Effect of Providing a Web-Based Collaboration Medium for Remote Customer Troubleshooting Tasks

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Abstract. This study investigates the effect of providing a Web-based diagnostic tool as a collaboration medium on remote customer troubleshooting tasks with and without the assistance of a customer call center agent. The study tested three troubleshooting modes (Web tool alone, call center agent alone, and Web tool + call center agent). The hypothesis that the Web tool + call center agent mode would be faster than the other two modes was not supported. However, the results of the experiment showed that the Web-based self-help diagnostic tool can be a potentially cost-effective way of providing customer support. The performance using the Web tool alone was comparable to the call center agent.

Keywords: collaborative troubleshooting, communication mode, web-based diagnostic tool.

1 Introduction

Customer support operations are increasingly supported by communication technologies such as instant messaging, e-mail, etc [1]. However, the telephone is still the most popular form of customer support service. Customers make phone calls to a customer call center and work together with an agent to solve their problems.

This research focuses on the inefficiency originating from the interaction between the customer and the call center agent. Since the customer usually does not have the background information to troubleshoot his/her problem, the call center agent goes through the detailed troubleshooting procedures. It is a time consuming task. As a way of improving the efficiency of the interaction, this research considers adding a visual information channel with the assumption that adding a visual information channel, the Web-based diagnostic tool, to the audio channel, telephone, would shorten the interaction time.

1.1 Literature Review

Conversations during collaborative physical tasks involve the identification of objects, descriptions of procedures/actions, and confirmation of whether the actions are completed [2]. Therefore it is important to establish a c*ommon ground*, which

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refers to mutual knowledge, understanding, and assumptions between the participants [3], for effective collaboration [4]. The collaborators establish the common ground through *grounding*, communicating what they do or do not understand over the course of a conversation [4]. Grounding becomes more critical for the joint activities between a novice user and an expert since the expert guides the novice user who significantly lacks common ground through a task.

This study assumes that providing a visual information channel would be effective for establishing common ground and improving communication between the two parties. The assumption that providing visual information channel with audio channel would help the collaboration for the collaborative physical tasks can be supported by media richness theory [5]. Richer media provided rapid feedback and multiple cues so that participants could reach a common interpretation by reducing information uncertainty and ambiguity. [6] indicates that the selection of communication mode needs to be based on the assessment of the richness of communicated information since the fit between the message and the communication mode influences the performance. A rich medium should be used for communicating difficult messages and a lean medium for simple messages.

1.2 Purpose of the Study

The literature provides evidence for the argument that adding a visual information channel to an audio channel would increase the performance of a collaborative task. Therefore, the research hypothesizes:

Providing a Web-based collaboration medium (Web-based diagnostic tool) for a physical collaborative task between the customer and the call center agent would reduce the task completion time.

The study also aims to check whether a Web-based diagnostic tool can be easily used by the customers without the assistance of the call center agent. Three troubleshooting modes are investigated in the context of a print quality troubleshooting process: Web tool alone, call center agent (CCA) alone, and Web tool + CCA. The Web tool is expected to reduce the interaction time between the customer and the call center agent by reducing time related to *grounding*.

2 Method

2.1 Web-Based Diagnostic Tool

The Web-based diagnostic tool consists of hyperlinked Web pages, which describe the necessary procedures to troubleshoot and repair print quality problems. The tool is composed of three layers as shown in Fig. 1. Layer 1 consists of printing test pages and then selecting a test page with a problem. Layer 2 consists of selecting a matching print quality issue. Layer 3 consists of performing troubleshooting procedures. The troubleshooting process is described in the detailed step-by-step procedures with explanatory images. The images of printer components and detailed explanation of procedures were provided as hyperlinks to help the understanding of the users assuming that the users have no previous knowledge about the printer. Several sets of

