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Students' Learning Attitudes toward CDIO-Based Business Administration Course Design: An Investigation from two Universities in Central Vietnam

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ABSTRACT--*The purpose of this study was to investigate students' learning attitutes toward the application of "Conceive-Design-Implement-Operate" (CDIO) approach in two Departments of Economics-Business Administration Faculty in two universities in Central Vietnam. The study aimed to investigate students' creative thinking ability, problem-solving ability and their attitudes toward this 'learning by doing' and 'outcome-based learning' method. The sample was composed of 339 students from two departments of those two universities who were chosen to complete a 32-item questionnaire on a Likert scale to measure their learning attitudes toward the CDIO-based Business Administration courses. The results showed that students are more engaged and motivated in the courses, and they learn how to integrate feedback from their peers. Overall, all the students have positive attitudes toward the CDIO-based program and they are willing to take more relevant courses in the future.*

Keywords-- *CDIO-based, Business Administration students, creative thinking, learning attitudes*

I. INTRODUCTION

The approach of Conceive-Design-Implement-Operate (CDIO) is a new model for improving higher education because the higher education is facing the problems of low academic achievement among students in response to the increasing requirements of the working market (Cloutier, Hugo, & Sellens, 2011; Dai et al., 2017; Ha et al., 2019; Malmqvist, 2016; Nassir & Chong, 2016). How to motivate the students to learn has become a big problem (Hmelo-Silver, 2014). Thus, the CDIO approach provides an opportunity for students to solve problems, complete projects and learn new concepts in thinking through hands-on practices and cooperate with their peers (Pittaway & Cope, 2017).

Higher education institutions (HEIs) in Vietnam in general and those in Central Vietnam in particular sensed this crisis and faced the challenges to improve the training quality to satisfy the increasing requirements of labour market and want to make necessary changes (Ha et al., 2019; Tran, Hallinger & Truong, 2018; Vu & Phung, 2015).

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The A University (pseudonym, referred to as AU) applied the CDIO approach in the Department of Economics and Business Administration in 2018. The B University (pseudonym, referred to as BU) applied CDIO innitiative since 2016. These two universities are located in two big city centres of two Central provinces of Vietnam. A total of 339 students from both universities took the CDIO-based courses. They took the required courses of introduction to CDIO-embedded system, practice of outcome-based course analysis, and applications on geospatial information in the university year of 2018 for AU and of 2016 for BU. In these courses, students were encouraged to form interdisciplinary teams, and lecturers assigned projects/tasks to them. In addition, students had to work together to solve the problems, and they were also encouraged to think of new ideas. In these courses, they are 'student-centered' instead of only paying attention to lecturer's guidance. In order to check students' learning attitudes toward the CDIO-based program, a 32-item questionnaire on a Likert scale was given to 339 students in both departments of AU and BU. In the past, there were some creative problem-solving scales; however, there was no CDIO-based creative problem-solving scale. By applying the CDIO approach, university students' imagination is encouraged to find problems and solutions. So the 'CDIO-based creative problem-solving scale' was developed to evaluate students' attitudes toward the CDIO- based courses.

In Vietnam, the research on students' learning attitudes toward CDIO-based Business Administration Courses in Vietnam (Tran & Phan, 2020) is still scarce. This research was conducted to investigate Vietnamese students' creative thinking ability, problem-solving ability and their attitudes toward this 'learning by doing' and 'outcome-based learning' method in two departments of AU and BU in Central Vietnam and to pave the first study in the literature.

II. LITERATURE REVIEW

In this section, the CDIO approach, students' imagination and innovation, and problem-solving ability are discussed.

1. CDIO Approach

In the late 1990s, a group of educators of engineering field noticed that the engineers need not only professional backgrounds but also other abilities to solve problems we faced nowadays (Pittaway & Cope, 2017). In order to solve the problem, a new International engineering education model, Conceive-Design-Implement-Operate (CDIO), was proposed by MIT and the Royal Swedish Academy of Sciences in 2000 (Crawley et al., 2012; Malmqvist, 2016).

The basic idea of CDIO is that under the premises of maintaining scientific basis, the courses should strengthen the engineering practices and develop the engineering abilities (Crawley et al., 2012; Ha et al., 2019). The aims of CDIO hoped graduates from engineering field possess abilities to imagine, design, practice, and operate the complex engineering systems in the group-based environment in society nowadays (Malmqvist, 2016).

