Innovations in Laboratory Development for Computer Engineering Technology Programs

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Abstract

The paper presents an ongoing departmental sponsored project, CLABS (reads as C-LABS) Project, in the Computer Engineering Technology program at the University of Houston. In the past two years, a team of faculty, technical staff and student assistants has been working together to plan and develop a set of actively engaging, cohesive, applications-oriented and challenging laboratories. The educational objective of the CLABS Project is to train students towards graduating with a skill set that allows them to anticipate and respond to the changes in fast-paced technological advancements: hardware/software system integration and troubleshooting, soft skills, and a state-of-the-art technical hands-on experimentation. Students are introduced to projects in their freshmen and sophomore courses and a small-scale project is a major component of each laboratory following the ABET 2000 recommendations and the Bloom's Taxonomy. The paper discusses the major thrust behind the philosophy of the CLABS Project and reviews the accomplishments, challenges in deployment and mid-course adjustments in the past two years. The CLABS Project uses advanced assessment tools for continuous improvement of the laboratories and the summary of the results are briefly discussed together with the complementary achievements in the support structure of the laboratory operations. The paper then outlines the plan for the next two years, developing the junior and senior laboratories and will attempt to draw some meaningful conclusions so that it can pave the way for future laboratory development in similar programs.

Introduction

The most desired educational outcome of an engineering technology department is the creation of skillful technologists who are able to approach the design and application of both hardware and software and demonstrate mastery of the fundamentals. Recent report [1] shows that there is a skills gap between traditional training and the skills actually needed in today's job markets: creativity, knowledge transfer and adaptability. Therefore, being able to solve new problems based on the knowledge acquired has become a desired outcome of higher-education institutes. The study of science, technology, engineering, and mathematics (STEM fields) is a means to introduce these skills required in today's society. However, STEM will reach this goal only when the education is engaging, interactive and delivers a set of leadership, teamwork, problem solving, analytical thinking, and communication skills. Since laboratory teaching plays an important role in engineering technology education, it should have special attention and contribute to the development of the stated skills in student professional development. There is a

consensus that traditional "cook book" style laboratory manuals does not contribute effectively to the development of the needed skills for student to be creative and analytical in solving problems. In order to close this educational gap, the CLABS team was charged to study the freshman and sophomore core laboratory courses, their interrelationships and linkage to higher-level courses in the Computer Engineering Technology (CETE) curriculum. The mandate was to develop a plan in order to transition the laboratories into a progressively more engaging laboratory experience with problem solving emphasis and various skill and knowledge acquisition.

The CLABS project was lunched in summer 2004, funded by the Department of Engineering Technology (ET) and the dean's office. At the end of summer 2004, the CLABS team produced three reports: Surveys Report, Software Simulation Report, and CLABS Web Site Report [2,3,4] and later presented in the ETLI conference [5]. In fall 2004, the team presented their findings and laboratory framework to the ET faculty. With unanimous approval of the faculties, the project then moved into its implementation phase.

The CLABS team identified three key objectives for the implementation phase: **(i)** active and hands-on student engagement to develop excellent problem solving and troubleshooting skills; **(ii)** provide opportunities for the students to develop teamwork skills; and **(iii)** encourage lifelong curiosity towards science and technology with project-based materials, instruction, and research emphasis.

The paper begins with the CLABS Project overview, accomplishments in the past two years, plan for the next two years and ends with a set of recommendations.

CLABS Project Overview

The author has been directing the senior project class in CETE program since spring 2004. It was identified that students lacked basic understanding of the fundamentals and had difficulty integrating the knowledge gained through other courses in their major. They did not have the skill and maturity required to work in a team to design, test and prototype something useful and significant. The students also lacked proficiency in presenting their projects orally and in written technical reports. This resulted into exhaustive study and led to the CLABS Project initiative that started in summer 2004.

The purpose of the CLABS project was to train students towards graduating with a skill set that allows them to anticipate and respond to the changes in fast-paced technological advancements: hardware/software system integration and troubleshooting, communication, teamwork, working on small-scale projects, and a state-of-the-art technical hands-on experimentation. In this respect, CLABS approach included pre-lab simulations and post-lab reports, real-life applications, faculty coordination of lecture and laboratory, and an advanced outcomes assessment model for continuous improvement. Teamwork experience is enhanced through pre- and post-laboratory interaction of students [6,7,8,9].