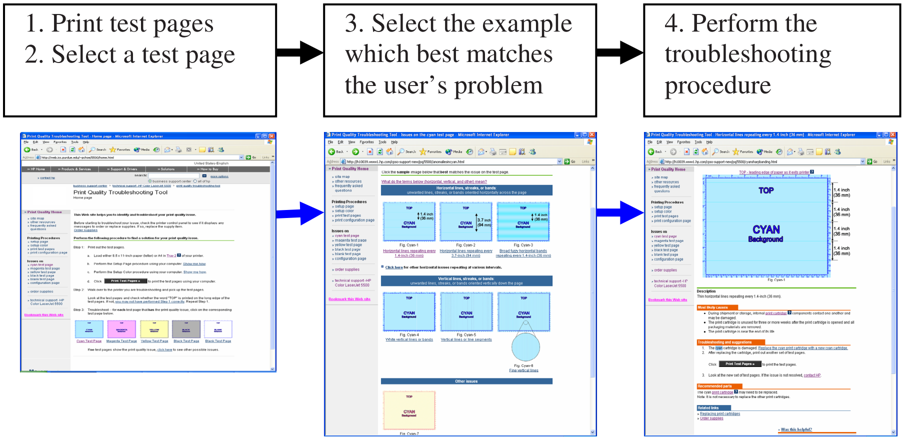

Fig. 1. Troubleshooting process of the web-based diagnostic tool

cognitive walkthrough, heuristic evaluation, and user testing were conducted during the development process to improve the usability of the website.

2.2 Experiment

Twelve students at Purdue University were paid to participate in the experiment. Real CCAs at a remote site participated in the experiment as a CCA. The subjects were composed of seven males and five females with an average age of 25.2 yrs. They had used the Internet more than two hours a day without previous experience with the printer used in the experiment.

A printer was placed right next to a speaker phone and a computer with a LCD monitor so that the subjects could work on the printer while looking at the website or talking with the CCA.

A 3x3 Latin square design was used. A total of nine tasks were generated by the full combination of three print quality issues and three troubleshooting modes (Web tool alone, CCA alone, and Web tool + CCA). The subjects were divided into three groups and each subject performed three scenarios of diagnosing and repairing a print quality problem.

Before starting the task, the subject was given a brief instruction on the purposes and the overall procedures of the experiment and a consent form to sign. After the initial briefing, the subject was given a defective printout with its original digital image on the computer monitor, and was asked to fix the problem using one of the three troubleshooting modes. After the task, a questionnaire was given to the subject to collect satisfaction measures on the troubleshooting mode. The subject repeated this procedure for the other two print quality issues.

For the Web tool alone mode, the subject only used the Web tool without the assistance of a CCA. Using the troubleshooting instructions on the Web tool, the subject fixed his/her problem, and verified whether the problem was fixed by printing out another set of test pages.

For the CCA mode, the subject dialed the CCAs' numbers until a CCA answered the call. The CCAs went through the process just as though they were dealing with real customers. They asked for the customer information and the product information. After the CCA gathered the information, the CCA verified the customer's problem by asking several questions and then guided the customer through the troubleshooting process. The success of the repair was verified by printing out the test pages embedded in the printer or the original image of the defective printout.

For the Web tool + CCA, the subjects dialed the CCAs' numbers until a CCA answered the call. The CCA asked for the customer information and the product information. After the CCA gathered the information, the agents asked the subjects to access the Web tool. The agent used the Web tool to guide the subject through the troubleshooting procedures. The success of the repair was verified by printing out the test pages within the Web tool or the original image of the defective printout.

3 Results

The tasks in the experiment were divided into two phases: diagnosis and repair. The diagnosis phase indicates the activities required until the subject or the CCA identifies or becomes confident about what the subject's issue is. The repair phase indicates the activities required until the subject fixes the printer by performing the troubleshooting procedures after identifying what the issue is. The time required to connect to one of the CCAs and to gather the customer and the product information is eliminated from the analysis.

Table 1 summarizes the diagnosis time, the repair time, and the total time for each troubleshooting mode. The diagnosis time for the Web tool is 46% faster than that of the CCA and is 53% faster than that of the Web tool + CCA. The repair time for the CCA is 25% faster than that of the Web tool and is 34% faster than that of the Web tool + CCA. The total time for the Web tool is 8% faster than that of the CCA and is 31% faster than that of the Web tool + CCA.

Table 1. Time to diagnose and repair a print quality problem (unit: sec.)

	Web tool		CCA		Web tool + CCA	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Diagnosis	271	139.6	503	295.4	582	388.9
Repair	585	295.4	432	156.1	650	279.4
Total time (diagnosis+ repair)	856	407.7	935	304.1	1232	458.7

Tables 2, 3, and 4 summarize the ANOVA results for the diagnosis time, the repair time, and the total time. The main interest of this study is the main effect of the troubleshooting mode. The main effect of the troubleshooting mode was significant for the diagnosis time ($F(2,16)=4.62$, $P=0.026$) and for the total time ($F(2,16)=6.04$, $P=0.011$) at $\alpha=0.05$. The results of the post-hoc analysis using Student-Newman-keuls test ($\alpha=0.05$) showed that the diagnosis time of the Web tool is significantly faster than those of the CCA and the Web tool + CCA. The total times of the Web

