Research on Usability of the Toolbar of Teaching Interactive Smart Tablet

Jialin LI¹, Junfeng WANG¹, Pingting HAO*¹, ²

¹School of Creative Design, Shenzhen Technology University, 3002 Lantian Road, Pingshan District, Shenzhen, Guangdong, China.
²Corresponding author, e-mail: pingtinghao@sina.com

Abstract: The work aims to find out the usability problems in the design of the toolbar of teaching interactive smart tablet, and provide an improvement basis and direction for improving the user experience of the teaching interactive smart tablet. Usability testing and user interview were used to research the toolbar of Seewo teaching interactive smart tablet. Quantitative analysis of task completion time, task success level and task completion efficiency were measured in usability testing. The thesis combines the results of user interviews with the results of usability testing to find out the specific factors that affect the usability of the toolbar of teaching interaction smart tablet. The icon design of the toolbar of teaching interactive smart tablet has a great impact on usability. The hiding of frequently used functions may make it difficult for users to find them. The larger screen makes it difficult to find icons outside the field of view. The usability of interactive smart tablet can be improved by improving icon recognition, optimizing common interactive processes, and setting important functions in the best visual field.

1. Introduction
More and more multimedia equipment has been served in the teaching process. Traditional multimedia classrooms are gradually transforming into intelligent classrooms, and the demand for intelligent teaching equipment is gradually increasing. Many companies have launched specialized intelligent interactive devices for teaching, such as Seewo (about 40% market share), HiteVision (about 20% market share), ChangHong (about 10% market share). However, it is found that there are still some usability problems in the use of these devices. In order to improve the operation convenience and use efficiency of teaching interactive smart tablet, this paper chooses Seewo teaching interactive smart tablet which occupies a high market share to study the usability of its toolbar.

For the concept of usability, different scholars have given different definitions. The International Organization for Standardization (ISO 924-11) have defined usability as “the effectiveness, efficiency and satisfaction of a product when a specific user accomplishes the target to be determined under a specific use situation” [1]. Usability testing, on the one hand, is very helpful in improving the system interface design, discovering the main problems in the interactive framework and refining button labels, operation sequence and priority, etc. [2] On the other hand, it is also an important reflection of user-centred design idea [3]. Nielsen J believes that usability evaluation can be regarded as an irreplaceable practical study, which directly reveals how users use the interactive design system through testing. In contrast to questionnaire, user interview and user diary, usability testing can avoid the subjective influence of users as much as possible [4]. For the evaluation of usability, several scholars proposed different evaluation systems [5-8]. The existing research mostly focused on the
teaching application and system design of teaching interaction smart tablet and similar products [9-11], barely on their usability. This paper mainly used the task completion time, task success level, task completion efficiency and other relevant indicators which is proposed by Tom Tullis, Bill Albert [8], and combined with the user interview to measure and make a comprehensive evaluation the usability of the toolbar of teaching interactive smart tablet.

2. Usability Testing Experiment Design

2.1. Preparation before the experiment

2.1.1. Experimental environment and materials
Seewo teaching interactive smart tablet is used as the experimental object in the experiment. The screen size is 86 inches, and the length, width and thickness are 1958 mm, 1160 mm and 89 mm, respectively. This experiment was carried out in a smart classroom, and the teaching interactive smart tablet was installed in the form of a bracket, without any other interference in front of it. Seewo digital tablet is the main interface. When not used, the toolbar is hidden on both sides of the teaching interactive smart tablet, and the left and right hidden ICONS are symmetrical to each other. The hidden ICON on the right toolbar was shown in Figure 1 (a). The toolbar expansion diagram is shown in Figure 1 (b). The circular icons from the top to the bottom of Figure 1 (b) means “Drawing Board”, “Paint Brush”, “Screenshot”, “Zoom In”, “Other Tools” and “Half Screen”, respectively. The experimental process was recorded by video recording equipment, so that the experimental results could be viewed and supplemented when analysed.