There twelve standards, which systematically covers the main requirements of Engineering Education of CDIO (Crawley et al., 2012; Chen & Zhu, 2015), have been applied for CDIO-based Business Admnistration Courses. The twelve standards can be divided into five main domains: curriculum, teaching and learning methods, assessment, faculty competence, and workspace (Chen & Zhu, 2015; Malmqvist, 2016). Moreover, the central idea of CDIO-based Business Admnistration Course is to lead the educators to meet the demands of CDIO-based

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Business Admnistration Course Education depend on the resources in different situations (Malmqvist, 2016). The following are the important features of CDIO-based Business Admnistration Course Education (Dai et al., 2017):

Build up the view of product/project orientation

Try to understand students' values by the products they designed in CDIO courses. Students can improve their human interactions, knowledge, and skills through modifying and improving their products or projects (Dai et al., 2017). As a result, the students, who are trained at HEIs, will be the talents who really possess knowledge of business administration and practical abilities and skills to adapt to the working environment after graduating.

Encourage students to attend teaching practices

CDIO-based Business Admnistration Course model helps cultivate students' study habits because its process emphasizes on their group values, cognition to their products, and individual learning attitude (Dai et al., 2017; Malmqvist, 2016). Under limited CDIO-based Business Admnistration Course resources, students can get considerable effectiveness by the comprehensive utilization of resources. They can manufacture products or design and implement projects at university immediately instead of waiting until they enter the workforce. Moreover, imagination evoked during the classes will form a new teaching situation and atmosphere.

Build up students' confidences

The educational idea of CDIO is to improve students' learning abilities by lecturers' raising expectations to them. Students discover their potentials in the product and project-based development process and create unlimited possibility by changing their learning attitudes positively towards CDIO courses (Dai et al., 2017).

Globalization

Promoting CDIO-based Business Admnistration Course model is conducive to the connections between students or universities and the world. It provides students with the most straightforward learning opportunities.

2. Imagination and Innovation

Imagination is the way of developing effective action, cultivating the innovative problem-solving ability, and finally forming a sense of community ability (Ayob, Hussain & Majid, 2017). Albert Einstein once said that "Imagination is more important than knowledge. Knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution. It is, strictly speaking, a real factor in scientific research" (Cited in Gardner, 2010). No imagination, no insight ability, not to mention the problem-solving and the motion of research and innovation (Dai et al., 2017). Innovation is not brought about by accident, but by the result of a series of events. According to Gardner (2010), students will be able to solve problems and adapt the changing world only if they have creative thinking skills. Consequently, it can be summed up that imagination is the way of developing effective actions, cultivating the innovative problem-solving ability, and finally forming a sense of community ability (Gardner, 2010; Gibson, 2017).

In addition, students should make use of critical design thinking and creativity skills to solve problems and create new values (Dunne & Martin, 2016). The critical design thinking courses of Institute of Design at Stanford emphasis on five stages: Empathize, Define, Ideate, Prototype, and Test (Platner, 2010). In addition, the idea of

the Tech Museum of Innovation is exploration and innovation, which contain human care at the same time. Therefore, it is argued that is a progressive process from imagination to innovation (Alexander, 2017; Christensen, 2013). This process should keep brainstorming for extending out more ideas to discover problems and solutions of them.

In addition, the operation course of imagination can be induced by cross-field. Imagination contains the following rules (Alexander, 2017, p. 135): "Turn extensive life experiences into different elements to find out new ideas; Imagination helps people develop simulation capability; The connection between sentiment and pictures can motivate the audiences; Finally, people can create the real exited objects". Thus, we can classify four steps of the process from imagination to innovation. First, we need to discover the problem and classify it by whether it needs solving or improving. Then gather interdisciplinary talents to put their ideas of solving the problem. They can give many different thoughts to enhance the chances of solving problems. Furthermore, we can go to the next stage, prototype design, which visualizes our thoughts. After continuously amending and improving the design, the model was finally perfected. Finally, test and amend the product again and again at the implementation phase. Thus it can be seen that it is important to create a learning environment for people have different backgrounds to exchange their ideas and design thinking (Platner, 2010).

Moreover, imagination and critical thinking can enhance student learning motivations (Lee, 2018). Students' learning motivations are affected by the course contents, lecturer characteristics and students' individual different (Lim & Kim, 2013). The learning motivations can divide into extrinsic motivation and intrinsic motivation (Benabou, 2017; Ryan & Deci, 2010). The encouragements from lecturers and rewards belong to extrinsic motivation. On the other hand, the intrinsic motivation attracts the students' interests and makes them be willing to make efforts to learn something. Therefore, motivating students' intrinsic learning motivations will help enhance their willingness to learn effectively (Benabou, 2017; Ryan & Deci, 2010). Inducing students' imagination can stimulate their intrinsic motivations. Evoking imagination can stimulate students' intrinsic learning motivations. Lecturers create the opportunities to interact with students, discover the problems, and solve the problems so that the students can apply knowledge practically, and discuss with each other, giving positive and innovative feedbacks, and finally create a fine product (Benabou, 2017; Ryan & Deci, 2010).

