Evaluation of Inspection Ability Promotion for Learning Mechanical Product Web-based Inspection Course in CAD Education

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ABSTRACT

This study evaluates students' learning effects in an experiment instruction of a mechanical product web-based inspection course this year. This study is extension of a research project launched two years earlier. The purposes of this study are to: (1) verify the use of online study system related to course achievement, (2) promote the inspection ability of students, (3) identify characteristics of online study system and construct a standard web-based learning platform. Furthermore, the system will integrate teaching and practical skills into overall new learning field by virtual reality and interactive technologies.

Through pre-test, achievement test, and post-test, the learning efficient value is about 0.80 and students' satisfactory degree is about 0.85 after statistical test to this web-based learning system. In conclusion, the mechanical product web-based learning inspection course will promote the ability of inspection for learners, and the system is available and improvement for learning interaction.

Keywords: Mechanical product web-based inspection course, Interactive platform, Online study system, Learning effectiveness, Inspection ability

1. INTRODUCTION

Inspection is critical and necessary to ensure product quality. A robust inspection procedure is the most direct and practical method to shorten production time, enhance production efficiency, strengthen market response, and reinforce productivity and competitiveness. Meanwhile, in the production process which is mainly composed of customer need identification, design, production and final product confirmation, each step should also incorporates the concept of quality inspection. Seeing the importance of it, this project is mainly intended to build up a system that can promote students' ability of final product inspection.

The web-based distance learning has become a new trend of learning recently. With multi-media and hyperlink features that integrate texts, images, audios/ videos, etc. and multi-media editing systems, teaching websites are mushrooming globally. Web-based classrooms and schools allow learning in the virtual world of computers through the technology of virtual reality. As indicated by Bill Gates, e-learning is like a "Digital Nervous System" which can expand human learning far and wide through information technology. According to John Chambers, president and CEO of Cisco, on-line training and education is the next-wave Internet industry that exhibits the fastest growth and the most significant changes. In this era of knowledge economy, web-based learning and teaching have become an irresistible trend in education.

To implement the concept of inspection and correspond to the current global trend of learning development, this study is intended to establish a web-based learning platform suitable for mechanical product inspection courses by using Internet and open-source technologies. This platform is free from the operation system limitations and allows learning virtually at anytime in anywhere. Moreover, valuable learning resources can be exchanged freely through this platform to achieve the goal of resource sharing and education proliferation.

2. CONCEPT ARCHITECTURE OF MECHANICAL PRODUCT WEB-BASED INSPECTION

The technological innovations on one hand, and the growing popularity and availability of Internet on the other, are the main reasons of recent development of numerous applications and research projects in the field of technology-mediated education [1-3]. In this study, studying is defined as voluntary student behaviors that follow the initial presentation of information (lecture, reading) with the intention of improving understanding and knowledge retention [4]. There is an abundant literature on various techniques and strategies students might use to learn more effectively, [5-6].

In product trouble-shooting inspection, Johnson [7] proposes a technical diagnosis model should include the two stages: hypothesis generation and hypothesis evaluation. In the first stage, data are collected and explained to generate a hypothesis while in the second stage, data are collected and explained to evaluate the accuracy of the hypothesis. The success of product trouble-shooting inspection is often decided by the in-time acquisition of relevant knowledge [8], including (1) concept/schematic knowledge, (2) knowledge for representation of problems, (3) procedural knowledge, (4) knowledge of strategies and (5) chunking knowledge. Lack of basic knowledge is one the reasons for ineffective trouble-shooting inspection [9]. Prior knowledge is an important indicator for learning achievement prediction. The size of prior knowledge can also influence learning effectiveness. With its significant influence on learning, prior knowledge is certainly one of the important factors deciding learning achievements [10-11].
This system is web-enabled using advanced information technologies like, for example: Java servlets and applets, VRML, Groupware, Multimedia, and Virtual reality. In this system, there are four essential learning features, called “Virtual Learning Zones,” including (1) Knowledge, where students can find all the necessary learning information; (2) Collaboration, where students can find real-life and virtual learning companions; (3) Consulting, where teachers or lecturers provide learning guidance and consulting (4) Experimentation, where students can have virtual-reality practices. In addition, there is a user zone that accumulates user-related information. These zones are supported by a number of tools developed using different information technologies (Fig. 1). The architecture and contents of this system were published earlier [12], therefore, the following section only provides a simple introduction to the important items.

