International Journal of Innovation in Science and Mathematics
Volume 7, Issue 3, ISSN (Online): 2347–9051

Teaching Mathematics for Economics Students According to the Cdio Approach to Meet the Output Standards

Hoan Van Tran
Lac Hong University, Dong Nai Province, Viet Nam.
Corresponding author email id: tranhoan.math@gmail.com

Date of publication (dd/mm/yyyy): 03/07/2019

***Abstract* – Up to now, in our country, primarily every university has built the output standard. However, specifying the output standards for each subject available in a school's training program, to contribute to helping students meet the school's output standards, it is generally not available. Therefore, the question is how to support university teachers concretize output standards with the subject they undertake? This is a new issue, and there is no explicit answer so far, especially for basic science subjects in the training program, including mathematics for economics sector. So we choose the research topic: Teaching mathematics for economics students according to the CDIO approach to meet the output standards.**

***Keywords* – Learning Outcomes, Economy, Integrated Situation, Professional Skill, Mathematics.**

I. INTRODUCTION

CDIO based on the philosophy of developing learners' core competencies to meet the principles of the cycle and system deployment: *Conceive - Design - Implement - Operate*, in the corporate and social context. CDIO is an approach, a training-oriented model that ensures output capacity in universities. Approaching CDIO helps us to concretize the output standard of the training program, and integrate the course output standards into the program output standards. Moreover, the CDIO approach also provides active learning methods and experiences that help meet the output standards that have developed. So, research to help teachers access CDIO in teaching mathematics at Universities to meet the output standards is an extremely urgent requirement but has not adequately studied [3].

Maths for economic students include: Advanced mathematics, Probability - Statistics, are subjects of basic knowledge in the university. Studying Maths not only helps students have an essential knowledge base but also helps to train the skills outlined in the output standard. But, how to teach Maths to help meet the output standards for economic students so far is still a question that has not answered satisfactorily.

The current education trend is more about practice, leading to schools cutting basic subjects in general and Mathematics in particular. To affirm the role of Math in the training program as well as the contributions of Maths to the components of the output standard, the study of teaching Math towards meeting the output standards is an urgent requirement.

For the above reasons, we choose the research topic: *Teaching mathematics for economics students according to the CDIO approach to meet the output standards*.

II. RESEARCH METHODOLOGY

2.1. *Methodology of Reasoning*

Research on the CDIO approach in education and training, research output standards according to the CDIO approach

of the economic sector, study economics practices, characteristics, and role of mathematics for the economics, allows us to clarify the concept of teaching Math according to the CDIO approach to meet the output standards and propose the professional skills to be formed and developed for students in teaching Mathematics.

2.2. *Practical Research Methods*

Using investigative methods to learn about career skills needed and can form and train through teaching mathematics at Lac Hong University; explore opportunities and realities of vocational skills training for students of the economic sector through teaching and learning Maths at Lac Hong University, clarify requirements for Math contents at Lac Hong University to teach in the direction meet professional obligations, to explain the practical basis of research issues.

Math-statistics methods in Educational Sciences is used to handle the data collected during the investigation and pedagogical experiment.

2.3. *Methods of Summarizing Experiences*

Summarizing the experiences of colleagues and themselves in the process of teaching mathematics at universities in the direction of training professional skills for students of the economic sector.

2.4. *Professional Solutions*

Consult with experts to clarify some comments on the quality of teaching Maths at universities and the correctness of pedagogical measures towards meeting the output standards for students in economics has proposed in the thesis.

2.5. *The Experimental Method of Pedagogy*

Conduct a pedagogical experiment at Lac Hong University school to initially test the feasibility and effectiveness of proposed pedagogical measures.

