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RESEARCH ARTICLE

THE CURRENT SITUATION OF TEACHING FUNDAMENTAL PHYSICFOLLOWING CDIO APPROACH

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Abstract

The article presents the surveying of the teaching situation of Fundamental Physics to meet the output standards in university which use the CDIO approach to teach students of engineering major, as well as information on the application of methods, form of evaluation in the teaching process of Fundamental Physics.

Introduction:-

Problem:

The fourth industrial revolution (IR 4.0) has been and will continue to create major changes, affecting all aspects of social life in the 21st century. With the strong development of science and technology, the problem for the education and training sector (especially university education) in IR 4.0 is to innovate from an education that is heavily equipped with knowledge for learners to the education that strongly improve skills, promote innovative thinking.

The CDIO initiative was created to train students to become an engineer who comprehensively Conceive – Design - Implement - Operate products andcomplexity systems in a modern environment, improve teamwork [1]. The key point of CDIO is the CDIO outline, a statement about the goals of the training program and the set of 12 CDIO standards designed to help achieve those goals [2]. These standards include the philosophy of the program, develop training program, workspaces and practical experiences, methods of teaching and learning, enhancelecturer's skills, evaluating and testing. In the engineering program of universities according to CDIO, Fundamental Physics belongs to the general education knowledge, with the goal of equipping students with core knowledge of physics. The knowledge of this sector is widely applied in the fields of engineering, industrial, electronic engineering, biomedical physics.…

Research content:

Select subjects for surveying:

We surveyed 10 universities, including: University of Science and Technology in Ho Chi Minh City, Ho Chi Minh City University of Technology, Hanoi University of Technology, Hutech University, Lac Hong University, Thu Dau Mot University, Tran Dai Nghia University, Ho Chi Minh City University of Natural Science, Vinh Long University of Technical Education, Ho Chi Minh City University of Industry, with 107 lecturers.

Research Method:-

Send survey form to 107 lecturers by the post office andby email 101/107 lecturers answered questions during the survey from December 2016 to June 2017.

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The first questions group
About the training program, output standards (OS), detailed outline, content and volume of Fundamental Physicsmodule including 04 questions:

With the training program question "Is the school's training program following the CDIO model or not?" based on the answers of 101/107 lecturers participating in the answer, the result is that 4/10 universities build training programs following CDIO approach, 5/10 universities build some training programs based on CDIO approach, 01/10 universities CDIO build training programs not based on CDIO approach.

With the question of output standards "Could you tell us about the output standards of the training program at the university you are teaching?" based on the answers of 101/107 lecturers responded, the results are as follows:

According to the survey results, 10/10 have built the output standards of the training program.

About the output standardsof the fouruniversities which build training program based on CDIO, all most standards are following the CDIO standards (including 12 standards) in an explicit and systematic manner.

About the output standards of the five universitieswhich havesome standards based on CDIO approach, the output standards are built in accordance with CDIO standards.

About the output standards of one university which does not build the training program according to CDIO, they build the output standards according to the training requirements of the university. There are clear training objectives, can be evaluate.

In general, through the survey data at 10 universities, the output standards of the training program are structured as follows:
a) Technical knowledge and argument (including basic scientific knowledge, basic technical knowledge, specialized technical knowledge, other supporting knowledge)
b) Professional skills and personal qualities (including the ability of technical analysis and problem-solving, experience and discover knowledge, systematically thinking about the personal abilities and attitudes, skills and professional attitude)
c) Teamwork and communication skills
d) Develop skills in conceptualizing, designing, implementing and operating systems

With the question about the detailed subject outline, based on the answer sheets, we summarize and the results are as follows:
According to the survey results on the detailed training sector, 10/10 universities have completed build and put into use the detailed outline of the Fundamental Physicsmodule.

About the number of training credits, 8/10 universitieshave 3 training credits inFundamental Physics, corresponding to 45 periods. Particularly, Hanoi University of Technology and Ho Chi Minh City University of Technology have 4 credits, corresponding to 60 periods.

About the name of the module, there are 5/10 universities that use the name physics 1 instead of Fundamental Physics1; Physics 2 for Fundamental Physics 2.

