CDIO CONTRIBUTION TO ABET ACCREDITATION OF ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMS

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ABSTRACT

ABET accreditation plays a very important role in enhancing higher education in technology and engineering disciplines. ABET accreditation is evidence to the fact that a collegiate program has met standards essential to produce capable graduates in fields of applied science, computing, engineering, and engineering technology. Graduates from an ABET-accredited program should be both effective and efficient in leading the way for innovation and in managing technologies so as to meet the needs of the general public. In our Electrical and Electronic Engineering (EEE) program at Duy Tan University, Vietnam, the CDIO (Conceive-Design-Implement-Operate) project courses have been designed to help cover 5 out of 11 major student outcomes (i.e., creativity, teamwork, problem solving, communication, and lifelong learning). Our Faculty of Electrical and Electronic Engineering, over the past three years, has learned many tough lessons about how to effectively administer CDIO project courses to achieve student outcomes based on the ABET standards. In order to evaluate the contribution of CDIO project courses to our ABET preparations, we collected grading data of our EEE students and analysed them in order to examine and clarify the effects of the CDIO project courses to our student outcome achievement. Simple statistical methods on the grading data of CDIO project courses of the last three years showed significant effectiveness of the CDIO model to student outcome improvement as well as the close correlation of CDIO standards with ABET outcome criteria. However, current settings of our CDIO project courses also hinder their full capacity and effectiveness, namely in terms of the uneven skill proficiency levels of students from one batch to another, inadequate training in time and project management, insufficient preparation of lab materials for completely new projects, etc. Based on these results, we propose certain course of actions for the next two years in order to adjust our CDIO project courses to better serve the student outcomes set forth by ABET.

(314 words)

KEYWORDS

ABET accreditation, CDIO Framework, CDIO Standard No. 7, 8, Electrical and Electronic Engineering, lifelong learning, problem solving, time management

1. INTRODUCTION

In recent years, Vietnam's integration into the global economy, through its accession to the WTO (2007) and the ASEAN Economic Community (2015), poses a growing demand for Vietnamese educational institutions. The task of Vietnamese higher education institutions is to train a highly skilled workforce those responses the needs of socio-economic development of the country. As a result, the quality of university education is got great attention from the society. Many comments that the quality of the education system at the university level in Vietnam today does not meet the expectations of society, not meet the development needs of the country. However, to identifying and addressing issues to improve the quality of education is a major challenge. There are a number of policies and initiatives that have been implemented, such as the University Quality Assessment Criteria (2007, modified in 2013); Advanced programs; AUN-QA (ASEAN University Network - Quality Assurance) training program evaluation (2007); ABET Accreditation training programs; Ministry of Education and Training's accreditation standards (2016). (Linh. A. Dinh, 2014)

While advanced programs, evaluation criteria, and accreditation provide the model and the specific requirements and conditions that a training program needs to address, Vietnamese higher education institutions still need a more comprehensive methodology for continuous improvement of the quality of the program. Many universities in Vietnam, including Duy Tan, soon realized that the CDIO approach (with a CDIO syllabus and a set of CDIO standards) was an initiative and methodology for technical education reform. Answer the questions "what" and "how" in a systematic manner, so it is feasible to address the specific requirements and conditions of different programs.

Grasping that trend, Duy Tan University strives to innovate its training program, to reach international standards and achieve the top 300 schools of the Times Higher Education World University Rankings. On the one hand, Duy Tan completes the curriculum to keep up with world trends. Putting CDIO into Technical and Technological discipline is a evidence. The other hand, Duy Tan has invited many accreditation commission teams in domestic and abroad evaluated school. The ABET accreditation is abroad team that Duy Tan has set up. The Faculty of Electrical and Electronics Engineering is one of the first faculties appointed by the Board of Management of Duy Tan University to accredit the ABET curriculum, which is expected in 2018. Faculty leaders decide to set up a task force is responsible for the application and implementation of the CDIO model to suit the status of the Faculty and towards ABET accreditation.

Specifically, over the past 3 years, the Faculty has developed and implemented the processes and materials and completed the standard system output, training programs, updated syllabus, training lecturers in terms of expertise and teaching methods, etc. to improve the quality of training at the Faculty and be ready to participate in ABET accreditation.

In the process, we have collected specific data for the ABET accrediation. These data have shown great contribution of CDIO to ABET training program. This report focuses on describing and analyzing the relationship between CDIO and ABET, the position of CDIO in the training program and contribution of CDIO in ABET accreditation at the Faculty of Electrical and Electronics Engineering (FEEE), Duy Tan University.

