

CDIO AS THE FOUNDATIONS FOR INTERNATIONAL ACCREDITATIONS

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ABSTRACT

Vietnam has around 400 universities/colleges, but accreditation can only be done by an accrediting agency of the Ministry of Education & Training (MoET) [10]. Only 40 universities have been accredited by the MoET and this effort stopped short due to limited resources. Unaccredited Vietnamese universities and colleges, as a result, are trying to get international accreditations. The problem is no Vietnamese university/college has ever acquired international accreditation, and there is no experience to learn from. This paper argues that under the legal, technical and social environment of Vietnam, CDIO will better prepare Vietnamese universities/colleges for international accreditation than other approaches.

KEYWORDS

AUN-QA, CDIO SYLLABUS, ABET, PROGRAM OUTCOMES, VABHE, PBL

INTRODUCTION

As of 2012, the Higher Education (HE) in Viet Nam is still considered backward compared to that of the rest of the world. There is no university or college in Vietnam which is in the charts of the Top 400 schools of the Times Higher Education World University Rankings or in the charts of Top 600 schools of the QS World University Rankings. The desire of people working in higher education in Viet Nam is to have a well-defined model and/or methodology to improve the quality of training in research-oriented and profession-oriented higher education programs as well as to elevate the position of Vietnamese universities and colleges in the international arena. Many solutions and models have been proposed and carried out from “importing” advanced curricula from prestigious universities and colleges in the world to creating internal mechanisms of quality assurance to setting up talented student programs to joining international associations of higher education quality, etc. Most solutions and models are providing positive results; however, Vietnamese universities and colleges still receive little recognition for their work because up till now, none has acquired any international accreditation. The only accreditation system available in Vietnam is a domestic one of the Ministry of Education & Training of Vietnam (MoET).

Currently, there are 419 universities and colleges in Vietnam (specifically, 204 universities and 215 colleges) with more than 2.2 million students. Public or private, all of these universities and

colleges are under the direct management and control of the Ministry of Education & Training. Except for the annual recognition of excellent universities and colleges of the MoET, there is no clear ranking or quality certification of Vietnamese universities and colleges [10]. The recognition by the MoET, in particular, is only for the top 10 to 30 universities and colleges in the nation, which does not provide a complete picture of the higher education in Vietnam and which also fluctuates from one year to another. So, in 2004, the MoET issued its first set of domestic accreditation standards. These accreditation standards, which consist of 10 standards and 61 criteria (Table 1) [11], are used for the evaluation and certification of different qualities of a university or college on a university- or college-wide accreditation level, not a program accreditation level.

Table 1: Accreditation Standards of Vietnam Accreditation Board for Higher Education (VABHE)

Standard No.	Content	Number of Criteria
1	Mission and goals	2
2	Organization and management	7
3	Curricula	6
4	Academic affairs	7
5	Management, lecturers and staffs	8
6	Students and trainees	9
7	Scientific research, applications, technology transfers	7
8	International collaborations	3
9	Library, teaching/studying facilities and equipment	9
10	Finance and financial management	3

Until now, there are only 40 universities (including Duy Tan University), which are accredited by the VABHE and there are another 112 universities and colleges, which have completed their self-assessment reports and are still waiting for the external evaluation and accreditation. The accreditation effort by the VABHE, however, came to a delay from 2011 due to limited financial and human resources. This put many Vietnamese universities and colleges at an awkward position, and the MoET has been encouraging Vietnamese universities and colleges to reach out for international accreditations. The questions, however, are:

- Which international accrediting agency/organization should a Vietnamese university or college apply to?
- Should a Vietnamese university or college apply for institutional or program accreditation?
- Which educational model or methodology should a Vietnamese university or college adopt to prepare for their international accreditation application?

The first two questions are not too difficult to answer. As long as the accrediting agency or organization is recognized by the Council for Higher Education Accreditation (CHEA), it should be appropriate for Vietnamese universities and colleges to apply to. Also, since most Vietnamese universities and colleges are not well-developed in many aspects, there is a trend at the moment for them to apply for program accreditation rather than for institutional accreditation. The third question though not difficult to answer is usually ignored by most Vietnamese universities and colleges as they simply try to respond to specific requirements of a certain accrediting agency or organization. Only half-way through the process do they realize that there is a need for a well-defined model or methodology to prepare them for the accreditation process and that their quality and structure transformation through the accreditation process is more

important than the eventual accredited status itself. The ultimate question comes down to the choice of the educational model or methodology to help prepare for the accreditation process.