The CLABS Project team identified the following objectives for the laboratory courses:

1. Laboratories should culminate towards a project, namely, an end product.
2. Experimental, computational, simulation, testing, teamwork, and communication skills should be gained through varying educational practices in laboratory instruction.
3. Active student engagement should be enhanced to increase curiosity and research aptitude.
4. Design and troubleshooting practices should be integrated to nurture creativity and innovation.
5. The instructional methods should span learning styles of diverse body of students to raise strengths of each individual learner.

The laboratory experiment model developed within the CLAB project to revamp the freshman and sophomore laboratory education is explained in the next section.

Laboratory Experiment Model

The main motivation in the CLABS Project laboratory experiment model, as shown in Figure 1, is to create a lab experience that engages the student in the active learning process through creative lab activities with special attention to cognitive processes. The educational activities listed below are derived from the cognitive process of Bloom's Taxonomy [10]: knowledge, comprehension, application, analysis, synthesis, and evaluation. Each lab experiment has the following components:

1. *Objectives*: Specific expected outcomes.
2. *Introduction*: Brief introduction.
3. *Pre-lab*: Before the lab session, where applicable, simulation and creation of electrical circuit diagrams, calculation and verification of parameter values.
4. *Parts list and equipment*.
5. *Experiment Body*: Implementation and testing procedures.
6. *Application*: Real-life example related to the main concept of that experiment.
7. *Conclusion*: Analysis.
8. *Report*: Experimental data and simulations, results and knowledge evaluation.

The laboratory experiment model is linked to the educational objectives of the ABET TC2K (Technology Criteria 2000) [11] as outlined in Figure 1. The Objectives, Introduction, Pre-Lab and Parts List and Equipment conform to the Knowledge and Comprehension section of the laboratory experiment model. In this section, the student teams are introduced to the laboratory. The teams consist of two students where students choose their own partners. This part of the experiment is simulation and calculation intensive in which tools such as PSpice, LabView, MultiSim or Electronics WorkBench are used by the students to discover and verify expected results.