2. ABET ACCREDITATION

The first, we present some general information about the accreditation of higher education in Vietnam. In fact, the establishment and development of the Quality assurance and verification system of higher education is a relatively new issue in Vietnam. Currently, three sets of educational accreditation standards are available at a number of Vietnamese universities, including the Ministry of Education and Training's accreditation standards; Asean Universities Network and ABET standards. The following table 1 gives an overview of these benchmarks. (Linh. A. Dinh, 2014)

Table 1. Comparison between ABET, AUN and domestic standard

ABET	AUN	Ministry of Education and Training's accreditation standards
Professional application on the world	Regional application in Asia (about 30 universities membership in ASEAN)	National (Vietnam)
Highly socialized, closely linked	Highly socialized	The socialization is not high
Use for Technical program	Used for grade-level and program-level assessments of all majors	Used for grade-level and program-level assessments of all majors
Qualitative and quantitative	Qualitative and quantitative	Absolutely qualitative

With 52/61 satisfactory results, accounting for 85.25%, Duy Tan University is the first non-public university of Vietnam to meet the Ministry of Education and Training's accreditation standards. This is also the highest level of publicly-funded (both public and non-public) universities in the Central Vietnam. However, the aspiration of Duy Tan is to become an international university. As the names of universities in Vietnam are unfamiliar and our position is low for the world, achieving international accreditation standards is a way to assert ourselves. In the areas of technology, the Accreditation Board for Engineering and Technology (ABET) is a reputable institutions for quality training programs in the world. ABET accreditation consists of a system of standards, operational procedures and closely interrelated regulations. ABET takes the law as the foundation, takes fair judgment as the premise, takes objective judgment as the basis, takes quality improvements as goals; try to build management and assuarance system for technical university program.

ABET is an accreditation organization established in 1932 by American industry associations. This is an accredited institution of higher education in the fields of Engineering, Technology, Computing and Applied Science. ABET offers university-level qualification assessments, calling ABET standards, for accreditation of training programs. Today, ABET has been accredited for approximately 3,600 training programs from more than 700 universities in 29 different countries.

In 1996, the new Engineering Criteria 2000 standard (EC2000) was used as the basis for the ABET test. In 2001, the EC2000 standard was widely used in the United States. The EC2000 standards focus not only on the student ‘s acquisition of knowledge and on the improvement of the faculty's teaching process, but also on the construction of the qualification of graduated engineering majors should have: Applied Mathematics, Natural Science, Design and Experimental Ability, Teamwork, Professional Ethics, ...

Participating in the accreditation process of ABET will bring the following direct benefits:

- ✓ It is an external evaluation, necessary to manage the quality of a training program.
- ✓ It is the opportunity and motivation to implement reforms for a training program.
- ✓ It's a passport to graduates of a training program that joins the global human resources market.

ABET does not include the curriculum development process. ABET only sets out the criteria that a training program needs to meet, which can be summarized as follows:

- ✓ The training program must have clear objectives
- ✓ ABET sets out the output standards for the training program, and requires training programs that want to be tested responses.
- ✓ There must be a process for assessing the level of student responsiveness for the output standard of the program. Based on that, the program must be modified continuously to improve quality.
- ✓ The content of the program must meet a number of ABET requirements and should be consistent with the training objectives and the learning outcomes of the program

3. THE CORRELATION BETWEEN CDIO AND ABET

The idea of CDIO was started in 1997 by Massachusetts Institute of Technology (MIT) to approach the development of technical training programs that help students gain practical experience, meet the demands of the industry in the new era.

CDIO is not an accreditation standard like ABET. CDIO proposes a methodology for developing engineering programs based on the philosophy those graduating engineers should be able to conceive-design-implement-operate complex value-added engineering systems in a modern team-based environment.

Overview, we can see that ABET identifies the objective modern engineers need to achieve, while CDIO provides a process for developing training programs for graduates from this program can meet the requirements of ABET. So, CDIO and ABET complement each other in developing technical training programs that can train good engineers (Nguyen et al, 2013). Specifically, the correlation between CDIO and ABET can be clearly seen in the following table 2.

Table 2. Comparison between CDIO and ABET

CDIO Program Outcome	ABET Criteria
1.1 Knowledge of underlying mathematics and science	a. An ability to apply knowledge of mathematics, science, and engineering
1.2 Core fundamental knowledge of Engineering	
1.3 Advanced engineering Fundamental knowledge, methods and tools	k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
2.1 Analytical reasoning and problem Solving	e. An ability to identify, formulate, and solve engineering problems
2.4 Attitudes, though and learning	i. A recognition of the need for, and an ability to engage in, lifelong learning
2.5 Ethics, equity and other Responsibilities	f. An understanding of professional and ethical responsibility
3.1 Teamwork	d. An ability to function on multidisciplinary

	teams
3.2 Communications	g. An ability to communicate effectively
4.3 Conceiving, systems engineering and management	c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4.4 Designing	

We found that most ABET criteria are strongly correlated with CDIO Program Outcome. So, the Electrical and Electronic Engineering program is very focused on the CDIO project with total 5 credits. In the next section, we will discuss the location of CDIO in the Electrical and Electronic Engineering program of Duy Tan University.

