

A study on the screen designs of e-learning material

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***Abstract:** - In recent years, as information materials become increasingly multimedia, we are having more and more opportunities to construct and take advantage of learning aid systems that introduce multimedia by utilizing various visually and acoustically effective methods for individual learning and teaching aids. Today, many learning systems under development have screen designs dependant upon experiences and senses. It is pointed out that learning systems are not effective since their screen designs do not properly deal with human sensation and information processing capability. In this study, we will examine effective learning aid system screen designs by conducting experiments on the displayed position and the amount of information in the learning aid system. As a conclusion, it was revealed that the first position in which learning is started is the upper left and the position in which learning is repeated is the middle center, and that those displayed positions are proven to have a high learning effectiveness. It was also found that learning effectiveness declined in a learning environment where long text is presented by screen separation or scrolling.*

Keywords: Usability, e-learning, Screen designs, User-interface, Multimedia

1.0 Introduction

In recent years, as information materials become increasingly multimedia, we are having more and more opportunities to construct and take advantage of learning aid systems that introduce multimedia by utilizing various visually and acoustically effective methods for individual learning and teaching aids.

When using computers for learning, among other things which make a difference in the quality of a learning material, there is an issue of whether it is “easy-to-use”. This is what is called the usability of learning material. In developing the computer software itself, the study on usability has been accumulating technologies as of considerations for users of software. This is the field alternatively called “user interface study” and it is useful for improving screen visibility, function maneuverability and organizing manuals.

Today, many learning systems under development have screen designs dependant upon experiences and senses. It is pointed out that learning systems are not effective since their screen designs do not properly deal with human sensation and information processing capability. Many hope that studies on screen designs that are effective for learning and consider the learner’s point of view will advance.

In this connection, in this study, we will examine effective learning aid system screen designs by conducting experiments on the displayed position and the amount of information in the learning aid system.

2. 0 A study on the displayed position.

2.1 Objectives

In the learning system, its design needs to consider the visibility characteristics of learners. It has been reported from previous studies that the perception of information is affected by the display position in computer screens [1]. Therefore, it is presumed that learning effectiveness is also affected. In this experiment, we shall examine from which displayed positions learners will pick up information and how they affect the learning effectiveness considering the use of a computer-based learning aid system.

2.2 Experimental method

We have used a case in which a number of selection buttons are presented on a learning screen. The learning screen used for the experiment is indicated in Fig. 1. All buttons are of the same size and color (blue) and are evenly located on the display.

As a learning subject on which learners have no study experience, “International telegram flag (alphabet)” was given as an assignment to them. When learners click on any desired button, an international telegram flag (in color) with its description is displayed (Fig. 2). Learners had a 3-minute free learning session without being instructed on any sequences and methods of learning.

In addition, learners had 2 learning sessions in different positioning patterns displaying the type and position of the international telegram flag at random.

After finishing the sessions, we had learners write down their answers on the learning confirmation sheet on which the flags were indicated.

2.3 Experiment conditions

Number of subjects: 11 (4 male, 7 female aged from 19 to 22)