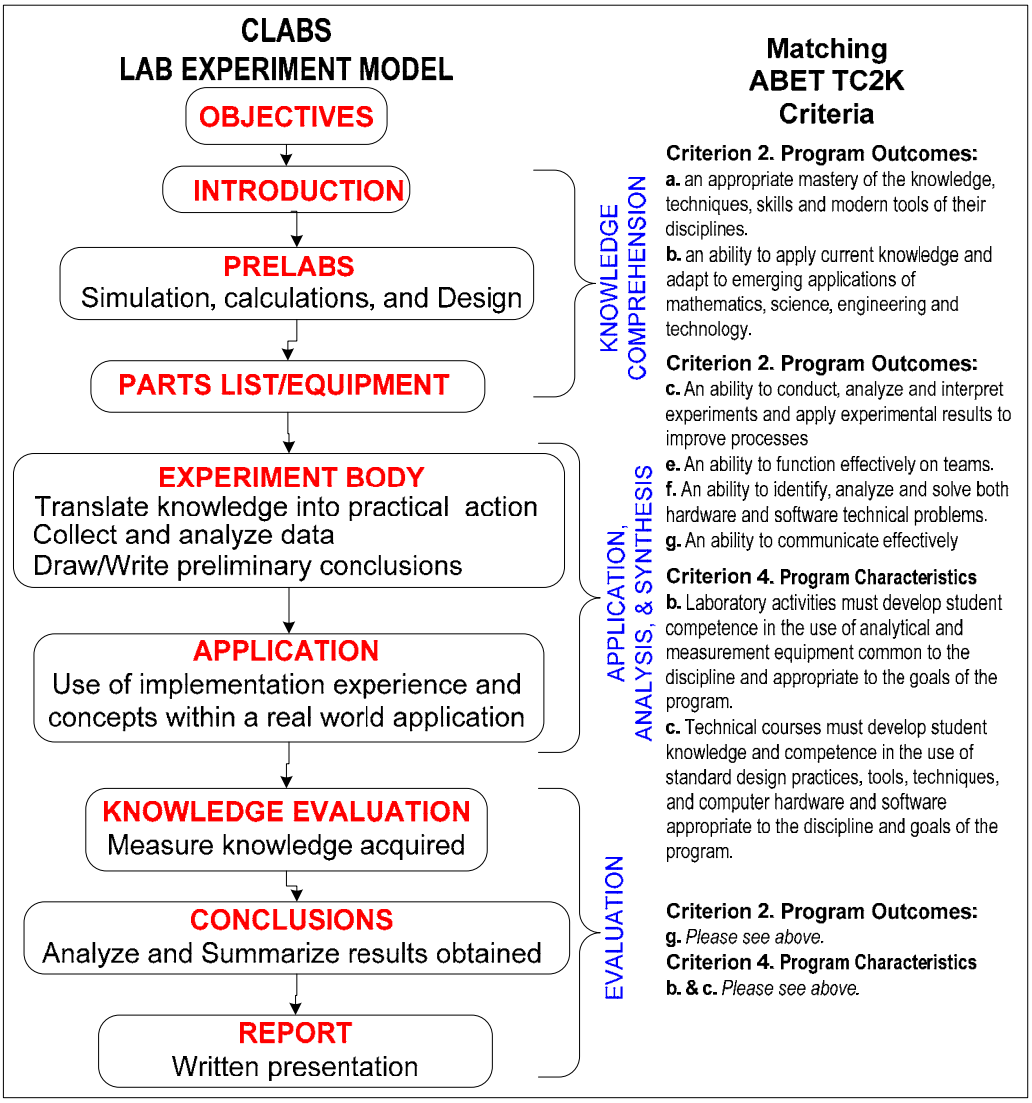

Figure 1: Laboratory experiment model, matching educational components, and ABET TC2K learning outcomes

Once the simulations and calculations have been completed, each team implements a sequence of hands-on procedures that go from basic to complex and lead to a final application. During the procedure section, each team constructs electronic circuits simulated in the previous Pre-Lab section. The students then compare the obtained results from the procedures with the results obtained in the simulations and draw conclusions. These conclusions are recorded in pre-designed worksheets that are to be turned-in and graded according to knowledge comprehension, quality and validity of the results. Finally, students are presented with a real-life project, an application that uses the knowledge gained and reinforces the lessons learned in earlier procedures.

Upon completion of the application, the team's work is ready to be evaluated. A series of Knowledge-based questions are asked to test the team's comprehension of the laboratory activity. In addition, teams are required to provide a formal report that includes their findings in

addition to the result of the simulations, calculations, data verification and comparisons through concrete evidence such as graphs and mathematical analysis, circuit and logical diagrams, and conclusions.

At the end of the semester, a complex project is introduced where teams apply everything they have learned during the semester. The results of this project are to be presented in a formal report, a prototype and a presentation given in front of their peers, lab assistants, lab managers, faculty in charge, invited faculty and other guests. All teams' projects are evaluated by everyone present in the presentation and the top three teams are selected and subsequently rewarded and recognized.

Accomplishments

CLABS Project is an ongoing effort in the CETE program. As of the spring semester 2006, two freshman-level electronic labs, Electronic Circuits I and II, and one sophomore-level lab, Digital Circuits and Systems have been developed and are in full deployment. These laboratories have been pilot-tested prior to their full deployment. The pilot testing efforts proved useful in revising the procedures, amount of work required, lab/lecture synchronization and align the implementation with the educational objectives. In this respect, in addition to faculty observations, opinions, and feedback, interviews, mid-semester and end-of-semester student perception surveys were conducted. Formative assessment is embedded into the implementation practices of new instructional materials for seamless continuous improvement during the full deployments in the subsequent semesters. Table 1 shows the result of student perception of a pilot section and other sections on the new lab materials and experiences. Sample surveys are given in appendix A.

Table 1: Student perceptions in the pilot section and other sections on the new lab materials and experiences.

Opinions	Pilot Sections		Other Sections
	Mid-semester	End-of-semester	
Gaining new skills	17% neutral	100% positive	N/A
Increasing practical knowledge	67% positive	100% positive	38% positive
New practical applications	50% positive	100% positive	40% positive
Pre-labs: Good preparation for the lab	41% positive	92% positive	N/A

Plan for the Next Two Years

Because of the nature of the junior and senior courses and expertise required to develop new laboratories, the CLABS Project team is coordinating and working closely with CETE faculty to develop new set of laboratories. Some junior courses and labs are combined so that one instructor will be responsible for both lecture and lab, a new course in Sensor Applications replaced stand-alone Operational Amplifiers course and the Embedded Systems course now includes a laboratory unit. Table 2 shows the affected courses and their implementations

priorities. The rationale behind this decision reached after careful review of the learning outcomes of these laboratories. It was evident that graduate students and part-time instructors with minimal coordination with the lecture, often taught by full-time faculty, taught junior laboratories. The new mode of operation will be pilot-tested in fall 2006.

Table 2: Affected junior and senior courses.