4. THE LOCATION OF CDIO IN THE ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAM

EEE program build CDIO into a series of project, divided into 5 subjects who has code CR297, CR347, CR397, CR447 and CR497. All CDIO projects in Duy Tan are guaranteed to convey the spirit of CDIO in the most complete way to students. However, the amount of knowledge in each semester (increase per semester) of students is different, so the Faculty of Electronics - Electronics Engineering has arranged the CDIO projects in order from basic to advanced level. At the same time, the different sets of weights are also used to evaluate the CDIO skills that students accumulate through each project. That means the student assessment will focus on the CDIO skills that need to be emphasized in each project. We can imagine through the following table 3.

Table 3. The different sets of weights of CDIO courses

Project	C	D	I	O
CR297	85%	5%	5%	5%
CR347	5%	55%	35%	5%
CR397	5%	45%	45%	5%
CR447	15%	35%	35%	15%
CR497	25%	25%	25%	25%

The assessment scale has been carefully discussed by the CDIO lecturers, so that it can be applied in accordance with the amount of knowledge students have accumulated. In the curriculum, CDIO is distributed around core theoretical subjects. This means that the students will be fully provided with the basic knowledge, analytical method, how to use software support or simulation tools. The table 4 shows the position of CDIO in the education program.

Table 4. The position of CDIO in the education program

Semester	1	2	3	4
Mathematical knowledge	Advanced Mathematics 1	Advanced Mathematics 2	Principles of Statistics & Probabilitíe	Application Mathematics 1 Laplace's Equation
Electronic knowledge	Introduction to Computing system	Electronic Devices & Circuits	Computer Assembling, Setup & Maintenance	Circuit Analysis Assembler programming Digital Electronic

				Technology
Programming knowledge			Fundamentals of Programming	
General knowledge	Career Planning 1	Career Planning 2	English Reading 1 English Writing 1	English Listening 1
CDIO				**CR297 CDIO Project**

5	6	7	8	9
	Applied Mathematics for Electricity - Electronics			
Computer Architecture & Operating Systems	Introduction to Microcontroller Programming	Telecomunicatio n Systems	Application Programming for Mobile & Ubiquitous Devices	Telephone switching systems
		English for EE		
	Microprocessors & Interfaces	Introduction to Computing Security		
	Computer Vision			Wireless Communicaiton
	Digital Signal Processing	Signal Transmission Technologies		
Object-oriented programming Introduction to Data Structures & Algorithms		VHDL Language		
English Reading 2	English Reading 3	English Writing 3	English Speaking 3	
English Speaking 1	English Speaking 2			
English Writing 2	English Listening 2	English Listening 3		
CR347 CDIO Project	**CR397 CDIO Project**	**CR447 CDIO Project**	**CR497 CDIO Project**	

Note
- ❑ : General Education
- ❑ : Base maths and sciences
- ❑ : Base Engineering course
- ❑ : Core Engineering course

Based on the course distribution, we learned three major contributions of CDIO in the curriculum, namely:

The first, introducing CDIO in the second year of the program helps students to gain background knowledge and major knowledge at an early age, creating curiosity in the field of study, enhancing the interest in learning. CDIO combined with Career Planning 1 & 2

(including many practical sessions, students come directly to production facilities, electronics companies, industrial zones, or visit the production line printed circuit board ...) is really useful for students to take shape on general concepts of their field. These perceptions come from the practice help students impress with their field of study, and help them know how their future work looks like.

The second, the distribution of Base Engineering subjects and Core Engineering subjects become more balanced, distributed evenly over each semester thanks to series CDIO project. From the fourth semester to the final semester, Base Engineering subjects and Core Engineering subjects appear simultaneously in each semester. This is important in the distribution of difficult knowledge, which helps to avoid overloading in the final semesters, and gives students more time to learn the specialized knowledge before graduation.

Finally, some courses are designed to complement CDIO, so CDIO is considered as a consolidate knowledge course for each semester.

- ✓ The CDIO CR297 is in the fourth semester, when students are exposed to the core subjects. CR297 wants to formulate the general thinking about the system for students. From practical sessions, students understand and are able to model realistic systems. CR297 allows students to freely offer ideas to improve those models. “Conceive” will take the highest weight in this project.
- ✓ CDIO CR347 focuses on design; electronic circuit design. The Base Engineering subjects such that Electronic Devices & Circuits, Circuit Analysis, Assembler programming, Digital Electronic Technology… focuses on developing the most fundamental knowledge of the discipline, enabling students to analyse analogue circuit and digital circuit, system assembly, system troubleshooting, and system maintenance.
- ✓ CDIO CR397 focuses on “Design” and “Implement”, is supplemented by Introduction to Microcontroller Programming, Microprocessors & Interfaces, Introduction to Data Structures & Algorithms. The ideas will be implemented by a complete circuit, from circuit simulation, circuit drawing to actual circuit. This part aims to train student’s ability in designing microcontroller system, improve their C language programming ability.
- ✓ CDIO CR447 is a composite CDIO project, is supplemented by Computer Vision, VHDL Language, Signal Transmission Technologies. This is a high level project, requiring students to do projects in the field of image and video processing, programming on FPGA, GUI programming.
- ✓ CDIO CR497 is a real-world CDIO project, combining all the skills of CDIO, the most comprehensive CDIO. In this project, students have to find the real problems in the electronics field. Students are usually choosing the “hot” problem to solve, so CR497 is really an interesting project. Some common issues like that solutions for automatic car, wireless device management, intelligent device control, object detection and recognition… It helps students improve their ability to identify, formulate, and solve engineering problems skill (Student Outcome e). One of the most important requirements of this project is the students have to work in groups because the workload is really huge and requires a combination of resources. With an unanimity idea by the group, a number of system models will be discussed and selected the most feasible option (Student Outcome d). Next, each student group uses the accumulated knowledge to design the style, size and features of the product and put into operation (Student Outcome c). The assessment will be based on four sections, including work diary, design, presentation and product demonstration. Students are asked to give presentations to the instructors and to all of their classmates, using their arguments to persuade people to vote the project. Criticism among the groups is highly supported. In the end, the more votes the group has, the more they will be