III. Study Results and Comments

3.1. *Overview of Research Results Related to the Thesis Topic*

In this section we have studied in turn: Overview of CDIO approach; Output standards at university in the world and Vietnam; Approach CDIO in teaching disciplines and especially the economic sector; Teaching for college students toward meeting the output standards; Teaching Math toward meeting the output standards and experiential teaching models proposed by the CDIO approach to meet the output standards. These studies have helped us to create *the concept of teaching according to the CDIO approach to meet the output standards is the teacher process [11]:*

- *Based on the output standard of the training program, it is concretized according to CDIO approach to develop subject output standards with specific requirements on occupation skills that students need and can be formed and strengthened through studying that subject;*
- *Design and organize teaching in a way that helps students form and develop career skills in the course of learning subjects to meet the output standards.*

3.2. *The System of Essential Skills of People Working in Economic Sectors and the Role of Teaching*

Mathematics

In (Hoan, 2018), to obtain the system of necessary skills of economic sector occupants, we have researched in turn: Firstly, it requires occupation skills for the economic sector from employers' research and employer, teacher and students; Secondly, the occupation skills that some universities around the world focus on training for students; Third, we summarize the core skills of economic students in groups from the above studies; Fourthly, after determining the system of professional skills in the economic sector from practice, the question is whether these skills are by the requirements of the output standards that Lac Hong University has built and what math skills contribute to the formation and development of skills? So we studied the output standards of the economic sector. We find that the standard output requirement for the mathematics of all economic sectors at Lac Hong University is: "**Expected Learning Outcome 2:** Applying basic knowledge about essential application areas such as: Advanced Mathematics, Probability Statistics, Linear Planning." However, how to teach Maths modules to meet this output standard has not been studied. Moreover, with the above output standard, the construction of the output standards of Math modules integrated into the output standard "Expected Learning Outcome 2" is difficult because there is no specific requirement for knowledge and skills. Therefore, to accomplish this, we have researched and concretized the output standards of the economic sector according to the CDIO approach; Fifth, the standard output has been concretized according to CDIO, We identify career skills that need to equip students with economic disciplines and recognize the similarity between these career skills and the occupational skills of the above economic career practices; Sixthly, from the study of the role of mathematics for the economic sector and the content of the two modules of Advanced Mathematics and Statistical Probability. These Math contents have the opportunity to train some skills for students in economics, from there we propose skills that train through Math learning. Seventh, from the requirements of the output standard according to the CDIO approach, we study proposing the teaching of Maths modules towards training career skills for students of the economics sector to meet the output, from there we propose table 1 below:

Table 1. Table of the occupation skills needs to practice through the study of mathematics at school [11]

SERIAL	SKILLS CONTENT	SYMBOL
1	Skills to use the language of mathematics in economic activity	SK1
2	Teamwork skills	SK2
3	Creative thinking skills	SK3
4	Critical thinking skills	SK4
5	Self-learning skills	SK5
6	Modeling skills in situations economic practice	SK6
7	Skills in the research application in practice	SK7
8	Skills in collecting, analyzing and processing information	SK8
9	Problem-solving and decision-making skills in economic analysis	SK9
10	Information technology skills	SK10

From the table of occupation skills suggested above, it can see that skills 2, 3, 4, 5, 7, 8, 9 and 10 correspond to some skills in the economic sector output standards CDIO approach. However, SK1 and SK6 play a vital role, helping students to solve the problem of practical economic. Therefore, we have proposed ten occupation skills

that need to be formed and developed for students in the process of teaching Maths modules, to meet the output standards.

3.3. *The status of teaching mathematics under CDIO approach oriented to train occupation skills for students of the economic sector in the Lac Hong University*

In [12], through the survey of the current status of training occupation skills for students of the economic sector through teaching the Maths module under the CDIO approach, we have the following results:

Firstly, about training career skills for students of the economic sector through teaching Maths modules:

- Teachers, students and alumni affirm the important role of Maths (Advanced Mathematics and Statistical Probability) modules in the economic sector, especially for the occupation skills of students; one of the factors that make it difficult for students in the economic sector to find jobs, the most important factor is the lack of professional skills.
- The level of formation and skill development of students through studying mathematics courses at LHU is mainly at an average level; an excellent and good level is still limited. The SK3 (Creative thinking skills), SK4 (Critical thinking skills), SK5 (Self-learning skills) and SK8 (collecting and processing data) are formed and developed better than the remaining skills.
- In the first step, teachers have paid attention to economic career practice situations in teaching Maths modules for students, but the level is not much, and in general, they do not meet the career requirements of the students in the future.
- Some skills are regularly trained such as: Data analysis, self-learning. Some have trained but not as much: teamwork, problem-solving, modeling, and some skills are only mentioned such as: Information technology application, knowledge application in practice.

From the above results, the majority of respondents agreed with the list of occupation skills proposed and affirmed that students have the opportunity to form and develop these career skills through teaching Maths modules.

- Based on the survey results, allow us to propose the necessary knowledge of Math content to equip students to meet the learning and professional activities in the future.

Second, about CDIO Approach in Teaching:

- Most teachers know about the CDIO approach in teaching. However, the level of understanding of the contents to be implemented to be able to teach is limited. Therefore, there should be specific instructions on how to apply for teachers in approaching CDIO to teach Maths to meet the output standards.
- Most teachers believe that to be able to access CDIO in teaching mathematics; it is necessary to build pedagogical measures with specific techniques, propose design models and organize experiential teaching to help students get knowledge requirements, as well as forming and training occupation skills in the teaching process.

3.4. *Some Methods of Teaching Math According to the CDIO Approach to Meet the Output Standards*

Measures 1:

Teaching some new knowledge content by building an open - minded problem related to economics.

It is possible to visualize the purpose, meaning and how to implement this method through the following diagram:

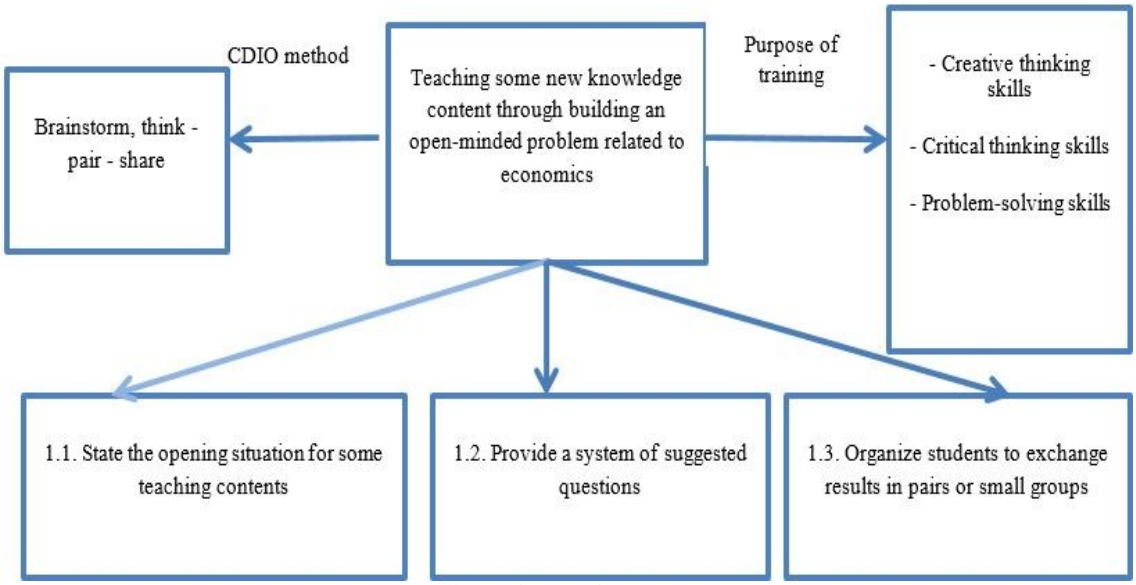

Fig. 1. Diagram of measure 1

Example 1.

