DESIGN PROCESS OF ENGINEERING TEACHING VIA APPLICATION OF THE SYSTEM ANALYSIS METHOD

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SUMMARY

An important aim of the educational innovation in our country today is to improve the quality of education and training. In which, innovation of teaching approaches is regarded as one of the strategic tasks. Innovation of teaching methods can be implemented in many different forms. In particular, the approach – transformation of systematic analysis method into the teaching method is one of transforming approaches of the scientific styles, the achievements of advanced technology and new technology into specific teaching methods. Applying systematic analysis methods in the teaching process allows teachers to plan extensive teaching process as well as each aspect of it. This article presents the design process of engineering teaching via application of the system analysis method that the author has studied.

Keywords: *Teaching method; Technical teaching methods; Systematic analysis methods, Teaching process; Teaching design*.

INTRODUCTION

One urgent task of our country's education sector in the current period and in the future is to innovate teaching methods. The teaching method is regularly innovated to improve the teaching - learning quality in order to take our country's education system advancing to international integration. The Central Resolutions No. 2 (Section VIII) states that "Innovation and modernization of educational approaches transformed from conveying passive knowledge, teachers teaching, student writing to instructions for learners in thinking proactively to access to knowledge; teaching students to get self-study methods, self-collection of information in a systematic way and with analytical thinking, synthesis, development of the capacity of each individual; strengthening the activeness , the autonomy of the students, etc. "[1].

Consequently, approach and transformation of the scientific methods to become a teaching method are the research directions to innovate teaching methods. Of which, access - transformation of systematic analysis method becoming the teaching method is one of the directions interested in by many researchers.

The research and application of system theory, systematic analysis methods are paid much attention by many scientists around the world from the 50s of the twentieth century, but it flourished and has widely been applied since 70s of this century. The fields in which the system theory are applied earliest are Biology, Mathematics, Mechanical Engineering, Philosophy, Geography ... For example, many scientists have applied systematic approach to present the logic contents of the biology curriculum and methods of teaching biology in [2, 3, 4, 5, 6, 7, 8, 9,11,12, 13]. In the field of Geographic, in the 70s and 80s of the twentieth century KA Salishev, AG Isachenco can be considered as the representative. In other fields, Kenneth Boulding is famours for his works "Generral Sytem Theory".

In Vietnam, systems theory has been studied and applied for ago in [14, 15, 16, 17, 18]. In the field of education science in general and science of teaching theory in particular in our country, the system views is one of the important idea which is studied and applied, such as [19, 20, 21, 22, 23].

So far, through theoretical studies, it can see that there is not any research studying

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thoroughly the application of the system theory in teaching specific technical subjects. The analytical method applied in the teaching system is not only increase interest in learning, but also support students understand the structure of the technical subject, functions and duties of each element of that subject in a science-based manner. From there, understanding the working principles of that subject will be more convenient and firmly. Therefore, the application of the system analytical method in teaching the engineering subjects to help students acquire knowledge in a firmly systematic manner with creation. It contributes to improving the teaching quality of the subject. This is a new research orientation which has significant meaning. Below is the presentation of the designing process of engineering teaching via application of the system analysis method that the author has studied.

OVERVIEW OF METHOD OF SYSTEMATIC ANALYSIS

The system

The system is a set of multiple elements (factors, components) having relations, closely together impacting to create a certain body.

The system has several specific basic characteristic [24, p. 253]:

- Each system is attached to the a certain form of organization. That organized nature was shown in the hierarchical structure, characterizing morphological structure and mode of operation of the system. Each system consists of multiple modules, multiple subsystems, many constituent factors. Each module, subsystem and factor are both a factor of higher system and a system of the lower factors.

- As a result of interactions among aspects and factors where the system has feature as a whole body that has new properties, new quality, the ones, which are not included in the elements and parts, form the system. Therefore, it is said that the whole body is greater than the sum of its parts.

- Systems are capable of self-regulation on the basis of the collection, storage, processing and handling of information in order to reach certain goals. From teaching results in the teaching process, teachers evaluate the effectiveness of teaching comparing with teaching purposes set out in order to adjust methods, means and organized forms of teaching.

- Characteristics of the system is not only the connection and relationship among elements, the components, but also the unity with the environment, through its reciprocal relationship of with the environment.

- It finds paths, methods and means for studying objects in a manner that is a system leading to form a new method - the method of system analysis. The wide application of this method has yielded positive results in practice as well as in scientific research.