The learning assignment: Study on international telegram flags

Learning time: 3 minutes / 1 session

Numbers of characters: 9

Display: 17 Inch CRT

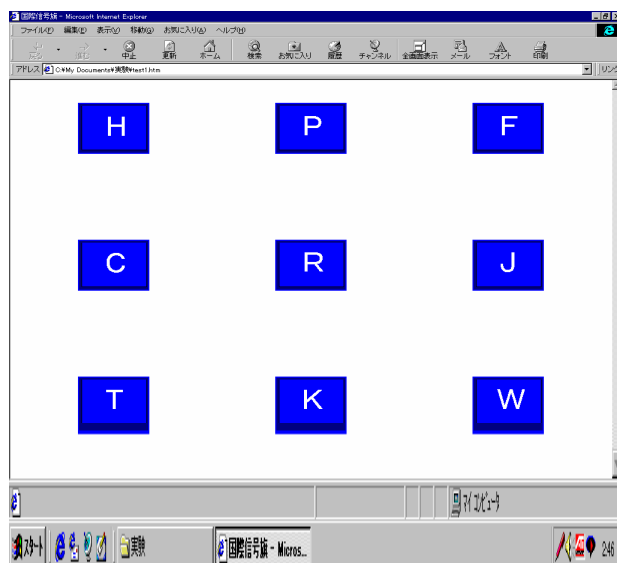


Figure 1 Experiment screen

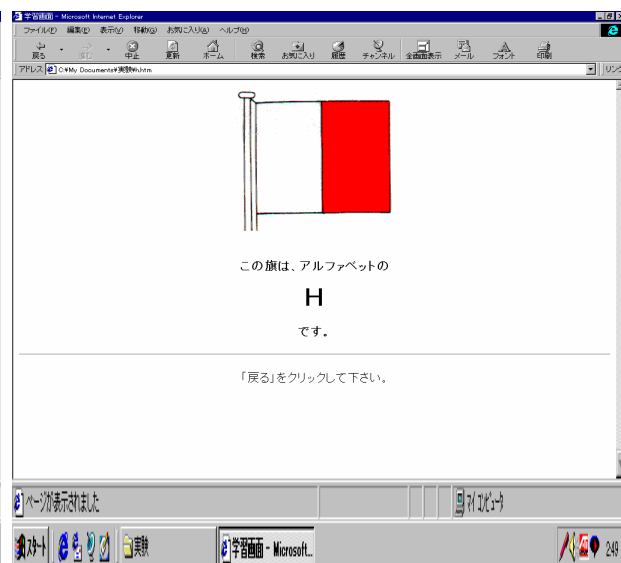


Figure 2 Contents of study

2.4 Experiment results and observations (Displayed position)

In Fig. 3, the average correct answer rate (%) for each displayed position is indicated. Viewed from this Fig., it is shown that the correct answer rate is 100% and every subject writes in correct answers for displayed positions in the upper left, upper center and middle center. However, we can see that displayed positions with lower correct answer rates of less than 90% are middle left and right, and lower positions. Especially, the correct answer rate is as low as 77% for lower center and right compared with other displayed positions.

Fig. 4 below shows the average number of click times (number of times per 3 minutes) for all subjects. From this illustration, it is observed that the displayed position with the highest number of click times is middle center and one with the smallest number of click times is lower. Particularly, the number of click times for the lower right is 2.05 times, the lowest compared with other displayed positions.

2.5 Experiment results and observations (Relation between the correct answer rate and the number of click times)

Fig. 5 is a scatter graph of correct answer rates (%) and number of click times (number of times per 3 minutes). From this illustration, higher correct answer rates tend to have higher number of click times. In other words, (5)Middle center (2)Upper center (1)Upper left shows both high correct answer rate and larger number of click times. However, (9)Lower right shows low correct answer rate and small number of click times. The calculated coefficient of correlation is $r=0.6784$ and positive correlation is confirmed.

(1)	(2)	(3)
100	100	91
(4)	(5)	(6)
82	100	82
(7)	(8)	(9)
86	77	71

Figure 3 Correct answer rate (%)

(1)	(2)	(3)
2.86	3.05	2.95
(4)	(5)	(6)
3.09	3.32	2.91
(7)	(8)	(9)
2.05	2.45	2.05

Figure 4 Number of click times

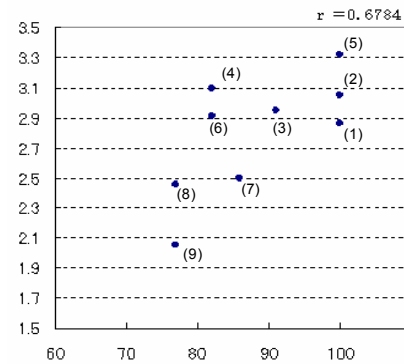


Figure 5 Scatter graph of correct answer rates (%) and number of click times

2.6 Experiment results and observations (Learning sequence)

Fig. 6 shows the learning sequence from the beginning of the session until the 10th click. We can identify 2 kinds of patterns from the results of all subjects. Pattern 1 is the pattern in which the learning sequence is from left to right, starting from upper left all the way to the upper right, then through the middle to bottom (9 subjects). On the other hand, Pattern 2 goes from top to bottom, starting from the top through to the middle and down to the bottom and then returns again to the top (2 subject).

For both Patterns 1 and 2, it is revealed that the first position to click in the session is the upper left and the last is the lower right. In addition, we found that more subjects tend to start from the upper left or middle center after once going through all displayed positions.

The following is a summary of the above results:

- Displayed positions with high correct answer rates are upper and middle center and ones with low correct answer rates is lower center and right.
- Displayed positions with a large number of click times is middle center and lower right with small number of click times.
- Displayed positions with a higher correct answer rate have a larger number of click times.
- The first displayed position to be clicked is the upper left.