Course No.	Course Description	Priority
ELET 3402	Communication Circuits	Low
ELET 3403	Sensor Applications	High
ELET 3405	Microcomputer Architecture	Medium
ELET 3425	Embedded Systems	High
ELET 4208	Senior Project Lab	High
ELET 4308	Senior Project	High
ELET 4421	Microcomputer Networking	High

Starting in fall 2006, all junior and senior laboratories will require their student teams to attend and evaluate the freshman and sophomore students' projects at the end of the semester. This plan will help students develop their professional responsibilities. Additionally, all students will be encouraged to take part in various K-12 robotics tournaments held at the University of Houston. This plan will improve students social and community awareness. The robotics tournaments such as Botball and First LEGO League (FLL) are organized by the Coordination Of Robotics Education (CORE) project, directed by the author.

Conclusions

At the beginning and during the pilot testing, where different sections were not required to adhere to the CLABS Project labs developed, there were some conflicts between the students and the CLABS Project team as the amount of work required of them was quite different and substantial compared to other sections. Working together and making some mid-course adjustments throughout the pilot testing, all freshman and sophomore labs are now into full-deployment and problems arising in various sections substantially subsided. Continuous and consistent assessment in all laboratory sections is essential to monitor the progress of the students. Tracking students until they reach the senior project course is very critical because it is in this stage where the results of the CLABS Project can be identified.

Projects of this magnitude require strong support from the faculty and administration to make it a reality. Because of the CLABS Project, new laboratory materials have been developed in- house and students begin to realize the benefit of their hard work.

Bibliography

[1] "Losing the Competitive Advantage? The Challenge for Science and Technology in the United States", p. 4, February 2005. http://www.aeanet.org/publications/IDJJ_AeA_Competitiveness.asp. Last Accessed August 20, 2006.

[2] Attarzadeh, Farrokh, Driss Benhaddou, Deniz Gurkan, Ray Khalili and Rohit Kurane (2004). University of Houston, CLABS Project: Surveys Report, 2004. \\cot-webserver\attarzadeh$\docs. Last Accessed August 20, 2006.

[3] Attarzadeh, Farrokh, Driss Benhaddou, Deniz Gurkan, Ray Khalili and Rohit Kurane (2004). University of Houston, CLABS Project: Simulation Software Report, 2004. \\cot-webserver\attarzadeh$\docs. Last Accessed August 20, 2006.

[4] Attarzadeh, Farrokh, Driss Benhaddou, Deniz Gurkan, Ray Khalili and Rohit Kurane (2004). University of Houston, CLABS Project: CLABS Web Site Report, 2004. \\cot-webserver\attarzadeh$\docs. Last Accessed August 20, 2006.

[5] Attarzadeh, Farrokh, "Role of Changing Laboratory Instruction in Engineering Technology", ETLI Conference, Session 3 B: Reengineering Engineering Technology for Faculty, Part 2, Clear lake, TX, October 2004.

[6] Seals, Roger K., "Innovative Laboratory Design," *Invention and Impact: Building Excellence in Undergraduate Science, Technology, Engineering and Mathematics (STEM) Education Symposium*, [Online document], April 2004, Crystal City, Va., available at HTTP: http://www.aaas.org/publications/books_reports/CCLI/. Last Accessed August 20, 2006.

[7] Denniston, Katherine J., "Successful Pedagogies," *Invention and Impact: Building Excellence in Undergraduate Science, Technology, Engineering and Mathematics (STEM) Education Symposium*, [Online document], April 2004, Crystal City, Va., available at HTTP: http://ww.aaas.org/publications/books_reports/CCLI/. Last Accessed August 20, 2006.

[8] Zia, Lee L., "Web-enabled Learning Environments," *Invention and Impact: Building Excellence in Undergraduate Science, Technology, Engineering and Mathematics (STEM) Education Symposium*, [Online document], April 2004, Crystal City, Va., available at HTTP: http://www.aaas.org/publications/books_reports/CCLI/. Last Accessed August 20, 2006.

[9] Denniston, Katherine J., "Creative Approaches to Faculty Development," *Invention and Impact: Building Excellence in Undergraduate Science, Technology, Engineering and Mathematics (STEM) Education Symposium*, [Online document], April 2004, Crystal City, Va., available at HTTP: http://www.aaas.org/publications/books_reports/CCLI/. Last Accessed August 20, 2006.

[10] Bloom, S. Benhamin, "Taxonomy of educational objectives: The classification of educational goals: Handbook I, cognitive domain," New York, Toronto: Longmans, Green, 1956.

