Research on Building Lectures for Electrical and Electronics Practical Lessons Following the CDIO Method At Vinh University

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Abstract: *Curating lectures using the CDIO approach shows many new innovations, aimed at regarding the learner as the centerpoint. Teaching models relying on talent is a popular trend replacing traditional methods in the modern education system. The CDIO approach provides a complex set of tools to assist with designing, building, and implementing lessons on a competence-based approach. Utilising the CDIO approach to curate lectures for electrical and electronic practice subjects would allow development of the necessary skills for learners to perform their tasks well in a professional environment.*

I.   Introduction

Nowadays, there are many different approaches to creating lectures. One of the more effective approaches implemented in over 100 universities around the globe is the CDIO approach. This is a model for reforming education at universities in a way which meets the needs of professions in business and social fields. It provides a highly specific set of tools to help develop necessary skills for the learner.

A survey on teaching electrical and electronic practices shows that: lectures and practical guides are currently compiled using the traditional teaching method based on the experiences of each lecturer. This is not truly innovative, as the lectures would be heavy on theory, yet light on practice. Therefore, it is imperative to curate lectures on the subject of electrical and electronic practice following the CDIO method in the engineering field, especially electrical engineering in universities. Lectures must be designed in a way which is easy to implement, with a content structure and a practical process suitable with the learning outcome objectives, as well as developing the competence of students, in order to meet the requirements of the society and businesses in the context of international integration.

II.   Theoretical and practical basis of curating lectures based on the CDIO approach in educating engineering subjects

2.1. Overview of the history of the topic

In 2000, Massachusetts Institute of Technology (MIT) and a number of other universities launched the CDIO initiative to reform engineering education. CDIO stands for: Conceive, Design, Implement, and Operate. In 2007, it was developed into a teaching approach applied in engineering subjects in universities and the book "Rethinking Engineering Education: The CDIO Approach" was published. This book was translated to Vietnamese by Tan Nhut Ho and Thi Minh Trinh Doan and published by the National University of Ho Chi Minh City Publishing

House in 2010.

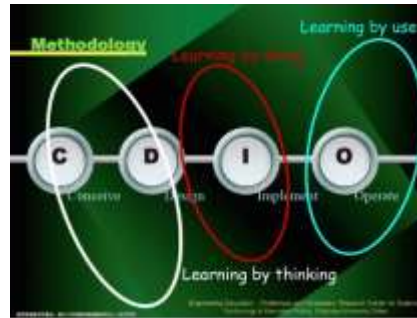The CDIO approach is demonstrated as follows:

Figure 1. Model of the CDIO approach
(Source:https://www.slideshare.net/Yossisv/reingegnerizzare-ingegneria-ii-implementazione-cdio)

To date, over 100 universities in many regions around the globe such as Europe, North America, Asia, South America, Australia, New Zealand, etc. have applied the CDIO approach in training major engineering disciplines. The content of this reform focuses on: Developing the standard outcome (CĐR) of the field; designing lectures in an integrated manner with the participation of relating members (businesses, lecturers, students, and school leaders); teaching and evaluating in accordance to CĐR, ensuring the activeness of learners, emphasising integrated teaching activities and experimental learning. Learning assessment activities are improved, focusing on evaluating output competence of students, based on evidence of the learning process and results achieved during education. On the other hand, universities also rely on CDIO standards to improve infrastructure and technical conditions for teaching, and qualifications of the teaching staff in terms of expertise, personal quaities, and teaching ability in accordance with the requirements of CDIO. *(Source: Tan Nhut Ho, Thi Minh Trinh Doan, "Cải cách và xây dựng chương trình đào tạo kỹ thuật theo phương pháp tiếp cận CDIO", National University of Ho Chi Minh City Publishing House, 2010).*

2.2. *Building lectures using the CDIO approach*
Lectures are a part of the content presented by the lecturer to students in a course, with a view to transfer knowledge to students to achieve the goals of the lecturer, expressed through appropriate teaching methods and tools. A lecture is considered as a unit of content of a subject, over the course of one or two classes. Building a lecture is building the content structure according to the goals of the subject, with an amount of knowledge and logical order suitable for different demographics to ensure a solid knowledge foundation. Basic requirements for building a lecture include:

+ Clear orientation of the topic

+ Coherent, systematic, and expressive presentation of content

+ Clear and easily understandable analysis of possibly related events and phenomena, with a general summary *(Source: Hien Bui, Van Giao Nguyen, Huu Quynh Nguyen, Van Tao Vu, "Từ Điển Giáo Dục Học", Bach Khoa Dictionary Publishing House, 2021).*

The theoretical basis above shows that building a lecture following the CDIO approach is: building the content structure of the lecture according to CĐR with specific and detailed objectives consistent with the training program, while being closely linked to active and experimental teaching methods in a specific and practical way, suitable for the level and profession of the learner. Based on the criteria when building a subject following the CDIO approach, the lecturer can check and evaluate the knowledge of students after completing the subject, in order to achieve the objectives and CĐR of the course, whilst meeting the expectations of the learner and employers.

When building a lecture for a subject, the process below must be followed:

+ Find out the expectations of the learners, requirements of labour employers, current economic situation, trends in society, infrastructure and study programs the university regulate.

+ Research the CĐR of the university, conditions to carry out goals, learning conditions, reference materials, technical technology textbooks, etc. in order to determine the goals, contents, and methods applied to solve practical problems in a creative and scientific way.

+ Analyse to identify type of lesson taught and target issues of the lecture.

2.3. Objectives and CĐR of lectures

a. Objective of lectures: Objectives are established by the school and lecturers based on the CĐR of the course and must clearly specify the level of content and implementability. Determine the objectives of the lecture in terms of knowledge, skill, and attitude. The objectives of building a lecture are presented to express thinking and skills from low to high, from concrete to abstract. According to B.J. Bloom, the objectives of a course lecture are divided into three levels:

+ Knowledge objectives: describe the level of cognitive ability

+ Skill objectives: describe the level of ability to act

+ Attitude objectives: describe the ability of emotional level

Below is a table of levels of objectives for course lectures, according to B.J.Bloom:

OBJECTIVE	LEVEL	DEFINITIONS
Knowledge	1. Know	Recognize, memorize, describe, list, state, and reproduce.
	2. Understand	Have the ability to explain, illustrate, judge, interpret, describe, and summarize concepts from information learned.
	3. Apply	Apply the knowledge learned, distinguish, process, outline, and develop further to solve problems and situations in real life.
	4. Analyze	Distinguish, classify, and divide the whole into many smaller parts to see relationships and overall structure clearly.
	5. Evaluate	Compare, select, make decisions, and evaluate implementation based on given criteria and standards.
	6. Create	Know how to reorganize different elements based on the basis of the knowledge that has been absorbed to create a new model or structure with value.
Skills	1. Imitate	Observe, follow, and repeat using their own efforts.
	2. Finish task	Complete the correct sequence of a skill operation that has been observed according to the instructions of the lecturer.
	3. Finish task accurately	Repeat a skill in a rhythmic, correct, and accurate way, and can carry out tasks independently without guidance.
	4. Automate	Complete one or more skills in a natural and simple way, without requiring physical or intellectual effort.
	5. Create	Combine multiple standard skills to process and solve problems and situations in real life with meaning and value in economic and technical terms.
Attitude	1. Receive	Listen and pay attention to the peer
	2. Respond, react	Consciously express emotions and have reactions to understand, comply with.
	3. Evaluate, admit	Compare, analyze, comment, and express opinions about one's own views.
	4. Organize, implement	Establish a system of organizational values, and can attract others.
	5. Characterize	Have the belief, passion, will, and decisiveness to act in an independent way with their circumstances.