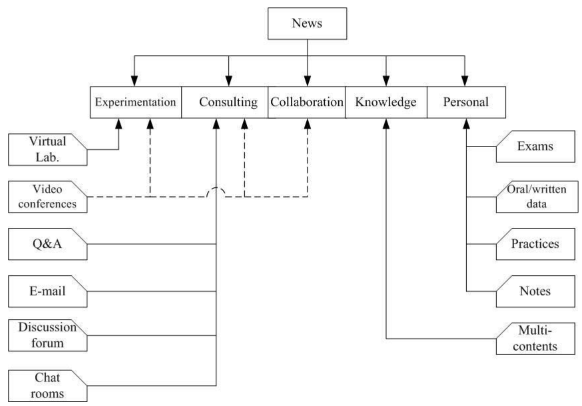

Fig. 1: Learning regions and modules distribution.

As for the learning strategy of this system, adaptable learning follows the AEHS (Adaptive Educational Hypermedia Systems) terminology [13-15]. The concept of “adaptability” is used in the system to allow end-user modifiability and provide learners control over several functionalities. It can not only improve the tradition learning model, but also offers learners a variety of options to choose from such as the content is presented in a hypermedia form enabling access to different units, a variety of tools/activities (e.g. course studying activities, discussion forum, chat rooms, case study, video conferences). The paths of adaptable learning are shown in Fig. 2. Furthermore, the above mentioned activities are planned mainly to implement the goal of adaptable learning, allowing students to adjust their own learning situation through one or many of the activities. By mean of the above mechanisms, two purposes are achieved: (a) keeping track of the learning conditions to find out problems students encounter in the process and to offer timely assistance; (b) preventing students from memorizing the answers so as to ensure actual learning effects.

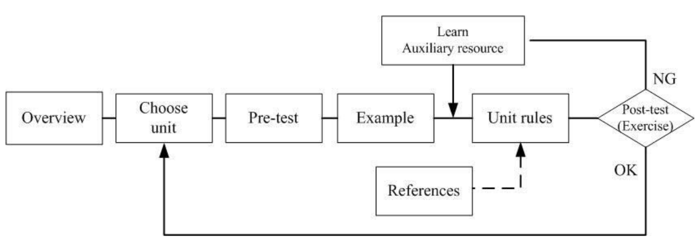

Fig. 2: The diagram of adaptable learning paths.

To realize the adaptable learning strategy, course contents are divided two parts—textual/audio materials and interactive practices. Fig. 3 illustrates the network structure of the mechanical product web-based inspection learning system, the client end can be connected to platform through the Internet, and students can discuss with teachers or other classmates by entering the chat room (a kind of real-time learning mode) or posting questions in the discussion forum (a kind of non-real-time learning mode). Meanwhile, operation and many other functions in the hope that students can obtain complete inspection knowledge and skills. As for the software, Linux is used for the main architecture of the system platform in this study. The Linux operation system (Redhat Linux 8.0) is used as operation system of the Internet mainframe for the Linux system is a mission-critical system superior to other systems in both performance and stability. The MySQL database is used for it has the fastest response and processing speed among the databases of the same class. The Apache SERVER 2.0 software is used at the Web server.
As shown in Fig. 4, the website framework of the mechanical product web-based inspection learning system, the users are divided into four groups in accordance with authority: guests (non-registered learners), students, lecturers and administrators. Users of different types are given different levels of permission in this learning system. Moreover, explain the course contents in following statement:

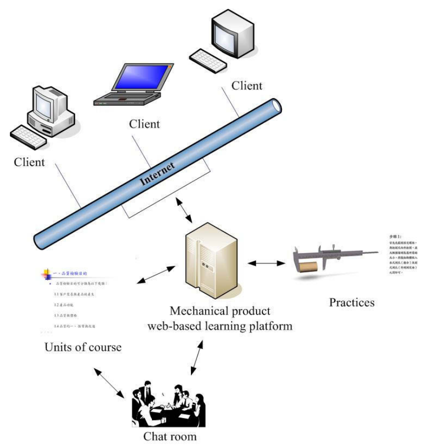

Fig. 3: Network structure of mechanical product web-based inspection learning system.