Such as teaching situations of ***random quantities with Bernoulli distribution*** in the following:

The teacher mentioned the problem. A machine produce a type of product, the probability that made defective products is 10%. Once the machine produces 3 products, please tabulated probability distribution the number of defective products in 3 products are made.

Teacher posed the questions suggests following:

1. *Define Random Variable and Find its Value?*

Expected answers: Put X is the number of defective products in 3 products manufacturing, the inferred $X \in \{0, 1, 2, 3\}$

2. *Calculate Probability with the Values of X based on the Formulas Learned ?*

Expected answers:

$$P(X = 0) = 0,9.0,9.0,9 = 0,729$$

$$P(X = 1) = 0,1.0,9.0,9 + 0,9.0,1.0,9 + 0,9.0,9.0,1 = 0,243$$

$$P(X = 2) = 0,1.0,1.0,9 + 0,1.0,9.0,1 + 0,9.0,1.0,1 = 0,027$$

$$P(X = 3) = 0,1.0,1.0,1 = 0,001$$

3. *In the Result of* $P(X = 1)$, *each event has the Occurrence of Events of Defective Products and how many Standard Products?*

Expected answers: 1 defective products and 2 standard products.

4. *In the Result of P(X = 1), how many set of Accumulate Aforementioned and why?*

Expected answers: 3 set of accumulates, for each accumulates above how to choose one location for the event is defective products from 3 position, so: $P(X = 1) = C_3^1\ 0,\ 1^1 0,\ 9^2$

5. *Do the Same Thing for the Remaining Results?*

Expected answers: $P(X = 0) = C_3^0\ 0,\ 1^0 0,\ 9^3 = 0,729$; $P(X = 2) = C_3^2\ 0,\ 1^2 0,\ 9^1 = 0,027$; $P(X = 3) = C_3^3\ 0,\ 1^3 0,\ 9^0 = 0,001$

6. *Teachers Mentioned the General Problem:*

If in each batch manufacturing 100 products. Calculate the probability of k substandard products in 100 products? (with $k = 0, 1, \ldots, 100$).

Expected answers: $P(X = k) = C_n^k\ 0,\ 1^k 0,\ 9^{n-k},\ k = 0,\ldots,100.$

Thence teacher guide students to state Bernoulli general formula.

Measures 2: Enhance examples and exercises in the direction of applying Math tools to solve practical economic problems and tasks related to specialized subjects in economics.

The purpose, meaning and how to implement this measure can visualize in the following diagram:

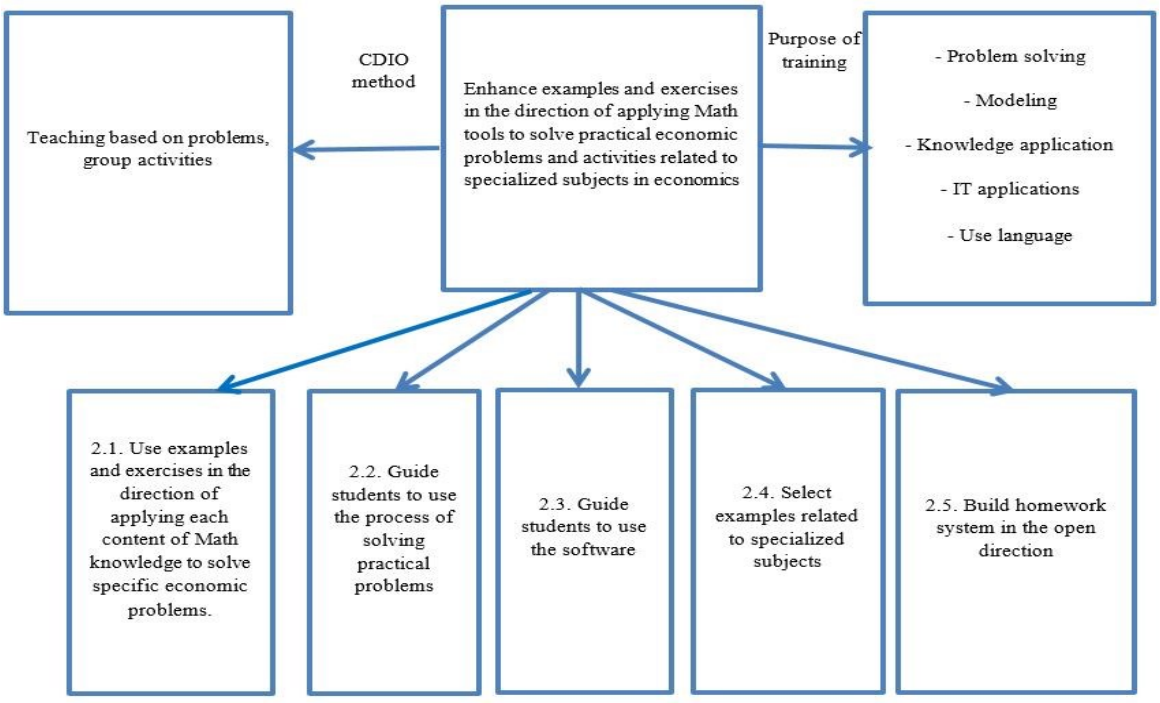

Fig. 2. Diagram of measure 2

Example 2.

Apply probability and statistics to solve the problem of insurance

Exercise

Suppose you have a motorbike worth 10 million. A company invites you to buy insurance with the following conditions: Every year, you pay a certain premium, if you lost the car, the insurance company will reimburse you 8 million (equivalent to 80% of the value of the car). How much is the highest premium you accepting? Now,

suppose you read the People's Police Newspaper and know that in the past year, the rate of motorcycle theft in the city was 0.1% (that is, with 1000 motorcycles, 1 motorcycles was stolen). How does this new information affect the decision on the maximum premium you accept?

Problem Situation, Given: A Person thinking how to Protect Personal Property

The solution that most people accept is to buy insurance for their motorcycles. However, whether buying or not buying insurance, he still faces the risk of being stolen. So, what to do to minimize losses, this question directs students to task the mathematical expectations model to calculate the expected level of expected holdings of all possible cases. We have to compare between two cases: Where to buy insurance and not to buy insurance?

Table 2. Cases of insurance fees

Insurance	Lost (p = 0, 1%)	Not lost (p = 99, 9%)	Expected asset value (E (X))
Yes	0 million	10 million	(99,9%). 10 million
No	(0,1%). 8 million	10 million	(99,9%) 10 + (0,1%) 8 million

Thus, if you buy insurance, expected asset value to be:

$EV_1 = (99,9\%).10(\text{million}) + (0,1\%).8(\text{million}) - \text{IF}$, with IF is insurance fees. If not, buy insurance, expected asset value is:

$EV_2 = (99,9\%).10(\text{million}) + (0,1\%).0 = (99,9\%).10(\text{million})$. So, if only based on the level of expectations to make decisions, you will buy insurance if $EV_1 > EV_2$, it means IF < 8.000 VND. This fee is 8.000 VND called fair premium after performing all these calculations, we try to ask ourselves again what is the maximum premium we can accept? And if the premium is not 8,000 VND but 10,000VND, are we willing to buy insurance?

From a real situation in class, it is possible to draw some initial comments related to the problem for students as follows: Why do we buy insurance (demand for insurance)? We buy insurance to reduce variability in consumption. Note that you only need to spend 8,000 VND a year you are not afraid of empty hands when losing a motorcycle anymore. Thus, variability or variance is one of the measures of risk. In statistics, people use the variance to measure the variability of a random variable. “Variability” here means that the variance of the mean (or expected value) [20].

