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A Study of Feedback Strategy to Improve Inspector Performance by Using Computer Based Training

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***Abstract*—**The purpose of this research was to study the inspector performance by using computer based training (CBT). Visual inspection task was printed circuit board (PCB) simulated on several types of defects. Subjects were 16 undergraduate randomly selected from King Mongkut's University of Technology Thonburi and test for 20/20. Then, they were equally divided on performance into two groups (control and treatment groups) and were provided information before running the experiment. Only treatment group was provided feedback information after first experiment. Results revealed that treatment group was showed significantly difference at the level of 0.01. The treatment group showed high percentage on defects detected. Moreover, the attitude of inspectors on using the CBT to inspection was showed on good. These results have been showed that CBT could be used for training to improve inspector performance.

***Keywords*—**Training, Feedback, Computer based Training (CBT)

I. Introduction

NOW, all industrial was interesting in area of product inspection. Because that is becoming increasingly important in manufacturing industries as quality demands have been tightened and the incidence of product liability litigation has increased [1]. Inspection essentially consists of two main functions - visual search and decision making [2] - which need to be performed effectively and efficiently for inspection to be successful. However, the inspection process is not extremely reliable with human inspectors. To overcome this drawback, many companies have resorted to automated inspection [3]. In the present, there are many competitive to the market to keep customer's satisfaction [4]. This would enforce company to have successful inspection on products. The best way to do this is 100 percent inspection to detect defects on product before reaching to customer. In this situation, visual inspection has become play significant role on inspected product. Visual inspection has composed of two significant categories, which are visual search for defect and decision making. Visual search is inspector looked for defect and compared to standard while decision making is that inspector has to make judgment to reject or not reject the product [4]. Therefore, this would be indicated that if inspector does not have the experience, the bad product could be passed to external customers. Even though the 100 percent on inspection, it could not be guarantee that bad product would be detected. In order to improve inspector performance, training is one of the best ways to be used [5, 6]. Training strategy would enhance the inspector on skill in speed and accuracy in a short time [7].

Training strategies for visual inspection have composed of on-the-job (OJT), classroom, and computer based trainings (CBT) [7]. However, the computer based training has become more superior those trainings because of high performance of technology and inexpensive devices. Right training would be decrease the gap of inspectors on their inspection performance [8]. Moreover, CBT could be used for training any place and any time on unlimited number of inspectors as long as they have enough devices [9]. Therefore, the purposes of this research were to study on development and usability testing of CBT, and comparison on inspector performance between feedback and no feedback strategies.

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II. Research Methodology

A. Visual task

Visual inspection task was simulated on printed circuit board (PCB). Defects were developed on missing component, wrong component, misaligned component, polarity error, trace defect, and broken board.

B. Stimulus Material

The experiment was run by using computer Pentium IV, 1.5 GHz ram 512 MB with 17 inch monitor. The example of screen capture was showed in Fig. 1

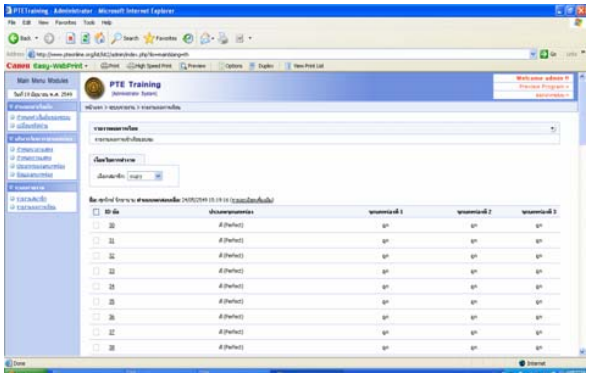


Fig. 1 Sample of defect display for computer programming

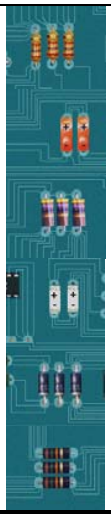
C. Subject

Sixteen subjects were randomly selected from King Mongkut's University of Technology Thonburi and test for 20/20. They were equally divided on performance into two groups (control and treatment groups) and were provided information before running the experiment. Treatment group was provided feedback information on inspection task performance.