Of different popular educational models and frameworks like Problem-Based Learning (PBL), Project-Based Learning (PrBL), Experimental Learning, Conceive-Design-Implement-Operate (CDIO) [4], CDIO appears to be the best option for Vietnamese universities and colleges for a number of legal, technical and social reasons:

LEGAL ASPECTS

Even though there is no requirement for the adoption of any specific educational model or framework for the accreditation preparation, CDIO is legally recognized and proposed by the MoET of Vietnam as a major tool. The MoET also recognized a team at the National University of Ho Chi Minh City, who was the first member of Vietnam in the CDIO™ Initiative as the official task force for the promotion and deployment of the CDIO framework in Vietnam [2]. The major implication behind this is the fact that most programs aimed for international accreditation in Vietnam are of technology and engineering disciplines, which are what CDIO was designed for. For example, the University of Da Nang, the International University of the National University of Ho Chi Minh City, FPT University and Duy Tan University are all currently bidding for ABET (Accreditation Board for Engineering & Technology). And yet, another implication is that to certain extent, the MoET does provide certain financial support for many of these programs.

Besides the recognition of the MoET for CDIO, one additional legal advantage for Vietnamese universities and colleges to choose CDIO is the peer support in the official pool of institutions which already adopted CDIO. Specifically, although CDIO is an educational framework, and not a set of accreditation requirements, by adopting it, Vietnamese universities and colleges can utilize the peer reviews and evaluations of one another. This was actually the lesson from what a number of universities in Vietnam have learned and benefited by joining AUN (ASEAN University Network), APQN (Asia Pacific Quality Network), or INQAAHE (International Network for Quality Assurance Agencies in Higher Education). So, for that reason, though it may not be relevant, a number of non-engineering universities and colleges in Vietnam are now applying for membership in the CDIO™ Initiative like the University of Social Sciences & Humanities of Ho Chi Minh City, the University of Medicine and Pharmacy of Ho Chi Minh City, and the University of Pedagogy of Ho Chi Minh City. Most non-engineering universities and colleges in Vietnam attempt to adopt CDIO because of the detailed and well-defined framework of CDIO, which helps save them a great deal of time and effort in developing quality procedures and benchmarks to satisfy different requirements of (international) accreditation agencies.

In the international arena, unlike other approaches of PBL or PrBL, CDIO has its universal and official society of the CDIO™ Initiative, which offers detailed guidelines and support for the development and deployment of the CDIO framework. Vietnamese universities and colleges can definitely benefit from these. In addition, this society also offers more independent and objective advice and/or evaluation about different qualities of any one Vietnamese university or college compared to the domestic accreditation of the VABHE (under direct control of the MoET of Vietnam), which does not ensure the independence of three major activities of self-assessment, external assessment and assessment outcome recognition.

TECHNICAL ASPECTS

In order to determine whether the CDIO model or framework will best prepare Vietnamese universities and colleges for international accreditations, a series of comparisons have to be made between specific criteria of the CDIO Syllabus (Table 2) [3, 4, 5 and 6] and different requirements of a certain accrediting agency or organization like ABET, AUN, CEAB (Canadian Engineering Accreditation Board), etc. Since most Vietnamese universities and colleges are currently only applying for VABHE, ABET, and AUN, these three accreditations will be used for the compare-and-contrast activities in this section. In addition, similar comparisons between the criteria of PBL (Table 3) [9] and those of VABHE, ABET and AUN will be carried out to determine where and/or when CDIO may or may not be a better option.

Table 2: CDIO v2.0 Syllabus

1. Disciplinary Knowledge and Reasoning	1.1 Demonstrate a capacity to use the principles of the underlying sciences
	1.2 Apply the principles of fundamental engineering science
	1.3 Demonstrate a capacity to apply advanced engineering knowledge in the professional areas of engineering
2. Personal and Professional Skills and Attributes	2.1 Analyse and solve engineering problems
	2.2 Conduct investigations and experiments about engineering problems
	2.3 Think systematically
	2.4 Demonstrate personal and professional habits that contribute to successful engineering practice
	2.5 Demonstrate ethics, equity, and other responsibilities in engineering practice
3. Interpersonal Skills	3.1 Lead and work in groups
	3.2 Communicate effectively
	3.3 Communicate effectively in one or more foreign languages
4. CDIO	4.1 Recognize the importance of the social context in the practice of engineering
	4.2 Appreciate different enterprise cultures and work successfully in organizations
	4.3 Conceive and develop engineering systems
	4.4 Design complex engineering systems
	4.5 Implement processes of hardware and software and manage the implementation process
	4.6 Operate complex systems and processes and manage operations