Starting from the practical problem, students can ask questions: Will the company always sell the desired amount of insurance? The rate of theft this year increased over last year ?, Therefore, the insurers themselves are also at risk when carrying out insurance projects above. What do they do to minimize the risks they will face? This is precisely the premise for students to enter into new, expanded and inherited models of mathematical and new economic model, broader and inheritance of probability models was built from Application of probability and statistics, such as: profit, risk, risk measurement, risk mitigation, profit maximization, the application of choice in business.

Measures 3:

Enhance large "project"-style exercises for students to apply Math to solve practical problems in the economy.

The purpose, meaning and how to implement this measure can visualize in the following diagram:

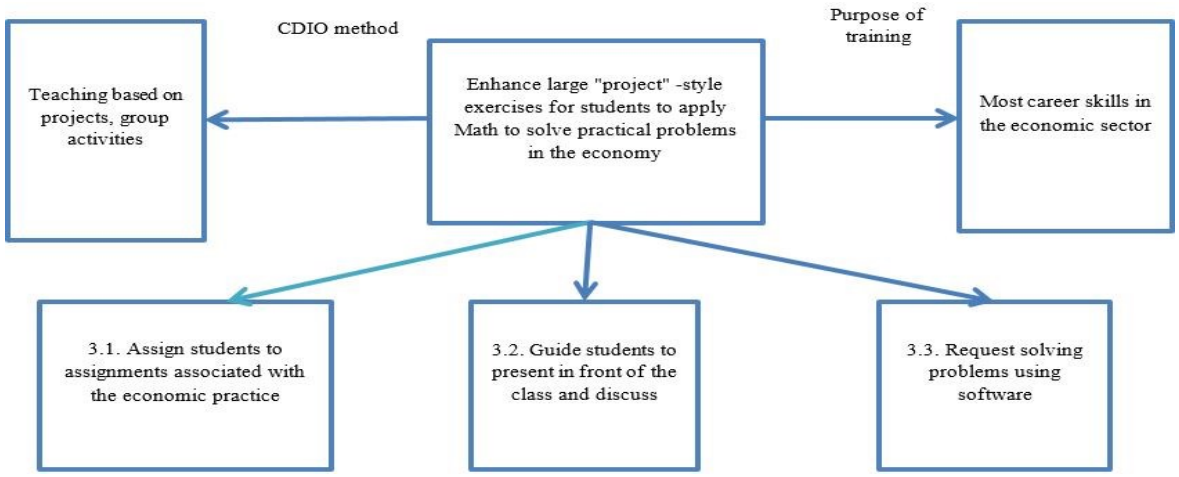

Fig. 3. Diagram of measure 3

Measures to help teachers improve awareness of teaching Math under CDIO approach know how to choose positive teaching methods and teaching experience according to CDIO applied in teaching Mathematics to train occupation skills for economic sector students. The measures aim at training ten occupation skills that the author proposed to students of economic sector following CDIO approach to meet the output standards.

IV. Purpose, Requirements, Tasks, Organizational Principles, Experimental Content

4.1. *Experimental Purpose*

Pedagogical experiment to initially test the feasibility and effectiveness of educational measures, through answering the following key questions:

(1) Are the pedagogical measures proposed by the dissertation possible in the process of teaching mathematics at Lac Hong University?

(2) Implementing these pedagogical measures has a good effect on whether students acquire knowledge that needs to equip? Do you form and develop some occupation skills in the economic sector through teaching Math under the CDIO approach?

4.2. *Experimental Requirements*

- The pedagogical experiment must ensure honesty and objectivity.
- The pedagogical experiment must be suitable for students, close to the actual teaching situation.

4.3. *Experimental Tasks*

- Compile materials to guide teachers of Maths according to proposed CDIO approach;
- Compiling experimental pedagogical documents and conducting teaching according to some educational measures and teaching design models according to the proposed CDIO approach.
- Collect, analyze and process experimental pedagogical results to check the feasibility and effectiveness of proposed educational measures.