System analysis method

The concept

System analysis is a method, a tool searching knowledge of a considered object (system). Analysis system can include a variety of contents to explore the characteristics of the system, especially the relationships among components in the system, the relationship between the external environment and the system and the system state.

Therefore, it can understand that *the system analysis method is a method of scientific research focusing on a research object, a system and when considering and studying each part and individual components of the subject are reviewed within interactive relationships, contact with other parts and elements of that object.*

Characteristics of the systems analysis method

The system analysis method has some following characteristics:

- It should consider the study object is a system.

- It recognizes that many different complex objects will have similar system characteristics.

- Researching object in motion of it.

- Through the analysis of relationships inside and outside of the system, study of interaction mode among the elements, the system components, the system environment to find the properties of the system is the most important principles of the systems analysis method.

- To realize activities, especially activities of destination of the system, the control process of the system.

Contents of the system analysis method

1) Identifying the view of system analysis.

2) Defining clearly the elements, the internal parts with external elements of the system (environment), the elements and components formulating the system.

3) Dividing the system into the sub-system, analyzing the position and their functions in the system, paying attention to the hierarchical structure of the system.

4) Establishing the model of object needing to study by certain language (drawings, diagrams, graph, mathematical equations etc.).

5) Studying completely on relationships between the elements, subsystem of the system and the relationship between systems and environment (relations regarding structures, effects, control etc.). Each connection has a certain position and function in a specific structure.

6) Determining the dominant characteristics of the system.

APPLICATION OF THE SYSTEM ANALYSIS METHOD IN TEACHING ENGINEERING SUBJECTS

As stated in Section 2, the system analysis method is the method of scientific research. The process of scientific research is the process of creative activity of scientists to perceive the world, to create the valuable knowledge system to use and improve the world. And the teaching process is unique and creative cognitive process of learners in order to reproduce the human knowledge for themselves. Thus, in society it takes place activities of human perception (characterized by cognitive process of scientists) and teaching activities for the younger generation, of which cognitive activities of humans occurring prior to teaching activities. However, human cognitive activities take place in the education environment, under the guidance, organization and control of teachers. Therefore, it does not repeat the whole process of human perception and should avoid the tortuous steps and mistakes in perception can avoid.

In view of modern theories of teaching, teaching process exists as a system. That process includes the basic structural factors such as purpose of teaching, teachers and teaching activities, learners and learning activities, teaching contents, teaching methods and means, examination and assessment methods and learning outcomes. All of these factors exist in the closely organic relationship and the entire system is placed in a natural environment, social - economic environment, environment of scientific and technological revolution. In particular, social - economic environment and environment of scientific and technological revolution has great influence on the process of teaching.

The training process under the credit system is the advanced training method. Therefore, it requires a comprehensive innovation of factors constituting the teaching process. What we need in students after their graduation today are not only the knowledge recorded in a notebook which teachers read for writing as it used to, but also are self-

learning ability, creativity to settle problems in practice, even never learnt in their universities.

The relationship among elements of the teaching process be represented through the diagram in Figure 1.

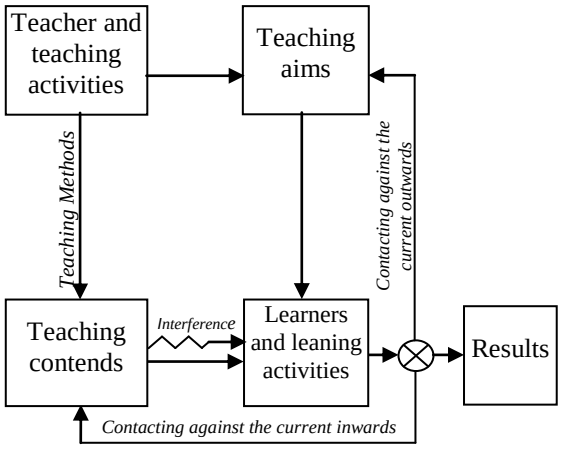

Figure 1. *The diagram of representation of the relationship among elements of the teaching process*

In the structure of the teaching process, the determinants of the quality of the teaching process is teachers and teacher training activities. Teachers are controllers and organizes, initiators and instructors at the same time as referees of cognitive process of learners, encouragers and encouragers of learners to overcome difficulties to dominate knowledge, formation and training dexterity and skills. In order to activization of the process of perception of learners, teachers must build appropriate teaching activities with teaching contents, teaching conditions and psychological characteristics, cognitive capacities of learners.