According to a report on displayed positions on a computer screen, it is said that the upper center shows a short search time and high positive regeneration rate and the lower right shows a long search time and a low positive regeneration rate [1]. In addition, information perceived initially has a high positive regeneration rate due to a primary effect according to the reports regarding short term memory [2][3]. It is also said that memorization work will have better information reproduction rate by conducting rehearsals [4]. In this experiment, the upper and middle center displayed positions have resulted in high correct answer rates. This proves that the first displayed position to be started with is the upper left. Consequently, the upper left has a high learning effectiveness due to the primary effect. Furthermore, the reason for center middle, which has a large number of click times, to have a high correct answer rate is considered to be due to the rehearsals.

Even in a case that a number of select buttons are displayed on the learning screen of learning aid systems, it is presumed that the top is the first position to start learning and the middle center is the position in which learning is repeated. Therefore, it can be concluded that they are positions of high learning effectiveness.

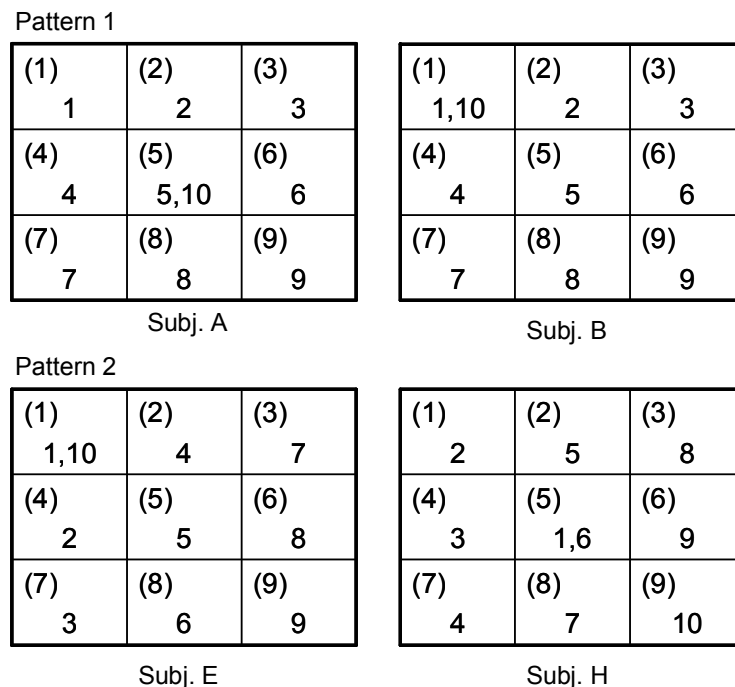


Figure 6 Learning sequence

3.0 Examination on information amount

3.1 Objectives

There have been several guidelines as to the amount of information displayed on the screen. For example, those guidelines proposed are like “reduce the number of characters as much as possible.”, “make the printing area ratio approximately 60%.”, “make each sentence short and concise.” However, in the

learning aid system, there are sometimes cases that long sentences need to be presented because of learning contents or characteristics of text. System-wise counter measures for this problem is to utilize screen separation and scroll. This study examines, through experiment, the effect of screen separation on learning of long sentence reading.

3.2 Experimental method

Short story was displayed on the screen and learners have read it to understand its contents. (Fig. 7). The length of text presented was set to fit into three screens and learning time frame was at the learners' convenience. In addition, the learner carried out screen scroll manipulation on a scroll bar with a mouse (Fig. 8).

After finishing learning, learners were instructed to answer questions on the learning achievement judgment sheet. Number of questioners are 9 (3 questioners per screen) and all answers are made in numerals.

3.3 Experimental conditions

Number of subjects: 6 (3 male, 3 female aged 19-22)

Learning assignment: Long text reading

(Short story "Ocean", Author : Emu Ito)

Learning time: Fee (approximately 9 to 11 minutes)

Displayed volume: 3 screens (4523 characters)

