A USABILITY TEST FOR THE OPERATING MANUAL OF BRAIDMAGIC™

Heecheon You[†], Ronda Young[†], David Zimmerman[†],
Carrie Ekrut[†], Anil Kumar[†], and Myun Woo Lee[‡]
[†]Department of Industrial and Manufacturing Engineering
Wichita State University, Wichita, KS 67260 USA
[‡]Department of Industrial Engineering
Seoul National University, Seoul, 151-742, Korea (ROK)

A usability test was conducted for an operating manual developed for the BraidMagic braiding machine. The manual consisted of five sections including (1) Safeguards, (2) Parts and Specifications, (3) Operating Instructions, (4) Maintenance, (5) Warranty and Service. For each section of the manual, various performance and preference measures were applied and opinions regarding likes, dislikes, and suggestions were surveyed. Five cosmetology students participated in this usability study, consisting of seven test modules. The manual received a high evaluation for satisfaction (overall mean = 4.6; range = 4.3 to 4.9) as measured on a 5-point Likert scale throughout the seven modules. Based on the usability test, recommendations were made for better usability of the manual. This study indicated that usability testing is an effective tool to identify potential usability problems in a systematic manner.

INTRODUCTION

An operating manual has been developed for BraidMagic™, a braiding machine developed by HiBraid, Inc. (see Figure 1). The operating manual has 16 pages, including 5 sections: (1) Safeguards, (2) Parts and Specifications, (3) Operating Instructions, (4) Maintenance, and (5) Warranty and Service. The manual was designed for use by cosmetologists having at least a high school education or its equivalent. For better user-friendliness, step-by-step, short instructions in plain language were developed along with pictures and symbols. Also the structure of the contents was organized for easy accessibility. A usability test was needed to verify the features of the manual and identify usability problems prior to publication.

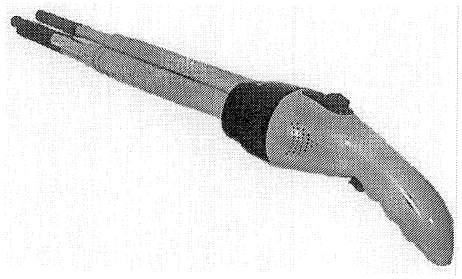

Figure 1. BraidMagic™ braiding machine

The present study was to evaluate the usability of the BraidMagic operating manual and identify terminologies and instructions which need improvement. Each section of the manual was assessed by using various performance (completion time and % correct answers) and preference (usefulness, ease-of-use, learnability, accessibility, clarity, conciseness, accuracy, and overall satisfaction) measures as applicable. Also, opinions of participants were collected regarding their likes, dislikes, and suggestions to identify their qualitative perceptions and experiences for the manual.

MATERIALS AND METHODS

Participants

Five cosmetology students from a local beauty school participated in the operating manual usability study. All participants were females aged 18 to 25 years (mean = 20.8) with a high school education or the equivalent. Four of the participants were right-handed and one was left-handed. Their cosmetology training ranged from 60 to 700 clock hours (mean = 276 and S.D. = 260). Their participation in this study was compensated.

Test Design

The manual usability test was performed in a secure room for each individual participant. One test monitor administered the complete test with the assistance of one video recorder and one timer.

The test consisted of three sessions (pre-test session, test session, and post-test session), lasting about two

hours. At the pre-test session, the BraidMagic testing was first introduced by reading an orientation script. Then, an informed consent was obtained. Lastly, the demographic information and cosmetology training experience were surveyed.

In the test session, seven separate usability evaluation modules were conducted in sequence:

1. Locate information
2. Understand safeguards
3. Identify and learn parts and specifications
4. Follow operating instructions
5. Follow maintenance instructions
6. Understand warranty conditions
7. Use service cards

During each module, the performance of the participants with the corresponding manual section was evaluated by using various types of questions (true/false, matching, and multiple-choice) and by recording task completion times. Also, right after each module, a questionnaire was provided to record the participants' likes, dislikes, open suggestions for improvement, and subjective usability assessment. After Module 4, a 10-min. break was offered.