D. Experiment Design

The experiment was run on two groups between control (no feedback) and treatment (feedback) groups. There were seventy two PCB boards on each experiment, which were 18 boards of each of the following: good PCB, single defect, two defects and several defects. Subject was asked to perform inspection task and PCB boards were randomly showed to inspector.

TABLE I
EXAMPLES OF PERFECT AND DEFECT PRINTED CIRCUIT BOARDS

Perfect	Defect	Defect types
		Missing component
		Wrong component
		Misaligned component
		Polarity error
		Trace defect
		Broken board

E. Procedure

The steps on running experiment were as following:

1. Day 1 subjects were provided preliminary information,
2. Day 2 subjects asked to perform test. Subjects who passed the test at least 60 percent of defects detected were randomly divided into two groups,
3. Day 3 both groups were asked to perform the inspection test on PCB boards. Then, feedback information was provided to only treatment group,
4. Day 4 subjects on both groups were asked to perform the seconded test.

F. Data Correction

Data was collected on performance measure, which is percent defects detected, and attitude of inspector to computer base programming. Questionnaire was used to collect data on usability of program rating scale from 5 to 1, which is according to strongly agree to strongly disagree, respectively.

III. RESULTS

A. Performance Measures

The result of difference between the first and seconded tests on percent defect detected of treatment group was showed in Table II. It was showed significantly different higher score on the seconded test than the first test.

TABLE II
ANALYSIS OF DIFFERENCE ON PERCENT DEFECT DETECTED OF TREATMENT GROUP

Test	Avg.	SD	$\overline{D}$	$SD_{\overline{D}}$	t-test	P-value
1	69.37	11.59	23.25	9.14	7.19	0.00
2	92.62	6.75				

P < .01

The result of difference between the first and seconded tests on percent defect detected of control group was showed in Table III. It was showed significantly different higher score on the seconded test than the first test.

TABLE III
ANALYSIS OF DIFFERENCE ON PERCENT DEFECT DETECTED OF CONTROL GROUP

Test	Avg.	SD	$\overline{D}$	$SD_{\overline{D}}$	t-test	P-value
1	71.00	10.08	7.00	2.82	7.00	0.00
2	78.00	9.05				

P < .01

The results was showed that performance on treatment (feedback) group has higher significantly difference than control group. Table IV represents the difference on percent defect detected between treatment and control group.

TABLE IV
ANALYSIS OF DIFFERENCE ON PERCENT DEFECT DETECTED

Group	Avg.	SD	t-test	P-value
Control	7.00	2.828	4.801	0.00
Treatment	23.25	9.145		

P < .01

From the Table IV, the average differences on percent defect detected on treatment and control groups were shown after the first and seconded tests. When the result on the first test was conducted, it was shown not significantly different at the level of 0.01between two groups as shown in Table V. This would be indicated that both groups had the same performance before providing feedback information.

TABLE V
ANALYSIS OF THE FIRST TEST ON PERCENT DEFECT DETECTED

Group	Avg.	SD	t-test	P-value
Control	71.00	10.08	0.299	0.769
Treatment	69.37	11.59		

