



## Experiments on Effects of Behaviours in the Rest Time between Learning

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### Abstract

*In e-learning, students can learn at their own pace without being relatively restricted by the learning place and the time. On the other hand, there is a tendency that the students gradually get tired during learning. It is important to have break times during study to refresh students and maintain the learning performance. This research investigates how the behaviors during rest times affect the performance through experiment. In the experiment, 30 university students are asked to solve the problems of mathematical calculation for 15 minutes as many as possible. The experiment consists of three learning sessions and two rest times between the learning sessions. The rest time to refresh their feeling is 3 minutes long. Five actions are employed as resting behaviors: (1) a fly-tapping game that refreshes users with an active game by moving their bodies, (2) a game that takes care of a dog to relax their feelings with a non-active operation, (3) reading a book, (4) listening to music, and (5) doing nothing to be calm. The effect of those resting behaviors on learning is examined through experiment. The experimental results are evaluated with regard to the accuracy of calculation and the answering time, and the effect of these behaviors will be discussed based on the experimental results and the questionnaire.*

**Keywords:** rest time, concentration, e-learning, mathematical calculation

### 1. Introduction

E-learning is proactive learning that utilizes communication networks and information technology. In recent years, e-learning systems have begun to spread in university lectures and company training. The diversification of devices used for learning, such as smartphones and tablets as well as the fact that students can learn at their pace without the restriction of the location and the time seem to push this spread of e-learning forward. Additionally, there are various good points such as the functions for students to learn repeatedly and to be able to choose learning programs that suit their levels, the low cost, and the ease of managing learning data such as learning progress and results of study [1]. While these various advantages are accelerating the spread of e-learning, there are also disadvantages. For example, because there are no instructors on the spot, subjects with practical skills are difficult to give lectures, and those who do not have a network environment cannot take the courses in the first place. Furthermore, the biggest disadvantage is that it is difficult for students to maintain the concentration and the learning will, since students don't gather at the same time and place, the opportunity to communicate with the instructor and other students is lost, and that if they cannot be stimulated by the lecture, their willingness to learn gradually declines. In order to solve the problems and to promote student concentration in e-learning, we constructed a system with a function to praise and scold students during learning, and a system with Kinect to measure the concentration of users and learning states during learning [2]-[4].

It is also important to have a break during study. There is research investigating how to spend the rest time affect the performance of office workers using Visual Display Terminals (VDT) [5]. This research introduced that Ministry of Health, Labour and Welfare of Japan makes recommendations as a guideline for occupational health management in office workers' VDT work in April 2002 [6] such as "Make sure that one continuous work time does not exceed one hour" and "Make a 10-15 minute break between consecutive works." It is shown that the work performance is actually improved by taking a break. Therefore, for e-learning using VDT it is necessary and important to take an appropriate break between learning, and it is required to take an effective break within the limited time.

In this study, we investigate what kind of actions during break times increases the concentration of learners and affects the learning performance through experiment. The experiment consists of three working sessions and two brake times between the working sessions. Five actions are employed as resting behaviours: (1) a fly-tapping game that refreshes users with an active game by moving their bodies, (2) a game that takes care of a dog to relax their feelings with a non-active operation, (3) reading a book, (4) listening to music, and (5) doing nothing to be calm. The effect of those resting



behaviours on learning is examined through experiments. The experimental results are evaluated with regard to the accuracy of calculation and the answering time, and the effect of these behaviours are discussed based on the experimental results and the questionnaire.

## 2. Experiments

### 2.1 Mathematical calculation

As shown in Fig. 1, the mathematical experiment consisted of three work sessions and two breaks between sessions. The work sessions lasted 15 minutes, and the breaks lasted 3 minutes. Fig. 2 shows an example mathematical calculation. We asked the participants to continue calculating similar problems for 15 minutes in each work session.

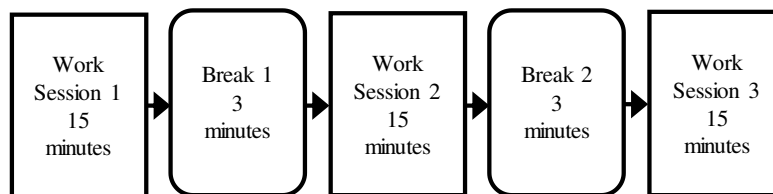


Figure 1. The flow of the mathematical calculation experiment.