(a) The hidden icon of the toolbar

(b) The expanded view of the toolbar

Figure 1. the toolbar of Seewo teaching interactive smart tablet

2.1.2. Selection of subjects
In order to ensure the accuracy of the usability test of the Seewo teaching interactive smart tablet, people who have never used the Seewo teaching interactive smart tablet were selected as the subjects in this experiment. Seventeen subjects, who have normal physiological functions, and aged between 22 and 30, were selected for the experiment. All of them were undergraduates or graduate students. The subjects were familiar with electronic teaching equipment, but they had never used the Seewo teaching interactive smart tablet. So they could meet the experimental needs. All the subjects signed the informed consent, and the final valid data of each task in the experiment was more than 15.
2.1.3. Preparation of experimental tasks
Before the experiment, we summarized the functions of Seewo teaching interactive smart tablet toolbar and communicated with 5 teachers who often used the teaching interactive smart tablet (among whom, one is a primary school teacher, two are junior high school teachers and two are university teachers). According to the results of communication, 9 frequently used functions were selected as experimental test tasks, as shown in Figure 2.

|   |   |   |
|---|---|---|
| 1. Find the toolbar. | Start Time | End Time |
|   | Remarks |   |
| 2. Find the blue brush. | Start Time | End Time |
|   | Remarks |   |
| 3. Find page zoom. | Start Time | End Time |
|   | Remarks |   |
| 4. Find other tools. | Start Time | End Time |
|   | Remarks |   |
| 5. Run the countdown. | Start Time | End Time |
|   | Remarks |   |
| 6. Open the drawing board. | Start Time | End Time |
|   | Remarks |   |
| 7. Move a single graph. | Start Time | End Time |
|   | Remarks |   |
| 8. Move the whole page. | Start Time | End Time |
|   | Remarks |   |
| 9. Add a page. | Start Time | End Time |
|   | Remarks |   |

At the end of the experiment, now the subjects could explore the functions which they found confusing in the experiment.

Figure 2. Experiment record sheet

2.2. Experimental process

2.2.1. Equipment adjustment and task explanation
Relevant parameters of the video recording equipment and the teaching interactive smart tablet were adjustment before the experiment, so that the initial parameters of the teaching interactive smart tablet (such as the shape and colour of the paint brush) at the beginning of the experiment were the same for each subject. The subjects were numbered 001 to 017, and the experiment content was explained to them. While one of the subjects was doing the experiment, other subjects took a rest in another classroom to avoid the interference of bystanders on the subjects in the experiment and the influence on the following subject.

2.2.2. Task releasing and execution
After the experimenter confirmed, the experiment would start, and the subjects were informed of the experiment task by voice. During the testing, the subject can try the uncertain operation. When the subject completed a task by himself, completed the task under a prompt, or indicated to give up the task, this task testing ended, and the experimenter informed the next experimental task. After all the 9 tasks were completed, the subjects could explore the tasks which they found confusing in the
experiment. The test conditions and results of each subject were recorded in the table in Figure 2. A total of 17 experimental records were obtained.

2.2.3. User interview
The subjects were interviewed after experiment. The contents of the interview mainly included the overall evaluation of the usability of the toolbar of teaching interactive smart tablet, the confusion in the process of using the toolbar and the suggestions for improvement of the toolbar. After the interview, the usability test ended.

3. Analysis of experimental results

3.1. Task completion time
According to the observation in the experiment and the video review, the completion of each task was sorted out, and the completion time and standard deviation of each task were sorted out in Table 1. The subjects who did not complete the task or completed the task after asking for help were defined as task failure. The time of task failure was not included in the statistics since the completion time of task failure did not need to be considered in the analysis of the success level of the follow-up task and the completion efficiency of the task, meanwhile, the completion time of task failure was of little reference significance.

| Task   | Task 1 | Task 2 | Task 3 | Task 4 | Task 5 | Task 6 | Task 7 | Task 8 | Task 9 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Average completion time(s) | 22.87  | 10.38  | 11.07  | 22.69  | 11.22  | 16.24  | 11.48  | 10.11  | 12.25  |
| Standard deviation         | 17.22  | 10.66  | 12.94  | 13.56  | 7.07   | 14.79  | 7.75   | 7.52   | 12.59  |

It can be seen from the average completion time of Task 1 (find the toolbar), Task 4 (find other tools) and Task 6 (open the drawing board), the average completion time is longer and the standard deviation is larger, indicating the completion of these tasks took a long time in the task process and the difference in time was large. The average completion time of Task 2 (find the blue brush), Task 3 (find the page zoom) and Task 8 (move the whole page) is relatively short. Since when the task fails the time data is not included, the average task completion time and standard deviation cannot be used to directly judge the usability of each task-related function of the toolbar. In the analysis of task success level and task completion efficiency, the usability of task-related functions will be evaluated by combining the average completion time of each task with the completion situation or completion rate.