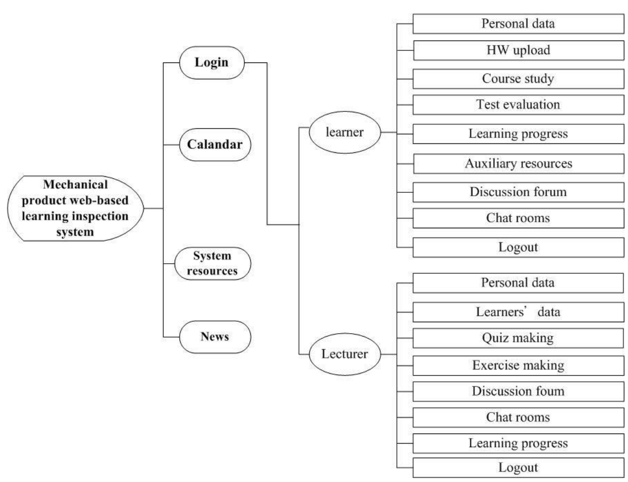

Fig. 4: Website framework of mechanical product web-based learning inspection system.

(1) Textual/audio materials

Apart from the textual presentations of concept and theories (in HTML format) in each unit, audio explanations of unit subjects and related contents are also applied. The audio explanations in each unit can be divided into three parts:

objectives, subjects and contents. The major points of each unit are listed and displayed on the webpage. By clicking on the page browsing keys, e.g. Previous/Next page, Home, etc., students can decide their own learning progress.

To prevent boredom and confusion in the learning process, quizzes of the unit contents are arranged in the proper part of each unit. The quizzes can not only enhance fun of learning but also enable students to see if they totally comprehend the unit contents. The system will automatically evaluate students' answers.

(2) Interactive practices

This part is a realization of the idea of virtual laboratory. The practices provide simulation before actual operations and can help enhance leaners' knowledge and experience about how to operate the instruments and what to notice during the actual operations. Meanwhile, they can also reduce the risks of instrument damage due to improper use.

There are two parts in each practice: browsing of inspection process and interactive operation. The former is an automatic presentation through textual explanation and virtual model of how to do the practice step by step; the later allows students to simulate the actual use of the inspection tool in the laboratory. Students mouse click the single choice question in the practices to conduct the virtual inspection.

3. EXPERIMENT METHODOLOGY AND EFFECTIVENESS ANALYSIS

In the planning and designing of learning evaluations, Glaser [16] proposes that in the basic model of teaching, the teaching process can be divided into four major parts: teaching goals, entry behaviors, teaching activities and teaching evaluations. Through evaluations such as quizzes or examinations, feasible goals can be established with suitable teaching materials and methods selected to design suitable evaluation tools and methods and to bring the optimal teaching results. According to Vogel and George [17], a good on-line testing system should have (1) suitability, (2) effectiveness, (3) objectivity, (4) uniqueness, (3) proper difficulty, (6) good item analysis results, (7) reliability, (8) validity and (9) fairness. Khattri and Sweet [18] also indicate that, with the increasing emphasis on systematic evaluations, goal-oriented teaching, curriculum and new evaluation methods, teachers can use the learning activities in the learning map to design assessment methods for the activities so that the methods correspond to the learning goals and the assessments can closely integrate with the learning process and goals. Evaluations of question-oriented learning include evaluations of learners by teachers and self-evaluations by learners.

In the production of on-line exercise questions, Criswell [19] points out, in the drill-and-practice CAI system, there are two principles in question selection: questions should be related to important contents of teaching materials or to the parts repeatedly presented in the teaching process. Hannafin and Peck [20] think, if the drill-and-practice CAI program only presents questions to learners, the learning is prone to become rigid and mechanical, lowering learning motivation and weakening the learning effectiveness. Therefore, it is suggested to consider feedback and correction in the system design.

3.1 Experimental Learning Framework

The experimental learning framework developed is shown in Fig. 5. Before learning the mechanical product web-based inspection system, students need to accept an evaluation of mechanical product inspection background knowledge. The main purpose of this evaluation is to understand the students' prior knowledge. Afterwards, students will have a pre-test of professional knowledge, which is intended to find out how much each student knows about this course before studying it.