4.4. *Principles of Empirical Organization*

- Helping students understand the role and importance of Mathematics in the reality of economics;
- Guiding students to master the basic and necessary knowledge of the subject to forming and developing occupation skills;
- Organizing students to implement and practice component activities compatible with the content and objectives of the lesson, and building and growing some occupation skills in the economic sector;
- In the process of teaching always motivates students, creates excitement for students; still create favourable opportunities for students to experience the experience teaching model and the operation of the economic sector;
- Lead students to use knowledge as a means and result of learning activities;
- Classify activities into appropriate component activities for learners;
- Ensure students have enough time to think and perform their learning activities in a small content.

4.5. *Evaluate Pedagogical Experiment Results*

+ Qualitative Assessment:

Most students of the group participating in pedagogical experiment agree on the idea that teaching mathematics in the direction of developing occupation skills in an economic sector not only helps them to acquire basic knowledge and the core of the subject but also helps them to gain knowledge related to occupation practical, training occupation skills. Also, more than 80% of students believe that pedagogical measures taken in the pedagogical experiment are useful, not only in helping students gain knowledge, developing occupation skills, but also contribute to promoting students' positive learning, increasing cooperation ability when working in groups.

+ Quantitative Evaluation:

The majority of students in the pedagogical experiment group have a more precise and more in-depth understanding of the use of Math knowledge in economic practice, especially skills: Using Math language, modeling practical problems, solving practical problems are better than control groups. This proves that the implementation of pedagogical measures proposed in the thesis has created for students the needs, habits, and ability to apply Math knowledge to solve practical problems, especially economic career practices, thereby forming and developing students some career skills in the economic sector.

V. CONCLUSIONS

Through the research process, the article has obtained the following main results:

- Having proposed the concept of teaching Math according to CDIO approach to meet the output standards; Giving the idea of occupation skills; Proposing a system of occupation skills that can be formed and developed through teaching maths modules in the economic sector training program of universities to meet the output standards.
- Through the investigation of the current status of teaching Maths modules at Lac Hong University, it shows the necessity of forming and developing occupation skills for students in economic sector in teaching Maths modules to meet output standard; Clarify the Math content to prepare students; Clarify the level of training with occupation skills.

- Proposing three measures together with techniques to teach math to students in the economic sector in the university towards forming and developing career skills.

- Pedagogical experimentation has initially illustrated the feasibility and effectiveness of pedagogical measures and proposed teaching design and organization. The results of the pedagogical experiment initially showed that the proposed pedagogical measures are feasible and obtained good results.

- The new contributions of the article can be deployed, applying in practical teaching Math towards training occupation skills for students in the economic sector at university to meet the output standard according to CDIO approach.