3.2. Task success level
When dividing the task success level, the 4-point scoring method proposed by Tom Tullis and Bill Albert will be referred to [8]. On the four-point success scale, the number 1 means no problems, 2 means minor problems (completing a task after taking a short detour), 3 means major problems (completing a task after taking a long detour), and 4 means failure or giving up. Based on the actual requirements of usability testing of teaching interactive smart tablet toolbar, this paper formulated the task success grading standards as Table 2. According to the classification criteria, the task success levels of the nine tasks were divided, and the proportion of success levels of each task was shown in Figure 3. The average success level of each subject in the same task was calculated according to Formula 1, and the average success level obtained was shown in Table 3. The task success level is sequential data, the levels are not strictly equidistant. Therefore, when the average task success level of the two tasks is not quite different, it cannot be judged which task is better completed. Only when the average task success level of two tasks differs greatly, the usability of the corresponding functions of the two tasks can be compared through the average success level.
Table 2. Task success grade criteria

| Success grade | Criteria for the classification |
|---------------|---------------------------------|
| 1             | The task is completed successfully and took less than 10s |
| 2             | The task is completed by self after one error, or it takes between 10s-20s |
| 3             | The task is completed by self after multiple mistakes, or take more than 20s |
| 4             | The task is incomplete or completed after seeking tips from the experimenter |

Average success rating = \( \frac{\sum \text{Task success rating of subjects}}{\text{Number of valid data}} \)

As can be seen from Figure 3 and Table 3, task 1 (find the tool bar), task 2 (find the blue brush), task 4 (find other tools) and task 6 (open the drawing board) have the small percentage of success level 1 (that is, successfully completed), and have a high value of success level and poor usability. Task 3 (find page zoom), Task 5 (run the countdown), Task 8 (move the whole page.), and Task 9 (add a page) have a lower success rate and better usability.

3.3. Task completion efficiency

This study adopted the efficiency measurement combining task completion rate and task completion time to measure task completion efficiency of the toolbar of Seewo teaching interactive smart tablet. This calculation method is the task completion rate/the average task completion time (for those who successfully complete the task). The higher the efficiency value is, the better the usability is. The time unit was selected according to the actual situation. After selection, the efficiency percentage must be between 0-100. This paper chose 10s as a time unit, and the efficiency measurement results of each task were shown in Table 4.
Table 4. Efficiency of completing tasks

| Task | Task success rate (%) | Average completion time(s) | Number of time units | Task completion efficiency (%) |
|------|-----------------------|-----------------------------|----------------------|-----------------------------|
| Task 1 | 87.5 | 22.9 | 2.29 | 38.23 |
| Task 2 | 52.9 | 10.4 | 1.04 | 50.86 |
| Task 3 | 100.0 | 11.1 | 1.11 | 90.09 |
| Task 4 | 94.1 | 22.7 | 2.27 | 41.45 |
| Task 5 | 100.0 | 11.2 | 1.12 | 89.29 |
| Task 6 | 94.1 | 16.2 | 1.62 | 58.09 |
| Task 7 | 88.2 | 11.5 | 1.15 | 76.70 |
| Task 8 | 94.1 | 10.1 | 1.01 | 93.17 |
| Task 9 | 93.3 | 12.3 | 1.23 | 75.85 |

It can be seen from the efficiency measurement results that the efficiency of task 1 (find the toolbar), task 2 (find the blue brush), task 4 (find other tools), and task 6 (open the drawing board) is low, that is, the usability is poor. Task 3 (find page zoom), task 5 (run the countdown), and task 8 (move the whole page) have higher task efficiency, that is, better usability.

Table 5. Task success level and completion efficiency ranking table

| Task | Task success level | Ranking | Task completion efficiency | Ranking |
|------|-------------------|---------|---------------------------|---------|
| Task 1 | 2.50 | 7       | 38.23 | 9 |
| Task 2 | 2.71 | 9       | 50.86 | 7 |
| Task 3 | 1.59 | 1       | 90.09 | 2 |
| Task 4 | 2.53 | 8       | 41.45 | 8 |
| Task 5 | 1.65 | 2       | 89.29 | 3 |
| Task 6 | 2.29 | 6       | 58.09 | 6 |
| Task 7 | 2.06 | 5       | 76.70 | 4 |
| Task 8 | 1.88 | 4       | 93.17 | 1 |
| Task 9 | 1.80 | 3       | 75.85 | 5 |