[11] CRITERIA FOR ACCREDITING ENGINEERING TECHNOLOGY PROGRAMS, www.abet.org. Last Accessed August 20, 2006.

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Biography

Dr. FARROKH ATTARZADEH is an associate professor in the Engineering Technology Department, College of Technology at the University of Houston. He teaches software design and programming, operating systems, digital logic, and is in charge of the senior project course in the Computer Engineering Technology Program. He directs the CLABS Project and the CORE (Coordination Of Robotics Education). He has been with the University of Houston since 1983. His areas of interests are in software development, embedded systems, project management, robotics and electromechanical folk art.

Appendix A

Department of Engineering Technology
ELET Programs

Mid-Semester Student Opinion Survey
Spring 2006

Please help us determine the strengths and shortcoming of your lab experience.

Classification: ☐ Freshman ☐ Sophomore ☐ Junior ☐ Senio

Program: ☐ CETE ☐ EPTE ☐ Others

Laboratory: ELET _____

Number of hours completed towards the degree? _____

Number of hours taken this semester: _____

Do you work while going to school? ☐ Yes ☐ No

If yes, you work ☐ Fulltime ☐ Part-time

Hours work per week: _____

Overall GPA: _____

Plans after graduation:

☐ **Go to graduate school**

☐ **Work in the industry**

☐ **Own business**

☐ **Teaching**

☐ **Others (please explain)_____**

Is the lab manual helpful in the following areas?		Very Helpful		Neutral		Not Helpful
1	Explanation of concepts.	a	b	c	d	e
2	Procedural directions.	a	b	c	d	e
3	Equipment/components list.	a	b	c	d	e
4	Pre-lab content/concepts.	a	b	c	d	e

Additional comments/suggestions:

Prelab: For each question please indicate your experience:		Strongly Agree		Neutral		Strongly Disagree
5	Good preparation for the lab	a	b	c	d	e
6	Too repetitive	a	b	c	d	e
7	Too much work/no time	a	b	c	d	e
8	Difficult to do	a	b	c	d	e

Additional comments/suggestions:

On-Lab: Please indicate your experience in the laboratory:		Strongly Agree		Neutral		Strongly Disagree
9	Procedures were straightforward.	a	b	c	d	e
10	Too many procedures in the allotted time.	a	b	c	d	e
11	Gained new skills.	a	b	c	d	e
12	Practical knowledge increased.	a	b	c	d	e
13	Procedures were logically sequenced.	a	b	c	d	e
14	Learned new practical applications.	a	b	c	d	e

Additional comments/suggestions:

Lab Assistant – please indicate your comment about the lab assistant(s):		Strongly Agree		Neutral		Strongly Disagree
15	Is an enthusiastic assistant.	a	b	c	d	e
16	Gives enough instruction at the beginning of each lecture.	a	b	c	d	e
17	Responds to your questions clearly and promptly.	a	b	c	d	e
18	Is knowledgeable about the lab	a	b	c	d	e

Additional comments/suggestions:

Quizzes – (if given in your lab) please indicate if the quizzes are:		Strongly Agree		Neutral		Strongly Disagree
19	Helpful in keeping you updated with the lab experiments	a	b	c	d	e
20	Fair	a	b	c	d	e
21	Relevant	a	b	c	d	e
22	Complex	a	b	c	d	e

Additional comments/suggestions:

Lab reports and worksheets – please indicate your comments about the lab reports and worksheets:		Strongly Agree		Neutral		Strongly Disagree
23	The guidelines to complete the report and worksheet are clear.	a	b	c	d	e
24	The grading of the report and worksheet are fair.	a	b	c	d	e
25	Comments on the graded reports are helpful.	a	b	c	d	e
Additional comments/suggestions:						

Lab equipment and lab components – please indicate your comments about the lab equipment and components:		Strongly Agree		Neutral		Strongly Disagree
26	The new breadboards, probes and cables as well as the lab kits facilitate your work in the labs.	a	b	c	d	e
27	The new equipment and components help you to optimize your time in the labs.	a	b	c	d	e
28	Our labs have state of art equipment.	a	b	c	d	e
Additional comments/suggestions:						

Lab Procedures – please indicate your comments about the Lab procedures:		Strongly Agree		Neutral		Strongly Disagree
29	The lab procedures and guidelines are clear and easy to follow.	a	b	c	d	e
30	The open lab procedure helps to control and optimize the use of our labs	a	b	c	d	e
31	The new wiring style provides extra skills	a	b	c	d	e
32	The LA presentations (power point)during the lab session are useful for the pre-labs and the labs					
Additional comments/suggestions:						