appreciated (Student Outcome g). In order to create a playground for students, encourage students to approach the active learning method, experience and creativity, the annual CDIO Design Contest is organized by the Faculty of Electrical and Electronics Engineering. During the contest, there are also some products from typical CDIO projects is displayed. In addition, CDIO products of the group also participated in many competitions at home and abroad, and won many awards such that DTU Innovation Cup and MIC Internship, Go Green in the City Schneider Electric… Success requires groups of students to continually study, improve and update the latest features of the product in the spirit of lifelong learning (Student Outcome i).

With this specific contribution, the FEEE decided to choose CDIO CR497 to participate in ABET accreditation.

5. CDIO CONTRIBUTION TO ABET ACCREDITATION OF ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMS

In this section, the paper analyse the contribution of CDIO CR497 to ABET accreditation at criteria c, d, e, g, i (Accreditation Board for Engineering & Technology, 2010). Data is actually collected in 2014, 2015, 2016. Each row of Assessment Results includes the outcome assessment and the evaluations that follow.

5.1 Student Outcome (c): *An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability*

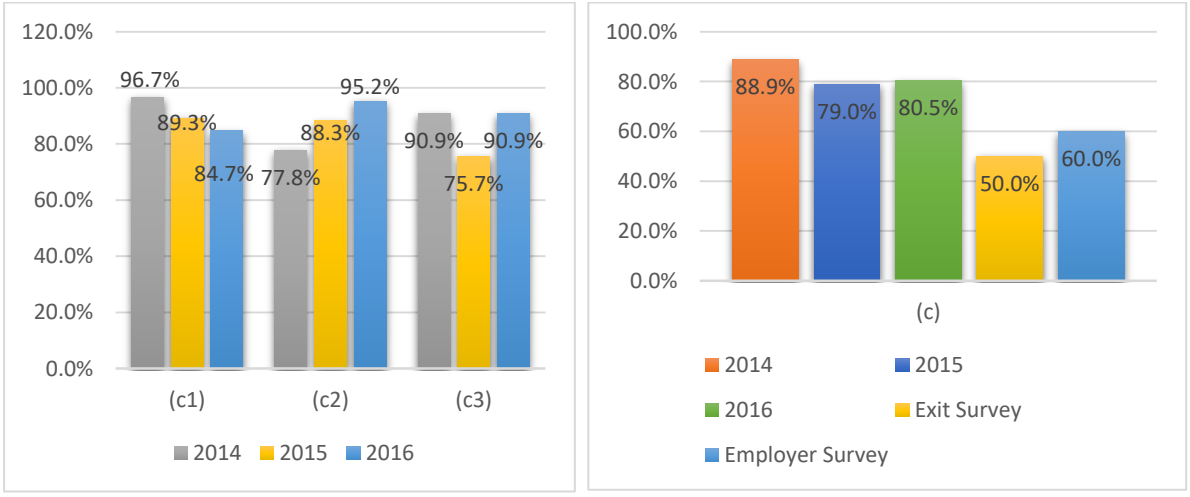


Figure 1. Percentage of students achieving proficiency or better in ABET outcomes c1-3

In 2014, 88,9% of the Electrical & Electronic Engineering students achieved Proficiency, Good Proficiency, and Superior Proficiency levels for this outcome. Students performed very well in their capability for technical documentation (96.7%) (c1), cost, safety and manufacturability consideration (90,9%) (c3). Student did not perform as well in their consideration of environmental, socioeconomic, and political constraints even though it was still relatively high at 77,8% (c2).

The reason is students have no lessons about environmental, socio-economic, or political topics. FEEE determined to include lectures on economic, environmental, social, political, ethical constraints as well as on safety and sustainability in the courses of CR 497. At the

same time, large-scale group projects on environmental, socioeconomic, political and ethical topics in the real world is set up instead of smaller- scale individual work like currently set up.

