually consists of 15-30 students. It is common for any particular instructor to work in an overloaded condition. Due to this overload, teacher assistance is not always readily available to students. In addition, most EET/CET laboratory courses consist of a weekly formal report based on the results of the laboratory experiments. This produces a significant amount of paperwork that requires grading by instructors, and it is often difficult to grade reports efficiently while providing significant feedback. This workload not only keeps the instructor from the students, but also hampers any efforts toward developing new procedures or upgrading and improving existing laboratory exercises.

There also existed a need to provide students with an opportunity to engage in learning activities beyond the traditional classroom and laboratory. This included activities likely encountered in industry but found to be seldom available in a normal academic setting. Activities such as experimental preparation, testing and development, as well as working in teams, functioning in supervisory positions, and assisting others with technical problems were industrial practices that were deemed to be desirable for students to experience.

Beginning in the fall semester of 2002, the Laboratory Internship Program was created and became available to ambitious students ranging from the sophomore to senior level, with the goal of reducing the workload of instructors and producing better quality students to meet industrial needs. The Laboratory Internship Program was also intended to provide students an enhanced learning experience through teaching.

[1] Electronics Engineering Technology, University of Southern Mississippi, Hattiesburg, MS 39406
[2] Electronics Engineering Technology, University of Southern Mississippi, Hattiesburg, MS 39406

Course Descriptions

The Laboratory Internship Program was offered for two EET lab courses: Introduction to Electronics Laboratory (EET 101L) and AC Analysis Laboratory (EET 111L). Four students participated as interns in the program. The interns assisted other students (Fig. 1) in both courses with laboratory procedures, experimental design approaches, equipment operation, troubleshooting, and measurement techniques.

Being offered for the first time, EET 101 and 101L were first semester freshman courses designed to provide a foundation in most major areas of electronics. Most topics within the course were an introduction to future courses. The laboratory was a co-requisite to the course, and included a variety of practical experiences ranging from the construction of relay and logic circuits to simple power supply design. Prior to the fall of 2002, DC Circuit Analysis (EET 110) was the first electronics emphasis course offered to freshmen, and consisted of a theoretical approach to resistive and capacitive circuits. A course on semiconductor devices, such as SCRs and transistors, was not offered until the student's sophomore year. As a result, some interns were not familiar with the topics of the course in which they were assisting. In addition, some topics were introduced within the labs that were not in any other courses; such as electromagnetic theory and dc/ac motor operation. The laboratory experiences guided students through measurement techniques involving the interpretation of voltage, current, resistance, and time measurements, as well as the operation of a waveform generator, a variable DC voltage power supply, and the use of analog and digital multimeters.

Figure 1. Interns Assisting Introductory Student

The AC Circuit Analysis lecture course (EET 111), consisted of a theoretical approach to solutions of AC circuits. Therefore, the lab, EET 111L, included phase and frequency observations of resistive, inductive, and capacitive circuits. This laboratory involved more advanced measurement techniques with the oscilloscope, such as the use of cursors to measure frequency and phase relationships.

The Interns

The candidates selected for the Lab Internship Program were required to have a minimum 3.0/4.0 cumulative grade point average and to have completed at least six EET/CET course credit hours. The level of laboratory responsibility assigned to the intern was based in part on the extent to what technical courses had been thus far completed by the student. Since the lab intern received credit for the course, near perfect attendance was expected and required. If the intern were to demonstrate a lack of discipline or to be deficient in knowledge in the area of study, the student would be advised to withdraw from the internship before the university deadline.

Four EET majors enrolled in the Laboratory Internship Program for fall 2002: a sophomore, two juniors, and a senior. The interns assisted other students with laboratory procedures, experimental design, equipment operation, troubleshooting, and measurement techniques. Instruction was given to the interns at the beginning of the program to not solve problems or operate equipment for the other students, but to simply assist in helping them understand the problems and provide guidance in experimental and equipment

operation. None of the interns had functioned as an assistant in a laboratory before becoming involved in the program. Each intern signed a proposal at the beginning of the semester that stated his or her agreed upon duties for the program. During the course of the semester, one intern asked to be withdrawn from the program. A lack of time to apply toward the program was cited as the major reason for withdrawal. Data was collected from all four interns at the beginning and from the remaining three at the end of the semester. A graduate student provided direct supervision and mentoring to the interns.

