

Design a Competence-based Networked Learning System: Using Sequence Control as Example

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Utilization of the Internet is very extensive today. Not only for information transfer, but also can be applied in the area of learning. We have witnessed many networked learning platforms established for this purpose. The results are very significant if we implement it right. Along this trend, we make use of competence-based education theory as the main foundation to integrate networked learning platform and networked control laboratory to design a competence-based networked learning system.

The main focal points of competence-based education are as follows. First, its purpose is to promote learners to achieve a presetting ability. Each individual learner's behavior in the learning process is of concern. Second, its evaluation is to emphasize criterion-referenced. This feature is suitable to be realized on the Internet. Under such an environment learners are able to determine personal learning pace and learning sequence. Therefore, we expect the application of such a scenario is beneficial to learners in the colleges

Keywords Competence-based Education; Internet; e-learning; Virtual Lab; Sequence Control

1. Introduction

Accompanied by the rapid development of computer multimedia and network technology, the Internet based teaching and learning methods have become the developing trend and the traditional classroom learning also expands to the virtual network learning environment. The competence-based education is originated from American vocational education, developed from normal education, and finally was successful expanded to the vocational education in other countries, and applied to various courses and careers [1][2][3][4][5]. The competence-based definition is like the following [6]: competence-based education is a systematic yet flexible approach to organizing instruction. This approach focuses on defining in measurable terms what students are to learn and then evaluating how well they can perform designated tasks after instruction. Expected behaviors or tasks, conditions for their performance, and acceptable standards are shared with students prior to instruction.

This research is based on education theory to design an on-line learning system of sequence control experiment, provide proper materials and can record students learning paths. Students should finish the theory study first and use networked control system[7], access to the remote control program, and thus access the lab equipments on-line, just like the student is actually in the lab.

2. Application of competence-based education to networked learning system

Competence-based education is a concept, a system learning method. It is to develop default ability of the students. Therefore competence-based education should design the goal for students, and the goal should express the performance that students should reach. Teachers then modify the learning activities

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and learning environment according to the evaluation. The characteristics of competence-based education are as follows.

(1) Unit materials

The unit material is a complete and goal orientated learning activity. The reasons to use the material are (a) goal orientated and the grade can be given by each unit, and it is easier than grade for the whole semester. (b) the material is easier to add, modify or delete. (c) it provides more opportunities for students to choose.

(2) Goal of behavior

Goal orientated is the goal based on students' actual actions. It is based on a normal goal, and then divide into several actual goals. It should be clear and fixed. The action goal is enough to test students if they are through the changes of behavior.

(3) Criterion-referenced

The evaluations are norm referenced and criterion-referenced. The norm referenced is to compare the students' performance to normal students. And then group them by level A, B, C, D and E. And criterion-referenced is compare the student's action to the goal in order to evaluate if the performance reached the standard. It has nothing to do with other classes.

(4) Individual learning

Individual learning means student learn process can be free, the individual learning is important. The common used strategies are depth learning and individual learning. Depth learning means that students must learn thoroughly and individual learning means students learn based on a certain process and evaluate the performance after an activity is finished.

(5) Teacher is the administrator

In the learning system, students are willing to learn. And the teacher can be the instructor, administrator of the material and the pusher of learning motivation. Students are the focus and the teacher is just the instructor.

In order to reach the goal, course design must be evaluated before entering into the next study unit. A study process is like Fig.1.

(1) After enter a learning unit, if the learner thought that he can reach the goal, he can take the evaluation directly. If he passes, he can skip the unit and enter the next unit; otherwise he can enter the normal learning process.

(2) Students can choose based on time and speed, in order to finish each learning process.

(3) After all materials are learned, students can take the evaluation, and upload the assignment when finished.

(4) After the evaluation, the result will be released on the bulletin. If he passed, he can enter the next unit; otherwise he should retake the exam until pass.

3. Teaching activity design

This research is based on sequence control of the 4-floor elevator, the unit contents are like the followings.

(1) Pre-learning ability

1.1 Understand PLC programming: including how to read, write, insert, and delete

1.2 Understand PLC commands, including basic instructions, step instructions and application instructions

1.3 Understand PLC basic design theories, including inching circuit, serial circuit, parallel circuit and self-holding circuit etc.