Table 2. ANOVA summary table for the diagnosis time

Source	d.f.	Mean Square	F-value	P-value
Troubleshooting mode	2	312510.0	4.62	**0.026***
Issue	2	103733.7	1.53	0.246
Troubleshooting mode x Issue	4	106483.6	1.57	0.229

* Significantly different at α =0.05

Table 3. ANOVA summary table for the repair time

Source	d.f.	Mean Square	F-value	P-value
Troubleshooting mode	2	151023.7	2.90	0.084
Issue	2	186933.0	3.59	0.052
Troubleshooting mode x Issue	4	33601.0	0.65	0.638

Table 4. ANOVA summary table for the total time

Source	d.f.	Mean Square	F-value	P-value
Troubleshooting mode	2	470211.1	6.04	**0.011***
Issue	2	410420.6	5.27	**0.018***
Troubleshooting mode x Issue	4	179638.0	2.31	0.103

tool and the CCA were significantly faster than that of the Web tool + CCA. There were no significant interaction effect between the troubleshooting mode and the issue.

Table 5 shows the average ratings of the subjective questionnaire measures for each troubleshooting mode. There are no significant differences among the three troubleshooting modes ($F(2, 33)=1.90$, $P=0.166$ for 1, $F(2, 33)=2.54$, $P=0.094$ for 2, $F(2, 33)=0.64$, $P=0.531$ for 3) other than the ratings for overall satisfaction ($F(2, 33)=4.28$, $P=0.022$). The results of the post-hoc analysis using Student-Newman-keuls test (α =0.05) showed that the overall satisfaction for the CCA is significantly higher than that for the Web tool. There were no significant differences between the Web tool and the Web tool + CCA and between the CCA and the Web tool + CCA.

Table 5. Average ratings of subjective measures

	Web tool		CCA		Web tool +CCA	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
1) Easiness of identifying the issue	5.5	1.51	6.4	0.67	6.0	1.13
2) Easiness of performing the troubleshooting procedure	5.3	1.37	6.0	0.60	6.2	0.72
3) Easiness of performing the whole task	6.1	1.16	6.4	0.67	6.4	0.51
4) Overall satisfaction	4.9	1.31	6.3	0.65	5.6	1.44

4 Discussion

The hypothesis that adding a visual information channel to a voice channel would improve the interaction efficiency between the customer and the CCA was not supported. The Web tool + CCA mode was significantly slower than the other two troubleshooting modes. It can be explained in terms of the time required to specify the objects that the two parties were indicating. Especially, the subjects needed to pay attention to three objects during the Web tool + CCA mode: the printer, the Web tool, and the CCA. While listening to the CCA, the subject needed to look at/control both the Web tool and the printer. Although it might be helpful for the subjects to understand what the CCA was explaining, it took more time to confirm which object or which page the subject or the CCA was using. In addition, some subjects got confused when they did not locate the Web pages which the CCA was using.

It may be explained in terms of the amount of the information provided on the Web tool. The Web tool seems to have too much detail for the interaction between the customer and the CCA. This may suggest that a simpler version of the Web tool is needed for the collaboration between the customer and the CCA. Although the very specific details were helpful in guiding a novice user to perform the procedures, it took more time for the CCA and the subject to go through all the steps within the Web tool. When the CCA skipped some steps, customizing the steps according to the subject's situations, the subject was often confused and did not know which page the CCA was using. The Web tool used for the experiment seems more suitable when the customers try to solve their problems on their own without the assistance of a CCA.

The results of the experiment show a potential of the Web-based interactive step-by-step self-help tool in dealing with remote customer problems. The tasks used in the experiment were real troubleshooting tasks with some complexities. The troubleshooting procedures required many steps: performing paper setting, printing test pages, identification of print quality defects, matching print quality defects, replacing print cartridges, swapping print cartridges, etc. The tasks of performing the procedures took an average time of 16 minutes 48 seconds, and the longest one took 18 minutes 45 seconds. Even though the tasks were long and somewhat complicated, the diagnosis error rate was only 9.1% (1 out of 12), and the repair error rate was 0 %. The subjects were good at performing the procedures if the procedures are explained step-by-step in detail with the explanatory images. Especially, the Web tool was useful in diagnosing print quality issues. Given that the very nature of diagnosing print quality issues is very visual, the sample images of the print quality problems were very useful. The subjects were easily able to figure out their problems by comparing their images with the sample images on the Web tool. The diagnosis time for the Web tool was significantly faster than the other two modes.

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