Table 3: PBL Standards

Standard No.	Content
1	Is organized around an open-ended driving question or challenge
2	Creates a need to know essential content and skills
3	Requires inquiry to learn and/or create something new

4	Requires critical thinking, problem solving, collaboration, and various forms of communication, often known as “21 st Century Skills”
5	Allows some degree of student voice and choice
6	Incorporates feedback and revision
7	Results in a publicly presented product or performance

Comparing CDIO Program Outcomes and PBL Standards with VABHE Standards/Criteria

Given that VABHE is for institutional accreditation, it may not be suitable to compare the standards and criteria of VABHE with those of CDIO and PBL, which are more for program accreditation. However, it is still possible to compare and contrast certain major requirements of VABHE against corresponding criteria or standards of CDIO and PBL. According to the Decision No. 2196 /BGDĐT-GDDH dated April 22nd, 2010, domestic accrediting organization(s) of Vietnam are instructed to place the emphasis on the following requirements:

- Knowledge Requirements: scientific knowledge, professional knowledge
- Skill Requirements:
 - Hard Skills: technical skills, problem-solving skills
 - Soft Skills: communication skills, teamwork skills, IT skills, foreign languages
- Attitude Requirements: ethics, civic responsibility, professional behaviors, service-oriented attitudes, creativity, life-long learning attitudes
- Requirements upon Graduation: job, working position, continuing education

For the knowledge and skill requirements, the criteria of CDIO closely resemble those of VABHE, requiring a wide variety of basic scientific knowledge as well as technical and interpersonal skills. In contrast, PBL standards call more for specific knowledge and skill set that help solve a certain problem. As for the attitude requirements, the criteria of CDIO are tied up to certain (technology/engineering) working environment or culture while those of VABHE and PBL are open to freedom of speech and creativity in a typical academic environment. Moreover, for the end outcomes, even though CDIO may be closely aligned with VABHE regarding the career capability outcomes, it does not exactly focus on the job placement or specific working positions like VABHE. PBL, on the other hand, focuses more on the process of teaching and learning rather than on the end outcomes themselves.

The conclusion about the outcome-oriented characteristic of CDIO and the process-oriented nature of PBL has been drawn upon by Kolmos and Edström in their comparison of PBL and CDIO in the 8th International CDIO Conference [8]; however, from our experiences in adopting CDIO at Duy Tan University, for successful deployment of CDIO in engineering disciplines, the focus should also be placed on the learning and teaching processes. The more structured or well-defined the learning and teaching processes are, the easier for engineering students to achieve their end outcomes or to build their skills and knowledge. In addition, by tying to criteria of a certain (technology/engineering) working environment or culture, there is a good chance that our graduates satisfy most of the requirements of the local labor market or of a certain industry; yet, they become ill prepared for the international labor market. As a result, while closely adhering to most CDIO standards to prepare for VABHE, Duy Tan University also integrates certain PBL attributes in order to add more value [7].

Comparing CDIO Program Outcomes and PBL Standards with AUN-QA Criteria

AUN-QA is the Quality Assurance for the ASEAN University Network, which was set up in 1998 and has been implemented continuously amongst different ASEAN universities since 1999. This network has two Vietnamese members of the National University of Hanoi and the National University of Ho Chi Minh City. The goal of AUN-QA is to create a universal set of standards for ASEAN universities in order to prepare for the integration ASEAN education systems by 2015.

AUN-QA includes 18 criteria with 74 portions (Table 4) [2]. Each portion is assessed from the lowest level of 1 to the highest level of 7.

Table 4: AUN-QA Criteria & Portions

Criteria No.	Content	Number of Portions
1	Goal and aim, outcomes	4
2	Detail of the program	4
3	Detailed program description	3
4	Program implementation	4
5	Pedagogic attitude and teaching strategy	5
6	Student assessment	8
7	Lecturer and coordinator quality	10
8	Assistant quality	4
9	Student quality	4
10	Student consultancy and support	5
11	Infrastructure and facilities	5
12	Quality insurance	4
13	Student's assessment	4
14	Program mainframe design	2
15	Human resources development activities	3
16	Feedback from the relevant objectives	2
17	Outcome results	2
18	Satisfaction of relevant objectives	3

Based on Figure 1 and Figure 2, it can be said that CDIO has more in common with AUN-QA than PBL with AUN-QA. Specifically, both AUN-QA and CDIO emphasize analytical reasoning and knowledge discovery skill set. On the other hand, the most correlations between AUN-QA and PBL are in the area of feedback and revision in the learning experience, which is mostly ignored by CDIO. CDIO, PBL and AUN-QA all require students to have strong communication, language and teamwork skills.