Lab organization – please indicate your comments about the lab organization:		Strongly Agree		Neutral		Strongly Disagree
38	The handouts provided at the beginning of the semester are useful	a	b	c	d	e
39	The workstations are clean and set-up before and after the lab session support and stimulating educational environment.	a	b	c	d	e
40	Emphasis in teamwork is very important	a	b	c	d	e
Additional comments/suggestions:						

General – please indicate your lab experience in general:		Strongly Agree		Neutral		Strongly Disagree
33	Lab & lecture are synchronized	a	b	c	d	e
34	New skills were learned.	a	b	c	d	e
35	Feel enthusiastic to learn new applications	a	b	c	d	e
36	The lab procedures provided sufficient theory to complete the lab.	a	b	c	d	e
37	The lecture provided enough theory for the related experimental tasks.	a	b	c	d	e
Additional comments/suggestions:						

Tutorial Manuals – please indicate your comments about the tutorial manuals:		Strongly Agree		Neutral		Strongly Disagree
41	The manuals provided at the beginning of the semester are useful (training board, Multisim, PSpice, etc.)	a	b	c	d	e
42	The manuals are clear and easy to follow	a	b	c	d	e
43	The tutorial manuals reinforce the LA instruction	a	b	c	d	e
Additional comments/suggestions:						

CLABS Website– please indicate your comments about the CLABS website:		Strongly Agree		Neutral		Strongly Disagree
44	Everybody is familiar with CLABS website.	a	b	c	d	e
45	The CLABS website has important resources related to the ELET labs.	a	b	c	d	e
46	The CLABS website provides extra information useful for the labs.	a	b	c	d	e
Additional comments/suggestions:						

Lab Management website – please indicate your comments about the lab management website:		Strongly Agree		Neutral		Strongly Disagree
47	Everybody is familiar with Lab Management website.	a	b	c	d	e
48	The Lab management website has important resources related to the ELET labs.	a	b	c	d	e
49	The Lab management website provides extra information useful for the labs.	a	b	c	d	e
Additional comments/suggestions:						

Department of Engineering Technology
ELET Programs

End of Semester Student Survey

Thank you for taking the time to fill out this survey. The information you provide is important and will help us decide where we need to improve. Please follow the directions for each section.

SECTION I: DEMOGRAPHIC INFORMATION

The following demographic data is being collected for statistical purposes only.

Academic Classification**:** O *Freshman* O *Sophomore* O *Junior* O *Senior*

Program**:** O *CETE* O *EPTE* O *Other* _____

Number of hours completed towards degree: _____
Number of hours taken this semester:_____

Do you work while attending school? O *Yes* O *No*
If *yes*, you work: O *Full-time* O *Part-time*
Hours per week:_____

Overall GPA:_____

Please indicate your plans after you graduate:

O *Go to graduate school*
O *Work in the industry*
O *Own business*
O *Teaching*
O *Other plans* (Please Specify):_____

SECTION II. THE LABORATORY EXPERIENCE

Please indicate your level of agreement with the following statements regarding the usefulness of the lab manuals.

Lab Manuals	Very Helpful	Mostly Helpful	A Little Helpful	Not Helpful
1. The manual's explanation of concepts was…	O	O	O	O
2. The lab manual's procedural directions were…	O	O	O	O
3. The section of the equipment and components list was…	O	O	O	O
4. Pre-lab content/concepts description was…	O	O	O	O

Please indicate your level of agreement with the following statements about your lab experience by filling in the appropriate circle in the right column.

Pre-Lab	Strongly Agree	Mostly Agree	Mostly Disagree	Strongly Disagree
5. The pre-lab was good preparation for the lab.	O	O	O	O
6. The pre-lab was too repetitive.	O	O	O	O
7. There was too much work in the pre-lab.	O	O	O	O
8. There was not enough time to do the work in the pre-lab.	O	O	O	O
9. The pre-lab work was difficult to do.	O	O	O	O
Laboratory	**Strongly Agree**	**Mostly Agree**	**Mostly Disagree**	**Strongly Disagree**
10. The lab procedures were straightforward.	O	O	O	O
11. There are too many procedures for the allotted time.	O	O	O	O