Besides, teaching contents are also a very important role in the teaching process. Because, the teaching process is the process by which learners dominate knowledge, form and train dexterity and skills. Therefore, in order to learners able to promote positively and actively in the process of perception, teachers need to know how contents of the teaching are processed. In engineering teaching, engineering subjects studying specific objects such as materials, tools, technical equipment, etc. has the systematic nature. Because the contents of these subjects has the high systemic feature, application of system analysis methods is facilitated.

Outstanding advantage in applying the system analytical method in the teaching is formed for students to understand the object perception method entirety, to see relationships, connections among contents of knowledge; at the same time to develop thinking manipulation such as analysis, synthesis and thinking mode as inference, etc. However, to apply effectively the system analysis method in the process of engineering teaching, in addition to teaching contents, it must also include other factors such as the level of awareness of learners, material facilities, duration of teaching and especially teachers need to know how to combine the systematic analysis method with other active teaching methods such as discussions to raise issues, solutions of problems, etc.

DESIGN PROCESS FOR ENGINEERING TEACHING VIA APPLICATION OF THE SYSTEM ANALYSIS METHOD

The system analysis method is a scientific method. When applied to the teaching process, this method should have adjusted and supplemented and omitted to suit the characteristics and specific teaching conditions. Through research and application of contents of the system analysis method into the teaching process, the author has developed the design process for engineering teaching via application the systems analysis method that consists of 5 steps:

**** Step 1: Selection of Contents.***

To select the teaching contents, firstly lecturers should identify the objectives of the lesson. Those are questions for students to perform teaching lessons. The determination of the objectives of teaching lessons has many factors affecting, in which the most notable factors are the elements: contents of teaching

lessons, cognitive abilities of students and faculty capacity.

After defining teaching objectives, lecturers will analyze the choice of teaching contents. Work contents of this step are to determine the system of teaching contents. The systematic feature of teaching contents expressed in place is that such contents can be split into the contents of component or not, research objects can be separated into independent components relative to each other or not, etc.

Although most of matters, things and phenomena are more or less systematic, it is necessary to select matters, things and phenomena existing the high systemic feature to use the system analysis method conveniently and promote it effectively. Therefore, when this approach is applied in the teaching process, firstly it is necessary to analyze teaching contents (the whole subject, a part of contents, a chapter or a lesson) to see whether those contents is apparent systemic or not. That is, based on the characteristics and nature of the system, to consider whether teaching contents can ensure the quality and characteristics of the system or. It is only, when contents are the high systematic feature, to use of the systematic analysis method in the teaching process of those contents. The success or failure when teaching under this method depends much on the quality of analysis and the choice of this step.

**** Step 2: Analysis of the system.***

The contents of this step is to identify the elements in the system. The systematic review in Step 1 is only generalizations and in this step, components, component layers and relationships among them should be clearly identified in a specific way. Analysis is to define the contents of components, elements or parts in learning contents. In other words, this is to divide the system (teaching contents) into the subsystem, analyze their positions and functions in the system, pay attention to the hierarchical structure of the system, the relationship among the subsystems and with the environment etc.

When analyzing contents in term of a system, it is necessary to determine the stratification and the layering of the system. For instance, it may be considered "distribution and electric power transmission" is a two - layer system. The first layer is that system considered as the large system, in which the transformer is an element. But the transformer can be regarded as a subsystem, in which the steel core, windings, insulation, etc. are the elements. That means that teaching content are a comprehensive issue including many contents related to each other on content logic as well as cognitive logic and availability of relationship with the surrounding environment (material facilities, awareness of learners, etc).

**** Step 3: Establishment of diagram and the system structure.***

Based on the analysis of teaching contents (the large system) into the small contents (the subsystem), it will define tasks of the subsystem and requirements that this subsystem must be met to implement tasks posed by the large system. Since then, the relationship of each subsystem within the large system is analyzed. For the selected system, it is analyzed tasks, the affected relationship among elements to establish the diagram of the system structure. On this diagram, starting elements only acting on other elements will be at the beginning of the branch. Components only affected by other elements will be put at the end of branches and often stub branches.

The analysis of the relationships inside and outside of the system, study of reciprocal interaction mode between the elements and components forming the system and between the system and environment, etc. is the most important principle of the system analysis method.