CDIO Program Outcomes	AUN-QA Criteria																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1.1 Knowledge of Underlying Mathematics, Science																			
1.2 Core Engineering Fundamental Knowledge																			
1.3 Adv. Engr. Fund. Knowledge, Methods, Tools																			

From our experiences of CDIO and PBL deployment at Duy Tan University, it has been found that while it seems both CDIO and PBL put an equal emphasis on analytical and critical thinking, the CDIO approach tends to foster more creativity in problem solving and product development because of its strong requirements for the setup and quality of the end products or prototypes. Students are under constant pressure of developing something new, and they usually have to go the “extra mile” to get this done. There are certain critics about this from PBL supporters who mentioned that some students even break their team formation in order to roll out new things, and most of the time, only top students benefit from the “new ways” of CDIO at the expense of ordinary ones. A mix of CDIO and PBL attributes in team formation appears to be a better approach according to Kaikkonen and Lahtinen in their report for the 8th International CDIO Conference [7].

Comparing CDIO Program Outcomes and PBL Standards with ABET Criteria

ABET EC2010 Criteria include 11 criteria from a to k as listed below [1, 5]:

- a. An ability to apply knowledge of mathematics, science, and engineering
- b. An ability to design and conduct experiments as well as to analyse and interpret data
- 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
- d. An ability to function on multidisciplinary teams
- e. An ability to identify, formulate, and solve engineering problems
- f. An understanding of professional and ethical responsibility
- g. An ability to communicate effectively
- h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- i. A recognition of the need for, and an ability to engage in, lifelong learning
- j. A knowledge of contemporary issues
- k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

CDIO Program Outcomes	ABET AC2010 CRITERIA										
	a	b	C	d	E	f	g	h	i	j	k
1.1 Knowledge of Underlying Math, Science	■										
1.2 Core Engineering Fundamentals	■										
1.3 Adv. Engr. Fund. Knowledge, Methods, Tools	■										■
2.1 Analytical Reasoning / Problem Solving					■						■
2.2 Exper., Investigation and Knowledge Discovery		■									
2.3 System Thinking			■								
2.4 Attitudes, Thought and Learning									■		■
2.5 Ethics, Equity and other Responsibilities						■					
3.1 Teamwork				■							
3.2 Communications							■				
3.3 Communication in Foreign Languages											
4.1 External, Societal and Envir. Context			■					■		■	
4.2 Enterprise and Business Context			■					■			

4.3 Conceiving, Systems Engr. & Mngmt.											
4.4 Designing											
4.5 Implementing											
4.6 Operating											
		Strong correlation						Good correlation			

Figure 3. Correlations between CDIO Program Outcomes and ABET EC2010 Criteria

Even though ABET is a well-recognized accreditation for technology and engineering programs and CDIO is also a well-known framework for technology and engineering programs, the two do have certain differences as shown in Figure 3: ABET seems to put the most emphasis on design aspects while CDIO also covers implementation and operation. From our experiences at Duy Tan University, by also covering implementation and operation, it becomes easier to intrigue and inspire our students to follow on with their search for new engineering knowledge. In addition, ABET, similar to PBL, emphasizes general critical thinking and problem solving skills (Figure 4) rather than digging deep into specific technical skills necessary for the study of a certain engineering or technology discipline. ABET also does not put as much focus on the actual end product or outcome like CDIO. A prototype or product demo is considered good enough by both ABET and PBL. All of these only signify the fact that CDIO is a more encompassing model for technology and engineering programs as well as for the preparation of international accreditation of these programs, and that is also the reason why Duy Tan University as well as many other Vietnamese universities and colleges are now adopting the CDIO framework.