12. I gained new skills in the laboratory.	O	O	O	O
13. The lab increased my practical knowledge.	O	O	O	O
14. The lab procedures were logically sequenced.	O	O	O	O
15. I learned new practical applications in the lab.	O	O	O	O
Lab Assistant	**Strongly Agree**	**Mostly Agree**	**Mostly Disagree**	**Strongly Disagree**
16. The lab assistant was enthusiastic about the work.	O	O	O	O
17. The lab assistant provides enough instruction at the beginning of each lecture to do the lab.	O	O	O	O
18. The lab assistant responds clearly to my questions.	O	O	O	O
19. The lab assistant responds promptly to my questions.	O	O	O	O
20. The assistant is knowledgeable about the lab.	O	O	O	O
Quizzes	**Strongly Agree**	**Mostly Agree**	**Mostly Disagree**	**Strongly Disagree**
21. The quizzes are helpful in keeping me updated with the lab experiments.	O	O	O	O
22. The quizzes in the lab are fair.	O	O	O	O
23. The quizzes are relevant to the lab.	O	O	O	O
24. The quizzes are within the academic level of the lab material	O	O	O	O

Please indicate your level of agreement with the following statements about your lab experience by filling in the appropriate circle in the right column.

Lab Reports and Worksheets	**Strongly Agree**	**Mostly Agree**	**Mostly Disagree**	**Strongly Disagree**
25. Guidelines for completing the lab report are clear.	O	O	O	O
26. The grading of the lab report is fair.	O	O	O	O
27. The guidelines for the lab worksheets are clear.	O	O	O	O
28. The grading for the lab worksheets is fair.	O	O	O	O
29. Comments on the graded reports are helpful.	O	O	O	O
Lab Equipment and Lab Components	**Strongly Agree**	**Mostly Agree**	**Mostly Disagree**	**Strongly Disagree**
30. The new lab equipment (e.g. breadboards, probes, and cables) facilitate my work in the labs.	O	O	O	O
31. The lab kits help me complete my work in the lab.	O	O	O	O

32. The new equipment helps me use my time in the lab more efficiently.	O	O	O	O
33. The labs have state of the art equipment.	O	O	O	O
Lab Procedures	**Strongly Agree**	**Mostly Agree**	**Mostly Disagree**	**Strongly Disagree**
34. Lab procedures and guidelines are easy to follow.	O	O	O	O
35. The open lab procedure helps to control and optimize the use of our labs.	O	O	O	O
36. The new wiring activity provides an opportunity to build new skills)	O	O	O	O
37. The LA PowerPoint presentations during the lab session are useful for the on lab activities.	O	O	O	O
38. The LA PowerPoint presentations during the lab session are useful for the pre-labs.	O	O	O	O
Lab Organization	**Strongly Agree**	**Mostly Agree**	**Mostly Disagree**	**Strongly Disagree**
39. The handouts provided at the beginning of the semester are useful.	O	O	O	O
40. The workstations are clean prior to the lab session.	O	O	O	O
41. The workstations are ready to be used when I get to the lab.	O	O	O	O

Please indicate your level of agreement with the following statements about your lab experience by filling in the appropriate circle in the right column.

Lab Organization (*Continued*)	**Strongly Agree**	**Mostly Agree**	**Mostly Disagree**	**Strongly Disagree**
42. The condition of the workstations supports a stimulating educational environment.	O	O	O	O
43. The lab's emphasis on teamwork is very important.	O	O	O	O
Tutorial Manuals	**Strongly Agree**	**Mostly Agree**	**Mostly Disagree**	**Strongly Disagree**
44. The manuals provided at the beginning of the semester are useful (e.g. training board, Multisim, PSpice, etc.)	O	O	O	O
45. The manuals are easy to follow.	O	O	O	O
46. The tutorial manuals reinforce the LA instruction.	O	O	O	O
CLABS Website	**Strongly Agree**	**Mostly Agree**	**Mostly Disagree**	**Strongly Disagree**
47. I am familiar with the CLABS Website.	O	O	O	O
48. The CLABS Website has important resources related to the ELET labs.	O	O	O	O
49. The CLABS Website provides extra information that is useful for the labs.	O	O	O	O
Lab Management Website	**Strongly Agree**	**Mostly Agree**	**Mostly Disagree**	**Strongly Disagree**

50. I am familiar with the Lab Management Website.	O	O	O	O
60. The Lab Management Website has important resources related to the ELET labs.	O	O	O	O
61. The Lab Management Website provides extra information useful for the labs.	O	O	O	O
General Lab Issues	**Strongly Agree**	**Mostly Agree**	**Mostly Disagree**	**Strongly Disagree**
62. The lab and lecture are synchronized.	O	O	O	O
63. I learned new skills in the lab.	O	O	O	O
64. The lab made me enthusiastic to learn new things.	O	O	O	O
65. The lab procedures provided sufficient theory to complete the lab.	O	O	O	O
66. The lecture provided enough theory to complete the related experimental tasks.	O	O	O	O

Please use the space provided below to provide more detailed comments about your responses or another issue we may have overlooked. Feel free to use the back of the sheet.