**** Step 4: Studying the elements.***

After establishing the structure diagram of the system, it will study each subsystem, element and factor in the system to review their tasks, functions, structures and operations. The study is non-isolated. It is considered in relationship of each subsystem within the large system; studying the relationship between them in the performing process of tasks of the system. In teaching, the study of small contents will help students understand the nature of the issue and the relationship between them in the teaching content system.

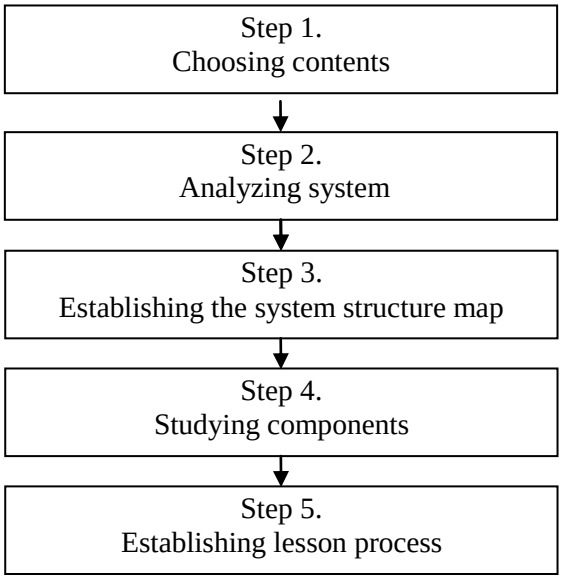

Figure 2. *Procedures of teaching design applying the system analytical method*

**** Step 5: Establishment of the process of teaching lessons***.

The applying process of the system analytical method in teaching design through the diagram on the Figure 2.

This step is both results of procedures and purposes of the process. Based on the results of the above steps, teachers will develop teaching process. The development of the teaching process must ensure the linkage among purposes - contents - teaching methods and is not only compliance with each stage and each step in teaching house, each component unit of knowledge, but also to create a harmonious transition among stages, steps and the knowledge units. Also, the teaching process must also demonstrate the consistency between the activities of teachers and learners in each stage and each step as well as well as in receptiveness of knowledge units with a common principle that is to promote the highest positiveness and proactiveness of students in learning.

CONCLUSION

The system analysis method is a unique scientific method that is developing in the world and has a rich variety of applications in fields of very different activities. Applying studies of systematic analysis method to build the technical teaching design process in the teaching process are not only practical significance when applied to specific subject, but also have the special significance for theory aspect due to enrichment for the positive teaching methods. The system analysis method applied to develop design process of technical teaching allows the teacher planning extensive teaching process as well as each aspect of it. It also allows the teacher to design optimal activities of teaching and learning and to control reasonably this process to advance to technologization in an effective way of teaching process in universities towards activelization of perceptive activities of learners. Further research will focus on analysis of experiments result.

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TÓM TẮT

QUY TRÌNH THIẾT KẾ DẠY HỌC KỸ THUẬT VẬN DỤNG PHƯƠNG PHÁP PHÂN TÍCH HỆ THỐNG

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Nâng cao chất lượng giáo dục và đào tạo là một mục tiêu quan trọng của sự nghiệp đổi mới giáo dục hiện nay ở nước ta, trong đó đổi mới phương pháp dạy học được coi là một trong những nhiệm vụ chiến lược. Đổi mới phương pháp dạy học có thể được thực hiện bằng nhiều hình thức khác nhau. Trong đó, việc tiếp cận - chuyển hoá phương pháp phân tích hệ thống thành phương pháp dạy học là một trong những hướng tiếp cận chuyển hoá các phương pháp khoa học, các thành tựu của kỹ thuật tiên tiến và công nghệ mới thành phương pháp dạy học đặc thù. Vận dụng phương pháp phân tích hệ thống vào quá trình dạy học cho phép giáo viên quy hoạch được quá trình dạy học tổng quát cũng như từng mặt của nó. Bài viết này trình bày quy trình thiết kế dạy học kỹ thuật vận dụng phương pháp phân tích hệ thống trong quá trình dạy học mà tác giả đã nghiên cứu xây dựng.

Từ khoá: *Phương pháp dạy học; Phương pháp dạy học kỹ thuật; Phương pháp phân tích hệ thống, Quá trình dạy học; Thiết kế dạy học*

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