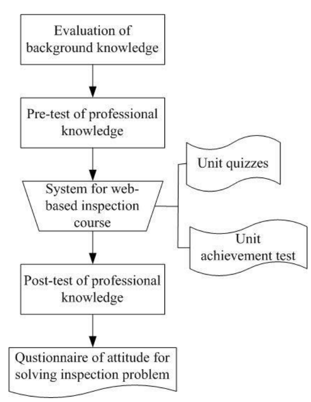

Fig. 5: Experimental learning framework of mechanical product web-based inspection.

In the learning process of each unit, in addition to unit quizzes and achievement tests, students will receive a post-test when the whole course is completed. The results of the pre-test, post-test and each achievement test are collected and analyzed statistically to find out if there is any significant progress in learning effectiveness. At the end, questionnaires of attitude for solving inspection problems are given to know how each learner thinks and does when facing inspection problems and to provide references for promotion of inspection abilities.

3.2 Experimental Design of Mechanical Product Web-based Inspection Course

The experiment design in this study is composed two sets of pre-test and post-test for the experimental group and the controlled group. There are totally four steps in the experiment: (1) giving learners the pre-test to measure the dependent variables, (2) conducting the experiment on the learners, (3) measuring the learning results when the experiment is finished and (4) using proper statistic methods to find out if the differences between the results of pre-test and post-test reach the level of significance.
This study uses an equivalent pretest-posttest group design for the experiment. Since there are many uncontrollable situations at the education sites, it is impossible to achieve complete experiment controls. Therefore, research experiments can only be implemented with students of certain classes as the subjects. This experiment design is also rather popularly used in the current education studies. The details of the experiment design are listed in Table 1.

Group	Pre-test	Experimental procedure	Unit evaluation	Post-test	Questionnaire
C.G.	Y_1	X_1	Y_3	Y_5	□
E.G.	Y_2	X_2	Y_4	Y_6	□

Tab. 1: Experimental design table of mechanical product web-based inspection.

C.G: Controlled group, E.G.: Experimental group

Y_1, Y_2 : Accept pre-test of professional knowledge

Y_3, Y_4 : Take achievement test of unit

Y_5, Y_6 : Take post-test of professional knowledge

X1 : Receive traditional teaching and review the contents

X2 : Accept traditional teaching and mechanical product web-based inspection learning system

□ : Take questionnaire of attitude for solving inspection problems

3.3 Experimental Participants and Instruments

The participants are the first-year students of the Department of Mechanical Engineering. These 36 students in total are evenly divided into two groups - controlled group (C.G.) and experimental group (E.G.) with 18 students in each group. Meanwhile, in the curricular design, the two learner groups get the mechanical product inspection course titled "Precision Metrology" with three hours per week and 24 hours in total (eight weeks). In every week, both groups get two-hour traditional instruction of mechanical product inspection. However, the experimental group spends one hour studying with the mechanical product web-based inspection system while the other group spends one hour reviewing. The textbook used in this study is "Metrology for Engineers [21] and the reference books are "Precision Machine Design" [10] and "Measurement Systems Application and Design" [22]. The inspection tools and instruments used in this study include measurement tools for manual inspection, such as the vernier caliper, micrometer, optical flats and profile projector. Besides, laser scanning machine for automatic inspection is also applied.

The fact that there are only 36 samples might arouse doubts if the small number of samples might cause significant variations. According to many statistic experts, such as Glass R. L., non-normality has only limited influence on the type I error rate (α). (Glass and Hopkin 1984) also indicate that even if the matrix becomes orthogonal or skewed, which means there are only five to ten samples, the sample distribution will gradually become close to the normal distribution. According to the above-mentioned scholars, the influence of small sample size on the statistics validity seems minimal.