Lastly, in the post-test session, debriefing was conducted to learn more details. The test monitor asked questions derived from salient observations during the test (such as tasks not completed and critical comments). This test plan has been approved by the Institutional Review Board at Wichita State University.

Usability Assessment Questionnaires

Different performance and preference measures were applied to different test modules considering module context (see Table 1). For an example, for Module 1, the time to locate each specific item of information in the manual was measured and six criteria (usefulness, ease of use, learnability, accessibility, clarity, and overall satisfaction) were used to evaluate the participants' performance and preference, respectively.

Based on the evaluation measure matrix table, usability assessment questionnaires were developed for the test. Table 2 displays matching questions for performance assessment and Figure 2 shows sample questions for preference assessment using a 5-point Likert scale.

Table 2. Assessment questions (selected)

No	Questions	Very Poor	Poor	Fair	Good	Very Good
1	How useful is it for information search?	①	②	③	④	⑤
2	How easy is it to use?	①	②	③	④	⑤
3	How easy is it to learn?	①	②	③	④	⑤
4	How explicit is its organization?	①	②	③	④	⑤
5	How clear is the terminology?	①	②	③	④	⑤
No	**Questions**	**Very Dissatisfied**	**Dissatisfied**	**Somewhat satisfied**	**Satisfied**	**Very Satisfied**
6	What is your overall satisfaction with the table of contents?	①	②	③	④	⑤

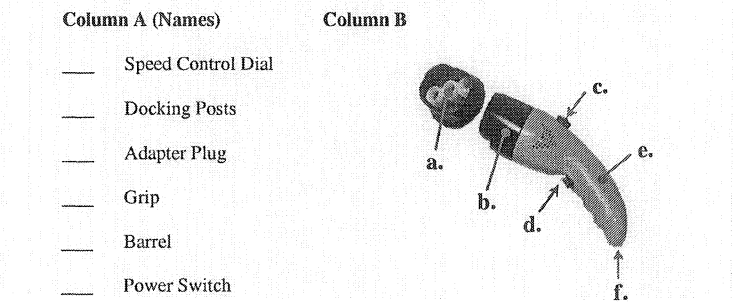

Figure 2. Matching task for parts name identification (selected)

Table 1. Evaluation measures for BraidMagic operating manual usability test*

Modules	Performance Measures		Preference Measures							
	Completion Time	% Correct Answers	Usefulness	Ease-of-use	Learnability	Accessibility	Clarity	Concise-ness	Accuracy	Overall satisfaction
1. Locate information	●		●	●	●	●	●			●
2. Understand safeguards		●	●	●	●	●	●	●	●	●
3. Identify and learn parts and specifications		●	●	●	●	●	●	●		●
4. Follow operating instructions	●		●	●	●	●	●	●	●	●
5. Follow maintenance instructions	●		●	●	●	●	●	●	●	●
6. Understand warranty conditions		●	●	●	●	●	●	●		●
7. Use service cards			●	●	●	●	●			●

* ●: Applied measure

RESULTS

Module 1: Locate Information

Times to locate 10 items of information (2 items for each section) were recorded. The information items were presented in random order one at a time. For each item, the test monitor read the name of the item and then the participant started to locate the specific information by using the table of contents, blue tabs on the sides of the pages, and headings in the manual. When the information was located, the participant signaled her completion by raising her hand.

A longer time was spent searching for information items located in the sections having multiple subsections. Of the five sections, the multiple subsections were present in two sections: Operating Instructions and Maintenance. The average (S.D.) time to locate information was 9.9 (5.3) sec. where multiple subsections were present and 7.6 (5.6) sec. where there were no subsections, respectively.

Consistently high evaluation scores were given for the usability of the table of contents in the manual (see Module 1 in Table 3). Of the assessments, 70% were a 5 (very good) with an overall mean (S.D.) of 4.7 (0.5).