(2) Learning objectives

2.1 Understand the normal operating process

2.2 Understand the elevator design theory

2.3 Simulate and check if the elevator motion is acting correctly

- (3) Learning activities
 - 3.1 Knowledge area
 - a. Describe elevator mechanical architecture and theory
 - b. Describe elevator operation manual
 - 3.2 Technical skill area
 - a. Describe the methods of elevator design for control circuit
 - b. Complete the elevator programming design and complete the operation
 - 3.3 Learning attitude area
 - a. Evaluate student's learning attitude
 - b. Evaluate the spirit of the team work and team collaboration
- (4) Post-learning evaluation
 - 4.1 Knowledge evaluation
 - 4.2 Skill evaluation

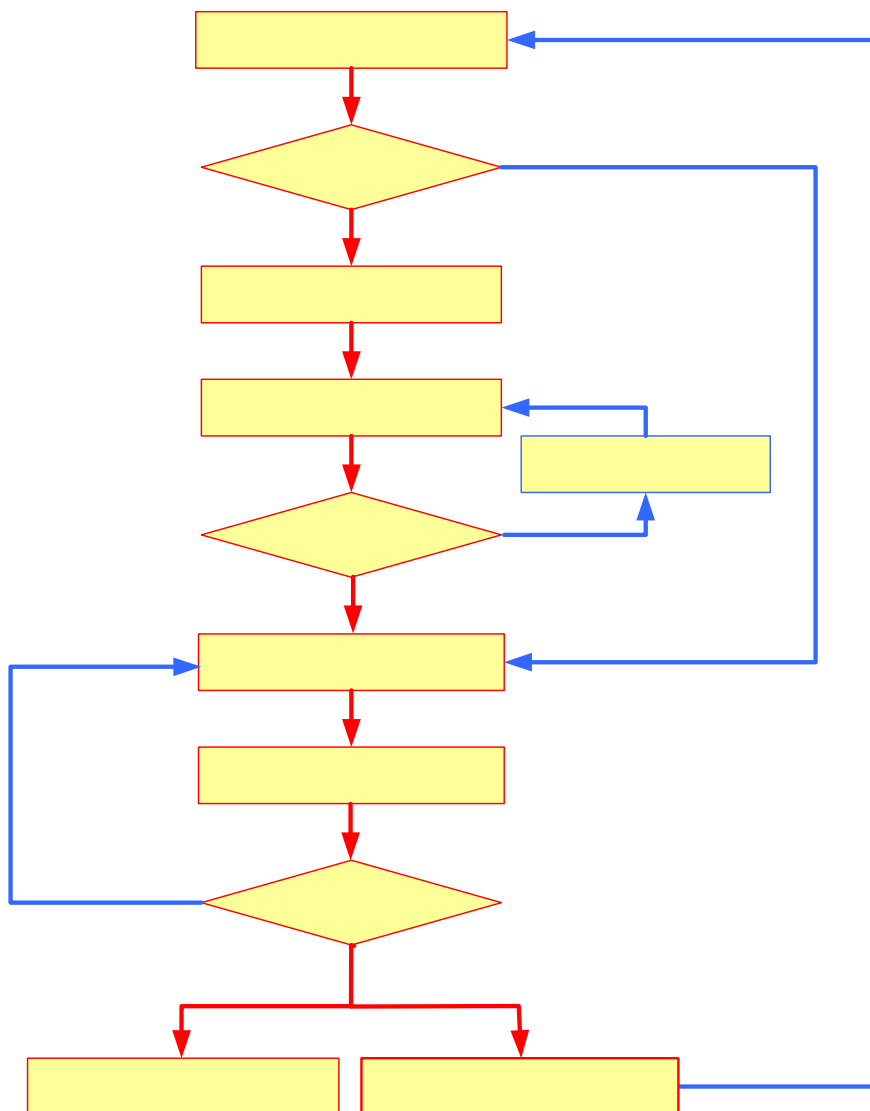


Fig. 1 Learning flow chart of competence-based education

4. Learning effectiveness analysis

This research designs “Design a Competence-based Networked Learning System” for students to learn and control remotely. Students are EE major students and divided into control group and experimental group with 20 students each. After the learning, a performance evaluation will be conducted. And the result, after using SPSS analysis, can be seen on table 2. The average of control group is 75.4 and standard deviation is 7.10. The average of experimental group is 74.25 and standard deviation is 8.52. When using SPSS, we see from its output screen that Levene $F=0.866$ and $P\text{-value}=0.358>0.05$, indicating these two teaching methods have no significant difference.

Table 2 Learning effectiveness analysis

group	no. of sample	average score	standard deviation
control group	20	75.40	7.10
experimental group	20	74.25	8.52

5. Conclusion

This research is based on on-line learning and lab. Not only enhance student theory and technology, but also improve their working ability with group members. In such a learning environment, students don't need to be in the lab, and can be more flexible. This research can be applied to the learning environment, we will use these technologies on equipment monitoring, maintenance and administration.

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