In 2015, the Performance Indicator (PI) c2 improve significantly (increase from 77.8% to 88.3%), demonstrating that the additional lessons are effective. However, the reverse effect occurs when c1 and c3 are seriously degraded. The reasons given by the CDIO trainers are:

- ✓ CDIO CR497 is more difficult to keep up with the development trend of the electrical and electronics industry, while the quality of students through the year almost unchanged, resulting in many students have not kept up with the learning progress.
- ✓ The more technical issues of the CR497, the higher the cost of research, the more difficult the technical documentation process.

Although the effect is not as Falcuty's expectations, we remain determined by the proposals from 2014. Students are recommended to order components from reputable suppliers. It is not only cost-effective but also meets environmental standards

In 2016: 80,5% of the Electrical & Electronic Engineering students achieved Proficiency, Good Proficiency, and Superior Proficiency levels for this outcome, The situation remains stable from 2015 (79%). We found that certain successes were shown when c2 (95.2%) and c3 (90.9%) continued to rise sharply, c1 decreased slightly (89.3% - 84.7%). Thus, changing CDIO CR497 to real-world CDIO has positive effects. The next task of Faculty is to improve c1 by connecting more closely with the manufacturing facility in the area, giving opportunity to access the professional technical documentation.

5.2 Student Outcome (d): *An ability to function on multidisciplinary teams*

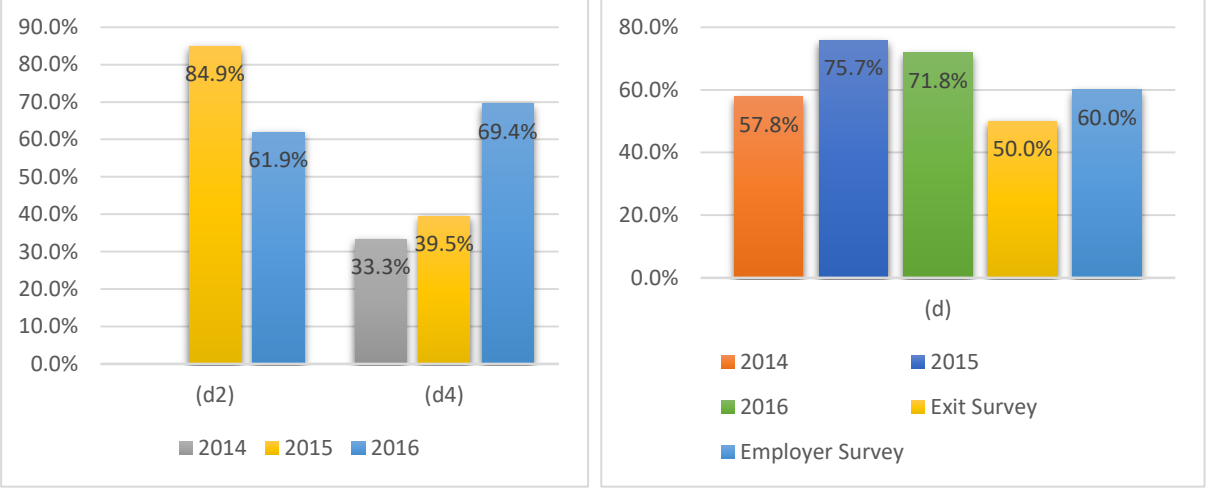


Figure 2. Percentage of students achieving proficiency or better in ABET outcomes d1,d4

In 2014: 57.8% of the Electrical & Electronic Engineering students achieved Proficiency, Good Proficiency, and Superior Proficiency levels for this outcome. There was no collected information for the assessment of their ability in assigning responsibilities amongst team members (d2) in 2014.

In 2015: Although the outcome d2 (*The students assign responsibilities to each team member*) was very good (84.9%), the PI d4 (*The students apply knowledge from at least two different expertise areas to reach a solution to the problem*) was very low (33.3%). This problem comes from the psychology of students always want to choose the group which

have the same research direction (same strengths). For example, students who are good at microcontroller design love to work together, because they easily exchange algorithms, programming methods, tricks, etc. In addition, in those groups, the assignment of tasks would be easier and the assistance would be relatively simple. This can cause a problem that the projects are difficult to expand into other areas. So, students need to be given additional multidisciplinary, interdisciplinary projects to help improve their teamwork collaboration, and their constant search for new knowledge from different sources.

The solution is given:

- ✓ 1st : Encourage student to learn new IT skills in GUI (Graphical User Interface) design and application -level programming for CR497
- ✓ 2nd : Join the 3D design classes

In 2016: 71.8% of the students achieved Proficiency, Good Proficiency, and Superior Proficiency levels for this outcome, which was a major improvement from that in 2014. There was significant improvement in PI d4 (69.4%). However, d2 declines more than before. This problem may be due to the fact that many groups of students are unequal. Good students tend to do a lot of things, while others are more satisfied with their workloads. This is a "rely on other" hazard very easily encountered in the Vietnamese students. Students need to be guided through the process of planning, dividing, and assigning responsibilities among team members. The solution is:

- ✓ 1st: Provide project teams in CR497 with mentors from both academic and industrial background
- ✓ Evaluate results based on job log, which describes clearly the contribution of each member over time.