P < .01

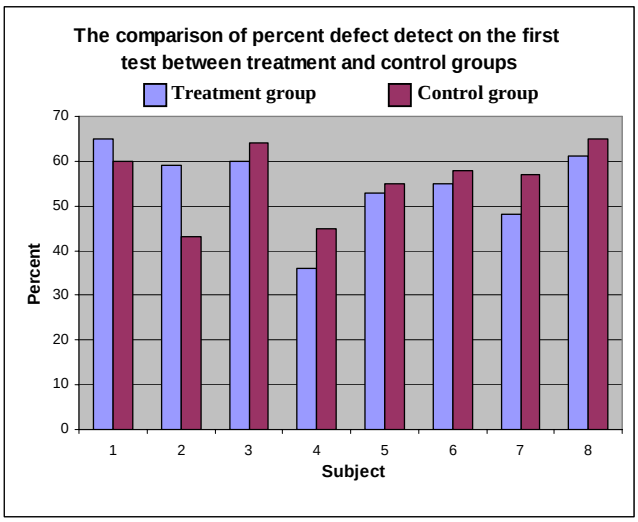


Fig. 2 Comparison of percent defect detected on the first test between treatment and control groups

On the other hand, when the result on the second test was compared after providing feedback information to treatment group, the performance of treatment group on percent defect detected was showed significantly different at the level of 0.01 as seen in Table VI.

B. Usability test

The usability test was collected by using questionnaire, which scale from 5 to 1 according to strongly agree to strongly disagree, respectively as shown in Table VII. Most of the results have showed on average better than 4.00, which mean the users were satisfied of using CBT program at the good level.

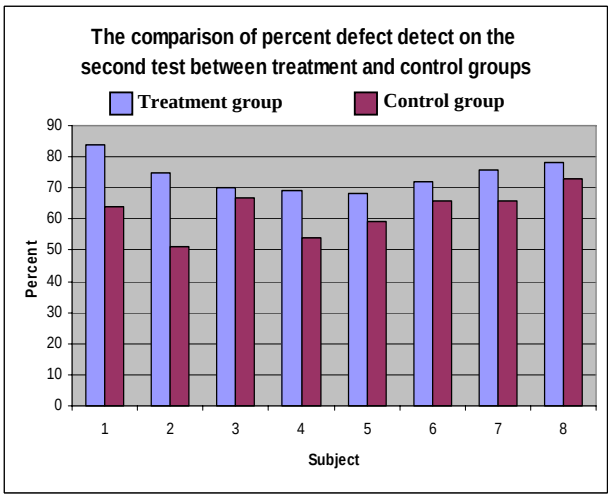


Fig. 3 Comparison of percent defect detected on the second test between treatment and control groups

TABLE VI
ANALYSIS OF THE SECONDED TEST ON PERCENT DEFECT DETECTED

Group	Average	Standard Deviation	t-test	P-value
Control	78.00	9.05	3.661	0.003
Treatment	92.65	6.75		

P < .01

TABLE VI
ATTITUDE TEST OF USERS ON COMPUTER BASED TRAINING

Item	Mean	SD.
1. Steps to login the system	4.17	1.23
2. Complete information to login the system	4.25	0.57
3. Ease of use	4.31	0.47
4. Appropriate step of program using	4.37	0.61
5. Appropriate font type	4.50	0.51
6. Appropriate font size	4.31	0.70
7. Appropriate font color and background	4.37	0.61
8. Ease of read	4.31	0.47
9. Contrast of picture	4.31	0.60
10. Appropriate of color and line	4.37	0.61
11. Appropriate of picture color	4.37	0.61
12. Appropriate of picture	4.56	0.51
13. The neat of picture	4.25	0.44
14. Appropriate of picture layout	4.50	0.51
15. The balance of screen monitor	4.37	0.61
16. Attractive color and picture	4.37	0.71
17. Ease of language using	4.43	0.72

IV. Discussion and Conclusion

From the results, this would be indicated that performance on the second test was performed more superior on average than the first test on both treatment and control groups. The difference from percent defect detected on feedback group was showed significantly different at the level of 0.01. This has indicated that feedback strategy has played a significant role to improve inspector performance. Information on inspector's performance was helped them on improving their performance measure as seen in Table 4. This result was supported by the study of Gramopadhye on Training for Decision-Making in Aircraft Inspection [10]. It revealed that training for visual inspection was helped inspector to improve their performance on searching for defect and making decision.

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