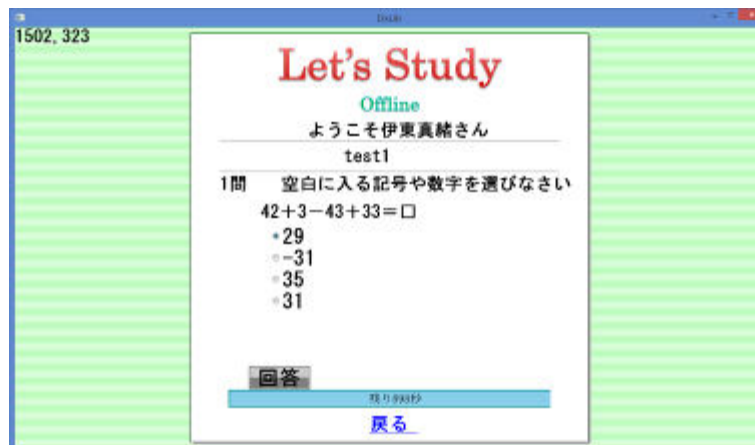


Figure 2. A page for mathematical calculation.

### 2.2 Resting behaviors

We employed five actions during brake times.

- (1) "listening to music": a user listens to his favourite music.
- (2) "reading a book": a user reads his favourite book.
- (3) "doing nothing": a user does nothing to stay calm.
- (4) "a fly-tapping game": this game is a kind of shooting game; a user tries to shoot as many flies as possible and the score is determined by the points corresponding to the kinds of flies. This game refreshes users with active actions by moving their bodies. Figure 3(a) shows a screen shot of the game.
- (5) "a dog-care game": An user takes care of a dog to relax user's feelings with a non-active operation. The user tries to keep the dog in good mood by giving it foods and tapping it. Figure 3(b) shows a screen shot of the game.



Figure 3. Examples of the screen shots of the two games.

### 2.3 Experimental results

Thirty students from our university served as participants. They were divided into five groups, and each group performed one of the resting behaviours during break times. The participants were assigned to groups on the basis of the results of preliminary experiments so that each group would be roughly equal in terms of computational ability. The mathematical calculation experiment consisted of three work sessions.

Figure 4 shows average correct-answer rates and the average answering time of the five groups for the three work sessions. We can see from Fig. 4 that the answering time and the correct answer rate of group 4 that did a fly-tapping game degrade most, and that degradation of those of group 3 that did nothing is least. A fly-tapping game is one that makes the user move his arm frequently, and it makes the user tired. The correct answer rate of group 2 that reads a book did not decrease much, but the answering time increased a lot. The correct answer rate of group 1 listening to music changes much. The break time is only 3 minutes, and it is too short to finish one song, which did not make the user