_____
_____
_____
_____
_____

THANK YOU FOR YOUR TIME AND PARTICIPATION!

CLABS Laboratory Practices
Full Deployment Labs Assessment
Lab Assistant Perspective

Please complete this form and email it to your supervisor immediately.

Name: _____ **Semester: _____**

Classification: ☐ SA ☐ TA ☐ GIA

Labs:

Electrical Circuit I ☐	Electrical Circuit II ☐	Digital Systems ☐
ELET 1100	ELET 1101	ELET 2103

- **Name of the instructor of record :_____**
- **Length of time worked for the ET department:_____**
- **Laboratories taught in the past:**

ELET 1100 ☐	ELET 1101 ☐	ELET 2103 ☐	ELET 2103 ☐
ELET 2105 ☐	ELET 3102 ☐	ELET 3105 ☐	ELET 3112 ☐
ELET 3303 ☐	ELET 3325 ☐	ELET 4108 ☐	ELET 4121 ☐

- **Major field of study:_____**

- **Expected date of graduation:_____**
- **Do you expect to return and work as a LA for the ET:_____**

1. How much of the lab materials you managed to cover in the course?

2. To what extent did you manage to synchronize the lab and the lecture?

3. What positive remarks did you hear about the CLABS implementation?

4. What negative remarks did you hear about the CLABS implementation?

5. Were there any major concerns/issues? Please elaborate.

6. How can we fix the issues/problems?

7. Please comment on the lab manual.

8. Please comment on the lab solutions manual.

9. Please comment on the software simulation tutorial manual.

10. Please comment on the equipment used in the lab.

11. If you work with a undergraduate laboratory students assistant (SA) or you are a SA, please answer the following questions:
    a. Comment on the SA/LA performance.

    b. Comment on the SA/LA preparedness.

    c. Comment on the SA/LA punctuality.

    d. Comment on the SA/LA r attitude towards helping the students.

    e. Please make other comments or suggestions about your SA/LA here.

12. What was your overall experience in the lab? Please elaborate on your observations.

13. Any suggestions, comments or concerns?

Faculty Evaluation of Laboratory Assistant
CLABS Project

Faculty Name:_____ Semester/Year: _____

Laboratory Assistant Name: _____ Course/Lab: _____

Please indicate your level of agreement with each of the following statements describing characteristics of the lab assistant.

	Poor	Adequate	Good	Excellent
Theoretical knowledge of the assigned lab	O	O	O	O
Applied knowledge of the assigned lab	O	O	O	O
The working knowledge of the lab instruments	O	O	O	O
The working knowledge of the simulation software	O	O	O	O
Assisting students	O	O	O	O
Presentation skills	O	O	O	O
Punctuality	O	O	O	O
Communication skills	O	O	O	O

Fairness in grading	O	O	O	O
Consistency of grading	O	O	O	O
Timely return of the graded assignment	O	O	O	O
Regular contact with the faculty	O	O	O	O
Consistent conduct of instructions	O	O	O	O
Professionalism as an assistant	O	O	O	O

Would you be satisfied with this assistant for future classes? (Please elaborate)

Your suggestions for improving this evaluation form are welcome.

Faculty signature: _____ Date: _____

CLABS Laboratory Practices
Pilot and Traditional Labs Assessment
A Faculty Perspective

Professor: _____ **Semester: _____**

Electrical Circuit I ☐ **Electrical Circuit II ☐** **Digital Systems ☐**
ELET 1100 **ELET 1101** **ELET 2103**

1. How much of the lab materials you managed to cover in the course?

2. To what extent, did you manage to synchronize the lab and the lecture?

3. What differences did you identify between the pilot and traditional students' performances?

Difference observations	none		somewhat		Very noticeable
Attendance	1	2	3	4	5
Homework	1	2	3	4	5
Grasp of the materials	1	2	3	4	5

4. Are you able to break the students into two different groups (pilot & traditional)?

5. What positive remarks did you hear about the CLABS implementation?

6. What negative remarks did you hear about the CLABS implementation?

7. Were there any major concerns/issues? Please elaborate.

8. How can we fix the issues/problems?

9. What was your overall experience? Please elaborate on your observations.

10. Any suggestions, comments or concerns?