The task success level and task completion efficiency of each task were combined for comparison as Table 5. It can be seen that there is a reliable correlation between the ranking of task success level and task completion efficiency, but they are not completely consistent. The Pearson correlation coefficient of task success ranking and task completion efficiency ranking is represented by r. The calculation method of r is as in formula 2, where $X_i$ is the success rank ranking of task i, $\bar{X}$ is the average number of success ranks of each task, $Y_i$ represents the ranking of the completion efficiency of the task i, $\bar{Y}$ is the average of the completion efficiency of each task, and the value of Pearson’s correlation coefficient r and the definition of correlation were shown in Table 6 [12]. Pearson correlation analysis was performed with SPSS software, and the value of r was 0.8. It can be considered that there is a strong correlation between the two, and the results of task success level and task completion efficiency can be mutually verified. The task success level and the completion efficiency ranking are not completely consistent. This is because the task success level considers more of errors and the completion status of the task completion process. When more attention is paid to errors during task completion, usability can be measured in terms of task success rating, and when more attention is paid to task completion time, usability can be measured in terms of efficiency.

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2} \sqrt{\sum_{i=1}^{n}(Y_i - \bar{Y})^2}}$$
3.4. User interview results
In order to further understanding the reasons why the subjects encountered problems when using the Seewo teaching interactive smart tablet toolbar, user interviews were conducted with each subject after the experiment. The opinions and suggestions put forward by the subjects were shown in Table 7.

Table 7. Collation of user interview records

| Confusion in the subjects’ usability test: | Frequency |
|------------------------------------------|-----------|
| 1. The toolbar icon is small and difficult to find when hiding. | 5         |
| 2. Since the screen is large, the contents on both sides are difficult to see, and need to move back and forth. | 4         |
| 3. The “Other Tools” icon setting can easily be mistaken for “Settings”. | 3         |
| 4. The “Artboard” icon is ambiguous. | 3         |
| 5. The “Brush” color switch is hard to find. | 2         |
| 6. The Zoom icon is ambiguous. | 1         |
| 7. The “roaming” name semantics are difficult to express the function of moving the whole screen. | 1         |
| 8. It’s difficult to move a single shape. | 1         |

It can be seen that tasks with poor performance in task success level and completion efficiency were mentioned more frequently in user interviews, and the interview results are consistent with the usability test results. According to the analysis of usability experiments and user interview records, the main reason for the poor usability of task 1 (find the toolbar) is that the tool bar prompt icon is small when hidden, so it is difficult to find. The reason for the poor usability of task 4 (find other tools) and task 6 (open the artboard) is that the meaning of the slogan is not clear, and it is difficult for the subjects to intuit the actual function corresponding to the icon. The main reason for the poor usability of Task 2 (find the blue mark) is that the colour switching function of the brush is hidden, and it is difficult for participants to find the colour switching. At the same time, during the interview process, problems that were difficult to find in the usability testing will be found, such as the difficulty of seeing the content of both parties due to the large screen of the teaching interactive smart tablet, and the need to walk back and forth in the process of completing the tasks.

3.5. Suggestions for usability improvement
Based on the results of usability tests and user interviews, the following suggestions has been proposed to improve the Seewo teaching interactive smart tablet toolbar: (1) Enlarge or change the
hidden icons in the toolbar to make it more eye-catching; (2) Redesign the icon styles of “other tools”, “drawing board”, and “zoom” to make their semantics more clear and more compatible with actual functions; (3) Cancel the hidden form of the brush colour change, and set the colour change next to the brush; (4) Change the name of “Roaming” for moving the entire screen to “Mobile Screen”; (5) Place important functions in a prominent position.

4. Conclusion

Through the study on the usability of Seewo teaching interactive smart tablet toolbar, it can be found that the icon design of teaching interactive smart tablet toolbar has a significant impact on the usability. The unreasonable interactive process will reduce the usability. Ergonomic problems caused by large screen and page layout problems will also affect the usability. In the future, when improving the usability of the toolbar of the teaching interactive smart tablet, we can start from three aspects: improving the icon recognition, optimizing the interaction structure, and setting important functions in the best field of view. There are more and more applications of teaching interactive smart tablets. Research on usability of interactive smart tablets for teaching will provide guidance for the design of teaching interactive smart tablets, so that users can get a better teaching experience.

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