Finally, imagination makes people help the unpredictable future. The world is changeable, and people cannot precisely predict how it will be. Imagination helps us train our multi-thinking ability. Imagination developed by learners may become the ability of developing creativity, so it is the power of evoking creativity (Lim & Kim, 2013). The skills of imagining can be acquired through learning. Based on the above information, we know that creativity stimulate our abilities of innovating and capabilities of facing the challenges in the future (Ayob et al., 2017).

3. Problem-Solving Ability

Problem-solving ability helps students discover the problems, collect data, and analyse them with experiences and knowledge that they have already known (Prince & Felder, 2016). Then they can get new approaches of solving the problems after exploring and reasoning. It is a performance of higher order cognition that learners treat problem-solving as a way of learning at a learner's perspective (Jonassen, 2018). This kind of performance can help learners generate new observations and restructure their thinking course. Thus, problem-solving is not only a

learning method but also a higher order cognitive ability. The results after solving the problems should be meaningful, that is, it should meet all the learners' demands of learning (Jonassen, 2018).

Studies have showed that students' problem-solving abilities would be affected by their attitudes, thinking styles, emotional intelligences, the socioeconomic status of their families, etc (Jonassen, 2018). Under all circumstances, one of the core purposes of public education is to help students understand how to collect and categorize data, and make initial analysis and decision by critical thinking through various learning activities. Then they will reach to an agreement on using relevant information to effectively solve issues by communicating and negotiating rationally with others (Prince & Felder, 2016).

The process of solving problems varies from person to person and it can be summed up as follows: "Discover problems; Define or describe the problems; Develop problem-solving strategies; Start the problem-solving process; Check the result after solving the problems" (Jonassen, 2018, p. 57).

In Vietnam, improving the quality of higher education has been in focus for the last few decades (Tran, Hallinger & Truong, 2018; Vu & Phung, 2015). The Ministry of Education and Training of Vietnam provided the main guidelines for increasing the competitiveness of Vietnam higher education. They called for improvements in the quality of education and emphasize the importance of Higher Education Institutions to provide education that answers to the competence requirements of working life and employers' increasing demands. More recently, improving the education and training system quality has been set as a key target in Vietnam's strategy to become a smart, sustainable and developed economy (Do, 2015; Tran et al., 2018; Tran et al., 2020). In this process, CIDO innitiaves have been regarded as a great alternative. For the last ten years, the CDIO initiatives have been applied in Vietnam and a lot of measures taken to support the continued improvement of the CDIO implementation at the institution/programme (Ha et al., 2019; Tran & Phan, 2020; Truong, Ha & Le. 2019).

During that process, the students' learning attitudes play an important role in their learning achievements and success for CDIO-based Business Administration Course design and implementation. It is of significance to investigate their attitutes toward CDIO-based courses which can be an essential feedback to improve such courses.

1) What are the students' learning attitudes at two Departments of Economics and Business Administration at AU and BU in Central Vietnam toward the CDIO-based Business Administration course design and implementation?
2) How does the students' problem-solving ability change after taking the CDIO-based courses?

III. RESEARCH DESIGN

1. Research sample

The convenience sampling method was used to recruit students who volunteered to help with the research and administer the survey. The survey instrument was distributed to 350 students in the two Departments of Economics and Business Administration from AU and BU in Central Vietnam who were currently taking the CDIO-based courses, were invited to complete the questionnaire. They took the required courses of introduction to CDIO-based Business Administration course, practice of project-based analysis from the academic year of 2016 for AU and 2018 for BU. After the courses, they were asked to fill out the questionnaire, called "CDIO-based creative problem-solving scale" to collect their feedback toward the CDIO-based courses. However, 339 questionnaires were

returned, for a 96.5% return rate, which exceeds the 30% response rate most researchers require for analysis (Dillman, 2000). The sample of this research was drawn from 339 respondents who completed the survey instrument. There were more males (61.7%) than female students (38.3%) among the 339 student participants who were surveyed. Of these, 269 (34.2 %) were from AU, and 170 (31.3%) from BU. Most of them are sophomore and junior students (79%). Table 1 shows the distribution of participants by gender from the two universities, AU and BU.