3.4 Experimental Tools

There are three experimental tools in this study: (1) learning material of mechanical product web-based inspection course, (2) scale of inspection ability and (3) learning system of mechanical product web-based inspection. Each of them is explained as follows:

3.4.1 Material of Web-based Course

Based on literature review and related learning theories, the course materials in the systems are compiled systematically and then converted web-based learning materials. In enhancing students' inspection abilities, the framework is constructed by using problem solving models [23-24], including the following parts:

(1) Presentation of problem: describing the problems of mechanical product inspection, including causes, conditions and consequences.
(2) Hint of problem solving: guiding learners to find clues of problem solving in the course materials, such as the concepts and knowledge learners acquire from the pre-study. Suitable hints are given to remind learners of what have learned, help them understand problems and further solve find the clues for problem solving.
(3) Problem solving assistance: In the problem solving process, lecturers will not only provide in-time guidance, but also provide simple demonstration of how to solve problems.
(4) Problem solving demonstration: Since lecturers conduct the course mostly by lecturing and learners lack trainings of systematic problem solving, the problem solving demonstration by lecturers is added in the web-based learning course to prevent steep learning curves and learning difficulties. The demonstrations can give learners a basic concept of how to handle problems for the first time.
(5) Case practice: All the above-mentioned contents are produced to help students face real problems in mechanical product inspection, allowing them to find out solutions quickly. The practices in this part are based on related cases to allow learners to have actual operations. The actual inspection cases are presented through the web-based learning platform.

3.4.2 Scale of Inspection Ability

To evaluate the learning effectiveness of the course, several scales are constructed, such as the background knowledge of mechanical product web-based inspection learning, pre-test/post-test of professional ability, achievement test (including tools using, application of statistics and technologies of inspection), and the questionnaires of attitude for solving inspection problems. All the scales are used in the learning process to evaluate the improvement of inspection abilities.

3.4.3 Learning System of Mechanical Product Web-based Inspection

The web-based learning system is developed based on related literature review, analysis and the requirements regulated by the Ministry of Education in Taiwan. The web-based client-server learning framework has been tested by some experts and revised according to their suggestions. The contents and all the functions on the website can be used through internet browser (such as IE), lecturers can conduct teaching management and trace students' learning progress while administrators can maintain the whole system.

3.5 Results and Effectiveness Analysis

As mentioned above, the scales of mechanical product inspection ability are mainly used to evaluate the problem solving ability of students in the learning process. In addition to indicating the learning achievements of students in different units, they also help find out the differences among each learner in his recognition and understanding of the same course contents. Based on the scale measurement results, the learning strategies developed in this study can be applied to adjust the learning progress and contents of each learner in order to achieve the goal of adaptable learning. The experimental procedure and contents are explained as follows:

3.5.1 Test Scale of Background Knowledge

This study selects 36 samples from the first-year college students based on purposive sampling. After the evaluation, the true-false and single-choice are statistically analyzed and compared with the teaching material contents and questions for different levels of behavior goals in the two-way specification table.

The evaluation results are ranked from the highest to the lowest, and then divide into two groups following the statistical s-shape distribution. Furthermore, the independent sample T test is used to find out if there is any significant difference in background knowledge between the two groups. The t value is 1.51 and $p = 0.881 > .05$ which does not reach the level of significant difference. In other words, the two groups are not significantly different in background knowledge. The reliability of this scale is measured based on the coefficient of internal consistency (KR-20) and the value is 0.875.

3.5.2 Pre-test Scale of Professional Knowledge

40 pilot single-choice questions are generated for the pre-test scale of professional knowledge. The questions are reviewed and finalized by several teachers and experts well-experienced in inspection courses to make sure the sample questions are qualified to represent the tested fields. The scale is also used to evaluate the 36 students. After the evaluation, the questions are statistically analyzed and compared with the teaching material contents and questions for different levels of behavior goals in the two-way specification table. Among the 40 questions, 25 are kept to create the pre-test scale. The average difficulty value of the questions is 0.40, meaning the pre-test as a whole is of middle difficulty and suitable for the objectives of teaching and evaluation.

The independent sample T test is also used to find out if there is any significant difference in inspection course professional ability between the two groups. As indicated by the evaluation results, the t value is –1.588 and $p = .122 > .05$ (C.G. M = 42.72, E.G. M = 37.56) which does not reach the level of significant difference. In other words, the two groups are not significantly different before taking the mechanical product web-based inspection course.