PBL Standards	ABET AC2010 CRITERIA										
	a	B	C	d	e	f	g	h	i	j	k
1. Is organized around an open-ended driving question or challenge											
2. Creates a need to know essential content and skills											
3. Requires inquiry to learn and/or create something new											
4. Requires critical thinking, problem solving, collaboration, and various forms of communication, often known as “21 st Century Skills”											
5. Allows some degree of student voice and choice											
6. Incorporates feedback and revision											
7. Results in a publicly presented product or performance											
		Strong correlation						Good correlation			

Figure 4. Correlations between PBL Standards and ABET EC2010 Criteria

SOCIAL ASPECTS

As much as different technical and legal implications have strongly suggested for the adoption of CDIO in Vietnam, the current social implications and motivations for the transformation of the higher education system of Vietnam provide an even stronger “push” for the adoption of CDIO in different Vietnamese institutions. Indeed, there is currently a public outcry since the domestic accreditation and other official domestic recognitions did not have the capability to provide an authentic picture about the stratification of different layers in the Vietnamese higher education system. So, international accreditations will very much play an important role in providing an independent and objective recognition about different qualities of Vietnamese universities and colleges. The problem, however, is no Vietnamese university or college has acquired any international accreditation except for the 8 programs which received the general peer evaluations of AUN in the last two years [2]. As a result, for the moment, the adoption of CDIO by universities and colleges in Vietnam will be most appropriate for public approval because compared to other approaches, the CDIO™ Initiative has attracted the most number of well-recognized universities and colleges around the world. Adoption of CDIO, in turn, will serve as the foundations for later international accreditations of Vietnamese universities and colleges give the significant correlations between CDIO attributes and different requirements of various accrediting organizations, as mentioned in the “Technical Aspects” section.

An even more important social aspect in terms of public approval has to with the direction of development of the Vietnamese higher education system. Like many other countries in which the government used to have direct and complete control of every aspect of education and training, Vietnam is now facing two big questions of (1) whether it should invest more for research-oriented institutions or for profession-oriented ones, and (2) whether it should also invest in private institutions besides public ones as it is getting more involved in the world economy. For the first question, given the current socio-economic conditions of Vietnam, there should be insufficient funds and resources to develop many research-oriented universities, and it would be wiser to invest most of the resources in profession-oriented institutions to produce higher quality workers for different industries of the economy. CDIO with its focus on Design and Implement Experiences will gain public approval as the optimal solution if most Vietnamese universities and colleges choose to become profession-oriented institutions. This is particularly true given that scholars and researchers in many theoretical and empirical study disciplines in Vietnam have failed to adopt CDIO due to its strong requirements in Implementation and Operation [12]. For the second question, the majority of concerns by the Vietnamese government about the prospect of investing in private institutions have to do with the lack of mechanisms in controlling and monitoring the flow of funding at private institutions. However, as a matter of fact, that problem has always been there in the public sector, in which the lack of control mechanisms and transparency has led to corruption and wasteful use of funding and resources. CDIO and its syllabi at different levels provide very detailed quality attributes and criteria that even those of many accrediting agencies and organizations like ABET, CEAB, JABEE, etc. cannot be compared with; hence, they can serve as the much needed mechanisms for the governmental and public approval of investment in private institutions. And even if that may not be materialized, the use of CDIO attributes and criteria will help build up a big pool of working evidences for later international accreditation of both Vietnamese public and private institutions.

CONCLUSION

With the aim to transform the quality of higher education in Vietnam and to gain recognition in the international arena, many Vietnamese universities and colleges are seeking international accreditation. This has become even more relevant when the domestic accreditation of Vietnam is still primitive and not complete due to limited resources. The current problem, however, is that most, if not all, Vietnamese universities and colleges are ill-prepared for international accreditation. CDIO, as a result, emerged as the most relevant educational framework for the preparation of international accreditation by Vietnamese universities and colleges for a number of legal, technical and social reasons. Most importantly, CDIO has acquired the governmental recognition and the public approval in Vietnam because of its close alignment with the direction of developing profession-oriented universities and colleges of Vietnam. In addition, its strong correlations with the requirements of many international accrediting agencies and organizations (through very detailed quality attributes and criteria) have made it stand out from other approaches like PBL or PrBL. In the long run, when the domestic accreditation of Vietnam becomes more established and recognized, it is expected that the role of international accreditation may become a lesser one; still, many educators in higher education of Vietnam strongly believe that CDIO definitely will go on as the major framework for continuous educational improvement at many Vietnamese universities and colleges because of its down-to-earth relevance and popularity.

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BIOGRAPHICAL INFORMATION

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