About the conditions to join the modules: 6/10 universities require students to participate in Analytics 1 (or Advanced Math 1) and 4/20 universities choose to study both modules in parallel.

About the output standards of the Fundamental Physics, based on the training requirements of each university, each specific subject, the universitywill aim to build a different standard.

About the structure of the training module:
There are 6/10 universities with only train mechanics, electricity, magnetism, no thermodynamics, optics, modern physics, nuclear physics (this subject is classified in the basic subject of the sector), for example university Ho Chi Minh City Technology (Hutech)

There are 7/10 universities that do not teach nuclear physics, atomic physics

There are 4/10 universities with full 4 modules of mechanics, electricity, magnetism, optics, modern physics.

With the question "In teachers' school, the goal of teaching Fundamental Physics is to help students": we summarize the results as follows:

No.	Questions	Lecturer's comment	
		Approve	%
1	Accumulate credits as required by the training program	94	93,06
2	Applying Fundamental Physics knowledge to engineering majors	95	94,05
3	Have the skills to identify, deductive and solve problems through identifying exercise data, analyzing phenomena, physical processes to come up with solutions to completely solve technical physics exercises.	86	85,14
4	Have thinking skills and presentation skills. Communication skills and use communication tools to communicate	98	97,03
5	Have a systematic and analytical mindset, and have a scientific, effective and professional working methodology, including working independently and teamwork.	85	84,15
6	Have skills to process and report practice results; Have self-study skills	70	69,3
7	Have skills in collecting and processing information	65	64,35

Table 1:- The goal of teaching Fundamental Physics

The lecturers are well aware that the goal of teaching Fundamental Physics to undergraduate engineering students is not limited to basic goals such as accumulating credits according to the requirements of the training program; master the basic knowledge of physics; grasping subjects and research methods of physics (93.06%), but also the skill of applying general knowledge of physics to the technical specialization (94.04%) or identify skills, inferring and solving problems through identifying exercise data, analyzing phenomena, and physical processes to give complete solutions to technical physics exercises (85.14%). In addition, teaching Fundamental Physics also trains thinking skills and presentation skills (97.03%). Communication skills and use communication tools to communicate; Have skills to collect and process information (64.35%).

Second questions groupabout teaching methods, teaching facilities and forms of evaluationform of Fundamental Physics with 3 questions

With the question "Which teaching method are lecturers use mainly when teaching Fundamental Physics with 3 levels: 1 / Regularly; 2 / Occasionally; 3 / Rarely "survey results are presented as Figure 1. Chart 1

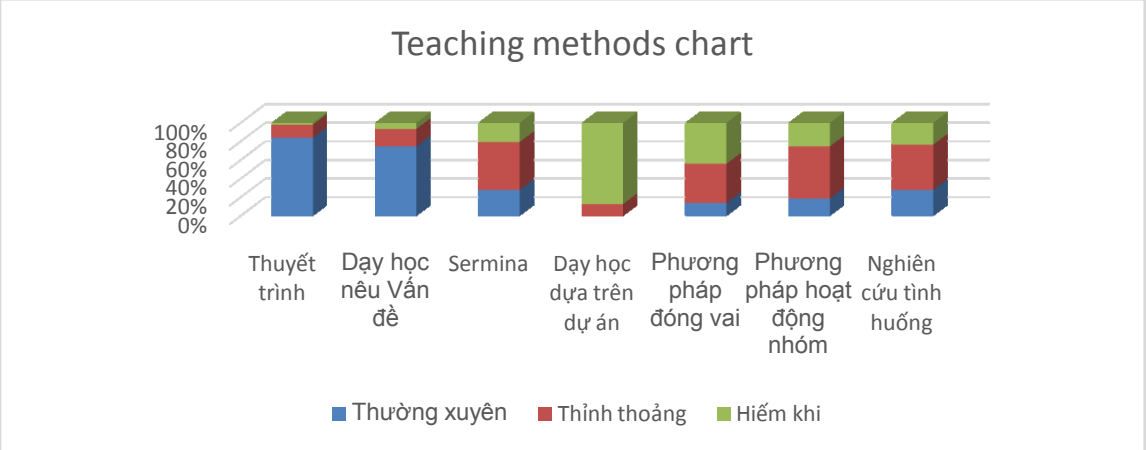

Figure 1:- Chart of a teaching method

Thuyếttrình: Present; Dạyhọcnêuvấnđề: problem-given teaching; Dạyhọcdựatrêndựán: Project-based teaching; Phươngpháp đóngvai:Role-play method; Phươngpháphoạtđộngnhóm: Teamwork method; Nghiêncứutìnhhuống: Case study method;Thườngxuyên: Regularly; Thỉnhthoảng: Occasionally; Hiếmkhi: Rarely