3.5.3 Achievement Test

The achievement tests are made to evaluate the learning results of the two groups after they complete the following major units of the course: (1) Tool Using, (2) Application of Statistics, and (3) Technologies of Inspection.

The independent sample T test is also used here to find out if there is any significant difference in learning achievements after each unit between the two groups. The evaluation results are summarized in Table 2.

Subject		Tools using		
	Mean	S.D.	t	p
C.G.	54.06	19.209	-4.357	.000*
E.G.	76.39	10.193	--	--
Subject		Application of statistics		
C.G.	54.50	16.023	-3.177	.003*
E.G.	67.11	5.189	--	--
Subject		Technologies of inspection		
C.G.	53.39	13.552	-3.995	.000*
E.G.	67.00	5.029	--	--

Note: * means $p < .05$

Tab. 2: Variant homogeneity test for Achievement test.

3.5.4 Post-test Scale of Professional Knowledge

After the post-test of professional ability, the test results are analyzed to find out the learning progress of the controlled group and the experimental group from the pre-test to the post-test. As shown in Table 3, the controlled group in the pre-test is 37.56 and, after the traditional mechanical product inspection teaching and self-review contents, increased by 14.11 points to 51.67. The effectiveness mean is around +0.37, meaning the use of traditional teaching methods in the course can be helpful for promoting inspection ability. The experimental group in the pre-test is 42.72 and, after the traditional teaching and the use of the web-based learning system, increase by 32.83 points to 75.56. The effectiveness mean reaches approximately +0.80, meaning that, in addition to the traditional teaching method and materials, the web-based inspection learning system can greatly help learners in improving their inspection abilities.

	Pre-test (T_{pr})	Post-test (T_{po})	T_{pr} - T_{po}	Effectiveness value
C.G.				
Total	676	930	254	
Mean	37.55556	51.667	14.111	0.3738

E.G.				
Total	769	1360	591	
Mean	42.72222	75.55556	32.83333	0.795508

Tab. 3: Effectiveness table for pre- and post- test of professional knowledge.

The independent sample T test is used to find out if there is any difference in the professional ability among the two groups caused by the use of the system. The t value is –5.954 and $p=.000<0.05$ (C.G. $M = 51.67$, E.G. $M = 75.56$), which reaches the level of significant difference, meaning learners of these two groups are showing a significant difference in their professional ability after the experiment group learners use the system.

At the same time, the paired-sample T test is used to compare the pre-test and post-test scores of the experimental group learners to find if there is any significant difference between their pre-test and post-test. The results are summarized in Table 4. The t value is –3.9587 and $p<.05$ which reaches the level of significant difference and it shows significant progress of the experimental group students after using the system. Their post-test (average result) is higher than pre-test by 32.84 points, which indicates that professional ability can be enhanced by this system.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Y2 - Y6	-32.833	3.519	.829	-34.583	-31.083	-39.587*	17	.000

Tab. 4: Paired-samples T test table for pre- and post- test of experimental group.

3.5.5 Questionnaire of Attitude for Solving Inspection Problem

The use of the questionnaire of attitude for solving inspection problems is mainly intended to find out the both-group students' attitudes and perceptions toward problem solving after participating in the traditional teaching and mechanical product web-based inspection course.

The item analysis is used to analyze the questions of each field and all the questions in the questionnaire; the Pearson product-moment correlation analysis is used to find out the connection between each question and the total sum. Besides, the Cornbach α internal consistency analysis and factor analysis are used to exclude unsuitable question and the analysis results. Based on the factor analysis, the components of each factor are not very different from one another. The item analysis and factor analysis results indicate that the reliability of this questionnaire is acceptable with a total reliability of the scale reaching 0.844, and the reliability of each field is 0.625 (problem-solving), 0.787 (escaping style), and 0.750 (personal control).

Furthermore, the independent sample T test is used to find out if there is any significant difference. The following is an explanation of the significant differences between the two groups;

(1) In addition to the traditional mechanical product inspection instruction, the experimental group also conduct learning with the system. The system has related auxiliary resources for unit learning and practices; therefore, the experimental group can use the resources better than the controlled group in the process of problem solving.