Table 1: Number of participants

University	Gender group		
	Male	Female	Total
A	165	104	269
B	104	63	170

2. Research Tool

In this study, the research tool is the five-point Likert scale consisting of 32 items and one open-ended question. Students respond to each item on a 1 to 5 Likert scale, with 5 being high. The scale is developed by a team of experts, and it is developed to investigate students' creative thinking ability (items 1-7), problem-solving ability (items 8-23) and their attitudes toward the CDIO-based courses (items 24-32). Therefore, it is called 'CDIO-based creative problem-solving scale'. The options are "strongly disagree, disagree, can't decide, agree and strongly agree." Students need to choose the option that best reflects their opinions. Moreover, there are 29 positive statements and 3 negative statements in the scale.

First, KMO values are tested to check if the items are adequate. In this study, the KMO values reach 0.8 (p=.000<.001); hence, the samples are adequate. The results are shown in Table I

Table 2: KMO AND BARTLETT TEST

Items	KMO	Bartlett	P value
Items 1~32	.857	1346.082	.000

In addition, the Cronbach's Alpha of the scale is above 0.8 (Cronbach's Alpha =.881), which shows the measure of internal consistency of the scale (reliability). Also, before the questionnaires were issued, the questionnaire was adjusted by experts, so the questionnaires have content validity.

IV. RESULTS AND DISCUSSIONS

In this section, the results and discussions of the CDIO-based creative problem-solving scale, including students' creative thinking ability, problem-solving ability and their attitudes toward CDIO-based courses, are introduced.

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1. *Students' Creative Thinking Ability*

The mean scores of students' creative thinking ability are summarized in Table II. Overall, students strongly agree with item 7, which presents their confidence in integrating ideas to solve problems. Item 2 "I use a risk-based approach to solve the problem" ranks the lowest among the scale items. It's probably because of the term "risk-based" scares some of the students. However, the average of items 1, 3, 4 and 6 are around 3.8, which means students' thinking ability has been inspired to be applied to the projects. This result reinforces the previous studies (For example, Ayob, Hussain & Majid, 2017; Gardner, 2010; Lee, 2018).

Table 3: Students' Creative Thinking Ability

Items	*M*	*SD*
I. I can come up with creating brand new solutions or ideas.	3.82	0.59
2. I use a risk-based approach to solve the problem.	3.53	0.65
3. I always carefully think about new technology or concepts before accepting them.	3.87	0.71
4. I can develop logical plans to solve problems.	3.85	0.68
5. I can integrate substitutional opinions.	3.94	0.57
6. I can create interdisciplinary knowledge.	3.82	0.72
7. I can integrate ideas and elaborate patterns to solve problems.	3.97	0.57

2. *Students' Problem-Solving Ability*

The mean scores, and standard errors of the students' problem-solving scale are listed in Table III. According to the results, item 20 and item 22 rank the top two in the scale, respectively. This shows students enjoying working and learning with peers and they also find the whole process exciting. They are willing to speak out and express their ideas while working in a team. They also show positive attitudes toward problem-solving. In this scale, item 23 is a negative statement, which scores 2.22. Hence, we can assume that students do not take the process of problem-solving as a waste of time. On the contrary, they believe there is an answer to every problem, and they identify possible ways to solve the problem (items 8, 10, and 11). Moreover, the students enjoy the process of problem-solving and they find it interesting and exciting (items 18 and 20). This result confirms what other former studies revealed (For example, Jonassen, 2018; Prince & Felder, 2016).

3. *Students' Attitude toward CDIO-based Courses*

In terms of students' attitude toward CDIO-based courses (items 24-32), the descriptive statistical analysis report is presented in Table IV.

The top three items in the questionnaire are item 26, item 25 and item 28, respectively. Item 26 aims to test students' ability to respect different opinions and ideas while item 25 and item 28 verify students' problem-solving ability has increased through the CDIO-based curriculum. Item 32 "I like this course, and I don't feel tired even when I spend a lot of time on it" gets the lowest score. The reason may be that comparing to other subjects, CDIO

emphasizes 'Learning by doing' (Benabou, 2017; Dunne & Martin, 2016; Ryan & Deci, 2010). Hence, students may spend more time and energy on completing the project