The methods that are frequently used in teaching Fundamental Physics are: Presentation, problem-given teaching (both approximately 80%). The project-based teaching method is used regularly by 16% of lecturers in teaching and 84% rarely used in teaching. The form of seminar is chosen by 20% of lecturers to use regularly in teaching, but also up to 18% of lecturers have never used this method. The role-play method is used regularly by 14% of lecturers, equivalent to 36% use it occasionally. Teamwork method that 28% lecturers rarely use and 56% teachers occasionally use, case study method is regularly used by 20% of lecturers, and 25% lecturers rarely use. Through the survey questionnaires, lecturers all mentioned difficulties in using teaching methods that are the uneven number of students attending school, large class sizes, or there are cases where lecturers think they have applied but bring low efficiency.

Among the teaching methods that we survey, the project-based teaching method; Case studies teaching method play a very important role in teaching with CDIO approach.

With the project-based teaching method, it can help achieve the output standards according to the CDIO outline such as: Making hypotheses; Design - deployment skills; Written communication skills; Presentation skills.

With the case study teaching method, this method can help to achieve the output standards according to the CDIO outline such as: Propose solutions; Estimation and qualitative analysis.

With the question “The extent of using the positive technique used by teachers in teaching Fundamental Physics (please numbering according to the level of use in the box: 1. regularly, 2. occasionally, 3. rarely), we describe by figure 2. Chart 2

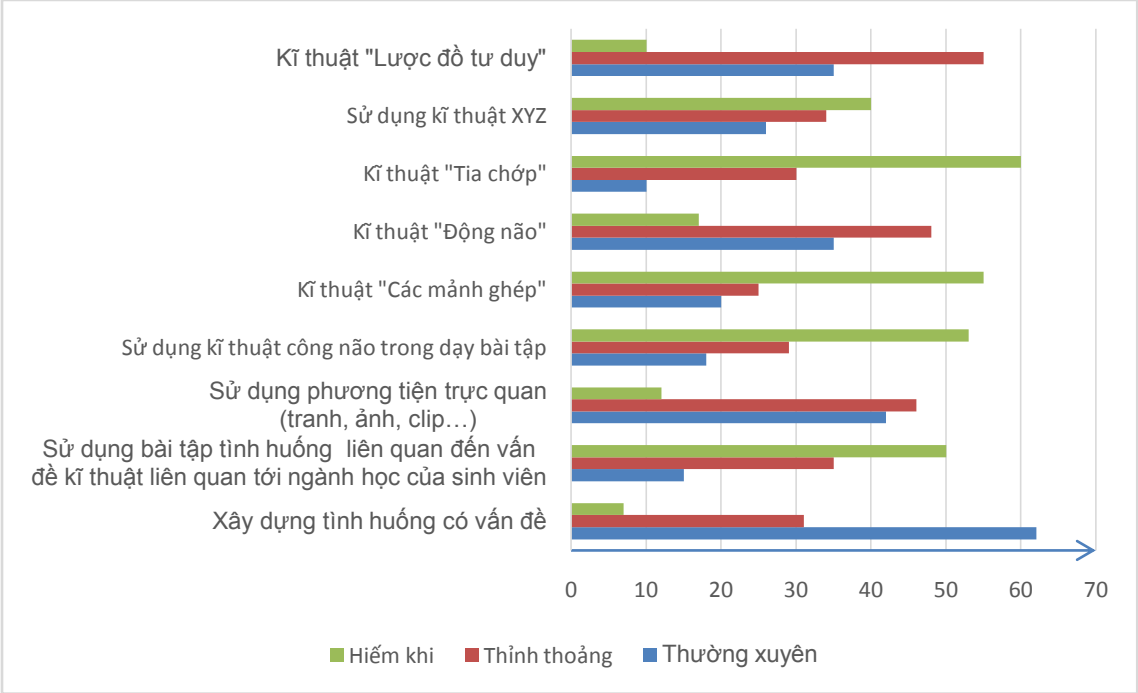

Figure 2:- Chart 2. Techniques used in teaching.