Data Collection

A questionnaire was presented to each intern at the beginning and end of the semester that included both technical and personal queries. The object of the questionnaire was to survey how each intern felt they would benefit from program. The survey included queries into the intern's background, understanding of the technical subject, and overall confidence and interpersonal skills. Questions that were asked of the students are listed in Table 1.

Table 1. Laboratory Intern Questionnaire

1. What is your student classification?
2. What technical courses have you completed or are currently enrolled?
3. On average, what grade do you earn in science and technical classes?
   Do you feel it will increase?
4. Do you feel you will have a better understanding of laboratory procedures or the use of equipment by participation in the program?
   If yes, provide examples.
5. How do you feel this experience will benefit you educationally?
6. How do you feel this experience will benefit you personally or socially?
7. Do you experience anxiety or nervousness before most examinations?
8. Do you get nervous when speaking formally in front of groups of people?
9. Are you nervous when assisting others in a formal supervisory situation?

Questions 1, 2, and 3 were intended to determine the interns' background. Questions 4, 5, and 6 were intended to measure the students' insight or how their understanding may increase with technical subject content. Questions 7, 8, and 9 were designed to indicate the students' confidence and interpersonal skills. At the end of the semester, each intern was again surveyed using the same questionnaire on a cumulative system to rate the outcome of his or her findings since the first survey. An interview was also conducted with each intern to allow for discussion and in-depth analysis of their experiences.

Beginning of Semester

According to the results of the beginning semester questionnaire (Table 2), all interns replied they would expect to benefit educationally from the program by gaining a better understanding of the laboratory equipment and measurement procedures. Three of the interns also replied that the opportunity would benefit them socially by providing experience in working as a team. One student stated: "This will allow me to get used to working as a team, both under and over people". [ref. 2] Two of the four interns stated that they experienced nervousness or anxiety during tests and speaking formally in front of a group. They verbally indicated that it was hoped the experience would help alleviate this problem.

Table 2 Survey Results: Beginning of Semester				
Interns	Sophomore	Junior 1	Junior 2	Senior
No. of Technical Classes:				
Completed	2	9	5	9
Currently Enrolled	1	2	2	4
*technical credit hours**	8	32	16	32
Average Grade Earned in Technical Classes	A	B	B	A
Feel GPA will increase	3	4	2	3
Benefit Educationally:				
Theoretical	4	3	3	2
Practical	5	4	3	3
Benefit Personally	4	3	2	1
Benefit Socially	4	4	4	2
Experience Anxiety:				
Before or During a Test	5	2	4	1
In front of a group (meeting etc.)	4	2	4	2
During a formal Speech	5	3	5	5
During a supervisory situation	4	2	2	1
** Includes Lab credit hours*				

End of Semester

Near the end of the course, the interns were asked the same questions they had been asked at the beginning of the semester, to discover if any there had been any change in the previously measured parameters. The end of semester questionnaire indicated that the interns believed they benefited in many ways, such as an increase in understanding and proficiency of the subject matter, as shown in Table 3 and Figure 2. When the senior was asked if there was any increase in knowledge or skills, he stated: "I'm definitely more fluent with the functions of the oscilloscope, especially when using cursors to measure phase shift between two waveforms. You have to understand it though if you are going to explain it to others." [ref. 3] According to the senior, the Laboratory Internship Program was a great opportunity to review course-related topics and laboratory operations in further detail. It was noted, however, that it consumed more time than expected due to work required outside of the lab. Similar responses were obtained from one of the juniors, who had to withdraw from the internship due to the extra workload the program required of interns. Extra workload included advance preparation, review of material, intern meetings, and academic investigations related to subjects not familiar to the interns.

To further observe the benefits of the Laboratory Internship Program, each intern was interviewed at the end of the semester on an individual basis. The interview consisted of an in-depth discussion of the questions and topics introduced by the survey to verify the survey results and to discover reasons behind answers to the questionnaires. During each intern interview, data from the questions along with specific quotes were recorded.