REFERENCES

[1] De Ketele, J.M., *L'évaluation des acquis scolaires : quoi ? pourquoi ? pour quoi ?*, Revue Tunisienne des Sciences de l'Éducation (Assessment of learning achievements: what? Why ? for what?, Tunisian Journal of Education Sciences), 23, p. 17-36, 1996.
[2] De Ketele, J.-M. & Gerard, F.-M., *La validation des épreuves d'évaluation selon l'approche par les compétences*, Mesure et évaluation (à paraître) (Validation of Assessment Tests using the Competency-Based Approach, Measurement and Evaluation (forthcoming)), 2004.
[3] Edward F. Crawley, *The CDIO Syllabus A Statement of Goals for Undergraduate Engineering Education*, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology, 2001.
[4] Gerard, F.-M. & Roegiers, X., *Des manuels scolaires pour apprendre*, Bruxelles : De Boeck Universite (Textbooks to learn, Brussels: De Boeck University), 2003.
[5] Grangeat, M., *Régulation métacognitive, transfert de connaissances et autonomisation (Metacognitive regulation, knowledge transfer and empowerment*, Educations, n°15, p. 37-40, 1998.
[6] Hayter A.J., *Probability and statistics for engineering and the sciences*, third edition, Thomson, USA, 2007.
[7] Hoan Van Tran & Hang Thuy Nguyen, Teaching Probability - Statistics towards Training, Occupational Skills for Economic Majored Students - Case Study at Lac Hong University Viet Nam, *International Journal of Learning, Teaching and Educational Research*, Vol. 15, No. 12, pp. 130-144, November, 2016.
[8] Hoan Van Tran & Trung Van Nguyen (2016), Approach CDIO in teaching of probability and statistics for students economic majors at Lac Hong University oriented to meet the learning outcomes, Proceedings of national CDIO conference, *Publisher the National University - HCM city, 2016.*
[9] Hoan Van Tran, Hang Thuy Nguyen, Building integrated situations in the teaching of Probability and Statistics oriented to occupation skills for economic majored students - case study at Lac Hong university Viet Nam, *International Journal of Learning, Teaching and Educational Research*, Vol 16, No. 4, 16-30, April, 2017.
[10] Hoan Van Tran, Approach to cdio in teaching probability and statistics in relation to career skills for economics students in lac hong University, *Proceedings of 6th International Conference on Didactic of Mathematics*, Publisher the Pedagogical University - HCM city, 2017.
[11] Hoan Van Tran, Career skills for students of the economic sector through teaching mathematics at Lac Hong University, *Journal of Educational Sciences, No. 1, 2018.*
[12] Hoan Van Tran, Hang Thuy Nguyen, Current situation of occupation skills for students of the economic sector through teaching Mathematics - case study at Lac Hong University Viet Nam, *International Journal of Innovation and Research in Educational Sciences*, Vol 5, Issue 2, 197-203, March, 2018.
[13] Hoan Van Tran, Hang Thuy Nguyen, Some measures to train occupation skills through Mathematics modules CDIO approach to meet output standards, *International Journal of Innovation in Science and Mathematics*, Vol 6, Issue 2, 77-83, March, 2018.
[14] Jay, L. Devore, *Probability and statistics for engineering and the sciences*, sixth edition, Thomson, USA, 2004.
[15] Jadoulle, J.-L. & Bouhon, M., *Développer des compétences en classe d'histoire* (Develop skills in history class). Louvain-la-Neuve : Unité de didactique de l'Histoire à l'Université catholique de Louvain (Louvain-la-Neuve: Department of Didactics of History at the Catholic University of Louvain), 2001.
[15] Johan Benken, Edward F. Crawley et all, *Benchmarking Engineering curricular with the CDIO syllabus*, Int. J. Engng Ed. Vol. 21, No.1, pp.121-133, 2005.
[16] John Burns, Martin Quinn, Liz Warren, Joao Oliveira, *Management Accounting*, Mcgraw-Hill higher Education, 2013.
[17] Lac Hong University, *The report of the implementation of public regulation at Lac Hong university in 2015 - 2016 academic year*, 2017.
[18] Moore DS, McCabe GP., *Producing data in Introduction to the Practice of Statistics*, 5th ed. New York, NY: W.H. Freeman and Company; pp. 191–250, 2006.
[19] Noël, B., *L'autoévaluation comme composante de la métacognition : essai d'opérationalisation, in Figari, G., Achouche, M. (2001), L'activité évaluative réinterrogée*. Regards scolaires et socioprofessionnels, Bruxelles : De Boeck Université (Noël, B., Self-evaluation as a component of metacognition: operationalization trial, in Figari, G., Achouche, M. (2001), Evaluative activity re-interrogated. School and socioprofessional perspectives, Brussels: De Boeck University), p. 109-117, 2001.
[20] Rob Thoyts, *Insurance Theory and Practise*, Routledge publisher, 2010.

AUTHOR'S PROFILE

Dr. Hoan Van Tran
Degree: Dr degree, Address: Lac Hong University - Dong Nai Province, Phone: 0973.851.989
email id: tranhoan.math@gmail.com