Kĩthuật “Lượcđồtưduy”: Mind mapping technique
Sửdụngkĩthuật XYZ: XYZ technique
Kĩthuật “Tia chớp”: Lightning technique
Kĩthuật “Độngnão”: Brainstorming technique
Kĩthuật “Cácmảnhghép”: Puzzle technique

Sửdụngkĩthuậtcôngnãotrong …: Using brainstorming method in teaching
Sửdụngphươngtiệntrựcquan …: Using visualize (picture, video, …)
Sửdụngbàitậptìnhhuống …: Using case-studied exercise related to the problem
Xâydựngtìnhhuốngcóvấnđề: Setup problem

From the above results, it can be said that, most lecturers apply active teaching techniques to one degree or another, of which the most common is building problematic situations (62 %), using visual aids such as pictures, clip illustrations for knowledge content (42%). Most active teaching techniques just stop at an occasional level (accounting for most of the techniques surveyed). However, modern teaching techniques have not been focused properly in the CDIO teaching process as the idea of the CDIO initiative (Conceive - Design - Implementation - Operation),factors affecting the implementation of the above techniques are the large number of classes, the means, the space is not guaranteed ...

With the question, which form does your university carry out the tests and evaluating the learning results of Fundamental Physics students**?**

Form	Number of university	Rate
Multiple-choice	6/10	60%
Essay examination	3/10	30%
Combination of Multiple-choice and Essay	1/10	10%
Seminar		
Major exercise		

Table 2:- Form of test to evaluate learning results.

Through the survey results, it was found that 06/10 universities chose the objective testing form, most of them were universities with a large number of students (accounting for 60% of the surveyed universities). The advantage is that the above universities have built a list of exam questions with a variety of questions, scores by machine tohave fast results, but the downside is that it cannot assess reasoning skills, expressing or creative ideas. In the learning process of students (out of 6 universities surveyed, 4 universities weighted 30% of the mid-term test score, the other 2 universities weighted 50%, the universities combined cost extra points for attendance, discussion, online check through the chapters learned)

3/10 universities do exam in the form of essay, the advantage is that it can evaluate skills of reasoning, analyzing interpretation, creative ideas, but the time of marking is long and partly depends on the intentions of the judge. In 3 universities in the form of essay (there are 02 universities that summarize the course by weight 50% of the final test score plus 50% of the process score (including midterm test; one university uses 60% weight of the final exam and 40% of the mid-term exam).

01/10 university do exam in the form of multiplechoice tests and combined essay, this form of exam covering all the content of the program's knowledge, relative assessment of the competencies needed to be achieved of students.

Thus, universities have been teaching in the direction of CDIO approach, although the program, detailed outline, output standards, but the methods of testing and evaluating the results have differences (in terms of weights, on the evaluation process ...) there are still shortcomings in the stage of testing and evaluating the results of learners, there is still no comprehensive form of evaluation and the full capacity of learners according to the spirit of CDIO initiative is thatwhat comprehensive knowledge, skills, attitudes will engineering students gain when leaving university and at what level of competencies? That is still an open question in surveyed universities.

Conclusion:-

Through the survey results, some of the following results have been recorded

Lecturers are fully aware, seriously notice the importance of the training in universities. Interested in the output standards of the training program based on the CDIO approach.

The school has facilities and equipment for teaching Fundamental Physics, creating favor conditions for students to self-study.

Teachers have innovated teaching and evaluating of Fundamental Physics subject following CDIO 2 and 11 standards.

Students have enjoyed the results of teaching innovation and evaluation of teachers in Fundamental Physics following CDIO approach..

Lecturers of Fundamental Physics in universities have not fully identified the CDIO initiative. Lecturers who still have certain difficulties in teaching Fundamental Physics will be effective in the direction of CDIO approach.

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