(2) The units in the system are designed based on the procedure of problem solving. Therefore, when using the system, the experimental group can acquire a series of knowledge about the problem definition, cause inquiry, manner decision and implementation. Hence, learning with the system is significantly helpful for the experimental group learners in solution analysis and result evaluation when facing problems.

(3) Since the controlled group students only receive the traditional teaching of mechanical product inspection and review contents by themselves, there are few practices of inspection problem analysis with actual cases as the experimental group. This is probably the reason why their abilities to find the key points of problems are worse when dealing with relatively complicated problems.

(4) The controlled group learners only have the traditional teaching of mechanical product inspection and self-review

activities, so they tend to have weaker command of related professional knowledge and lower familiarity with the operation skills than the experimental group. Their confidence in problem solving is also relatively low and, therefore, when they can not solve a problem after initial attempts, they are more likely to feel uncertain and insecure about their problem solving abilities.

3.6 Summary

Both groups all show significant progress base on the pre-test and post-test. However, the post-test of the experimental group receive the mechanical product web-based inspection course are significantly higher than pre-test and the post-test of the controlled- group. In the problem-solving attitudes, two groups indicate that the mechanical product inspection course has a positive influence on confidence and personal control when dealing with problems. With higher confidence and personal control, the escaping style of the learners is relatively reduced.

As for learning motivation encouragement, since the mechanical product web-based inspection learning system developed is based on virtual interaction and multi-media technologies, the teaching materials are more lively and diversified. The chat room and discussion forum of the system can not only integrate learner opinions but also promote interactions among lecturers and learners, reducing the sense of alienation caused by the Internet.

The following suggestions are made based on the data obtained from the use of traditional teaching together with the web-based learning system in this study:

(1) Pre-test of the two groups are generally low, which indicates that the learners have relatively insufficient professional ability of mechanical product inspection. Therefore, it is suggested that learners should reinforce prior knowledge of the field so as to improve professional inspection abilities and enhance learner effects.

(2) Learning mode with the mechanical product web-based inspection course exhibits significantly better post-test than merely traditional teaching. Therefore, in addition to using the system to convert teaching contents into web-based teaching materials, actual operations have to be incorporated in this course.

(3) The platform and framework in distance education which can help the schools create sharing channels with the communities and the industries besides using the mechanical product web-based inspection learning system for teaching assistance,.

(4) Traditional education is mainly based on lecturing of textbook contents. In this lecturer-centered education, students are given few opportunities to automatically think about the problem and to solve the problems by themselves. Therefore, the students have generally low abilities of problem solving. Hence, incorporate the teaching strategy of problem solving in the web-based learning system to achieve concrete learning results.

(5) The platform and system function modules are developed by using the open source mechanism, which is helpful in establishing the characteristics and autonomous functions of the learning system, saving costs on expensive licensed software, realizing the resource sharing models among communities, improving the system function through teamwork cooperation.

4. CONCLUSION

In this study, the mechanical product web-based inspection course is developed based on the related knowledge and skills required for learners in inspection. The combination of traditional teaching and web-based learning system is intended to promote learners' inspection abilities.

Meanwhile, the web-based learning platform in this course is established on open source softwares, which can be considered as a realization of the open-source learning system currently promoted by the education authorities and, furthermore, used as a common framework embedded in the learning modules of other courses or subjects in the future. Features of communications such as the chat room and discussion forum are used to allow group discussions among lecturers and learners in order to strengthen the effects of active learning.

By providing the browsing of the inspection technologies and process, the web-based system can free learners from textbook-based explanations. Before actual inspection operations, the technologies of virtual interaction, multi-media and 3D presentation can display the simulated inspection process on the screen, guiding learners through the whole process without going to the laboratory. Texts, voice and animations are also used to show what to notice in the inspection process to reinforce learners' impression about product inspection. In addition, interactive practices are also developed to allow learners to simulate the actual operations by themselves. Both the inspection browsing and practices can strengthen inspection abilities.

Judging from the experiment results in this study, it can be told that, in addition to the traditional teaching, the mechanical product web-based inspection course can bring substantial learning improvements. Hence, it can be concluded the learning system of this study is significantly effective in promoting inspection abilities.

5. ACKNOWLEDGEMENT

This research was supported in part by the National Science Council in Taiwan through Grant No. NSC-95-2516-S-132-001.

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