Table 4: Students' Attitudes toward CDIO-based Business Administration Courses

Items	*M*	*SD*
8. I try to find out solutions which can't be taught in the course.	4.01	0.52
9. I think that only people without question will ask questions.	2.07	1.03
10. When I notice confusing things in the daily life, I will find answers.	3.70	0.61
11. I believe every problem has a solution.	3.71	0.84
12. I can use all relative factors as evidence to construct a clear insight of the problem state.	3.83	0.55
13. I can identify multiple ways to solve problems with specific preconditions.	3.84	0.56
14. I can propose one or more solutions.	3.87	0.57
15. I can infer or diagnose the feasibility of solutions.	3.92	0.56
16. I can examine the impacts brought upon by the solutions.	3.73	0.62
17. I can practice different solutions.	3.71	0.59
18. I find solving problems interesting.	4.08	0.62
19. Only when I have the confidence of success, I will solve problems and situations.	3.43	0.92
20. I find the process of coming up with a solution exciting.	4.11	0.62
21. While solving problems, I'm not afraid to be ridiculed when making mistakes	3.87	0.65
22. I enjoy exchanging others' opinions and absorbing them	4.10	0.57
23. I think that challenging questions is a waste of time	2.22	1.01
24. I find the lecturer's course design and teaching making me interested.	3.91	0.60
25. I understand that there are different approaches to solve problems.	4.04	0.49
26. I respect different ideas and opinions.	4.19	0.60
27. I acquire professional skills through implementation.	3.82	0.65
28. This course can appreciate my problem solving abilities.	4.04	0.50
29. I think implementation of the courses as a waste of time.	2.15	0.97
30. I think taking courses like this can contribute to my future employment.	3.94	0.60
31. I will do my best to complete projects to view my achievements.	4.03	0.58
32. I like this course, and I don't feel tired even when I spend a lot of time on it.	3.65	0.74

4. Open-Ended Question Discussion

In the 'CDIO-based creative problem-solving scale', an item is an open-ended question which asks students: In the future, what kind of CDIO-based courses do you expect your university to provide? The feedback from the students can be summarized as follows:

1) Students want more hands-on activities.

S: Project-oriented courses, learning by doing courses.

S: Business-related management *software implementation.*

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2) Students expect more interdisciplinary cooperation.

Similar courses can be *done in a way that takes advantage of teamwork and in conjunction with the CDIO-based course contents* taught *during this semester, which can train our ability to work with others and apply what we have learned.*

3) Students want the university to provide students self-learning ability courses.

S: Guiding students to self-learning courses is the beginning of progress, especially the CDIO-based Business Administration courses.

S: The course can help students think logically, perhaps in a similar way to topic analysis.

There are a number of limitations of this study. The primary defect arises from the sampling process used. The sample was drawn from only two departments of two universities in Central Vietnam. The random selection of participants alleviates this concern to a significant degree but does not entirely remedy that shortcoming. The second limitation is related to the sample and the self-reported measurements. It might bias the findings as well, and was cross-sectional research, which does not allow. Future studies should address these limitations. All results obtained after this research are necessary for the improvements of CDIO-based Business Administration courses in Vietnamese HEIs in general and AU and BU in particular. The research was conducted with an expectation of acting as stimulation in extending similar investigations on bridging the gap between research related closely to CDIO course implementation and realistic applications in Vietnam.

V. CONCLUSIONS

The features and innovation of this study is that it combines the CDIO-based curriculum, creativity and problem solving to develop 'CDIO-based creative problem-solving scale'. To sum up, the conclusions can be summarized as follows:

Almost all the students surveyed from AU and BU in Central Vietnam feel positive toward the CDIO-based Business Administration curriculum design and implementation. In this generation, lecturers have to change to meet the students' need, so does the curriculum. The traditional 'lecturer-centered' instruction need to be revised, and the 'student-centered' approach need to be applied into the class. In the past, lecturers may worry about students' ability to complete the real projects.

However, through the CDIO-based Business Administration courses, students can learn from the hands-on project-based model activities. In addition, they work with their peers instead of working on the project alone. Working in the team gives them opportunities to communicate with one another, and the positive attitude really influence students' learning to be more active.

According to the results, students' feel that their creativity and problem-solving abilities have been increased. Through the CDIO-based courses, students learn that more than one answer is possible. Since it is 'student-centered' they are allowed to use their imagination to find best solutions. Besides, they are not afraid of facing challenging questions, and they are excited about problem-solving process.

In this study, the participants are from the students of two departments of Business Administration of AU and BU who are currently taking CDIO-based courses. It is the first research to investigate the students' attitudes towards CDIO-based Business Administration Courses in Vietnam, to the best of authors' knowledge. All results

obtained from this research are necessary for them to enhance the CDIO-based course implementation in Vietnamese HEIs. In the future, more hands-on activities can be added and adapted to any curriculum.

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