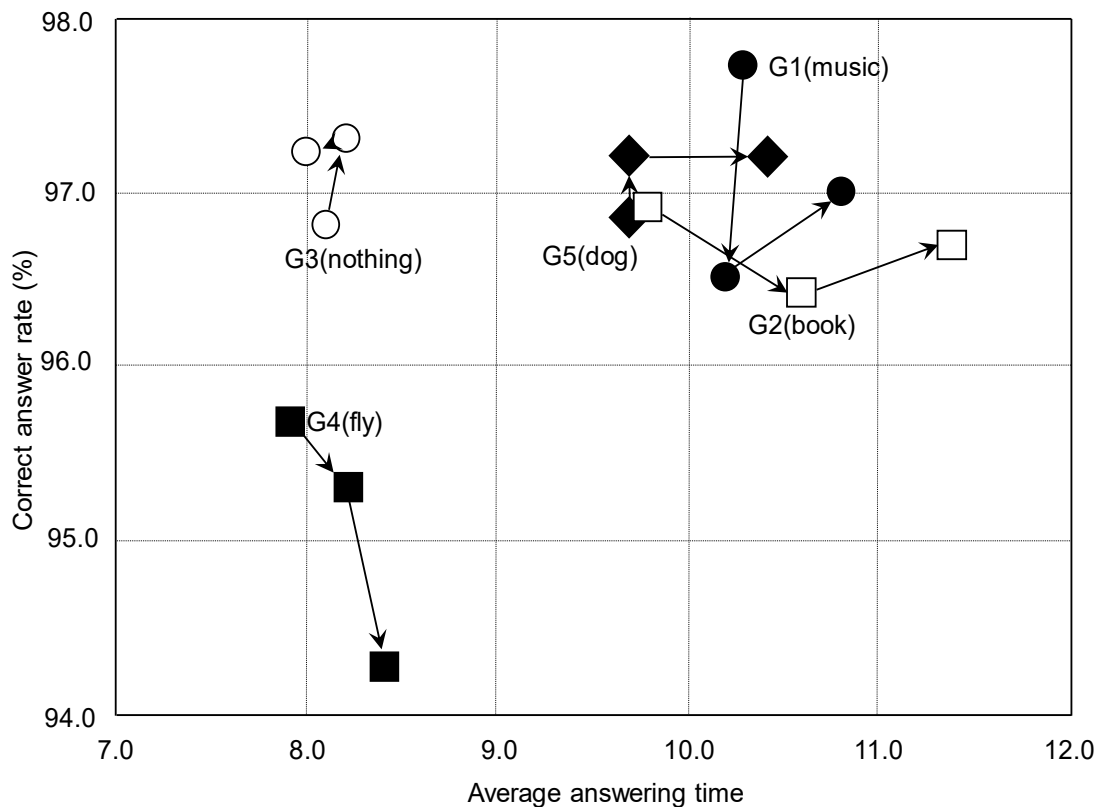


Figure 4. Average correct-answer rate vs. average answering time.



refresh. The correct answer rate of group 2 with a dog-care game did not degrade, while the answering time from session 2 to 3 increased.

## 2.4 Questionnaire

After the experiment, we asked the participants to complete a descriptive questionnaire and to respond to three statements by selecting responses on a five-point scale (5: strongly agree --- 1: strongly disagree).

Table 1 lists the evaluation items and the average scores for five groups. We can see from Table 1 that the highest score is 4.5 for items 5, 6 of group 1; "listening to music" users felt that they are refreshed and the concentration improved more than other resting actions, though the performance degraded. They felt that three-minute break time was too short. "Doing nothing" group and "a dog-care game" group answered high scores for items 5 to 8. The scores of "Doing nothing" group for items 1-3 increased as the sessions proceed, and three minutes is appropriate for the break time. The scores of "a fly-tapping game" group for items 1-3 decreased; there are comments saying that he was tired and the game didn't refresh him.

Table 1. Average scores in the questionnaire.

No.	Statement	Group 1 Listen- ing to music	Group 2 Read- ing a Book	Group 3 Doing nothing	Group 4 Fly tapping game	Group 5 Dog- Care game
1	I concentrated in the 1st session.	3.8	3.3	3.7	4.3	3.8
2	I concentrated in the 2nd session.	3.5	3.3	3.8	3.7	3.7
3	I concentrated in the 3rd session.	3.8	3.0	4.2	3.7	3.7
4	I kept concentration all through the work.	3.8	3.2	4.0	3.0	3.6
5	I felt refreshed well with the resting behaviour.	4.5	3.3	3.5	3.3	3.7
6	I felt that the resting behaviour improved my concentration.	4.5	3.2	3.8	3.2	3.7
7	The resting behaviour was effective.	3.0	3.2	3.5	2.7	3.2
8	The length of a break is appropriate.	2.5	3.3	3.9	3.7	3.4

## 3. Conclusion

We conducted experiments in which e-learning students take one of resting behaviours during study breaks to investigate the effect of those behaviours on the will to learn. We found that the "doing nothing" and "listening to music" behaviours refreshed the participants effectively for a simple work task (mathematical calculation based on four arithmetic operators).

Future task includes experiments with more participants and other resting behaviours to improve the accuracy of the effect. In our experiment, the break time was fixed to three minutes. More experiments with various break time will show the appropriate length of the break time.

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## References

- [1] Proseeds Inc., "Merits and demerits of introducing e-learning," <http://www.pro-seeds.com/trend/meritdemerit.html>, Accessed in Aug. 2019 (in Japanese).



- [2] M. Takeue, K. Shimada, K. Takahashi, and M. Inaba, “Experiments of displaying images to keep the motivation in e-learning,” Conf. Rec. IEEE International Conference on Systems, Man, and Cybernetics, Seoul, Korea, pp. 120–125, 2012.
- [3] T. Ito, S. Kotake, K. Takahashi, and M. Inaba, “Detecting Concentration of Students Using Kinect in E-learning,” The 5th IIAE International Conference on Intelligent Systems and Image Processing 2017 (ICISIP2017), Hawaii, USA, pp. 450–456, 2017.
- [4] T. Ito, K. Kamiya, K. Takahashi, and M. Inaba, “A method for identification of students’ states using Kinect,” The 13th International Conference on Ubiquitous Information Management and Communication (IMCOM2019), P3-3, Phuket, Thailand, pp. 341–350, 2019.
- [5] T. Miki, T. Terada, et al., “Research of the effects of the break time on work performance,” IPSJ SIG Technical Report, 2018-UBI-57(3), pp. 1–8, 2018 (in Japanese).
- [6] Ministry of Health, Labour and Welfare, “Guidelines for occupational health management in VDT work,  
<http://www.mhlw.go.jp/file/06-Seisakujouhou-11200000-Roudoukijunkyoku/0000184703.pdf>,  
Accessed in Aug. 2019 (in Japanese).