Table 1.1. Levels of objectives for course lectures

(Source: Duc Tri Nguyen, Ngoc Vinh Ho, "Phương pháp dạy học trong đào tạo nghề", Education of Vietnam Publishing House, 2013).

b. CĐR following the CDIO approach: CDIO outcomes are descriptions of what students are capable of, including the level of understanding or skill and attitude that students must achieve after completing the course, whether students are able to meet integrated learning experiences, skills that support the deeper understanding of basic foundation knowledge, experiential experiences, and situations that students will encounter in their careers. CDIO outcomes reflect the quality and professional competence of learners with specific target criteria as follows:

+ Technical knowledge and reasoning

+ Personal, professional, and behavior skills

+ Attitude and communication skills

+ CDIO in the context of society and business

(Source: Tan Nhut Ho, Thi Minh Trinh Doan, "Cải cách và xây dựng chương trình đào tạo kỹ thuật theo phương pháp tiếp cận CDIO", National University of Ho Chi Minh City Publishing House, 2010).

2.4. Structure of a lecture following the CDIO approach: This is the arrangement of related elements in a logical system to form a lecture. The structure is the basis for building a lecture, including: theoretical lectures and practical lectures, with the main components: introduction, body, and conclusion.

The structure of a theoretical or practical lecture can be divided into many teaching units corresponding to the levels corresponding to each teaching unit such as: Lesson 1, Lesson 2 ... Lesson n, each lesson containing the content related to a unique topic in the course objectives. The structure of the practical lecture includes the relevant theoretical content combined with the implementation procedures to train professional skills for students using practical methods with the sequence of steps performed with the specific instructions of the lecturer for students to practice.

The structure of a practical lecture involves technical knowledge and professional skills to achieve CĐR objectives with the following requirements:

+ Teaching level

+ Teaching methods

+ Technologies at hand

+ Professional technical skill

Each skill is divided into many smaller skills following the process below:
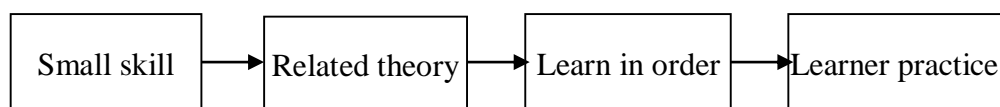
Figure 2. Smaller skills development process

(Source: Duc Tri Nguyen, Ngoc Vinh Ho, "Phương pháp dạy học trong đào tạo nghề", Education of Vietnam Publishing House, 2013)

2.5. Testing and evaluation of course lectures: Testing aims at collecting data and evidence to provide the data and information that form the basis for evaluation. Evaluation is the process of forming judgments and assessments about work results based on the analysis of the information collected, in comparison with the goals and CĐR, in order to propose appropriate decisions to improve the current situation, adjust and improve the quality and efficiency of work.

Below is a sample criteria table for evaluating lectures based on CĐR:

Criterion	Evaluation of Criterion	Level achieved				Standard score	Score	
							Student	Lecturer
Structure								

Knowledge								
Professional Skills								
Attitude								
Content								
Time								
Results	**Total Score**							

Table 2. Sample criteria table for evaluating lectures

(Source: Master's Degree Thesis, Thanh Chinh Pham, "Xây dựng bài giảng theo hướng tiếp cận CDIO cho môn học thực hành điện", presented at the University of Technical Education, Ho Chi Minh City, 2014)

III.   Conclusion

The CDIO approach proves to provide many new innovations with a goal of putting the learner at the centerpoint. The author's construction of electrical and electronics practical lectures is not outside that goal, in order to meet the CĐR goals of the education system and the expectations of students in the context of international integration. Researching the CDIO approach from the perspective of teaching theory provides a theoretical and practical basis for building lectures following the CDIO approach. Applying the CDIO approach to build course lectures and implement lecture compilations for electrical and electronics practice subjects according to the CDIO syllabus compiled by the Department of Electrical Engineering and Vinh University.

IV.   References

1. Thanh Chinh Pham (2014), "*Xây dựng bài giảng theo hướng tiếp cận CDIO cho môn học thực hành điện*" presented at the University of Technical Education in Ho Chi Minh City*,* Master's Degree Thesis, Library of University of Technical Education in Ho Chi Minh City.
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