Table 3 Survey Results: End of Semester				
Interns	Sophomore	Junior 1	Junior 2	Senior
No. of Technical Classes:				
Completed	2	9	5	9
Currently Enrolled	1	2	2	4
*technical credit hours**	8	32	16	32
Average Grade Earned in Technical Classes	A	B	B	A
Feel GPA will increase	3	5		4
Benefit Educationally:				
Theoretical	5	5		4
Practical	5	5		5
Benefit Personally	5	5		4
Benefit Socially	5	5		3
Experience Anxiety:				
Before or During a Test	4	1		1
In front of a group (meeting etc.)	2	1		3
During a formal Speech	2	1		5
During a supervisory situation	2	1		2
1- Strongly Disagree	*2- Disagree*	*3- Undecided*	*4- Agree*	*5- Strongly Agree*
** Includes Lab credit hours*				

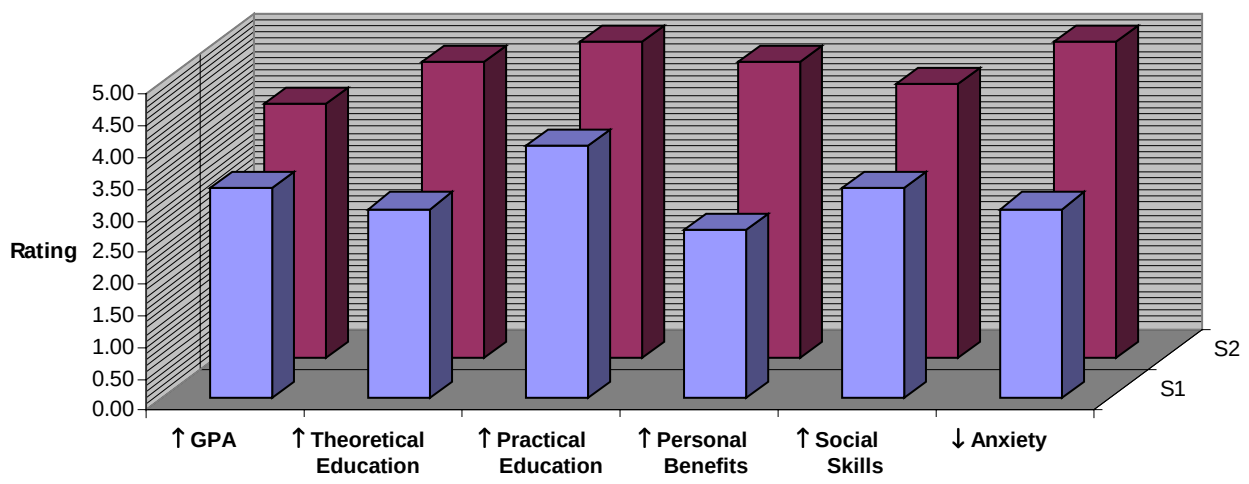

Figure 2. Beginning – End Semester Questionnaire Comparison

Increased confidence and interpersonal skills were expressed to have been experienced by Junior 1, as he interfaced with students and ultimately obtained a better understanding of the technical subjects he had been exposed to in the past. "You tend not to realize how much you've progressed. I feel confident because I understand what I am learning. This is important because you are not just taking a test, you are responsible for the students' education," he stated. [ref. 1] To this junior, the Laboratory Internship Program apparently was a good experience in learning how to interface with and gain the respect of others. "Practice builds confidence. It is a good feeling when people listen to you. People who don't normally speak (publicly) tend to

be nervous in this type of situation." again said Junior 1, as he claimed he was once very shy. [ref. 1] However, he was not the only intern to experience an increase in interpersonal skills. The sophomore intern was only slightly bothered by a formal presentation in one of her other classes, which was approaching soon. "I do not think I would have been as prepared if I had not participated in the internship program", she said. [ref. 2] The cumulative results obtained from the interviews are shown in Table 4.

Table 4 Interview Results: End of Semester

Interns	Sophomore	Junior 1	Junior 2	Senior
No. of Technical Classes:				
Completed	2	9	5	9
Currently Enrolled	1	2	2	4
*technical credit hours**	8	32	16	32
Average Grade Earned in Technical Classes	A	B	B	A
Feel GPA will increase	3	5		4
Benefit Educationally:				
Theoretical	Diode Theory	Semiconductors		Inductor Theory
Practical	Oscilloscope	Oscilloscope		Oscilloscope
Benefit Personally	Confidence	Responsibility		Patience
Benefit Socially	Vocal Skills	Vocal Clarity		N/A
** Includes Lab credit hours*				

Assessment

Evaluations of the students' perceptions and understandings of the Laboratory Internship Program were performed at the beginning and end of the semester. The realizations of their original perceptions were evaluated at the end of the course. The data collected will be used to modify and improve future laboratory internship experiences. Credit hours earned were proportional to hours per week involvement. Grades were assigned relative to deliverables stated in an agreement drawn between the instructor and the student, that both signed at the time of enrollment in the course. Participation in the analysis process of the program was conducted on a strictly voluntary basis. Neither the level of participation nor the type of responses affected the grades assigned.