Module 2: Understand Safeguards

Six true/false questions were administered to evaluate the participant's understanding of important safeguards involved in the use of the braiding machine and none of the participants gave incorrect answers. The true/false questions were presented in random order after the participant read the safeguards. Reference to the safeguards during the test was allowed.

High evaluation scores were given for the usability of the safeguards in the manual (see Module 2 in Table 3). Of the assessments, 93% were a 5 (very good) with an overall mean (S.D.) of 4.9 (0.3).

Several suggestions were made to improve the specificity of the safeguards. The participants asked for additional safety details regarding machine malfunctioning and limits of the use of the machine in relation to the condition of hair.

Module 3: Identify and Learn Parts and Specifications

Matching names with parts was administered before and after use of the manual. The 8 major parts of the machine were tested followed by tests for 13 individual parts. At the completion of the initial matching test, four minutes of study time over the manual were provided followed by the second matching test. During the tests, reference to the manual was prohibited.

The average of percent correct answers being similar, a somewhat higher variation of performance was observed in the matching test after the study of the manual. The overall mean (S.D.) of percent correct answers was 83% (4%) for the initial (before use of the manual) test and 80% (13%) for the second (after use of the manual) test.

Of the 21 parts total, the participants showed difficulty in matching two part names: hair grip and hair

Table 3. Averages (S.D.s) of preference assessments for BraidMagic operating manual*

Modules	Preference Measures							
	Usefulness	Ease-of-use	Learnability	Accessibility	Clarity	Concise-ness	Accuracy	Overall satisfaction
1. Locate information	4.8 (0.4)	4.6 (0.9)	4.6 (0.5)	4.8 (0.4)	5.0 (0.0)	-	-	4.6 (0.5)
2. Understand safeguards	4.8 (0.4)	5.0 (0.0)	5.0 (0.0)	5.0 (0.0)	5.0 (0.0)	4.8 (0.4)	5.0 (0.0)	4.8 (0.4)
3. Identify and learn parts and specifications	4.7 (0.5)	4.6 (0.5)	4.9 (0.9)	4.6 (0.9)	4.8 (0.3)	4.4 (0.9)	-	4.6 (0.5)
4. Follow operating instructions	4.3 (1.0)	4.4 (0.5)	4.2 (0.8)	4.5 (0.7)	4.2 (1.1)	5.0 (0.4)	5.0 (0.0)	4.2 (0.9)
5. Follow maintenance instructions	4.1 (0.9)	4.8 (0.4)	4.2 (0.8)	4.3 (0.5)	4.0 (0.8)	4.8 (0.4)	4.8 (0.4)	4.0 (0.8)
6. Understand warranty conditions	5.0 (0.0)	4.8 (0.4)	4.6 (0.9)	4.9 (0.2)	4.8 (0.4)	5.0 (0.0)	-	5.0 (0.0)
7. Use service cards	5.0 (0.0)	4.8 (0.4)	4.6 (0.9)	4.9 (0.2)	5.0 (0.0)	-	-	4.8 (0.4)

* Used a 5-point Likert scale, '1' for very poor or very dissatisfied and '5' for very good or very satisfied.

inserter. In the initial test, 80%, and in the second test, 60% participants could not correctly match the two names with parts. The average (S.D.) of the assessments of the parts and specifications section of the manual was 4.6 (0.6) (see Module 3 in Table 3) and 67% of the assessments were a 5 (very good).

Module 4: Follow Operating Instructions

Times were recorded for three groups of operating tasks: strand insertion, tube docking, and braiding. The overall goal of the tasks was to make a braid using BradiMagic. The participant conducted each of 11 tasks in sequence by referring to corresponding instructions in the manual. For each task, the test monitor read a short description of the task and then the participant started that task. Upon the completion of the task, the participant raised her hand.