Display: 17 inch CRT

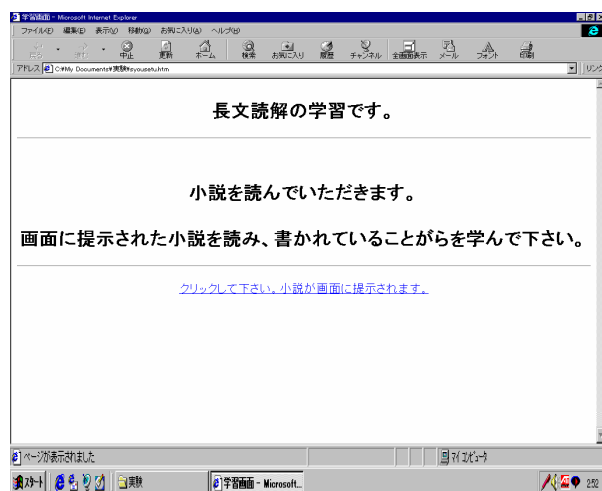


Figure 7 Experiment screen

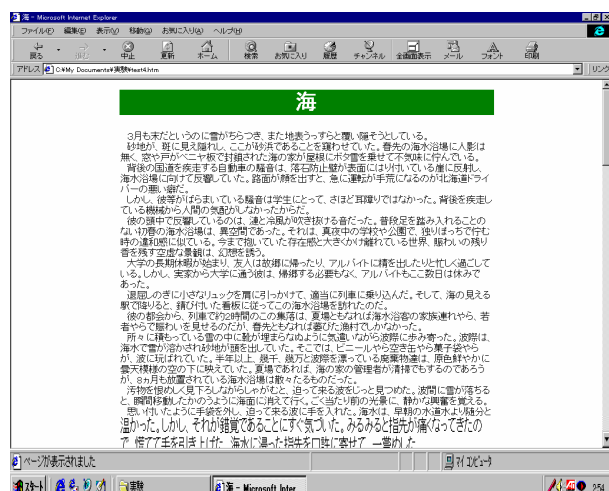


Figure 8 Contents of study

3.4 Experiment results and observations

Table 1 shows the results of the long text reading session. In addition, the correct answer rate (%) for each page is calculated and indicated by graph on Fig. 9. Although, the correct answer rate of the first page is as low as 44%, the correct answer rate of the third page is as high as 78%. However, if we compare the 2nd and 3rd pages, the correct answer rate tends to decrease but the difference is not noticeable. As a result of t test between each page, a significant difference was observed between the 1st and 3rd pages ($t = -2.535, p < 0.05$).

In addition, in this experiment, we did not find any particular tendency regarding the relationship between learning time and performance.

After completing the experiment, we asked subjects to answer the question “Please state your impression about the sessions.” There are answers such as “I lost my place”, “I got tired” and “I have pain in my eyes”, all are presumed to be problems in reading long text on computer screen.

According to studies thus far, it is assumed that human beings can process only a limited amount of information within the limited time frame. Furthermore, concerning the points that web designers need to consider, it is said that a page that requires long scrolling must be avoided and one screen page needs to be designed to be as understandable as possible by itself [5][6]. In this experiment, the first page had a lower correct answer rate compared to the third page. From the above, in view of the amount of information human beings can process and their maneuverability, it is presumed that to present long text by scrolling is to reduce learning effectiveness. Therefore, it is necessary to review methods of screen scroll and separation and the parallel usage of paper media when screens are designed for the learning aid system.

Table 1 Results of long-passage reading

Subj.	gender	Score (page)				Learning time
		1	2	3	mean	
A	Female	2	2	3	2.3	11"24
B	Female	0	1	2	1.0	09"21
C	Male	2	2	2	2.0	10"33
D	Female	1	1	2	1.3	12"44
E	Female	2	3	3	2.7	11"07
F	Male	1	3	2	2.0	10"58
mean		1.3	2.0	2.3	1.9	10"53

Score: Number of correct answer(3question/page),

Leaning time: minute" sec

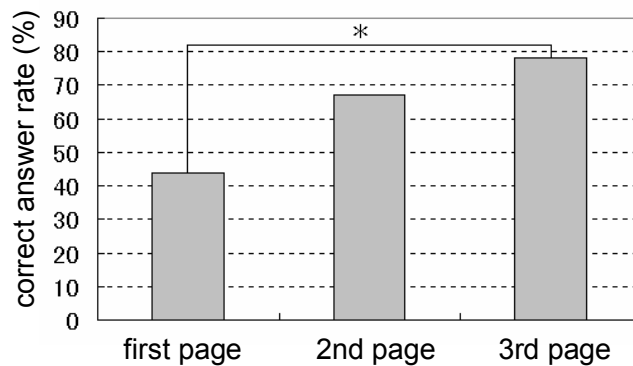


Figure 9 Correct answer rate (%) for each page

4.0 Conclusion

In this study, from the standpoint of usability of learning systems by learners, we have conducted an experiment on the displayed position and the amount of information in them in order to verify effective screen designs. As a conclusion, it was revealed that the first position in which learning is started is the

upper left and the position in which learning is repeated is the middle center, and that those displayed positions are proven to have a high learning effectiveness. It was also found that learning effectiveness declined in a learning environment where long text is presented by screen separation or scrolling.

In the screen design of learning aid systems, it is preferable to display the information directly related to learning on the upper part of the screen and to display the information not directly related to learning such as screen change on the lower part. Furthermore, screen separation must be avoided whenever it is possible and the parallel use of paper media needs to be adopted when a long text is presented to be read on a computer screen.

5.0 References

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