5.3 Student Outcome (e): *An ability to identify, formulate, and solve engineering problems*

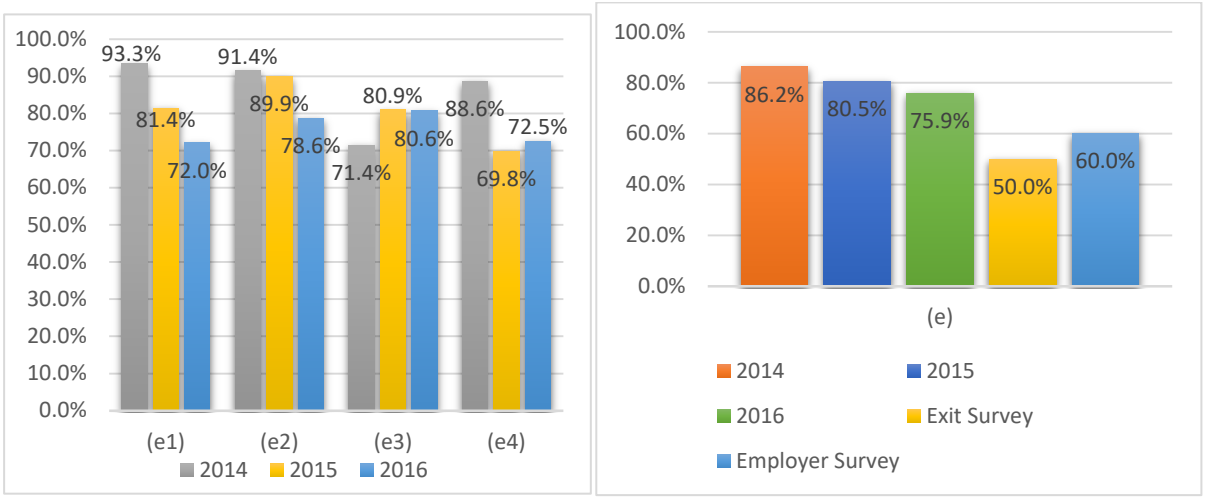


Figure 3. Percentage of students achieving proficiency or better in ABET outcomes e1-4

In 2014: Overall: 86.2% of the Electrical & Electronic Engineering students achieved Proficiency, Good Proficiency, and Superior Proficiency levels for this outcome. Students performed very well in their ability to identify (93.3%) (e1), to formulate (91.4%) (e2), and to solve (88.6%) (e4) engineering problems. They performed the worst in proposing a series of plausible solutions for a problem (71.4%) (e3).

To improve e3, FEEE has 2 solutions:

- ✓ 1st: Demonstrate various microprocessor and interface designs to similar problems in microprocessor course.

- ✓ 2nd: Provide the same engineering project problem in CR497 and require different groups of students to solve that problem in different ways or approaches.

In 2015 and 2016: 75.9% of the Electrical & Electronic Engineering students in 2016 achieved Proficiency, Good Proficiency, and Superior Proficiency levels for this outcome, which was a decline in performance compared to 2014 (86.2%) and 2015 (80.5%), but was still above the target performance of 75%. The highlight in this chart is e3 has increased dramatically, proving that additional courses from 2014 have been effective. However, the decline of Student Outcome e through each year is a worrying fact for students in the FEEE. Through research and survey, we have pointed out some outstanding issues in the implementation of CDIO in Duy Tan as follows:

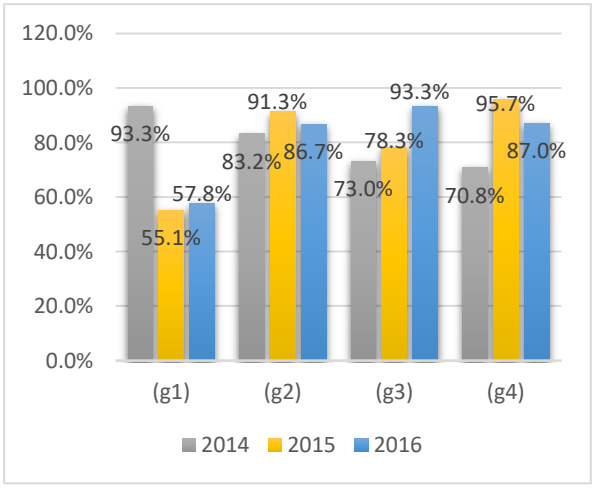
- ✓ Inadequate training in time and project management.
- ✓ Restrictions on facilities, insufficient preparation of lab materials for completely new projects
- ✓ The uneven skill proficiency levels of students from one batch to another, lead to the stereotype of some "sluggish" students.