To make a braid by referring to the manual as a first-time user, the overall time required for completion of all 11 tasks was 9.2 min. on average (S.D. = 1.3 min.; range = 8.3 to 10.8 min.). Of the three task groups, strand insertion for three extender tubes (mean = 6.3 min.) needed significantly more time than tube docking (mean = 1.2 min.) or braiding (mean = 1.7 min.).

The average (S.D.) of the assessments of the operating instructions section was 4.4 (0.9) (see Module 4 in Table 3) and 62% of the assessments were a 5 (very good). The participants' opinions indicated that the lower assessment was due to the perceived small size of the images accompanying the instructions.

Module 5: Follow Maintenance Instructions

The same procedures as the operating instructions module were used for two groups of maintenance tasks: tube disassembly and tube assembly. A total of 6.1 min. on average (S.D. = 0.4 min; range = 5.7 to 7.1 min.) was needed to disassemble and then assemble three extender tubes; each of the two task groups needed about equal amounts of time (mean = 3.0 min. for disassembly and 3.1 min. for assembly).

The average (S.D.) of the assessments of the maintenance instructions section was 4.3 (0.9) (see Module 5 in Table 3) and 52% of the assessments were a 5 (very good). The same criticism (perceived size of images) as for the operating instructions section was offered by the participants.

Module 6: Understand Warranty Conditions

Five multiple-choice questions were administered to evaluate the participant's understanding of the warranty conditions of the machine. Reference to the warranty conditions during the test was allowed.

Although evaluation scores were high for the usability of the warranty conditions section in the manual (see Module 6 in Table 3), incorrect answers were given to the multiple-choice questions. An average of 12% incorrect answers occurred with unknown reasons. The average (S.D.) of the assessments of the warranty conditions section was 4.9 (0.4) and 90% of the assessments were a 5 (very good).

Module 7: Use Service Cards

A scenario of machine malfunctioning was provided along with a blank service card. The participant filled out the card using her personal information and the scenario.

The average (S.D.) of the assessments of the service card was 4.5 (0.9) (see Module 7 in Table 3) and 67% of the assessments were a 5 (very good). Suggestions were provided such as enlarging the boxes, thinning the box lines, using lines instead of boxes, and resizing labels.

RECOMMENDATIONS

Based on the usability test results of the BraidMagic operating manual, the following recommendations were made for better usability of the manual:

- Provide a subsection listing and page numbers in Table of Contents.
- Provide additional details for machine malfunctioning and moisture content of hair in Safeguards.
- Rename two parts (hair grip and hair inserter) for better intuitive identification and learnability in Parts and Specifications.
- Enlarge the images in Operating Instructions and Maintenance.
- Enlarge the boxes, thin down the lines of boxes, provide two different types of service card (one with lines and one with boxes for address), and resize the labels in Service Card.

DISCUSSION

In the present study, usability testing helped to identify potential usability problems of the operating manual for BraidMagic prior to publication. The usability of the manual was evaluated by an analytical survey including performance (completion time and % correct answers) and preference (usefulness, ease-of-use, learnability, accessibility, clarity, conciseness, accuracy, and overall satisfaction) measures. These measures represent typical measures in usability testing (Rubin, 1994) and should be considered as independent of each other since they may not be significantly correlated (Frokjaer *et al.*, 2000). This analytical usability survey showed an advantage of being both comprehensive and effective to develop recommendations for improved usability of the manual.

A further study is needed to validate the present recommendations for the operating manual. When a revised BraidMagic operating manual is available, the same test procedures can be employed to verify that the usability of the manual has been increased. The more usable version of the manual will contribute to the usability of BraidMagic and the greater overall consumer satisfaction with the machine.

ACKNOWLEDGEMENTS

The authors would like to gratefully acknowledge the cooperation of all the participants in this study.

REFERENCES

Frokjaer, E., Hertzum, M., and Hornbaek, K. (2000). Measuring usability: Are effectiveness, efficiency, and satisfaction really correlated? In *Proceedings of CHI 2000* (The Hague, Netherlands, April 2000), ACM Press, 345-352.

Rubin, J. (1994). *Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests.* John Wiley & Sons.