Discussion

The presence of the interns in the laboratory was evident. The students treated the interns with respect and considered them somewhat the authority on lab procedures. Observations indicated that the interns as a whole provided much more significant one-on-one contact time than would ever be possible with a single instructor. The associated beneficial activities of prepping the lab, testing, troubleshooting, working on a team, etc., were additional pragmatic outcomes of the internship. The end of semester interview also indicated that the Lab Internship Program increased both the knowledge base and interpersonal skills level of the interns.

From the interview discussions, it was learned that the Laboratory Internship Program benefited the students educationally, socially, and personally. Findings indicated that the interns believed they gained a better grasp of the technical material employed in the lab. Analysis of data collected concluded that lab interns benefited from an increased in-depth understanding of the technical subject matter. When lab topics included those covered in previous courses, the interns achieved a more in-depth grasp. Topics that were new to them resulted in new learning experiences and expanded their knowledge base.

Although most interns felt the commitment demanded more time than expected, they expressed that the experience was worth the time spent. Responses also indicated a perceived increase in confidence that was the result of being placed in a pseudo-supervisory position. Interpersonal skills were articulated to have improved during the semester, because of continued interaction with students in the lab.

Conclusions

Students enrolled in the courses for which lab interns were assigned benefited from the ease of availability, communication, and approachability of the interns. There was also an additional benefit of receiving assistance from someone who was “fresh” and enthusiastic about the subject matter. The interns demonstrated a high level of enthusiasm and commitment to the task, and many of the students commented on the value of having the interns as a resource.

Participants in the program expressed a high level of satisfaction with the benefits to their overall educational experience and professional career preparation and appeared to be pleased, albeit surprised by the results. The interns gained an understanding of laboratory procedures, interpersonal skills by translating their thoughts to freshman students, and confidence within their field of study. However, it is surmised that the personal benefits may have resulted from the knowledge-related benefits; similar to a domino effect. For instance, it is possible that the interns were able gain an in depth understanding of the topics presented in the laboratory that in turn provided insight that allowed them to question their own knowledge. They were forced to be responsible because the students depended on them. It appeared that the interns increased the ability to think for themselves, for they were for the first time the answerers of questions instead of askers. Overall, the Laboratory Internship Program appeared to allow the participants to mature as students and individuals. With this maturity grew confidence, which consequentially produced the social skills necessary for communication with other students and for use in the future with industry. Real world experience was gained by allowing the interns to work in a professional supervisory role. During laboratory sessions, the interns would be placed in situations that required them to guide, lead, and direct the students through technical procedures.

Benefits for the university included the ability to develop new laboratory experiments. The interns functioned as implementers for the new lab experiments used in the introductory course. In the future, they could be utilized to upgrade existing experiments. There was some investment in mentoring the interns, but having a graduate student in place to serve this function, greatly reduced the actual supervision time-on-task. The presence of the interns in the lab created a highly productive learning environment and captivated

the attention of many other students, who were not enrolled in the lab and therefore, did not have access to such an environment. Due to the success of the pilot program, a newly spawned interest in the internship program has been generated within the department by both faculty and students and future expansion into other areas is expected.

References

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[3] Blansett, Dewey. Personal interview. 15 November 2002.

Randy K. Buchanan

Randy Buchanan is an Assistant Professor and Coordinator of Electronics Engineering Technology at the University of Southern Mississippi. Previously, he was a faculty at Kansas State University and Pittsburg State University in Kansas. His undergraduate degrees were in the areas of Electronic Engineering and he completed his graduate studies in Physics, specializing in the area of electron spectroscopy.

He has conducted applied research projects at several NASA centers, as both a fellow and a contractor through VirCon Engineering Research & Development. He has experience and expertise in the areas of instrumentation, automation, material science, control systems, and planetary/space simulation. He recently served as a representative for the IEEE Control Systems Delegation to China.

Brett J. Chessher

Brett Chessher is currently a graduate student and teaching assistant for Electronics Engineering Technology at the University of Southern Mississippi (USM). In his graduate studies, he is specializing in control systems, electromagnetics, and communications.

As an undergraduate, he has worked as engineering assistant for VirCon Engineering on the Optically Stimulated Electron Emission (OSEE) system for Thiokol Propulsion at Marshall Space Flight Center. He is also currently the lab instructor for *Introduction to Electronics* at USM.