Take a simple example: Students can think of ideas to solve problems, but they do not have the tools to do that. For example, students are designing a robot, but the lab does not have a prototype machine (such as 3D printer), forcing them to buy the components available on the market. It's a stereotype for that robot model. In addition, the available model can only fit a particular motherboard, students must continue to use the module available.... This has limited the creativity of the students. Besides that, there will always be some "sluggish" groups of students who are less capable than other groups. They often do not have enough time to implement the project, and tend to refer to other groups. Therefore, they do not practice their CDIO skills and receive very low scores.

This is a serious problem, therefore FEEE has set a series of actions as follows:

- ✓ Supplementary laboratory facilities
- ✓ Evaluate results based on job logs. This diary presents all the possible solutions to a problem, the implementation process until the final result. Lecturers should carefully supervise on this diary in order to provide additional comments, as well as to reorganize and strengthen "sluggish" groups of students.
- ✓ Student should be provided with less theoretical project requirements and more “hand-on” experimental requirements.

5.4 Student Outcome (g): *An ability to communicate effectively*



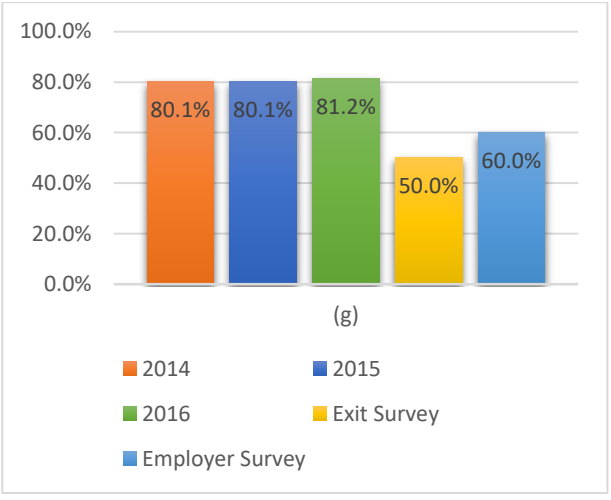


Figure 4. Percentage of students achieving proficiency or better in ABET outcomes g1-4

In 2014: Overall: 80.1% of the student Electrical & Electronic Engineering students achieved Proficiency, Good Proficiency, and Superior Proficiency levels for this outcome. Students performed the best in their ability to communicate graphically (93.3%) (g1), the second best in the use of language (Vietnamese or English) in their schoolwork (83.2%) (g2). On the other hand, they did not perform that well in public presentations (73%) (g3) and in written reports (70.8%) (g4).

The problem is many students have the ability to work very well, while the ability to present is not appreciated. Students encountered many errors in the presentation of technical drawings, not confident in communication, passive in the review questions, reports are long lines, lack of coherence. So, the solution is:

1. Students need to be provided with additional training on their public speaking and professional writing skills in another course. Particularly in the CDIO CR497, presentations will be held three times, instead of the current one. The contents are as follows:
    - ✓ Presentation 1: The student group gives a presentation on the problem that the group needs to address, and offers at least two different approaches to the problem. CDIO lecturers and other groups give comments, lecturers evaluate.
    - ✓ Presentation 2: The student group gives a presentation on the selected problem and outlines the reasons for the selection. Presentations must be accompanied by a job log. CDIO lecturers and other groups give comments, lecturers evaluate.
    - ✓ Final presentation: The student group gives a presentation the final report, including the results of the research, the level of product improvement and the practical applicability. CDIO lecturers and other groups give their opinions and assessments
2. Students must improve their skills in using graphic tools
3. Reward points for groups presented in English

In 2015: 80.1% of the Electrical & Electronic Engineering students achieved Proficiency, Good Proficiency, and Superior Proficiency levels for this outcome. The chart shows a significant increase in the PIs g2, g3, and g4. As a result, the more public presentations, the easier reporting, also improved public speaking skills. Dark spots in 2015 are very serious decline g1. Because the skills of using graphic tools of students is not good and not standardized in a subject.

Solutions:

- ✓ Keeps proposals 1 and 3 in place since 2014.
- ✓ Standardized proposal 2: Provide students with extra tutorials on SolidWorks, AutoCAD and Inventor in CDIO project CR397, CR447, and CR497

In 2016: 81.2% of the Electrical & Electronic Engineering students achieved Proficiency, Good Proficiency, and Superior Proficiency levels for this outcome. The little difference in student's performance from 2014 to 2016 indicated stability in the assessment of this outcome. Students showed improvement in their performance through the use of language in their work (86.7%) (g2), their public presentation capability (93.3%) (g3), and their report writing skills (87%) (g4). This data shows that the presentations are very effective. They not only meet the requirements of knowledge, increase the criticism in a topic but also makes the CDIO very attractive and interesting. The good news is g1 has slightly increased again,

although it is at a fairly low level. This is understandable because the additional requirement of skills and knowledge on graphics software in CR497 is quite difficult and requires a lot of time to complete.

Solution: Keeps all proposals since 2015

5.5 Student Outcome (i): *A recognition of the need for, and an ability to engage in, lifelong learning*

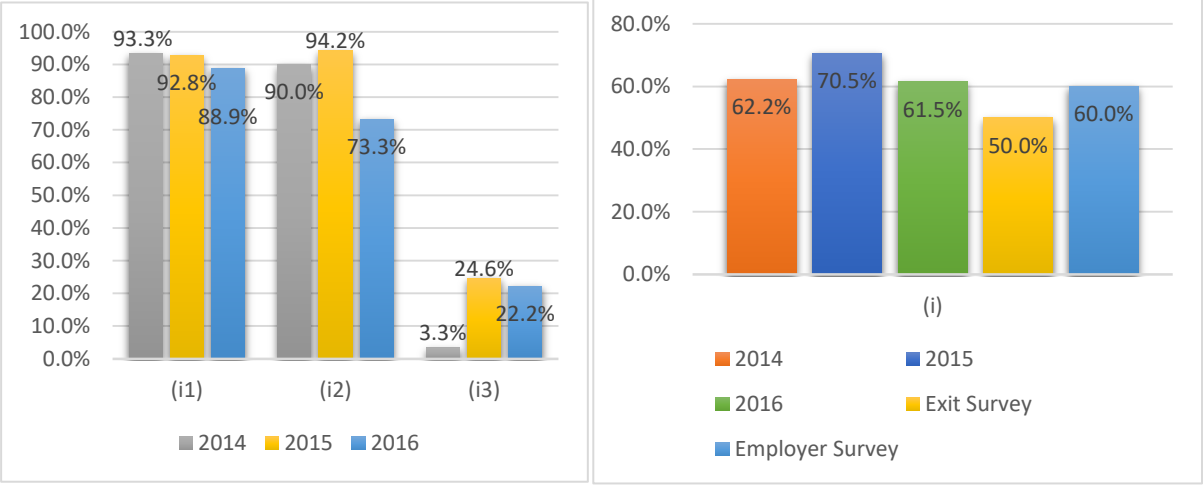


Figure 5. Percentage of students achieving proficiency or better in ABET outcomes i1-3

In 2014: 62.2% of the Electrical & Electronic Engineering students achieved Proficiency, Good Proficiency, and Superior Proficiency levels for this outcome. Students performed extremely well in terms of searching for library resources professional databases for references (93.3%) (i1) and citing references in the report content (90%) (i2). But they completely lack the motivation or awareness of the need to learn to use a software or tool or equipment by reading its manual or following its tutorials (3.3%) (i3).

Weaknesses of the majority of students have been demonstrated through i3. These students can do well with laboratory equipment or instructor guidance. But when thay meet a new tool, device or software, students are not able to read the instructions and follows. The causes are:

- ✓ Limited English
- ✓ Lack of practical time

Solution:

- ✓ Students should be given additional lectures on the need to learn new knowledge and tool in a formal way by reading and following manuals or tutorials rather than taking the short-cut of these “trial and error” approach
- ✓ Present student with a list of additional software, tools, and equipment along with their manuals and tutorial that students need refer to in CR497

In 2015: The parameters maintained at a stable level, especially i3 increased extremely (from 3.3% to 24.6%). In contrast, there was a significant improvement students' motivation to learn to use a software or tool or equipment by reading its manual or following its tutorials (24.6%) (i3), but it was still way below the target, performance of 60%.This is a encouraging sign and the Faculty has decided to keep the proposals since 2014.

In 2016: 61.5% of the Electrical & Electronic Engineering students in 2016 achieved Proficiency, Good Proficiency, and Superior Proficiency levels for this outcome, which was a slight decline from that in 2014, and was still above the target, performance of 60%. There was a decline in the performance of both students' ability to search the library resources and professional databases for references (88.9%) (i1) and to cite references in the report content (73.3%) (i2), but they both were still above the target performance, i3 (22.2%) decline but not significant. Student should be required to learn to use new software applications, tools or equipment in important courses of their major

Solution:

- ✓ Prepare mandatory assignments for students to select and learn 1 or 2 new software tools or equipment in courses of CR497
- ✓ Establish a testing, operating, and troubleshooting process for at least two hardware devices that have same functionality to give the student an overview, comparable, and inferable common process.

6. CONCLUSION

Implementing the ABET is a very difficult process that requires a lot of time and effort. However, this process really brings confidence in the management towards improving the quality of the training program. And, the CDIO curriculum has made a great contribution to the ABET accreditation of the Faculty of Electrical & Electronics Engineering at Duy Tan University. The paper presented the correlation between CDIO and ABET, the position of CDIO in the EE training program, and the CDIO contribution to the ABET accreditation. Data collected each year from 2014 to 2016 was analyzed to find out the strengths and weaknesses in the implementation of CDIO subjects. Based on these results, we propose certain course of actions for the next two years in order to adjust our CDIO project courses to serve better the student outcomes set forth by ABET.

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